Core Lithium Ltd

BP33 Underground Mine
Traffic Impact Statement

March 2021

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1. Introduction

1.1 Purpose of this report

Core Lithium is currently preparing a Definitive Feasibility Study (DFS) for its BP33 deposit at the Finniss Lithium Project. BP33 will be an underground mining operation and is located approximately 7.5 km south of the current Grants Mine via the site's internal haul road, and approximately 29 km south of Darwin, and will be accessed via the Grants Mine turnoff from Cox Peninsula Road.

The operation of the BP33 Underground Mine is proposed to commence once the Grants Mine open pit operation has concluded. This is proposed to begin at a nominal date of June 2023. The current timeline for the operation of the mine is 51 months from commencement. At the end of life of the BP33 Underground Mine, additional mining may commence underground from an access portal in the Grants Open Pit.

An Environmental Impact Statement has been undertaken for Grants Open Pit Mine which included a Traffic Impact Assessment and Heavy Vehicle Route Assessment undertaken by Flanagan Consulting which will be used as part of the basis of this report.

This Traffic Impact Statement (TIS) will assess the impacts of increased traffic along the proposed haulage routes associated with the BP33 Underground Mine and will form an Appendix as part of the DFS. Preliminary comments regarding traffic associated with the underground portion of the Grants Mine will also be provided within this report.

1.2 Scope and limitations

This report: has been prepared by GHD for Core Lithium Ltd and *may only be used and relied on by Core Lithium Ltd for the purpose agreed between GHD and the Core Lithium Ltd as set out in section 1.3 of this report.*

GHD otherwise disclaims responsibility to any person other than Core Lithium Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 1.3 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Core Lithium Ltd and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has not been involved in the preparation of the BP33 Definitive Feasibility Study *and has had no contribution to, or review of the* BP33 Definitive Feasibility Study *other than in the* BP33 Traffic Impact Statement*. GHD shall not be liable to any person for any error in, omission from, or false or misleading statement in, any other part of the* BP33 Definitive Feasibility Study.

1.3 Assumptions

The following assumptions have been made as part of the report:

- Some information has been taken out of the Grants Mine TIS prepared by Flanagan Consulting to prepare this report. It is assumed that the existing data and assessment within the Flanagan Report are sufficiently accurate to be used as baseline data.
- It is assumed that the BP33 Underground Mine operation will commence at some time near the end of the operation at the Grants Mine (noting that in practice there may be some short period of overlap).
- It is noted that some ancillary operations will still be undertaken at Grants Mine during the BP33 Underground Mine operation which will continue to result in additional traffic movements, including staffing for site access and ore refinement.
- It is assumed that all vehicles accessing BP33 Underground Mine will utilise an internal haul road from Grants Mine and no additional access points are required (noting that the Observation Hill Dam turnoff from the Cox Peninsula Road may be used from time to time as an infrequent access for either emergency access or egress, or, for special one-off deliveries requiring direct access to BP33 rather than via the 7.5 km internal haul road from Grants Mine).
- Haulage is likely to occur over 7 day working week and the haulage task may occur over a 12- or 24-hour working day.
- A conservative growth rate of 3% per annum for traffic volumes on haul roads is considered appropriate.
- Peak hour volumes are estimated to be 15% of Average Annual Daily Traffic (AADT) for the road assessed. This falls within the ranges set out by the Austroads Guide to Road Design Part 4.
- A nominal start date for the commencement of operations of BP33 of June 2023 has been proposed for the purposes of this report.

1.4 Reference Material

The following documents have been used as reference material in the preparation of this report:

- Austroads Guide to Road Design Part 4 – Intersections and Crossings
- Austroads Guide to Traffic Management Part 12 – Integrated Transport Assessments for Developments
- Austroads Automatic Vehicle Classification by Vehicle Length, 2006
- Grants Mine: Traffic Impact Statement, Flanagan Consulting, (Ref. R-RB1056 5 October 2018)
- Annual Traffic Report 2019, Department of Infrastructure, Planning and Logistics, 2019.
- Crash history (20210208 Urgent - crash data request - GHD - Cox Peninsula Road 15 years) was requested and was received on 09/02/2021 from DIPL Road Safety Team for Cox Peninsula Road.
- Traffic data associated with the BP33 Underground Mine was received from Core Lithium including:
  - 2011_DFS BP33 and Grants UG Traffic Impact Assessment_RFQ
  - 210205_Vehicle Traffic Movements_from RFQ Process

– 210209_DFS BP33 and Grants UG Traffic Impact Assessment_updated Contractor Numbers

2. Proposed Development

2.1 Proposed Development Overview

The BP33 deposit is located on the Cox Peninsula and is located approximately 29 km south of Darwin and 7.5 km south of the Grants Mine via an internal haul road, to which both form part of the Finniss Lithium Project. A locality plan showing the extent of the Finniss Lithium Project and the location of each of the deposits is shown in Figure 1.

Figure 1 – Locality Plan (Grants Mine TIS – Flanagan Consulting)

2.2 Haulage Route

Mineral mined from the BP33 deposit is proposed to be hauled back to Grants Mine via an internal road. The mineral will be processed and refined at Grants Mine prior to being hauled to Darwin. The amount hauled for the BP33 Underground Mine is expected to be the same as the Grants Open Pit Mine. Haulage is likely to occur over 7 day working week and the haulage task may occur over a 12- or 24-hour working day.

Haulage trucks are proposed to then follow the same haul route used for the haulage of material from Grants Mine. The haul route is proposed to utilise Cox Peninsula Road, Stuart Highway, Tiger Brennan Drive and Berrimah Road. The haul route is shown in Figure 2.

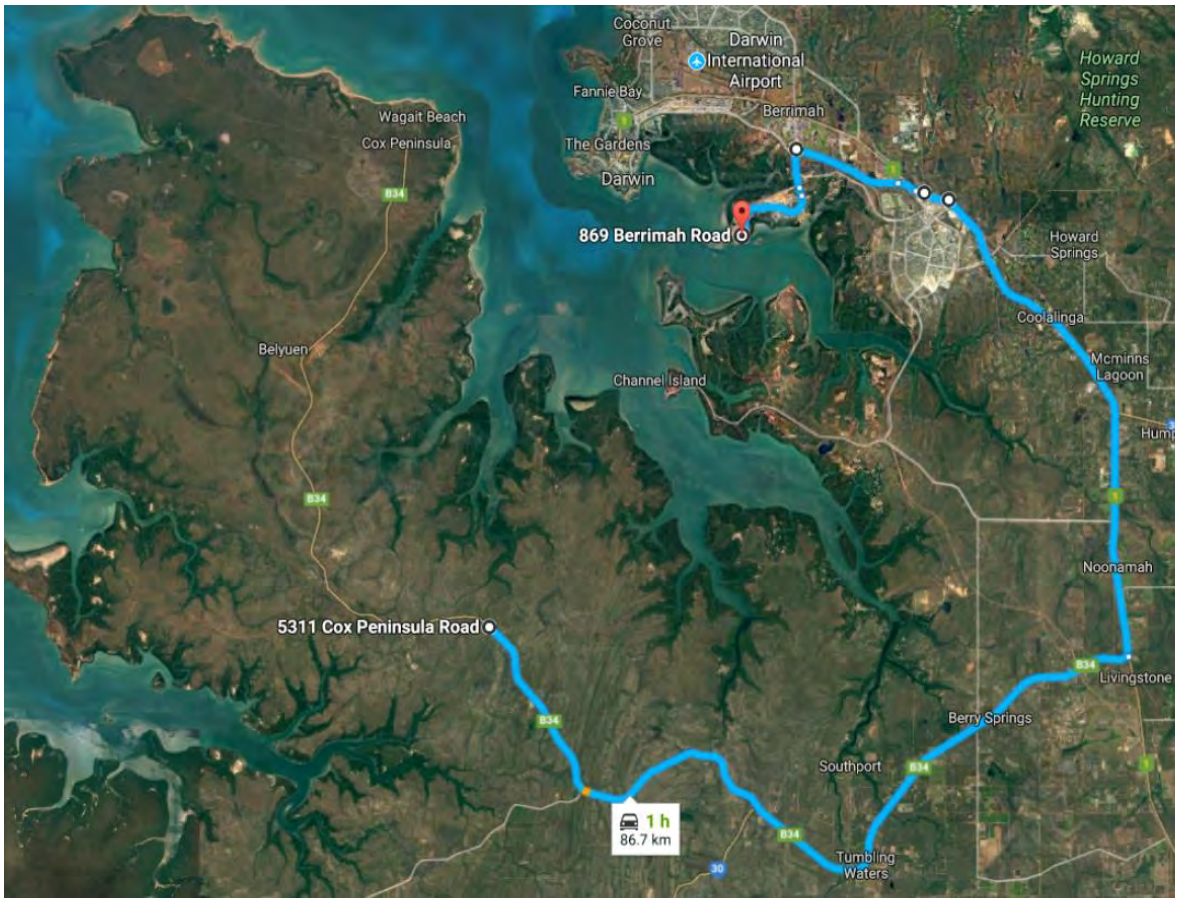


Figure 2 – Proposed Haulage Route (Grants Mine TIS – Flanagan Consulting)

3. Existing Conditions

3.1 Road Network

A desktop assessment of the road network that will carry traffic to and from the BP33 Underground Mine has been undertaken and is described in the following sections.

3.1.1 Cox Peninsula Road

Cox Peninsula Road is a rural arterial road which is under the control of the Department of Infrastructure, Planning and Logistics (DIPL). It generally runs in an east-west direction which provides for traffic between the Stuart Highway and the Cox Peninsula.

It is generally a two-way undivided carriageway consisting of one lane in each direction with unseal shouldered on either side. Cox Peninsula Road has a default speed limit of 130 km/hr.

Cox Peninsula Road provides access to a number of tourist destinations including Litchfield National Park, Dundee Beach, Crab Claw Island and Wagait Beach.

3.1.2 Stuart Highway

Stuart Highway is a national highway which is under the control of the DIPL. It generally runs in a north-south direction and provides the link between the Northern Territory and South Australia.

It is generally a two-way divided carriageway, consisting of two lanes in each direction and is un-kerbed. Stuart Highway has a posted speed limit of 110 km/hr.

3.1.3 Tiger Brennan Drive

Tiger Brennan Drive is an urban arterial road which is under the control of DIPL. It generally runs in an east-west direction between the Stuart Highway and Darwin.

It is generally a two-way divided carriageway, consisting of two lanes in each direction with kerbs along the central median and a sealed shoulder on the other side. Tiger Brennan Drive has a posted speed limit of 100 km/hr.

3.1.4 Berrimah Road

Berrimah Road is an urban arterial road which is under the control of DIPL. It generally runs in a north-south direction between Tiger Brennan Drive and East Arm.

It is generally a two-way undivided carriageway, consisting of one lane in each direction with kerbs on either side. Berrimah Road has a posted speed limit of 70 km/hr.

3.2 Traffic Volumes

Existing traffic volumes were obtained from the Annual Traffic Report 2019 by Territory Asset Management Services. The report provides annual daily traffic for a ten-year period from 2009 to 2019.

A conservative growth rate of 3% has been applied to the 2019 traffic volumes to forecast 2021 traffic volumes which is consistent with the Grants Mine TIS prepared by Flanagan Consulting.

Peak hour volumes were estimated to be 15% of the overall daily traffic for rural roads as per the Grants Mine TIS prepared by Flanagan Consulting and is consistent with the design hour volumes for rural situations with the Austroads Guide to Road Design Part 4.

A summary of traffic volumes is given in Table 1.

Table 1 – Traffic volumes on proposed haulage roads for 2019 and current year.

Berrimah Road 350 m West of Casey Street (UDVDP029)	2019 AADT (veh/day)	2021 forecast AADT (veh/day)	2021 peak hour traffic (veh/h)
Berrimah Road (UDVDP029)	1,229	1,304	196
Berrimah Road 400 m Sth of Tiger Brennan Drive (UDVDP028)	7,751	8,224	12,34
Berrimah Road 100 m South Marlow Road (UDVDC024)	6,982	7,408	1,112
Tiger Brennan Dr 800 m West of Berrimah Road (UDVDP022)	19,876	21,088	3,164
Stuart Highway Midway Yarrawonga & Tulagi Rds (UDVDC079)	24,378	25,864	3,880
Temple Terrace 100 m South of Stuart Highway (UDVDP024)	9,519	10,100	1,515
Stuart Highway 500 m West of Howard Springs Rd (UDVDP017)	25,096	26,625	3,994
Lambrick Avenue 200 m West of Stuart Highway (UDVDP023)	12,770	13,549	2,033
Howard Springs Road 500 m East of Stuart Hwy (UDVDP018)	7,779	8,254	1,239
Stuart Highway 100 m North of Henning Rd (UDVDC021)	16,886	17,915	2,688
Stuart Highway 500 m North of Arnhem Hwy (UDVDP020)	11,714	12,428	1,865
Arnhem Hwy 500 m East of Stuart Hwy (UDVDP019)	6,929	7,352	1,171
Stuart Highway 500 m North of Gulnare Rd (RDVDC051)	6,527	6,925	1,103
Stuart Highway 500 m North of Cox Peninsula Rd (RDVDC049)	5,667	6,014	903
Stuart Highway 500 m South of Cox Peninsula Rd (RDVDC091)	3,940	4,181	628
Cox Peninsula Road 4 km West of Stuart Hwy (RDVDP009)	2,110	2,240	336
Darwin River Rd 3 km West of Cox Peninsula Rd (RDVDC036)	852*	933	140
Cox Peninsula Road at Blackmore River Bridge (RDVDC030)	819*	897	135
Litchfield Park Rd 2 km West of Cox Peninsula Rd (RDVDP014)	186	198	30
Cox Peninsula Road at Pioneer Creek Bridge (RDVDP010)	607	645	97

Berrimah Road 350 m West of Casey Street (UDVDP029)	2019 AADT (veh/day)	2021 forecast AADT (veh/day)	2021 peak hour traffic (veh/h)
Fog Bay Road 2 km West of Cox Peninsula Road (RDVDP032)	422	449	68
Cox Peninsula Road 500 m West of Fog Bay Rd (RDVDC033)	210*	231	35

* Denotes 2018 traffic volume due to biannual traffic counts.

3.3 Public Transport

The following public transport routes exist on the proposed haul routes for the BP33 Underground Mine:

- Bus Routes 5, 8, 9, 16, 17, 28, 77, 440, 445, 446, 447, 450, OL1 and OL2 all exist along sections of the Stuart Highway to which will also be utilised as haul routes.

A bus route map showing sections to which will also be used as haul routes is shown in Figure 3

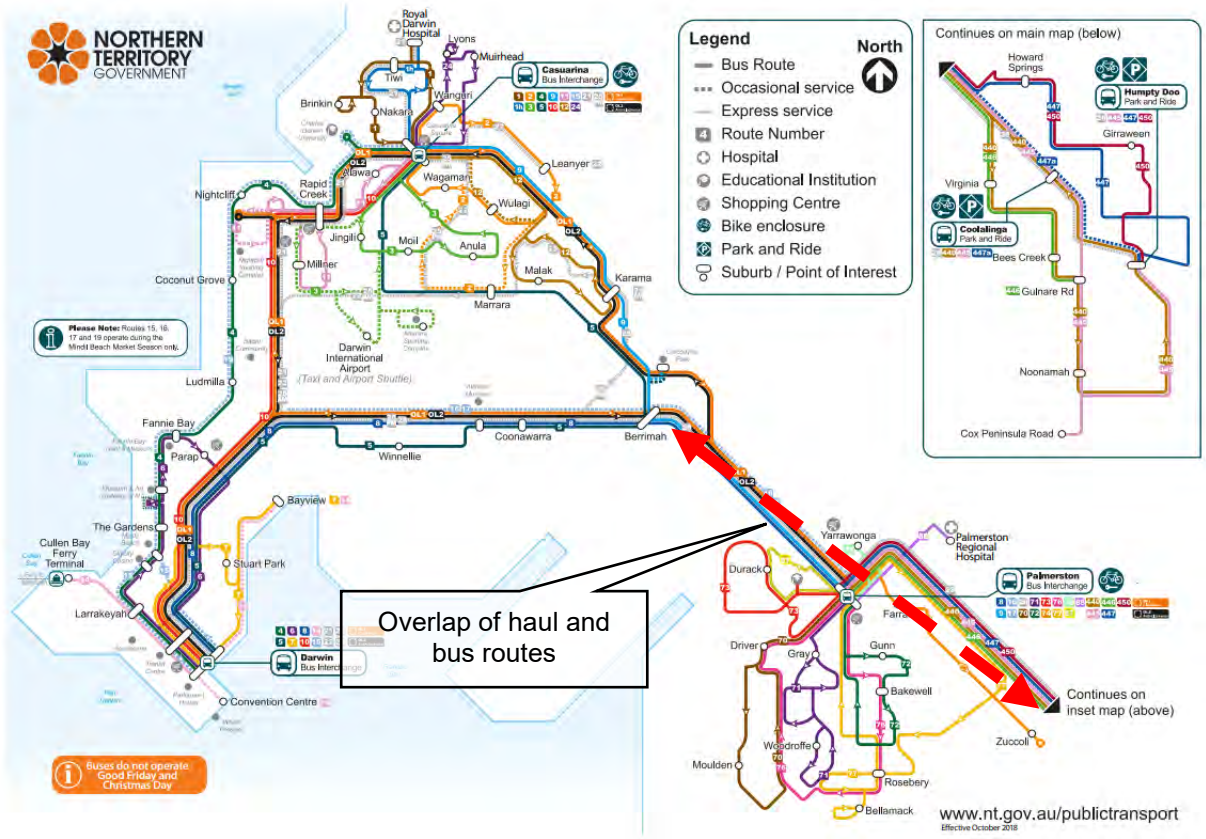


Figure 3 – Public transport network (Northern Territory Government)

3.4 Accident Data

DIPL provided accident data history for Cox Peninsula Road for the previous 5 years (2016-2020). A review of the data shows:

- A total of 26 accidents occurred along Cox Peninsula Road over this period of time. These accidents resulted in 2 fatalities and 15 serious injuries.
- 9 accidents involved two or more vehicles. Of these accidents, 4 involved rear ends, 2 involved angled collisions, 2 involved side swipes, and 1 involved hitting another object.

- The remaining 17 accidents were single vehicle accidents. Of these, 2 accidents involved a motorcycle and the remaining 15 were results of overturned vehicles or running off the road.
- 5 accidents were alcohol related (approximately 23% of all accidents), including the crash resulting in the two fatalities.

Based on the data provided, there is no discernible pattern of crashes which may indicate any particular safety issues with the Cox Peninsula Road.

4. Traffic Generation

4.1 Network Traffic Forecast

It is nominally proposed for the BP33 Underground Mine to commence site development activities in June 2023 (or 12 months after the start of the mining of the Grant's Open Cut mine). Traffic will be forecasted using the conservative growth rate of 3% per annum from the last recorded traffic volumes (2019). The forecasted traffic volumes along the haul route are shown in Table 2.

Table 2 – Forecasted traffic volumes on proposed haulage roads

Count Station	2023 forecast AADT (veh/day)	2023 peak hour traffic (veh/h)
Berrimah Road 350 m West of Casey Street (UDVDP029)	1,385	208
Berrimah Road 400 m South of Tiger Brennan Drive (UDVDP028)	8,726	1,309
Berrimah Road 100 m South Marlow Road (UDVDC024)	7,860	1,179
Tiger Brennan Dr 800 m West of Berrimah Road (UDVDP022)	22,373	3,356
Stuart Highway Midway Yarrawonga & Tulagi Rds (UDVDC079)	27,440	4,116
Temple Terrace 100 m South of Stuart Highway (UDVDP024)	10,716	1,608
Stuart Highway 500 m West of Howard Springs Rd (UDVDP017)	28,247	4,238
Lambrick Avenue 200 m West of Stuart Highway (UDVDP023)	14,375	2,157
Howard Springs Road 500 m East of Stuart Hwy (UDVDP018)	8,758	1,314
Stuart Highway 100 m North of Henning Rd (UDVDC021)	19,007	2,852
Stuart Highway 500 m North of Arnhem Hwy (UDVDP020)	13,186	1,978
Arnhem Hwy 500 m East of Stuart Hwy (UDVDP019)	7,801	1,171
Stuart Highway 500 m North of Gulnare Rd (RDVDC051)	7,347	1,103
Stuart Highway 500 m North of Cox Peninsula Rd (RDVDC049)	6,381	958
Stuart Highway 500 m South of Cox Peninsula Rd (RDVDC091)	4,437	666
Cox Peninsula Road 4 km West of Stuart Hwy (RDVDP009)	2,378	357

Count Station	2023 forecast AADT (veh/day)	2023 peak hour traffic (veh/h)
Darwin River Rd 3 km West of Cox Peninsula Rd (RDVDC036)	990	149
Cox Peninsula Road at Blackmore River Bridge (RDVDC030)	952	143
Litchfield Park Rd 2 km West of Cox Peninsula Rd (RDVDP014)	211	32
Cox Peninsula Road at Pioneer Creek Bridge (RDVDP010)	685	103
Fog Bay Road 2 km West of Cox Peninsula Road (RDVDP032)	477	72
Cox Peninsula Road 500 m West of Fog Bay Rd (RDVDC033)	246	37

4.2 Traffic Generation

The trips generated by the site on the external road network will be split between haulage of the product and staff and general operational traffic and is outlined below: There maybe additional trips generated on the internal haul roads which are not included in this assessment as they will have no impact on the external road network.

The trips have been split into light vehicles and heavy vehicles which are based on the Austroads Vehicle Classifications.

4.2.1 Product Haulage

The proposed haulage traffic generated on the external road network by the development has been provided from Core Lithium which has been calculated as the number of quad road train movements that would be required to transport the product at which it is extracted and refined.

The heavy vehicle movements which are expected to be generated by the operation of the BP33 Underground Mine on the external road network are likely to be the same as those during the Grants Mine Open Pit Mine. An extract from the Flanagan Consulting report is shown below showing the proposed traffic generation.

Parameter	Peak Month Value (26th Month of Operation)
Amount of Product to be Shipped (tonnes)	25,083
Maximum load for quad road train (tonnes)	95
Assumed Trip Duration (hours – 1 way)	1.5
Assumed Trip Duration (hours – return)	3.0
Assumed Number of Working Days Per Month (Days)	30
Assumed Length of Working Day (Hours)	10
Number of Trips per Month (Road Trains)	265
Number of Trips per Day (Road Trains)	10
Number of Trips per Hour (Road Trains)	1
Minimum Size of Road Train Fleet (Road Trains)	3

Figure 4 – Table of Haulage Trips on External Road Network (Grants Mine TIS – Flanagan Consulting)

The above assessment was based on a 7-day working week with a 10-hour working day. It has been indicated by Core Exploration that it is likely that the haulage task may occur over a 12 or 24 hour working day, the overall traffic impacts of the development would reduce slightly across the whole day but it is unlikely to reduce during the peak hour.

It is estimated that this will result in 10 heavy vehicle trips a day and one heavy vehicle movement during the peak period.

Table 3 – Estimated daily haulage traffic generated on external road network

Vehicle Type	Daily Traffic Movements
Light Vehicle	0
Heavy Vehicle	10
Total	**10**

4.2.2 Staff and General Operational Traffic

The proposed staff traffic generated by the development has been provided from Core Lithium which has been calculated based on 5 light vehicles travelling twice a day and 2 buses (heavy vehicles) travelling four times a day, resulting in up to 461 traffic movements to and from the site a month. Staff will travel from the surrounding areas to and from the site. There is no mining camp associated with Grants Mine or BP33 Mine.

There will also be general operation traffic of up to 2 trucks travelling twice a week, resulting in up to 40 traffic movements to and from the site a month on the external road network.

It is estimated that this will result in 10 light vehicle movement a day and up to 10 heavy vehicle movements a day and 5 light vehicle movements and 3 heavy vehicle movements during the peak period.

There will also be a number of staff movements associated with the ancillary operations at Grants Mine, including for refining of ore produced from BP33 Underground Mine. An extract from the Flanagan Consulting report is shown below showing the proposed traffic generation.

Transport Task	Mode	Quantum	Frequency
Mine Staff	Bus	4	Each Day/7 days
Mine Management	Motor Car / Ute	20	Each Day/7 days
Explosives - Consumables	3t Truck	1	Per month
Explosives - Bulk	Triple Road Train	5	Per month
Fuels	Triple Road Train	8	Per month
Rubbish Disposal	25t Truck	1	Per week
Tyres/Maintenance etc	Triple Road Train	4	Per month

Figure 5 – Table of Staff and General Operation Trips on External Road Network (Grants Mine TIS – Flanagan Consulting)

Based on the Grants Mine TIS there will be a total of 25 vehicle trips (20 light vehicle and 5 heavy vehicle) associated with the ancillary operations at Grants Mine on the external road network. It is estimated that half of these are attributed to peak hour trips.

Table 4 – Estimated daily staff and general operation traffic generated on external road network

Vehicle Type	Daily Traffic Movements
Light Vehicle	30
Heavy Vehicle	15
Total	**45**

4.3 Grants Mine Underground Traffic Generation

At the end of the BP33 Underground Mine operation, there may be an opportunity to further conduct underground mining at Grants Mine. It is unlikely that the traffic generated by the further operation at Grants Mine will be significantly different to the traffic generated by the Grants Mine open cut operation or the BP33 Underground Mine operation.

5. Traffic Impacts

5.1 Daily Traffic Generation

The estimated daily traffic generated by the development on the external road network is shown in Table 5 based on the combined total haulage trips and total staff and general operation trips.

Table 5 – Estimated daily traffic generated on external road network

Vehicle Type	Daily Traffic Movements
Light Vehicle	30
Heavy Vehicle	25
Total	**55**

An assessment of the percentage increase in overall traffic as a result of the development has been undertaken based on the forecasted 2023 traffic volumes on the haul roads. A threshold of 5% increase on the forecasted traffic volume for both the overall traffic and heavy vehicle traffic was adopted where additional analysis may be required. The assessment is shown in Table 6.

Table 6 – Traffic generation against forecasted traffic volumes on haul roads

Count Station	Ratio of traffic generation to forecasted daily traffic	Ratio of heavy vehicle generation to forecasted heavy vehicle traffic	Comment
Berrimah Road 350 m West of Casey Street (UDVDP029)	3.25%	4.01%	Insignificant traffic increase
Berrimah Road 400 m South of Tiger Brennan Drive (UDVDP028)	0.52%	1.34%	Insignificant traffic increase
Berrimah Road 100 m South Marlow Road (UDVDC024)	0.57%	1.38%	Insignificant traffic increase
Tiger Brennan Dr 800 m West of Berrimah Road (UDVDP022)	0.20%	7.00%	Further Analysis Required
Stuart Highway Midway Yarrawonga & Tulagi Rds (UDVDC079)	0.16%	0.46%	Insignificant traffic increase
Temple Terrace 100 m South of Stuart Highway (UDVDP024)	0.42%	13.30%	Further Analysis Required
Stuart Highway 500 m West of Howard Springs Rd (UDVDP017)	0.16%	0.44%	Insignificant traffic increase
Lambrick Avenue 200 m West of Stuart Highway (UDVDP023)	0.31%	0.87%	Insignificant traffic increase
Howard Springs Road 500 m East of Stuart Hwy (UDVDP018)	0.51%	55.56%	Further Analysis Required

Count Station	Ratio of traffic generation to forecasted daily traffic	Ratio of heavy vehicle generation to forecasted heavy vehicle traffic	Comment
Stuart Highway 100 m North of Henning Rd (UDVDC021)	0.24%	1.56%	Insignificant traffic increase
Stuart Highway 500 m North of Arnhem Hwy (UDVDP020)	0.24%	1.56%	Insignificant traffic increase
Arnhem Hwy 500 m East of Stuart Hwy (UDVDP019)	0.58%	3.13%	Insignificant traffic increase
Stuart Highway 500 m North of Gulnare Rd (RDVDC051)	0.61%	2.62%	Insignificant traffic increase
Stuart Highway 500 m North of Cox Peninsula Rd (RDVDC049)	0.71%	2.55%	Insignificant traffic increase
Stuart Highway 500 m South of Cox Peninsula Rd (RDVDC091)	1.01%	2.92%	Insignificant traffic increase
Cox Peninsula Road 4 km West of Stuart Hwy (RDVDP009)	1.89%	6.91%	Further Analysis Required
Darwin River Rd 3 km West of Cox Peninsula Rd (RDVDC036)	4.55%	12.44%	Further Analysis Required
Cox Peninsula Road at Blackmore River Bridge (RDVDC030)	4.73%	13.95%	Further Analysis Required
Litchfield Park Rd 2 km West of Cox Peninsula Rd (RDVDP014)	21.33%	58.14%	Further Analysis Required
Cox Peninsula Road at Pioneer Creek Bridge (RDVDP010)	6.57%	29.76%	Further Analysis Required
Fog Bay Road 2 km West of Cox Peninsula Road (RDVDP032)	9.43%	45.45%	Further Analysis Required
Cox Peninsula Road 500 m West of Fog Bay Rd (RDVDC033)	18.29%	48.08%	Further Analysis Required

The traffic increase on Berrimah Road and Stuart Highway are all less than 5% and therefore the traffic increase is considered insignificant.

Where the increase is greater than 5%, this can be attributed largely due to the forecasted combined traffic volumes or heavy vehicle traffic volumes on those roads being low, however may warrant further analysis at a later stage if requested by DIPL.

It is noted that the above traffic volumes conservatively includes traffic associated with ancillary operations at Grants Mine and haulage of materials which will be already be utilising the road network during the operation of the Grants Open Pit Mine (20 light vehicle movements and 15 heavy vehicle movements, total of 35 vehicle movements). Therefore 64% of the 55 daily vehicle trips associates with the BP33 Mine will be existing vehicle trips during the operation of Grants Open Pit Mine.

It is noted that this assessment differs from the Flanagan Consulting Grants Mine TIS Report for the following reasons:

- The Grants Mine does not include buses as heavy vehicles. In this assessment they have been included as heavy vehicle due to their Austroads classification
- The Grants Mine assessment compares only peak hour movements. This assessment compares the overall daily traffic generated as per the Austroads Guide to Traffic Management Part 12 – Integrated Transport Assessments for Developments.

The assessment shows that the roads requiring further analysis due to increases in traffic greater than 5% are similar to that of the Grants Mine TIS. The operation of the BP33 Underground Mine will occur at the end of the operation of the Grants Open Pit Mine and utilise the same haul roads, and only 36% of trips (20 vehicle movements per day) are new trips associated with BP33.

5.2 Site Access

The proposed access into Grants Mine will be utilised to access the BP33 Underground Mine. The TIS undertaken by Flanagan Consulting for the Grants Mine shows the concept design (prepared by Flanagan Consulting) for a short auxilliary left turn and basic right treatment for the access off Cox Peninsula Road, located approximately 17 km north west of the Fog Bay Road / Cox Peninsula Road intersection. The proposed intersection is shown in Figure 6.

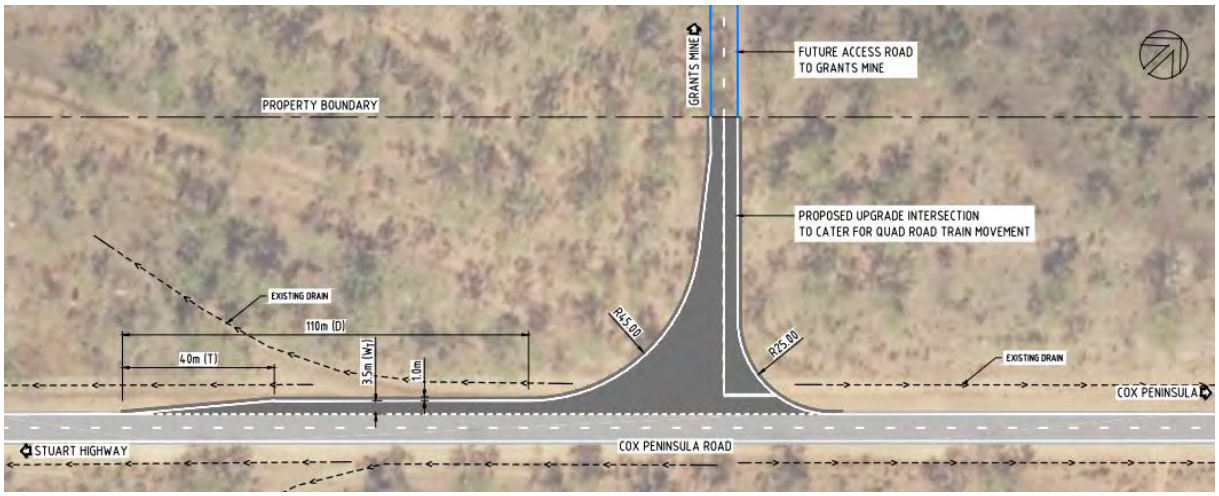


Figure 6 – Proposed access to Grants Mine (Grants Mine TIS – Flanagan Consulting)

It is noted for the concept design that A-Triples turning right out of the Grants Mine Access Road may cross the centre line of the Grants Mine access road. This may result in some safety concerns for the intersection design and should be investigated at a later design stage.

An assessment of the peak hour turn volumes for the BP33 Underground Mine against the forecasted peak hour traffic volumes along that section of Cox Peninsula Road has been undertaken to determine the most appropriate type of intersection treatment based on the Austroads Guide to Road Design Part 4.

The peak hour turn volume generated by the BP33 Underground Mine is 22 vehicles and the traffic volume along Cox Peninsula Road is forecasted to be 37 vehicles in 2023 as per Table 7. Plotting the two points on the graph in Figure 7, a basic right turn / basic left turn intersection is warranted. Therefore, the proposed intersection design prepared by Flanagan Consulting exceeds the requirement of the Austroads Guide.

Table 7 – Estimated peak hour traffic generated on external road network

Vehicle Type	Peak Hour Movements
Light Vehicle	15
Heavy Vehicle	7
Total	**22**

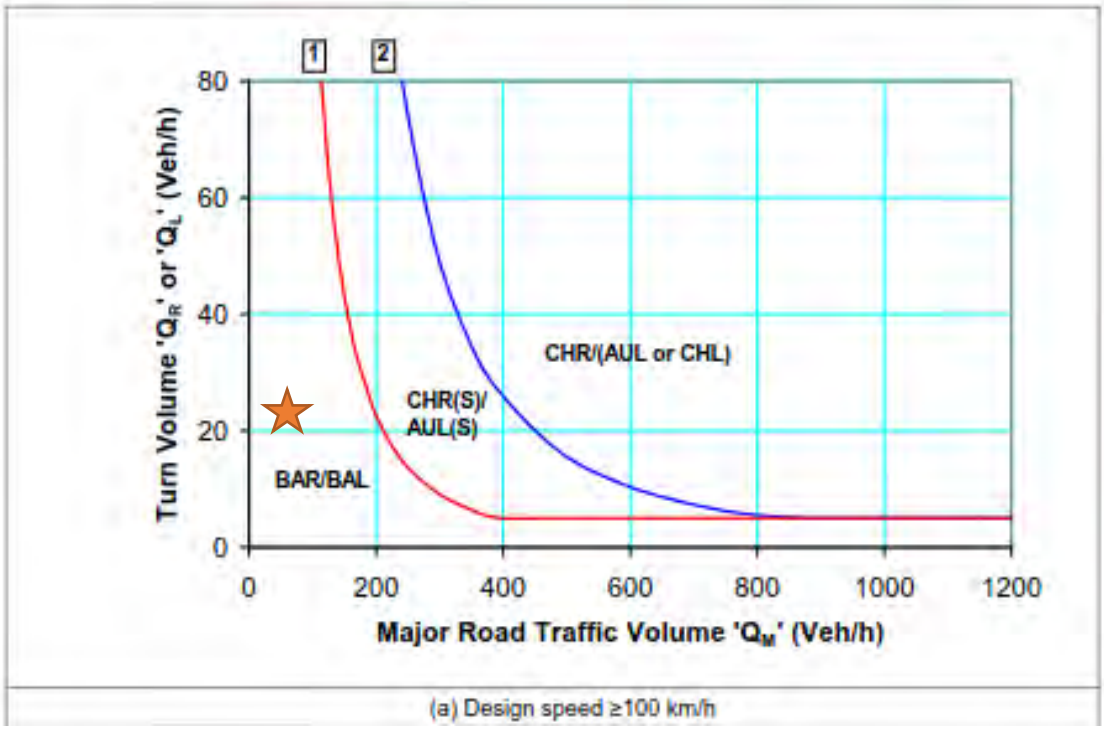


Figure 7 – Intersection design warrant assessment (Figure A10 – Austroads Guide to Road Design Part 4)

6. Conclusions and Recommendations

It is proposed to commence development activities then mine development and stoping operations at BP33 Underground Mine 12 months after the start of Open Cut mining at Grant's Mine.

- It is proposed to haul mineral from the BP33 Underground Mine back to Grants Mine via internal road and then along the same haulage route used for Grants Mine, utilising Cox Peninsula Road, Stuart Highway, Tiger Brennan Drive and Berrimah Road.
- Up to 10 heavy vehicle traffic movements will be associated with the haulage of material from BP33 Underground Mine, with approximately 1 heavy vehicle movement during the peak hour. The largest size vehicle is proposed to be a quad road train. This is consistent with the haulage movements with the Grants Open Pit Mine.
- New BP33 Underground Mine staff and general operation traffic will generate approximately 10 light vehicle movements and 10 heavy vehicle movements a day, with staff travelling to and from site from the local areas. There will also be staff retained at the Grants Mine for ancillary operations resulting in up to 20 light vehicle movements and 5 heavy vehicle movements a day. There is likely to be a total of 15 light vehicle movements and 6 heavy vehicle movements associated with staff and general operation traffic during the peak hour.
- An assessment of the increase in overall traffic on haul roads as a result of traffic generated by the site shows mostly insignificant traffic increases on the majority of roads. There may be some roads which may require further analysis due to percentage increases greater than 5%.
- The operation of the BP33 Underground Mine will occur at the end of the operation of the Grants Open Pit Mine and utilise the same haul roads, and only 36% of trips (20 vehicle movements per day) are new trips associated with BP33.
- The proposed access into Grants Mine will be located approximately 17 km north west of the Fog Bay Road and Cox Peninsula Road intersection. An assessment of the proposed access road intersection design prepared by Flanagan Consulting against the intersection design warrants within the Austroads Guide to Road Design Part 4 shows that the proposed intersection design exceeds the requirements.

Appendices

Appendix A – Grants Mine TIS

APPENDIX G TRAFFIC IMPACT STATEMENT (UPDATED)

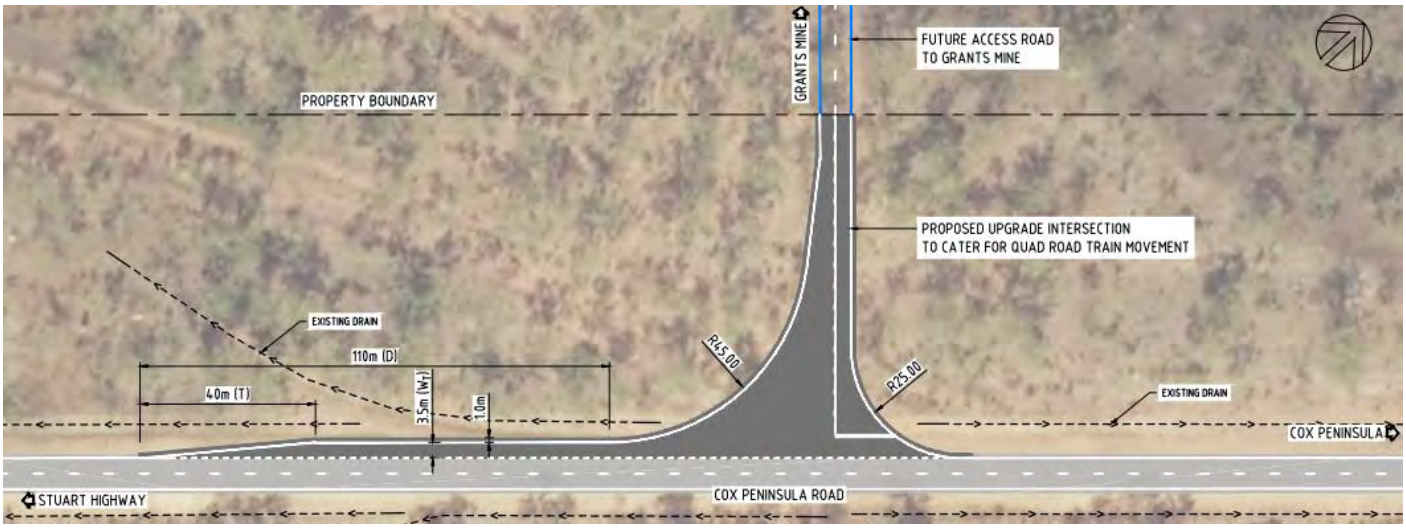
This document was originally submitted as Appendix G of the Draft EIS.

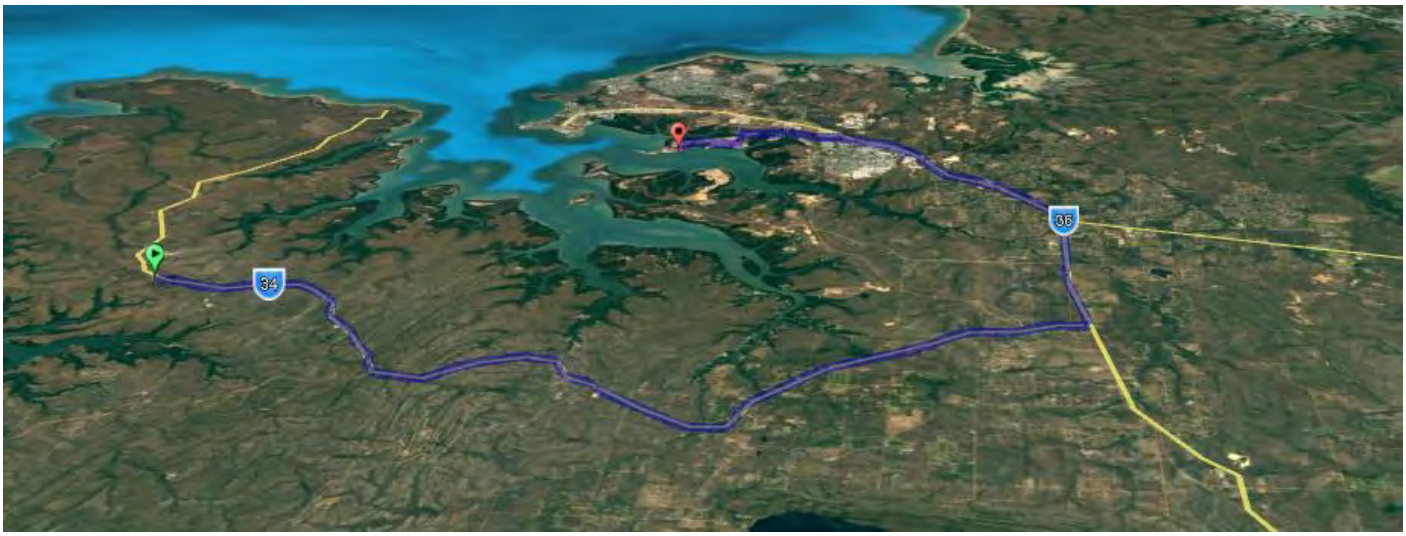
This document replaces all previous versions.

FLANAGAN CONSULTING GROUP
Trusted Advisor to Northern Australia

GRANTS MINE:
TRAFFIC IMPACT STATEMENT

CORE EXPLORATION LTD





Project No. **4966-01**

Reference No. **R-RB1056**

Date: **5 October 2018**

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1.0 INTRODUCTION

1.1 Background

Core Exploration Ltd proposes to mine spodumene, a mineral which can be processed to produce lithium. It is proposed that the spodumene will be processed onsite via dense media separation (DMS) to produce a beneficiated product of higher lithium concentration. This beneficiated product will then be transported via quad road train to the East Arm Wharf facility for export.

In progressing the development of the proposal, Core Exploration Ltd as owners of Grants Mine, seeks to inform the feasibility assessment of the project, and initial stakeholder consultation, by establishing a preferred route for haulage of the beneficiated product, and potential impacts on the preferred route associated with the transport task.

Flanagan Consulting Group (FCG) had earlier been engaged by Core Exploration Ltd to investigate the haulage route options, whereupon a preferred route between Grants Mine and the East Arm Wharf was identified (refer Flanagan Consulting Group Report *R-RL0131 Grants Mine – Heavy Vehicle Route Assessment* dated 17 October 2017). A copy of the route selection report is included in **Appendix A** for reference. This report relates to the impacts of increasing traffic along the selected route with consideration of the following:

- Existing operational conditions of the road network between Grants Mine and East Arm Wharf.
- The proposed trips generated by the development.
- Analysis of the operation of the intersections along the selected haul route.
- Professional opinion on the expected traffic impact during the expected critical peak hour.

It is noted that the Heavy Vehicle Route Assessment was undertaken based on direct shipping ore (DSO) being produced from Grants Mine, rather than a beneficiated product. As such, the Heavy Vehicle Route Assessment overestimates the amount of material to be transported and therefore overestimates the number of road trains required to complete the haulage task.

1.2 Proposed Development Overview

The Grants Mine is located approximately 22 km south of Darwin on the Cox Peninsula between Darwin and Bynoe Harbour. Grants Mine forms part of the Finniss Lithium Project, which contains an estimated 3.45 million tonnes of ore containing lithium dioxide. A locality plan showing the extent of the Finniss Project is given in **Figure 1**.

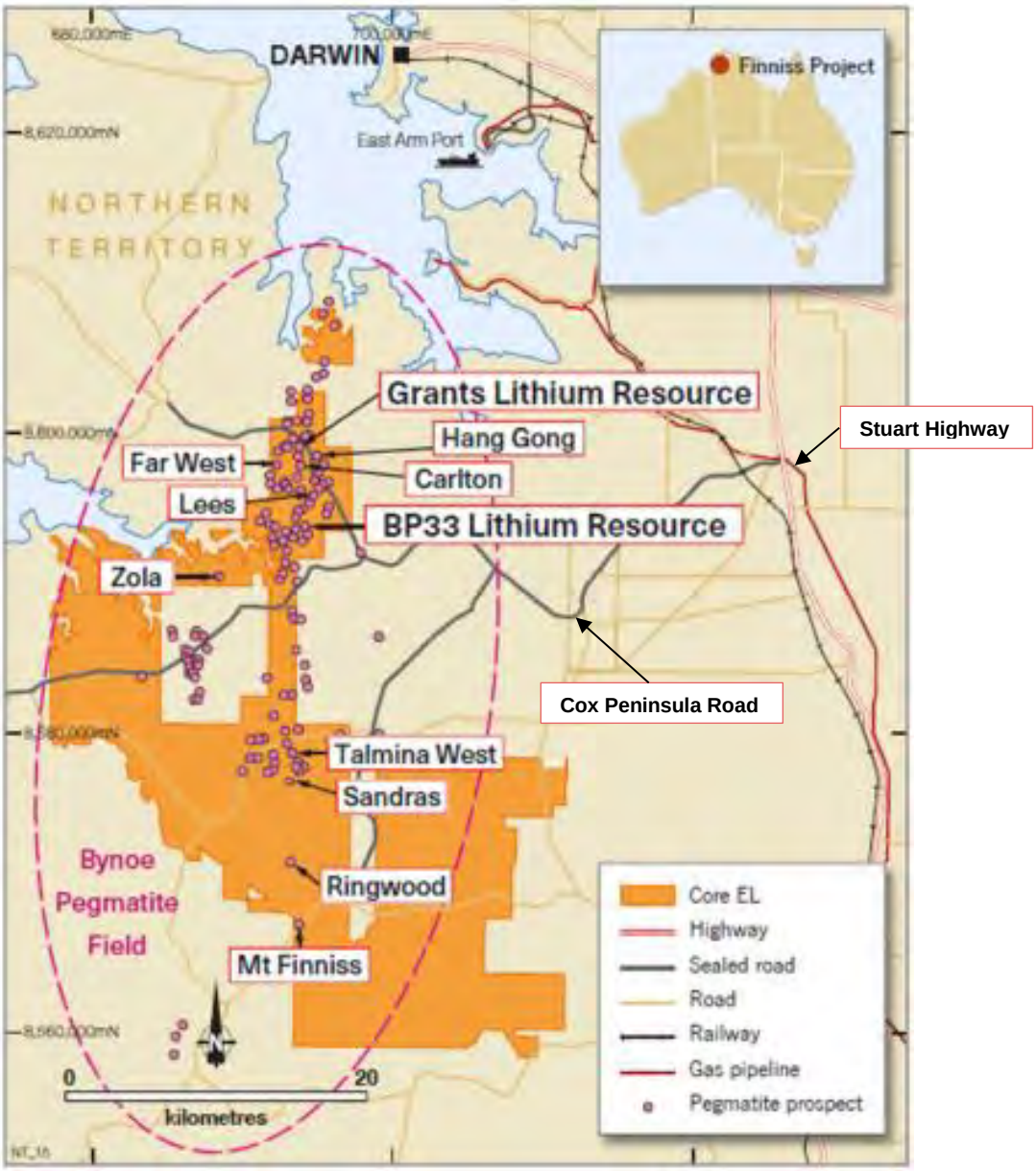

FIGURE 1 PROPOSED FINNISS PROJECT LOCALITY PLAN (CORE EXPLORATION LIMITED 2018)

Grants Mine is located approximately 500 m off Cox Peninsula Road. Core Exploration proposes to ship spodumene from Darwin Port to customers in China. The product is used as feedstock for lithium chemicals to produce a range of end products including lithium ion batteries.

The deposit contains an estimated 1.8 million tonnes of high grade spodumene ore, which will produce approximately 400,000 tonnes of beneficiated product. Core Exploration has a Heads of Agreement with Darwin Port to export the beneficiated product from East Arm Wharf over 2 to 3 years.

The transport task for the transfer of the beneficiated product to East Arm will be undertaken by quad road trains. It is planned to commence in the 2019 third quarter, peaking at a haulage rate of 25,083 tonnes per month and concluding in the 2021 third quarter.

1.3 Selected Haul Route

The selected haul route will travel along Cox Peninsula Road, Stuart Highway, Tiger Brennan Drive and Berrimah Road. Details of the selected haul route are shown in **Figure 2**.

FIGURE 2 SELECTED HAUL ROUTE (FLANAGAN CONSULTING GROUP 2018)

Total travel distance to the East Arm Wharf for the selected haul route is calculated to be approximately 86.7 km. Key features of this route include:

- The Stuart Highway is configured as a 4 lane divided carriageway which provides overtaking opportunity and safe passing of road trains
- All major intersections along the route (including Jenkins Road, Arnhem Highway, Tiger Brennan Drive, Berrimah Road) are signalised or grade separated providing a safe and controlled interaction with cross movements and potential conflicts.
- There are only 2 turning movements at intersections outside of the Port situated at the intersection of Cox Peninsula Road and the Stuart Highway and the intersection of Tiger Brennan Drive and Berrimah Road. For both intersections the fully laden road trains will be entering traffic in a left turn manoeuvre. Both intersections currently cater for either a continuous lane or merge lane to safely facilitate this manoeuvre.

2.0 EXISTING CONDITIONS

2.1 Road Network

2.1.1 Cox Peninsula Road

Cox Peninsula Road is located on the Cox Peninsula and provides the main road link between Stuart Highway (as the primary southern access to Darwin) and the Peninsula. Cox Peninsula Road is a rural arterial road and is under the control of the Department of Infrastructure, Planning and Logistics (DIPL). It is a two-way undivided road with a carriageway width of at least 7.0 m. It is predominantly un-kerbed with open drainage on both sides of the road. The road pavements and surface are generally well maintained and is fit for road trains. Cox Peninsula Road provides access to a number of tourist destinations including Litchfield National Park, Dundee Beach, Crab Claw Island and Wagait Beach.

2.1.2 Stuart Highway

Stuart Highway connects Darwin to Katherine, Tennant Creek and Alice Springs and provides the main link between the Northern Territory and South Australia. It is a national highway and is under the control of DIPL. Stuart Highway is a two-way divided road with two lanes in each direction. It is predominantly un-kerbed with open drainage on both sides of the road and through the median. The road surface is generally well maintained due to its function as a major road train route.

2.1.3 Tiger Brennan Drive

Tiger Brennan Drive provides the main link between Darwin and Palmerston and runs parallel to Stuart Highway. It is an urban arterial road and is under the control of DIPL. Tiger Brennan Drive is a two-way divided road with two lanes in each direction. It is predominantly un-kerbed with open drainage on both sides of the road and through the median. The road surface is generally well maintained and suitable for road trains.

2.1.4 Berrimah Road

Berrimah Road provides the main access to the East Arm Wharf facility. It is an arterial road and is under the control of DIPL. Berrimah Road is a two-way road that transitions from a divided dual carriageway to a single undivided carriageway approximately 350 m south-west of the Cochrane Road intersection. It is predominantly kerbed with a combination of open channel and underground drainage. The road surface is generally well maintained. The relatively high volume of heavy vehicle movements necessitates supplementary provisions for road trains including heavy vehicle warning signals.

2.2 Traffic Volumes

Existing traffic volumes were obtained from *Annual Traffic Report 2015* by Territory Asset Management Services. This report gives average annual daily traffic for a ten-year period (from 2005 until 2015). This data was used to derive a growth rate of 3% per annum. This was applied to the 2015 traffic counts to estimate the current (2018) daily traffic volumes. Peak hour volumes were estimated as 15% of the daily traffic. This is consistent with typical peak period generation on arterial classified road networks. A summary of the estimated traffic volumes is given in **Table 1**.

TABLE 1 CALCULATED 2018 TRAFFIC VOLUMES

Count Station	2018 total daily traffic (veh/day) (3% Growth PA 2015 – 2018)	2018 total peak hour traffic (veh/h) (15% of Estimated 2018)
Berrimah Road (UDVDP029)	1,143	172
Berrimah Road 400 m Sth of Tiger Brennan Drive (UDVDP028)	10,032	1,505
Berrimah Road 100 m South Marlow Road (UDVDP024)	9,068	1,361
Tiger Brennan Dr (UDVDP022)	18,400	2,760
Stuart Highway Midway Yarrawonga & Tulagi Rds (UDVDC079)	24,202	3,631
Temple Terrace 100 m South of Stuart Highway (UDVDP024)	12,178	1,827
Stuart Highway 500 m West of Howard Springs Rd (UDVDP017)	27,753	4,163
Lambrick Avenue 200 m West of Stuart Highway (UDVDP023)	11,591	1,739
Stuart Highway 100 m North of Henning Rd (UDVDC021)	18,385	2,758
Stuart Highway 500 m North of Arnhem Hwy (UDVDP020)	13,416	2,013
Arnhem Hwy 500 m East of Stuart Hwy (UDVDP019)	8,441	1,267
Stuart Highway 500 m North of Gulnare Rd (UDVDC051)	8,579	1,287
Stuart Highway 500 m North of Cox Peninsula Rd (RDVDC049)	6,965	1,045
Stuart Highway 500 m South of Cox Peninsula Rd (RDVDC091)	5,043	757
Cox Peninsula Road 4 km West of Stuart Hwy (RDVDP009)	2,367	356
Darwin River Rd 3 km West of Cox Peninsula Rd (RDVDC036)	797	120
Cox Peninsula Road At Blackmore River Bridge (RDVDC030)	781	118
Litchfield Park Rd 2 km West of Cox Peninsula Rd (RDVDP014)	149	23
Cox Peninsula Road At Pioneer Creek Bridge (RDVDP010)	627	95
Fog Bay Road 2 Km West of Cox Peninsula Road (RDVDP032)	409	62
Cox Peninsula Road 500 m West of Fog Bay Rd (RDVDC033)	212	32

Full calculations for the estimated background traffic are given in **Appendix B**.

2.3 Public Transport

Fourteen public bus services traverse the portion of the Stuart Highway coincident with the proposed haulage route (Services 5, 8, 9, 16, 17, 28, 77, 440, 445, 446, 447, 450, OL1 and OL2). One bus service travels Cox Peninsula Road (Service 445). This is shown in **Figure 3**.

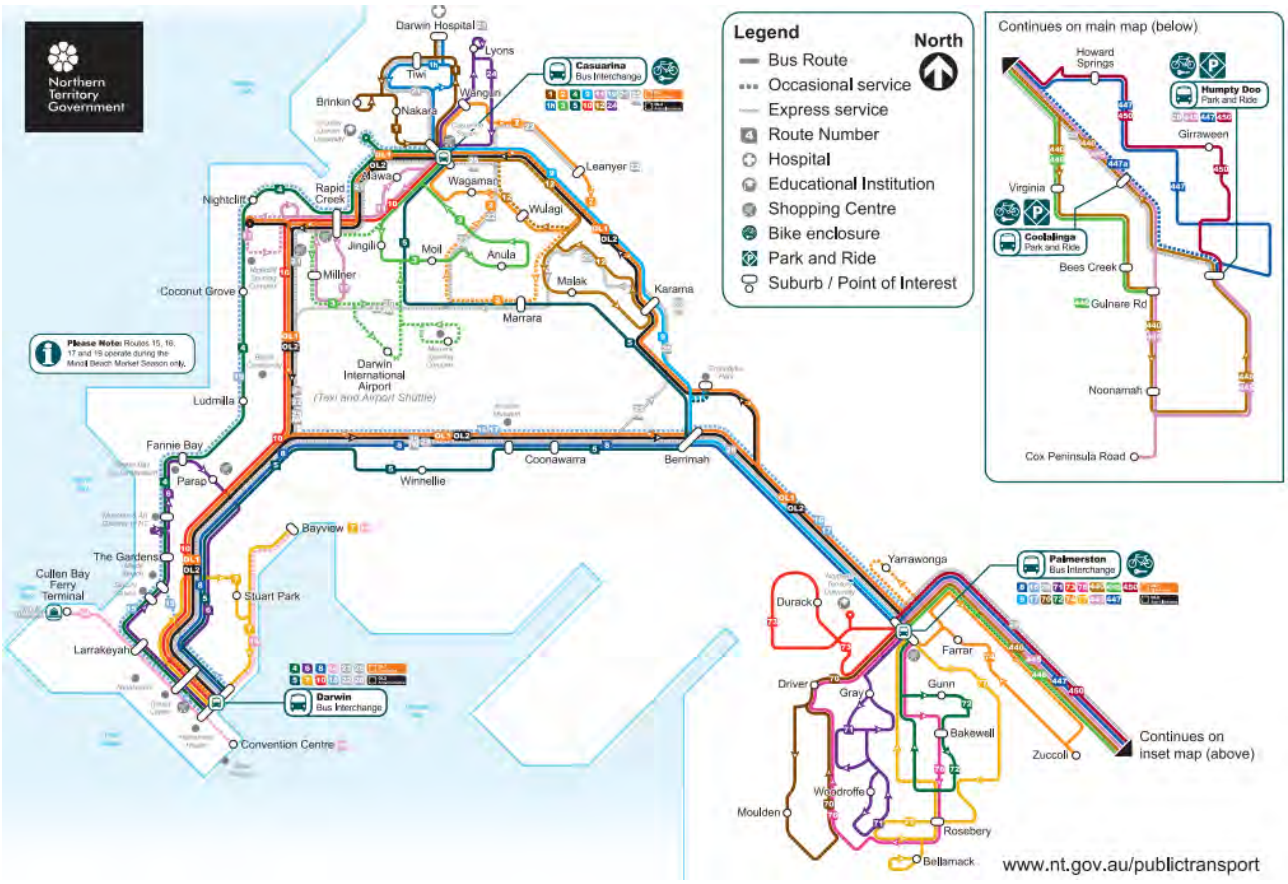

FIGURE 3 NT PUBLIC BUS NETWORK (NORTHERN TERRITORY GOVERNMENT 2018)

These buses mainly operate in the peak periods (7:00 AM to 8:30 AM and 5:00 PM to 6:30 PM), with a total of 31 bus trips occurring in each of these periods (62 trips total). Passenger pickup and drop off points are dedicated bus facilities that allow buses to pull over clear of the traffic lanes. Bus timetable data obtained from the Northern Territory Government shows that there are several school buses that also operate on Cox Peninsula Road and Stuart Highway to deliver students to Berry Springs Primary School. These bus services are 425, 433, 429, 435 and 427. These buses travel the proposed haul route between 6:30 AM to 8:30 AM and 3:00 PM to 5:00 PM. It is estimated that there will be 5 individual bus trips between 7:30 AM to 8:00 AM and 5 individual bus trips between 3:15 PM to 3:45 PM.

2.4 Accident Data

DIPL provided accident data history for Cox Peninsula Road for the previous 15 years. On review of the data, the following was noted:

- 119 accidents occurred on Cox Peninsula Road over that time. These accidents resulted in 9 fatalities (from 6 accidents) and 45 serious injuries (from 31 accidents). Of the fatal accidents, 3 involved an overturned vehicle, 2 involved a vehicle running off the road and 1 was a rear end collision.
- 26 accidents involved two or more vehicles. Of these accidents, 9 were angle collisions, 14 were rear end collisions, 2 were side swipe collisions and 1 resulted in an overturned vehicle. Of these accidents, 1 was fatal (rear end accident) and 5 resulted in serious injuries.

- The remaining 93 accidents were single vehicle accidents. Of these, 25 involved the vehicle colliding with a roadside hazard, such as signs, guide posts, animals, etc and 4 accidents involved a motorcycle. The remaining 64 accidents were vehicle overturning or leaving the road.
- 17 accidents were alcohol related (approximately 15% of all accidents). Of the 6 fatal accidents, 5 of these were alcohol related (83% of fatal accidents).
- Other than at intersections where the potential for conflict between vehicles exists, the distribution of accidents along Cox Peninsular Road does not present clusters that suggest there are issues with road condition or geometry that creates unsafe situations.

The accident data identifies the main accident type for this road involves a single vehicle. This suggests that the primary accident risk on Cox Peninsula Road is driver inattention. Furthermore, there were relatively few accidents involving two or more vehicles. This suggests that the road has no specific issues with creating conflict situations.

The majority of accidents (approximately 60%) involved vehicles travelling towards Darwin. It is likely that these vehicles were returning from one of the tourist destinations accessed via Cox Peninsula Road. As such, it is likely that the drivers were either fatigued from a long drive following their holiday or were unfamiliar with the conditions on Northern Territory roads.

It is also noted that accidents involving heavy vehicles were not specifically identified in the data. However, the Northern Territory Government advised that one fatal accident occurred with a light vehicle rear ending a road train. This accident occurred approximately 1.5 km north east of the Berry Springs Tavern Access Road on 1 October 2016. The accident was identified as being alcohol related. This was a significant motor vehicle accident, which resulted in four fatalities and two serious injuries. The area where the accident occurred is a relatively flat, straight section of road with no adjacent intersections. This means it is unlikely that poor road geometry caused the accident and therefore alcohol is the major contributing factor of this accident.

Accident data on Stuart Highway, Tiger Brennan Drive and Berrimah Road was not requested from DIPL as the increase in traffic along these roads is considered insignificant (as discussed in **Section 4.1**).

3.0 DEVELOPMENT TRAFFIC GENERATION

3.1 Background Traffic

Forecast background traffic has been based on the existing traffic volumes detailed in **Section 2.2**. An annual growth factor of 3% has been applied to the 2018 volumes to estimate the 2021 background traffic volumes when haulage operations conclude. A summary of the estimated background traffic is given in **Table 2**

TABLE 2 ESTIMATED 2021 BACKGROUND TRAFFIC VOLUMES

Count Station	2021 total daily traffic (veh/day) (3% Growth PA 2018 – 2021)	2021 total peak hour traffic (veh/h) (15% of Estimated 2021)
Berrimah Road (UDVDP029)	1,251	188
Berrimah Road 400 m Sth of Tiger Brennan Drive (UDVDP028)	10,963	1,645
Berrimah Road 100 m South Marlow Road (UDVDP024)	9,911	1,487
Tiger Brennan Dr (UDVDP022)	20,107	3,017
Stuart Highway Midway Yarrawonga & Tulagi Rds (UDVDC079)	26,448	3,968
Temple Terrace 100 m South of Stuart Highway (UDVDP024)	13,309	1,997
Stuart Highway 500 m West of Howard Springs Rd (UDVDP017)	30,328	4,550
Lambrick Avenue 200 m West of Stuart Highway (UDVDP023)	12,667	1,901
Stuart Highway 100 m North of Henning Rd (UDVDC021)	20,092	3,014
Stuart Highway 500 m North of Arnhem Hwy (UDVDP020)	14,662	2,200
Arnhem Hwy 500 m East of Stuart Hwy (UDVDP019)	9,225	1,384
Stuart Highway 500 m North of Gulnare Rd (UDVDC051)	9,377	1,407
Stuart Highway 500 m North of Cox Peninsula Rd (RDVDC049)	7,612	1,142
Stuart Highway 500 m South of Cox Peninsula Rd (RDVDC091)	5,512	827
Cox Peninsula Road 4 km West of Stuart Hwy (RDVDP009)	2,589	389
Darwin River Rd 3 km West of Cox Peninsula Rd (RDVDC036)	872	131
Cox Peninsula Road At Blackmore River Bridge (RDVDC030)	855	129
Litchfield Park Rd 2 km West of Cox Peninsula Rd (RDVDP014)	164	25
Cox Peninsula Road At Pioneer Creek Bridge (RDVDP010)	686	103
Fog Bay Road 2 Km West of Cox Peninsula Road (RDVDP032)	449	68
Cox Peninsula Road 500 m West of Fog Bay Rd (RDVDC033)	233	35

Full calculations for the estimated background traffic are given in **Appendix B**.

3.2 Traffic Generation

3.2.1 Product Haulage

The traffic generated by the development was calculated by determining the number of quad road train movements that would be required to transport the beneficiated product at the rate at which it is extracted and refined by Core Exploration.

The estimated generated ore haulage traffic from the proposed development is given in **Table 3**. Full calculations showing the traffic generation can be seen in **Appendix B**.

TABLE 3 ESTIMATE OF THE NUMBER OF QUAD ROAD TRAIN TRIPS REQUIRED (FLANAGAN CONSULTING GROUP 2018)

Parameter	Peak Month Value (26th Month of Operation)
Amount of Product to be Shipped (tonnes)	25,083
Maximum load for quad road train (tonnes)	95
Assumed Trip Duration (hours – 1 way)	1.5
Assumed Trip Duration (hours – return)	3.0
Assumed Number of Working Days Per Month (Days)	30
Assumed Length of Working Day (Hours)	10
Number of Trips per Month (Road Trains)	265
Number of Trips per Day (Road Trains)	10
Number of Trips per Hour (Road Trains)	1
Minimum Size of Road Train Fleet (Road Trains)	3

For this assessment, a 7 day working week with a 10 hour working day was adopted. Core Exploration has advised that the haulage task may operate over a 12 or 24 hour working day. This would slightly reduce the traffic impacts of the development; however, it is unlikely to reduce the impact of the development in the peak hour.

3.2.2 Staff and Operations Traffic Movements

Other than the transport of beneficiated product, the operation of the mine will result in traffic generation associated with the movement of staff, incoming goods and materials including fuels and explosives, maintenance contractors and the like that will support the function of the mine.

Below is a summary of the anticipated quantum, frequency and mode of transport that will be employed in meeting the operations need.

Transport Task	Mode	Quantum	Frequency
Mine Staff	Bus	4	Each Day/7 days
Mine Management	Motor Car / Ute	20	Each Day/7 days
Explosives - Consumables	3t Truck	1	Per month
Explosives - Bulk	Triple Road Train	5	Per month
Fuels	Triple Road Train	8	Per month
Rubbish Disposal	25t Truck	1	Per week
Tyres/Maintenance etc	Triple Road Train	4	Per month

To provide some context, the average movements per day on the Cox Peninsula Road during regular operations (excluding concentrate haulage) will be 25 movements per day comprising of 1 heavy vehicle movement, 20 motor vehicles and 4 buses. This is approximately 10% of the total number of vehicle movements on the Cox Peninsula Road, of which 1% represents an increase in heavy vehicle movements.

4.0 DEVELOPMENT IMPACTS ON EXISTING ROAD NETWORK

4.1 Traffic Impacts

4.1.1 High Level Assessment

Baseline traffic data has been sourced from *Annual Traffic Report 2015* and projected to 2021 when the haulage operations will conclude. The estimated development traffic was compared to this baseline traffic data to assess the relative increase in traffic. A threshold of 5% increase on the background traffic and/or background heavy vehicle traffic was adopted, as the measure by which increase in traffic volume triggers a "material impact" and warrants further analysis. This analysis was conducted relative to total traffic movements and heavy vehicle movements. A summary of this analysis is given in **Table 4**.

TABLE 4 RATIO OF DEVELOPMENT TRAFFIC TO BACKGROUND TRAFFIC

Count Station	Ratio of Development Traffic to Background Traffic (all vehicles)	Ratio of Development Traffic to Background Traffic (heavy vehicles)	Comment
Berrimah Road (UDVDP029)	1.06%	2.04%	Insignificant traffic increase
Berrimah Road 400 m Sth of Tiger Brennan Drive (UDVDP028)	0.12%	0.56%	Insignificant traffic increase
Berrimah Road 100 m South Marlow Road (UDVDP024)	0.13%	0.67%	Insignificant traffic increase
Tiger Brennan Dr (UDVDP022)	0.07%	0.42%	Insignificant traffic increase
Stuart Highway Midway Yarrawonga & Tulagi Rds (UDVDC079)	0.05%	0.25%	Insignificant traffic increase
Temple Terrace 100 m South of Stuart Highway (UDVDP024)	0.10%	0.50%	Insignificant traffic increase
Stuart Highway 500 m West of Howard Springs Rd (UDVDP017)	0.04%	0.22%	Insignificant traffic increase
Lambrick Avenue 200 m West of Stuart Highway (UDVDP023)	0.11%	0.88%	Insignificant traffic increase
Stuart Highway 100 m North of Henning Rd (UDVDC021)	0.07%	1.32%	Insignificant traffic increase
Stuart Highway 500 m North of Arnhem Hwy (UDVDP020)	0.09%	0.45%	Insignificant traffic increase
Arnhem Hwy 500 m East of Stuart Hwy (UDVDP019)	0.14%	0.72%	Insignificant traffic increase
Stuart Highway 500 m North of Gulnare Rd (UDVDC051)	0.14%	0.71%	Insignificant traffic increase
Stuart Highway 500 m North of Cox Peninsula Rd (RDVDC049)	0.18%	0.87%	Insignificant traffic increase
Stuart Highway 500 m South of Cox Peninsula Rd (RDVDC091)	0.24%	1.20%	Insignificant traffic increase
Cox Peninsula Road 4 km West of Stuart Hwy (RDVDP009)	0.51%	2.53%	Insignificant traffic increase
Darwin River Rd 3 km West of Cox Peninsula Rd (RDVDC036)	1.53%	7.41%	Further analysis required
Cox Peninsula Road At Blackmore River Bridge (RDVDC030)	1.55%	7.41%	Further analysis required
Litchfield Park Rd 2 km West of Cox Peninsula Rd (RDVDP014)	8.00%	40.00%	Further analysis required
Cox Peninsula Road At Pioneer Creek Bridge (RDVDP010)	1.94%	14.29%	Further analysis required
Fog Bay Road 2 Km West of Cox Peninsula Road (RDVDP032)	2.94%	18.18%	Further analysis required
Cox Peninsula Road 500 m West of Fog Bay Rd (RDVDC033)	5.71%	25.00%	Further analysis required

The traffic increase on Stuart Highway, Tiger Brennan Drive are all less than 5% of the background traffic. The increase in traffic on these links has no material impact and no further analysis has been undertaken.

This investigation also shows that the traffic increases are sufficient on Cox Peninsula Road to warrant further analysis.

4.1.2 Cox Peninsula Road

The intersections on Cox Peninsula Road were assessed to establish if the existing intersection arrangements are appropriate for the volume of traffic using the intersection for the following scenarios:

- 2018 Estimated Background Traffic Volumes
- 2021 Beneficiated Product Haulage + Estimated Background Traffic Volumes

This assessment was based on the warrants given in Section 4.8 of *Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections*. The warranted treatments for the intersections along Cox Peninsula Road are summarised in **Table 5**. Full details of these calculations are included in **Appendix C** for reference.

TABLE 5 WARRANTED INTERSECTION TREATMENTS ON COX PENINSULA ROAD INTERSECTIONS

No.	Intersection Major Road	Intersection Minor Road	Intersection Type	Current Treatment	2018 Warranted Treatment	2021 Warranted Treatment	Upgrade Required (YES/NO)
1	Cox Peninsula Road	Access Rds Prior to Fog Bay	Tee	BAR/BAL	BAR/BAL	BAR/BAL	NO
2	Cox Peninsula Road	Fog Bay Road	Tee	BAR/AUL	BAR/BAL	BAR/BAL	NO
3	Cox Peninsula Road	Litchfield Park Road	Tee	BAR/AUL	BAR/BAL	BAR/BAL	NO
4	Cox Peninsula Road	Stockwell Road	Tee	CHR/BAL	BAR/BAL	BAR/BAL	NO
5	Cox Peninsula Road	Lawton Road	Tee	BAR/BAL	BAR/BAL	BAR/BAL	NO
6	Cox Peninsula Road	Letchford Road	Tee	BAR/BAL	BAR/BAL	BAR/BAL	NO
7	Cox Peninsula Road	Mira Road	Cross	AUR/AUL	BAR/BAL	BAR/BAL	NO
8	Cox Peninsula Road	Darwin River Road	Tee	AUR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO
9	Cox Peninsula Road	Access Rds Past Darwin River	Tee	BAR/BAL	BAR/BAL	BAR/BAL	NO
10	Cox Peninsula Road	Southport Road	Tee	AUR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO
11	Cox Peninsula Road	Kentish Road	Tee	BAR/BAL	BAR/BAL	BAR/BAL	NO
12	Cox Peninsula Road	Carveth Road	Tee	BAR/BAL	BAR/BAL	BAR/BAL	NO
13	Cox Peninsula Road	Reedbeds Road	Tee	BAR/AUL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO
14	Cox Peninsula Road	Cyrus Road	Tee	BAR/BAL	BAR/BAL	BAR/BAL	NO
15	Cox Peninsula Road	School Access Road	Tee	CHR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO
16	Cox Peninsula Road	Territory Wildlife Access Rd	Tee	AUR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO
17	Cox Peninsula Road	Access Road	Tee	AUR/BAL	BAR/BAL	BAR/BAL	NO
18	Cox Peninsula Road	Berry Springs Park Access Rd	Tee	AUR/AUL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO
19	Cox Peninsula Road	Hopewell Road	Tee	CHR/AUL	AUR/AUL	AUR/AUL	NO
20	Cox Peninsula Road	Finn Road	Tee	CHR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO
21	Cox Peninsula Road	Oxford Road	Tee	BAR/BAL	BAR/BAL	BAR/BAL	NO
22	Cox Peninsula Road	Doris Road	Tee	AUR/AUL	AUR/AUL	AUR/AUL	NO
23	Cox Peninsula Road	Berry Springs Tavern Rd	Tee	AUR/AUL	AUR/AUL	AUR/AUL	NO
24	Cox Peninsula Road	Dump Access Road	Tee	AUR/BAL	AUR/AUL	AUR/AUL	NO
25	Cox Peninsula Road	Mala Plains Road	Tee	AUR/AUL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO
26	Cox Peninsula Road	Middle Arm Road	Tee	BAR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO
27	Cox Peninsula Road	Bradley Road	Tee	BAR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO
28	Stuart Highway	Cox Peninsula Road	Tee	CHR/CHL	CHR/CHL	CHR/CHL	NO

Table 5 demonstrates that the 2021 intersection treatments are the same as the 2018 configurations. This establishes that the development will not trigger the need for intersections to be upgraded beyond that warranted pre-commencement of haulage. Intersection upgrades are not considered necessary to facilitate the haulage operation.

Most of the intersections on Cox Peninsula Road meet the minimum standards as defined by the Austroads Guide. Intersections 8, 10, 13, 15, 16 and 20 do not meet the minimum standards. It is recommended that these intersections are investigated further by the Northern Territory Government to establish upgrade requirements to meet existing needs. The additional heavy vehicles generated by the development does not materially increase the risk to the public.

A detailed SIDRA analysis of each intersection is not considered necessary due to the low traffic volumes It is considered that the intersections on Cox Peninsula Road will not be materially impacted by way of safety, capacity or performance.

4.1.3 Berry Springs Primary School

Particular consideration was given to Berry Springs Primary School due to the sensitive nature of this land use with respect to noise, dust and presence of children and parents/carers during school hours. Urban development to the north of the school, would form the school catchment, and it is assumed that most movements into the school will be right turns and movements out of the school will be left turns. It is estimated that 260 vehicles will enter and exit the school during the peak hours based on current student numbers (Berry Springs Primary School 2017). This equates to approximately 182 vehicles travelling to/from the north east and 78 vehicles travelling to/from the south west (assuming a 70%/30% distribution based upon site observations).

The points of access to Berry Springs Primary School from Cox Peninsula Road are shown in **Figure 4**.

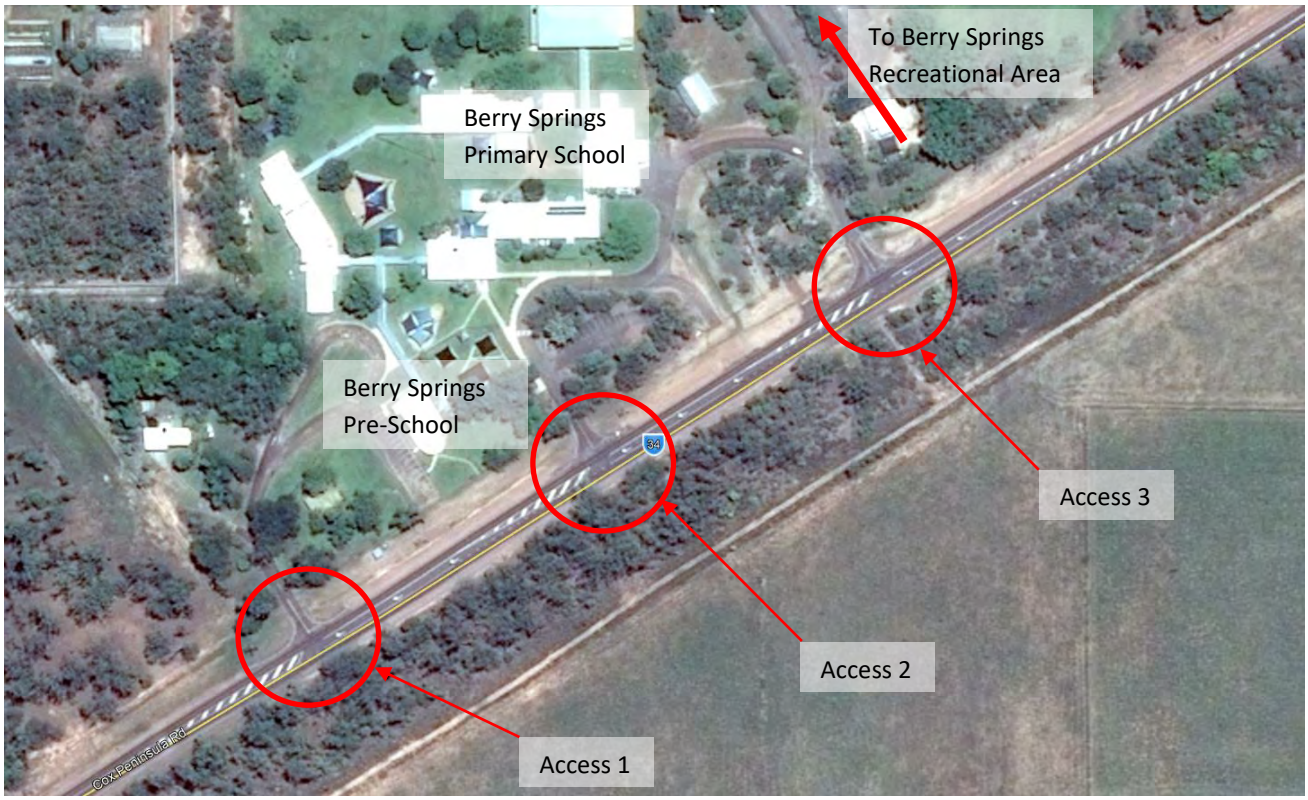

FIGURE 4 BERRY SPRINGS PRIMARY SCHOOL

There are three access points into Berry Springs Primary School. Access 1 services the Berry Springs Preschool, and Accesses 2 and 3 services Berry Springs Primary School. Access 2 is mainly for student pick-up and drop-off whist Access 3 caters for carparking and access to the recreational area behind the school. It is noted that internal roads link Access 2 and Access 3 and so movements may be into the school via one access and exit via another. Each access consists of a basic left turn treatment with a channelised right turn treatment. The right turn movements into the school are separated from through traffic movements, whereas left turn movements are not. It can also be seen that both the left and right movements out of the school are a basic treatment. The configuration of these intersections is appropriate given the frequency of turning movements and relatively low volumes of through movements. There have been no records provided that demonstrate a history of accidents at the school accesses.

The change in heavy vehicle movements when haulage commences will increase the number of heavy vehicle movements during the school peak periods by 1.3%. This is a negligible increase in the number of heavy vehicles and as such the relative increase in risk of collisions involving heavy vehicles does not materially increase. Road trains currently use Cox Peninsula Road and therefore the potential of heavy vehicle collisions with road trains exists as a managed risk.

There are no dedicated pedestrian facilities for crossing of Cox Peninsula Road in proximity of the school as the demand is very low and these facilities are not warranted. As discussed in **Section 2.3**, public school buses operate in the peak hour to service the school. The drop off and pick up point for the school buses is within the school ground. It is recommended that the school is advised when the haulage is to commence, as this will allow opportunity for the school to notify the parents and create a greater awareness of the marginal increase in road train movements.

4.1.4 Berry Springs Tavern

Further investigation was undertaken for the area of Cox Peninsula Road adjacent to the Berry Springs Tavern. The Berry Springs Tavern is a popular rural pub for both residents and tourists. The points of access to Berry Springs Tavern from Cox Peninsula Road are shown in **Figure 5**.

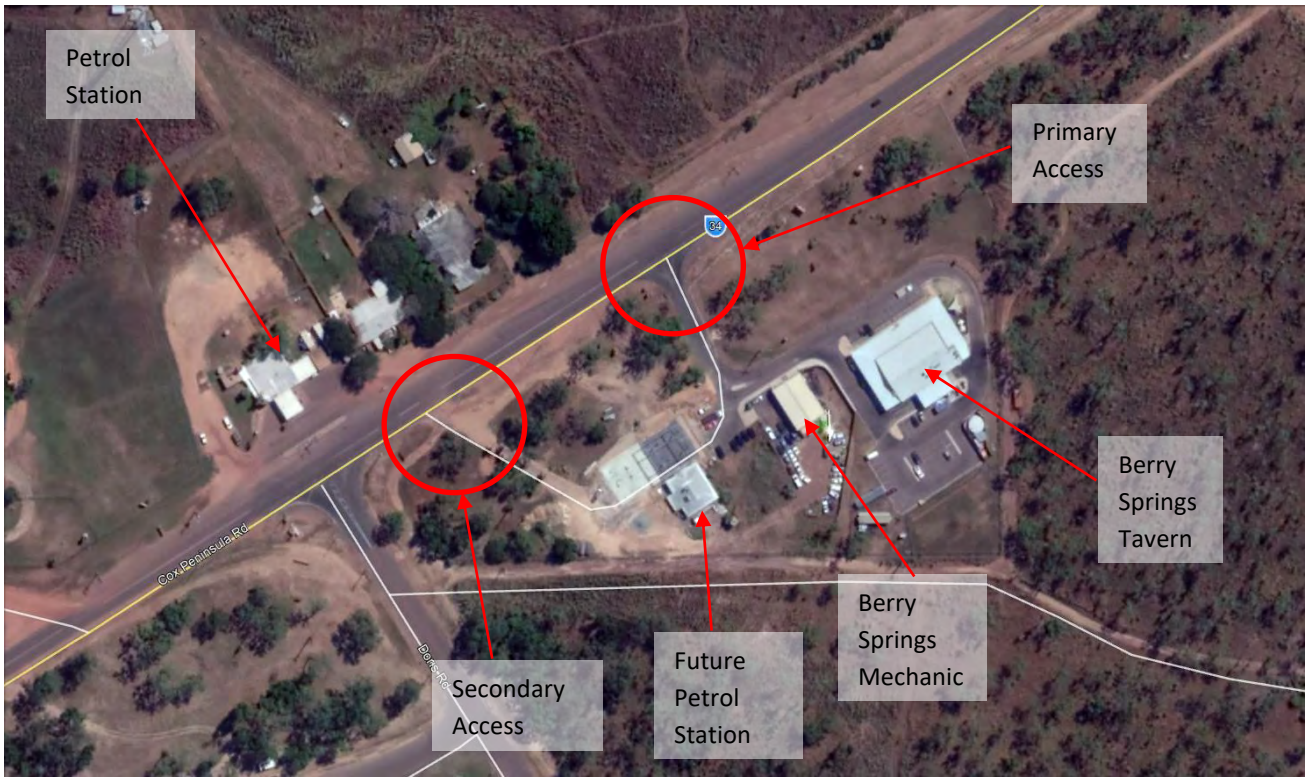

FIGURE 5 BERRY SPRINGS TAVERN

There are two access points into the Tavern. The main access is sealed and provides access directly to Berry Springs Tavern and Mechanic. The secondary access is unsealed and is rarely used to access the Tavern or Mechanic. As such, this investigation has assumed that all traffic will be using the primary access. It is expected that most movements into the Tavern will be from the east, as most people will be travelling from Stuart Highway. There are approximately 50 carparking spaces at the Tavern and as such it has been assumed that 50 vehicles will enter and exit the site during the peak hours. This equates to approximately 35 vehicles travelling from the east and 15 vehicles travelling from the west (assuming a 70%/30% distribution based upon site observations).

The primary access into the Tavern consists of an auxiliary left turn treatment and an auxiliary right turn treatment. Both the left and right movements out of the Tavern consist of basic treatments. The configuration of these accesses is appropriate for relatively low volumes of traffic and turning movements. Analysis of the provided accident data shows that only one accident has occurred at this intersection in the past 15 years. There are no dedicated pedestrian facilities for crossing Cox Peninsula Road in the proximity of the tavern. This is because the demand is sufficiently low to not warrant these facilities.

The change in heavy vehicle movements when haulage commences will increase the proportion of heavy vehicle movements from 20.3% to 20.5% during the peak periods. This is a small increase in the proportion of heavy vehicles and as such the relative increase in risk of collisions involving heavy vehicles does not materially increase.

It is noted that this assessment has assumed that the traffic that accesses the Tavern occurs at the same time as the peak hour traffic on Cox Peninsula Road. This represents a conservative estimate of the traffic at the intersection. In reality, it is likely that traffic accessing the Tavern will not coincide with the peak hour as most traffic will access the Tavern in the evening.

DIPL has advised that further development is expected adjacent to the Tavern. It is expected that potential traffic impacts of these future developments will be considered separately and is considered outside the scope of this assessment.

4.2 Pavement Impacts

The impact of the increased heavy vehicles on the Cox Peninsula Road pavement was assessed based on the pavement design procedure described in *Guide to Pavement Technology Part 2: Pavement Structural Design.* The comparative assessment considered the current background pavement loading relative to additional traffic generated from the development. Full calculations for this assessment are given in **Appendix D**.

The current traffic volume on Cox Peninsula Road is approximately 2,400 veh/day (1,200 veh/day in each direction). Assuming a 30-year design life and 20% of the traffic is heavy vehicles, this equates to a loading on the Cox Peninsula Road pavement of approximately 87.5 million equivalent standard axels (ESA).

Throughout the lifetime of the mine, an additional 40,000 truck movements (20,000 loaded and 20,000 unloaded) will occur. This equates to approximately an additional 666,000 ESA of load applied to the pavement. The mine will increase the loading on the pavement by approximately 0.75% and reduce the life of the pavement by approximately 0.5%. It is concluded the impact the haulage traffic will have on the pavement is negligible. Any localised impacts to the road pavement can be adequately managed through a standard road maintenance programme.

Notwithstanding the above, an existing pavement condition survey shall be undertaken for approximately a 2km approach to the mine access. The extents and scope of the survey shall be agreed with DIPL prior to haulage operations commencing. An agreement shall be entered with DIPL as to the defects to be corrected by the NT Government prior to commencing the haulage operations, and then frequency of inspections and associated interventions to be undertaken by the proponent in responding to pavement defects during and immediately following closure of the mine.

Stuart Highway, Tiger Brennan Drive and Berrimah Road were not assessed separately as the relative increase in heavy vehicle traffic on these roads is less than that of Cox Peninsula Road. The impact of the addition heavy vehicles on these pavements is also considered negligible.

4.3 Safety Impacts

Analysis of the accident data provided by DIPL suggests that most accidents occurring along Cox Peninsula Road are caused by driver inattention, inexperience and fatigue. Alcohol was the major factor in fatal accidents along the road.

These risks as they relate to the haulage operations will be actively managed by Core Exploration through a driver fatigue management plan. This plan will outline the policies and procedures that will be implemented to minimise fatigue of drivers such as limiting the length of time drivers can work for without a break. Core Exploration will implement an alcohol management system, which will require drivers to pass an alcohol breath test prior to commencing work. These plans will be developed and managed by Core Exploration in consultation with the Northern Territory Government.

To manage the risks associated with fatigued drivers, it is proposed that fatigue management signs be installed along Cox Peninsula Road and the major intersections to tourist destinations. These signs will remind drivers of the risks of driving while fatigued and make inexperienced drivers more aware of the risks associated with driving along this road.

4.4 Proposed Access into Grants Mine

The proposed access into Grants Mine will be located approximately 17 km north west of the Fog Bay Road and Cox Peninsula Road intersection. The proposed access consists of a tee intersection with a left slip lane off Cox Peninsula Road. An auxiliary lane is not required for right turns from Cox Peninsula Road as it is expected that very little traffic (if any) will access the site from this direction. The proposed intersection into Grants Mine is shown in **Figure 6**.

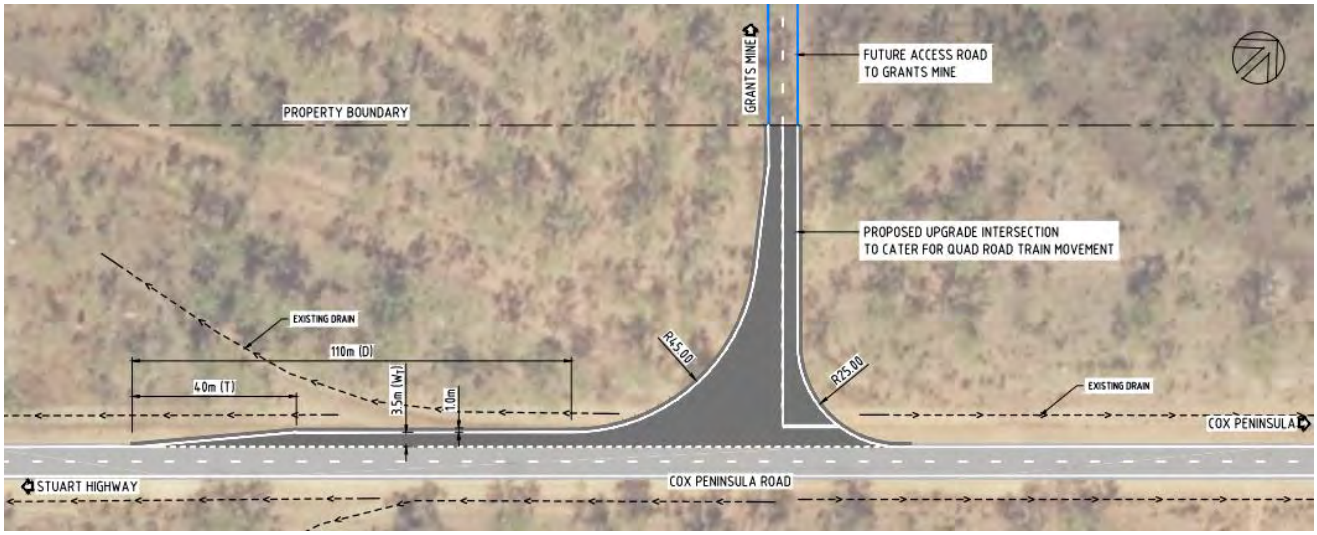

FIGURE 6 PROPOSED ACCESS INTO GRANTS MINE

The following design criteria were adopted for the design of this intersection:

- Design Vehicle = Quad Road Train
- Intersection Type = Rural AUL(S)
- Design speed of Cox Peninsula Road = 120 km/h (110km/h posted speed)
- Entry speed into turn lane = 90 km/h
- Curve speed = 30 km/h

It is proposed that the left slip lane on Cox Peninsula Road will be approximately 110 m long (including a 40 m taper) with a 1.0 m sealed shoulder. A speed of 90 km/h was adopted for the entry speed to the left slip lane. This means that road trains will need to reduce speed by 20 km/h in the through lane. Swept path analysis shows that a vehicle can turn left into the mine whilst another vehicle turns right out of the mine.

A concept layout for the proposed access into the mine is shown in **Appendix E**.

This performance of this intersection was assessed based on the warrants given in Section 4.8 of *Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections*. This assessment shows that a basic

left and basic right (BAL/BAR) treatment for the volume of traffic expected at the intersection. As such, the intersection arrangement exceeds the minimum standard warranted by the Austroads Guidelines.

4.5 Route Warning Signage

To inform the movement of traffic along Cox Peninsula Road, warning signage advising of the presence of Type 2 Road Trains on the route shall be installed at critical locations including:

- The mine access
- Each side of the Litchfield Park Road intersection
- Prior to the Stuart Highway intersection
- On the approaches to Berry Springs town limits

The sign locations and design layout shall be agreed with DIPL and erected prior to commencement of haulage operations.

4.6 Management of Mine Blasting Operations impacting on Cox Peninsula Road

A Blast Management Plan (BMP) has been developed for the mine operation and a copy is provided in **Appendix F** of this submission. The BMP identifies the following with respect to maintaining safe operation of the Cox Peninsula Road.

On average, blasting in the Grants Open pit is likely to occur every 2 to 4 days. Initial mining activities are unlikely to require blasting due to the weathered nature of the materials making free digging possible. As the pit approaches the base of the weathered zone (approx. 30 – 40 m below surface) blasting requirements will increase and then become a necessity once fresh rock is encountered.

Operating hours for the blasting times are proposed as follows:

Activity	Proposed Hours of Operation	Days of the week
Blasting – that requires the Cox Peninsula Road to be closed for Public Safety reasons.	Only to occur during daylight hours. Nominal Blasting times: 13:00pm to 13:15pm 17:00pm to 17:15pm Shot only to be tied in on the same day as the firing.	Monday – Friday Not on week ends Not on Public Holidays
Blasting – that does not require the Cox Peninsula Road to be closed for Public Safety reasons.	Only to occur during daylight hours. Nominal Blasting times: 13:00pm to 13:15pm 17:00pm to 17:15pm Shot may be tied in the day before.	Monday – Sunday inclusive

Given the location of the project, blasting is intended to be carried out during daylight hours any day of the week.

4.6.1 Exclusion Zones and Public Roads

Typical blasting exclusion zones for the size and nature of the blasting activities at Grants are:

- 300m for all personnel
- 500m for buildings, office areas, and public spaces

Exclusion zones are risk based on blast plans and other influencing factors. They may be changed as determined by a risk assessment completed for every blast as approved by the Shotfirer and Mine Manager.

The Grants Open Pit area is in close proximity to the main access road (a public road) and supporting Mine Operations Centre (MOC) and Processing facilities. Given the proximity, some blasting activities may require the evacuation of some facilities, and the temporary closure of the Cox Peninsula Road, although, given the pit design and development sequence, and pit blasting requirements, the evacuation and road closure requirements are only likely to be required occasionally with that frequency quickly reducing as the pit develops deeper.

Figure 7 shows the 300m and 500m blast exclusion zones based on the pit edge, with the 500m exclusion zone is only just encroaching on the Cox Peninsula Road.

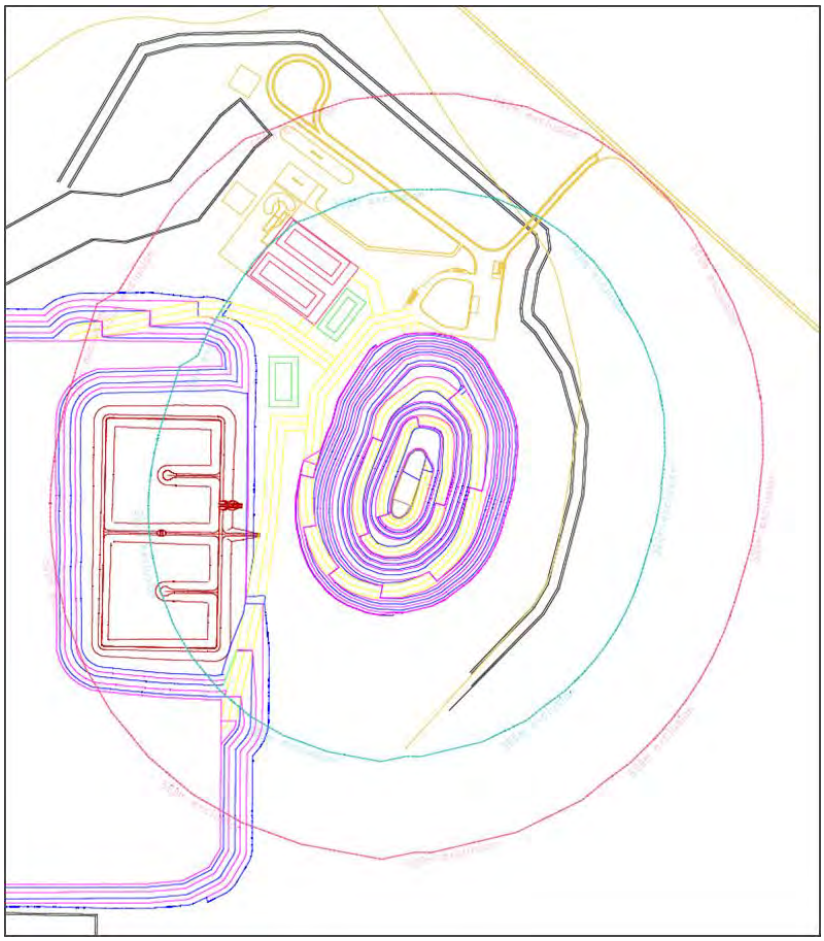

FIGURE 7 BLAST EXCLUSION ZONES FROM GRANTS PIT EDGE (500M IN RED)

The BMP in **Appendix F** includes a procedure and temporary road signage layout for the implementation of Road Closures on the Cox Peninsula Road.

5.0 TRAFFIC MANAGEMENT STRATEGY

A traffic management strategy (TMS) will be developed for the construction and operational phases of the development. The TMS will form the basis for commitments that Grants Mine will employ in the development of specific traffic management plans to be developed prior to commencement of construction and operations of the mine.

The underlying principles of the TMS will be as follows:

1. The operation of vehicular traffic associated with the development and operation of the Grants Mine will be undertaken such that it does not materially compromise the safety, efficiency or capacity of the NT Government Road Network.

2. Haulage operations shall be managed to avoid the potential for convoying of road trains, to ensure that opportunity for safe passing and overtaking opportunities is maximised.

3. Grants Mine will be implementing appropriate fatigue management strategies with vehicle operators so as to ensure vehicle operations are safe on the NT Government road network.

4. Grants Mine will maintain an ongoing dialogue with the NT Government as a means of proactively informing, seeking and acting upon issues or concerns arising from the operations of vehicles associated with the function of the mine.

5. Key stakeholders situated on the haulage route shall be directly engaged to ensure issues identified with respect to amenity and safety are proactively managed.

6. Material changes to the nature or frequency of haulage operations shall be communicated well in advance of any changes to the NT Government.

7. Product road trains would not pass the Berry Springs Primary school during drop off (8am – 9am) and pick-up (2.30pm – 3.30pm) times.

6.0 SUMMARY AND RECOMMENDATIONS

The Grants Mine proposes to export 400,000 tonnes of beneficiated product from the mine lease situated on the Cox Peninsula Road to the East Arm Wharf at the Port of Darwin. It is proposed to transport the ore over a three-year period (operating 10-12 hours per day and seven days per week) utilising quad road trains. The selected haul route will travel along Cox Peninsula Road, Stuart Highway, Tiger Brennan Drive and Berrimah Road.

An assessment of the impacts of the increased heavy vehicle traffic on the existing road network has been undertaken. This assessment has investigated the link and intersection capacity, safety and pavement impacts.

The increase in traffic along Stuart Highway, Tiger Brennan Drive and Berrimah Road is propositionally very small and the proposed development will have negligible impacts on these elements of the existing network.

The increase in traffic on Cox Peninsula Road warranted the need for further assessment. This assessment has concluded that the current road network will continue to operate safely as an outcome of the additional ore haulage movements and upgrades are not required. No upgrades to the existing road network are recommended to facilitate this development.

The increase in traffic will consume the life of the pavement by approximately 0.5%. This reduction in design life is considered negligible and can be managed by ordinary maintenance of the road. No upgrades to pavements are required to facilitate this development.

It is recommended that Berry Springs Primary School be notified prior to the additional haulage occurring to allow for informing parents/carers and transport operators.

It is recommended that Core Exploration implements a driver fatigue management plan to minimise the risk of accidents involving their drivers. This plan is to outline the policies and procedures that will be implemented to minimise fatigue of drivers. It is also recommended that Core Exploration implement an alcohol management system, which will require drivers to pass an alcohol breath test prior to commencing work. These plans are to be developed and managed by Core Exploration in consultation with the Northern Territory Government.

To manage the risks associated with fatigued drivers, it is proposed that fatigue management signs be installed along Cox Peninsula Road and the major intersections to tourist destinations. These signs will remind drivers of the risks of driving while fatigued and make inexperienced drivers more aware of the risks associated with driving along the road.

The proposed access into Grants Mine will be located approximately 17 km north west of the Fog Bay Road and Cox Peninsula Road intersection. The proposed access consists of a tee intersection with a left slip lane off Cox Peninsula into the mine.

7.0 REFERENCES

Austroads. 2012. *Guide to Pavement Technology Part 2: Pavement Structural Design.* Design Guideline, Sydney, NSW, Australia: Austroads Ltd.

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FLANAGAN CONSULTING GROUP
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APPENDIX: A

R-RL0131 Grants Mine - Heavy Vehicle Route Assessment (dated 17 October 2017)

FLANAGAN CONSULTING GROUP
Trusted Advisor to Northern Australia

GRANTS MINE-HEAVY VEHICLE ROUTE ASSESSMENT

CORE EXPLORATION LTD

Table of Contents

1.0 INTRODUCTION AND BACKGROUND

Core Exploration Ltd proposes to mine and export Direct Shipping Ore (DSO) from the Grants Mine via the East Arm Wharf facility.

In progressing the development of the DSO proposal, Core Exploration Ltd as owners of Grants Mine, seeks to inform the feasibility assessment of the project, and initial stakeholder consultation, by establishing a preferred route for haulage of the DSO, and potential impacts on the preferred route associated with the transport task.

Flanagan Consulting Group has been engaged by Core Exploration Ltd to investigate the haulage route options and associated impacts that inform this report.

This report relates to the preferred route selection phase of the commission with consideration of the following:

- Possible haul routes
- Capacity in local haul market and haul vehicle options
- Offload point at East Arm Wharf and constraints on haul movements
- Preferred haul vehicle arrangement
- Route length and estimate of cycle times
- Sensitive receptors
- Physical limitations
- Preferred route selection

A separate report will be prepared which assesses the transported related impacts on the preferred route.

2.0 THE SITE LOCATION AND MINE PRODUCTION

The Grants Mine is located approximately 22km south of Darwin on the Cox Peninsula between Darwin and Bynoe Harbour, refer locality plan in **Figure 1**.

Figure 1 – Locality Plan

The mine is located approximately 500m south west of the Cox Peninsula Road and will mine the mineral Spodumene.

2.1 Spodumene Transport Task

Core proposes to ship spodumene as a Direct Shipping Ore (DSO) product, and/or a six per cent upgraded product, from Darwin Port to customers in China. The ore is used as feedstock for lithium chemicals to produce a range of end products including lithium ion batteries.

The deposit contains an estimated 1.8 million tonnes of high grade spodumene. Core has a Heads of Agreement with Darwin Port to export up to one million tonnes per annum (Mtpa) of ore from East Arm Wharf, which reflects that the mine life is approximately 2 to 3 years.

The transport task for the transfer of the DSO to East Arm is planned to commence in 2nd quarter 2019, peaking at a haulage rate of 250,000 tonnes in the 2019 fourth quarter and concluding in the 2021 first quarter.

Table 1 illustrates the planned quarterly rate of haulage of DSO to East Arm Port.

Table 1: Proposed DSO Haulage Schedule

Year	2019			2020				2021	
Quarter	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr	2rd Qtr	3rd Qtr	4th Qtr	1st Qtr	**Total**
Ore Hauled (t)	208,000	220,000	248,500	243,750	246,350	246,350	246,350	140,700	1.8m

On the assumption that the ore haulage will be undertaken by quad road trains with a notional carrying capacity of 95 tonnes per vehicle combination and a round trip duration of 3 hours to East Arm, the following trip generation per 12 hour day / 7 days per week will result for the DSO haulage operation. It is noted that an estimated 3-hour trip duration is based on the longest route option, Option 1 (refer Section 4 for details).

Table 2: Proposed DSO Haulage Truck Movements

Year	2019			2020				2021
Quarter	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr	2rd Qtr	3rd Qtr	4th Qtr	1st Qtr
Daily No of Trips	24	26	29	29	29	29	29	16
Truck Fleet	6	7	8	8	8	8	8	4
Average Truck Movements per Hr	2	3	3	3	3	3	3	2

2.2 East Arm Wharf facility

It is proposed the DSO will be exported from the East Arm Wharf facility operated by Darwin Port which is part of the Landbridge group. The East Arm Wharf is located on the Darwin harbour approximately 6km south east of Darwin CBD and 22km north east of Grants Mine. The transport of the DSO will be via a much longer and less direct route to East Arm. FCG undertook a tour of the East Arm Wharf Facility with Grants Mine and noted the following features as they relate to the wharf transport logistics and facilities:

- The wharf is accessible for quad road trains (53.5m).
- The wharf is open for 24-hour operation.

- Hardstand area is available for stockpiling of material.
- Transport of material from the stockpile to the ship loader must be undertaken by one of the two licenced stevedores operating within the port.
- There is no requirement for weighing of trucks delivering to the wharf stockpile.
- All vehicles are required to stop at the security gate prior to entering the wharf. Drivers accessing the wharf will be provided with a personal identification tag following an online induction. Drivers are required to show their personal tag as part of the security check to enter the wharf.
- The speed limit is a maximum of 20km/hr on all roads within the wharf.

The inspection of the wharf facilities and concurrent discussions with the East Arm Wharf operators did not identify constraints of significance on the haulage and stockpiling of DSO to the wharf facility.

3.0 HAUL MARKET

It is anticipated that haulage of the DSO would be most efficiently and cost effectively delivered to the East Arm Wharf utilising quad road trains. An assessment was made as to the vehicle configurations and capacity of NT based haulage contractors to confirm that the needs of Grants Mine in the transfer of the DSO can be met.

Flanagan Consulting consulted with local haulage companies including:

- Ostojic Group
- Tomazos Group
- All Earth Industries

Given the "commercial in confidence" nature of the discussions, we were not in a position to garner detailed information from the transport operators and noted the following:

- There are several local haulage companies operating within the Darwin area that have quad road train vehicle configurations (53.5m).
- There are at least three local haulage companies with the existing fleet size and capacity required to service this project.

Potential timing and haulage rates for transport of the DSO to Port was discussed with the operators and no issues were raised in the context of the market being able to meet the transport demands of the Grants Mine.

4.0 HAUL ROUTE OPTIONS

An assessment was undertaken of potential haul routes between Grants Mine and the East Arm Wharf with the objective of identifying a haul route that best caters for an efficient and safe conveyance of the DSO material.

The process for identifying a preferred haul route is described as follows:

1) Establish minimum parameters that defines a suitable haul route for the DSO to Port
2) Identify potential haul route options that meet the parameters
3) Determine criteria that will differentiate the route options in selecting a preferred route
4) Undertake a Multi Criteria Analysis (MCA) of the route options that will facilitate selection of the preferred route

The "step-wise" process described above is explored in further detail as follows.

4.1 Minimum Haul Route Performance Parameters

In order to identify potential haul routes for the transfer of the DSO at Grants Mine to East Arm Wharf, it is important to establish the performance parameters that a haul route should meet as a minimum standard. In liaison with Core the following parameters were identified:

- Route is preferred to be capable of supporting the movement of quad road trains.
- Route must be as direct as possible between the mine site and the port with a notional return travel time no greater then 3 hours.
- Route must be fundamentally safe in accommodating the movement of quad road trains.
- Route can provide for haulage operations to extend from 12 to 24 hour operations without constraint

4.2 Haul Route Identification

Recognising the above performance parameters, 4 potential haul routes were identified as being suitable options. Common to each of the haul routes is the movement of DSO from the mine westwards along the Cox Peninsula Road. From the Cox Peninsula Road the route options diverge as shown in **Figure 2.**

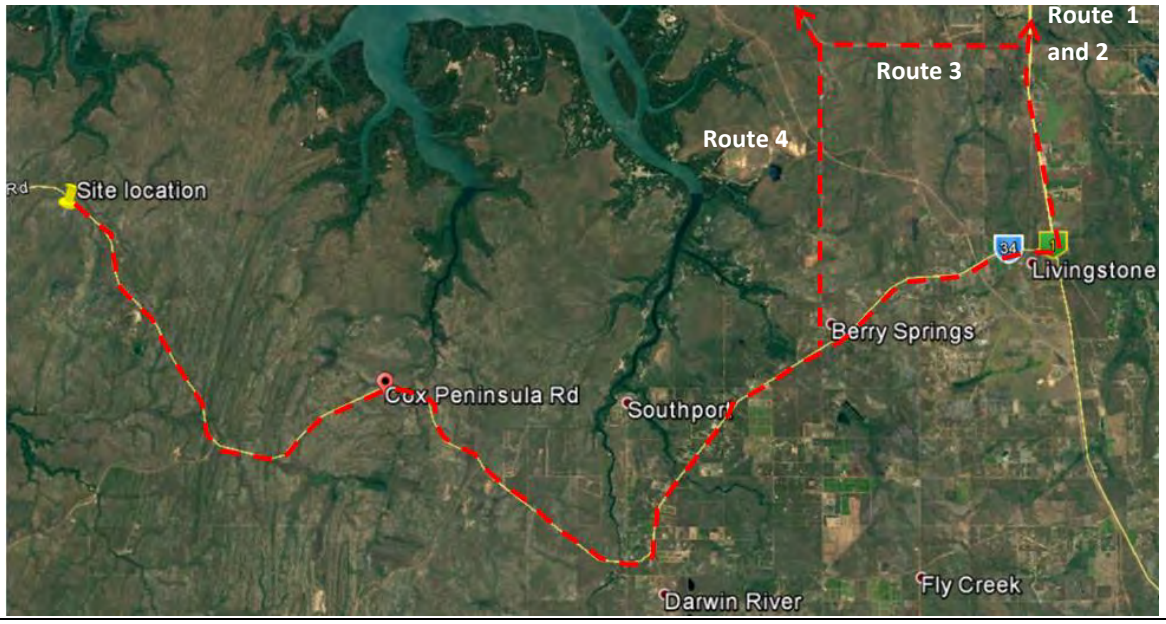


Figure 2 – Common Routes from Grants Mine

Figure 2 represents four (4) potential haul routes to the East Arm Wharf and are described as follows:

- **Route 1 :** Stuart Highway – Berrimah Road
- **Route 2 :** Stuart Highway – Wishart Road – Berrimah Road
- **Route 3 :** Jenkins Road – Berrimah Road
- **Route 4 :** Finn Road – Berrimah Road.

Each of these haul routes are further described below.

4.2.1 Route 1 : Stuart Highway – Berrimah Road

Figure 3 illustrates the specifics of the haul route to be taken to Berrimah Road for this option.

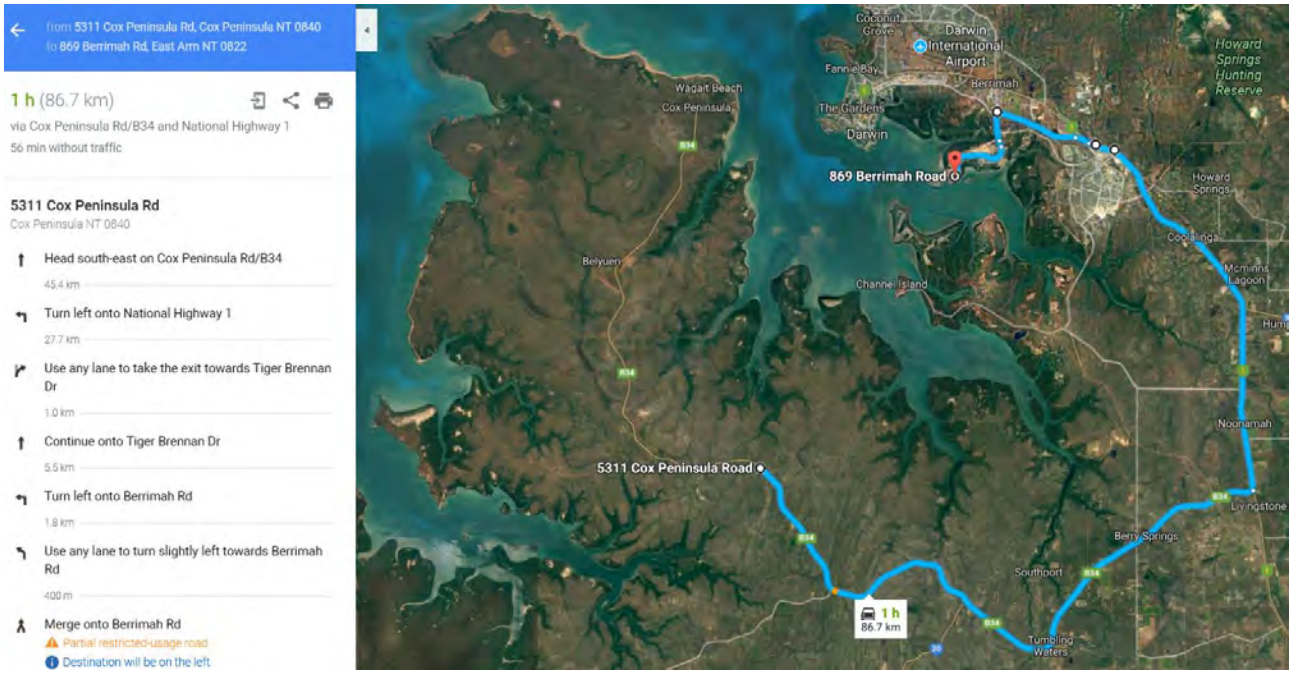


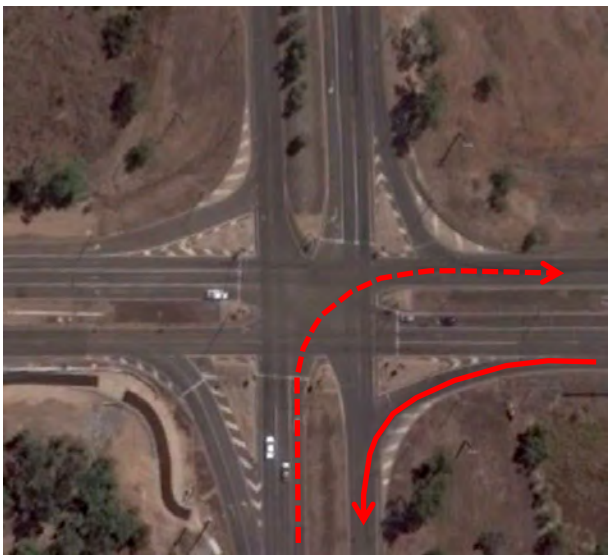
Figure 3 – Route 1 Stuart Highway – Berrimah Road

Total travel distance to the East Arm Wharf for Route 1 is calculated to be 88.31km.

Key features / issues of this route include:

- The route is an established road train route
- The Stuart Highway is configured as a 4 lane divided carriageway which provides overtaking opportunity and safe passing of road trains
- All major intersections along the route (including Jenkins Road, Arnhem Highway, Tiger Brennan Dr, Berrimah Road) are signalised or grade separated providing a safe and controlled interaction with cross movements and potential conflicts.
- There are only 2 turning movements at intersections outside of the Port situated at the intersection of Cox Peninsula Road and the Stuart Highway and the intersection of Tiger Brennan Drive and Berrimah Road. **Figure 4** illustrates the intersection configurations and the direction of turning movements.

Cox Peninsula Road – Stuart H'way



Tiger Brennan Drive – Berrimah Road

Figure 4 – Route 1 Intersection Turning Movements
(Solid Red Line – Loaded Direction, Dashed Red Line – Unloaded Direction)

- For both intersections the fully laden road trains will be entering traffic in a left turn manoeuvre. Both intersections currently cater for either a continuous lane or merge lane to safely facilitate this manoeuvre.
- The route does not cross any at grade rail crossings.

4.2.2 Route 2 : Stuart Highway – Wishart Road - Berrimah Road

Figure 5 illustrates the specifics of the haul route to be taken to Berrimah Road for this option.

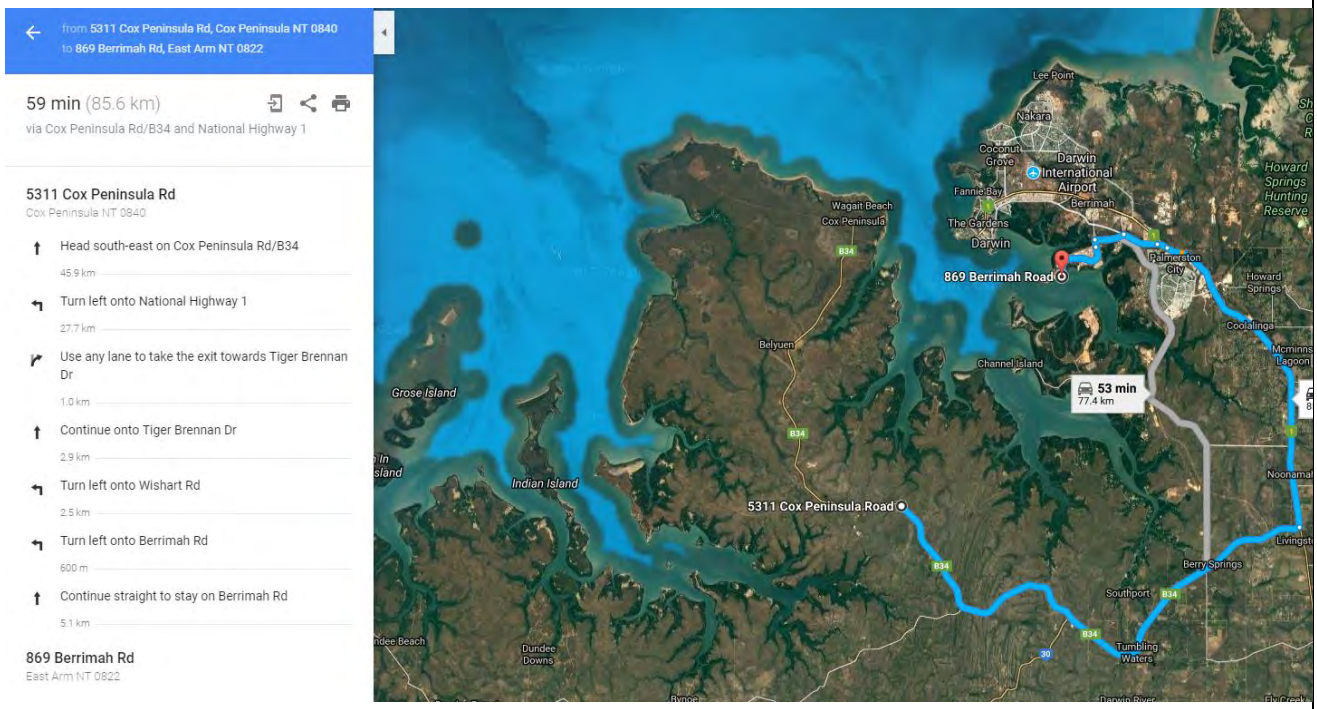


Figure 5 – Route 2 Stuart Highway – Wishart Road - Berrimah Road

Total travel distance to the East Arm Wharf for Route 2 is calculated to be 88.13km.

Key features / issues of this route are very similar to that of Route 1.

- The route is marginally shorter (200m).
- There are 3 turning movements at intersections outside of the Port situated at:
  - Left turn at the intersection of Cox Peninsula Road and the Stuart Highway
  - Left turn at the intersection of Tiger Brennan Drive and Wishart Road
  - Left turn at the intersection of Wishart Road and Berrimah Road
- The Wishart Road / Berrimah Road intersection is not signalised.
- Wishart Road provides frontage to several commercial industries that have numerous points of access and egress along the corridor. This creates a higher potential for vehicle conflict and accidents.
- For both intersections the fully laden road trains will be entering traffic in a left turn manoeuvre. Right turn manoeuvres will be required across opposing traffic by unloaded vehicles, which by their nature will be able to complete the manoeuvre much quicker than a loaded vehicle.

Figure 6 illustrates the intersection configurations and the direction of turning movements.

Tiger Brennan Drive – Wishart Road

Wishart Road – Berrimah Road

Figure 6 – Route 2 Intersection Turning Movements
(Solid Red Line – Loaded Direction, Dashed Red Line – Unloaded Direction)

4.2.3 Route 3 : Jenkins Road - Berrimah Road

Figure 7 illustrates the specifics of the haul route to be taken to Berrimah Road for this option.

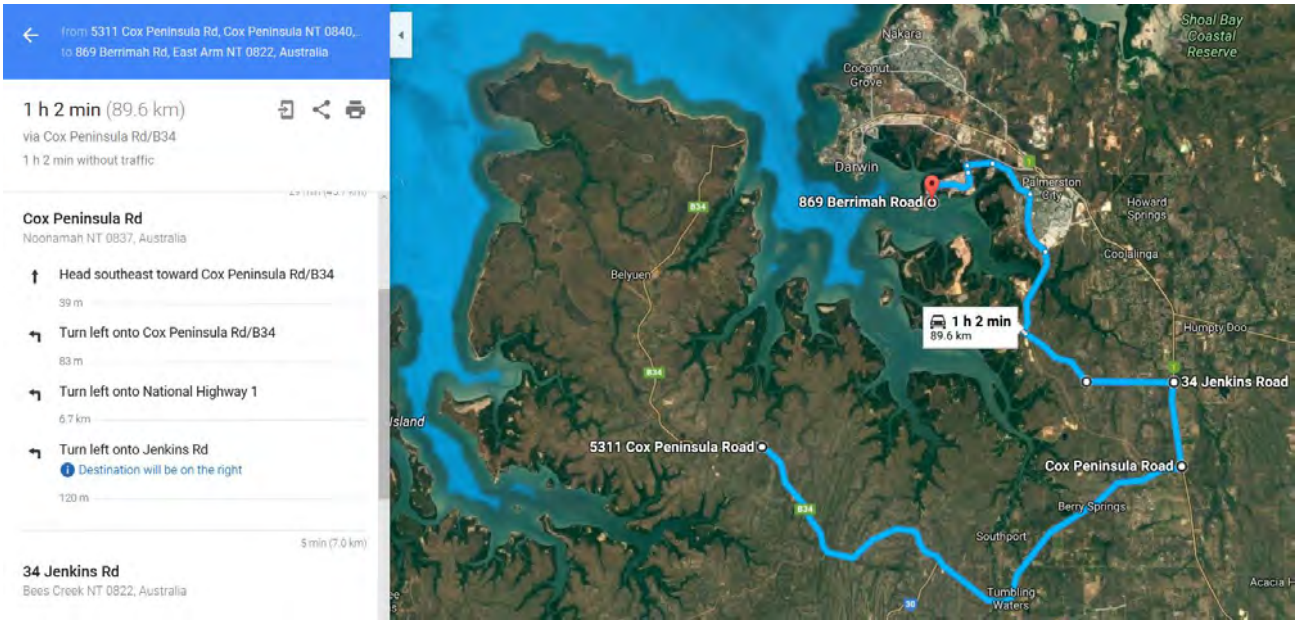


Figure 7 – Route 3 Jenkins Road - Berrimah Road

Total travel distance to the East Arm Wharf for Route 3 is calculated to be 90.18km.

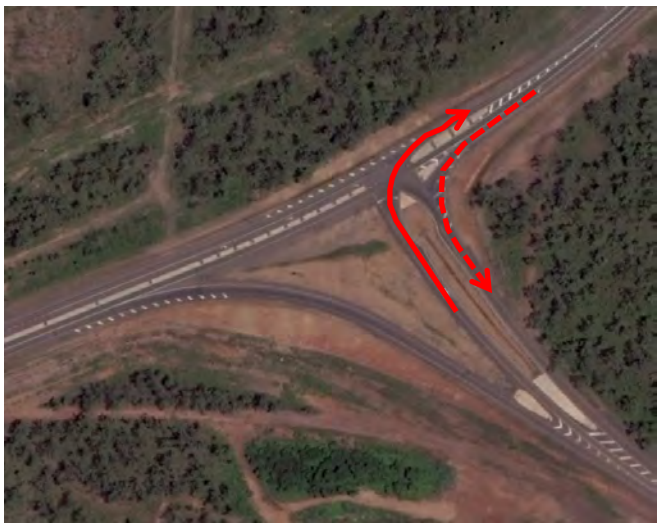
Key features / issues of this route include:

- The route is longer then Route 1 by 1.9km.
- There are 5 turning movements at intersections outside of the Port situated at:
    - Left turn at the intersection of Cox Peninsula Road and the Stuart Highway
    - Left turn at the intersection of Stuart Highway and Jenkins Road
    - Right turn at the intersection of Jenkins Road and Channel Island Road
    - Left turn at the intersection of Elrundie Avenue and Kirkland Road
    - Left turn at the intersection of Kirkland Road and Wishart Road
    - Left Turn at the intersection of Wishart Road and Berrimah Road
- The route has 4 at-grade crossings of rail corridors.
- In the public consultation processes, Palmerston Council expressed a strong view that utilisation of Elrundie Avenue was not favoured given there are adjacent sensitive receptors including urban development, recreational and schooling facilities.

Figure 8 illustrates the intersection configurations and the direction of turning movements.

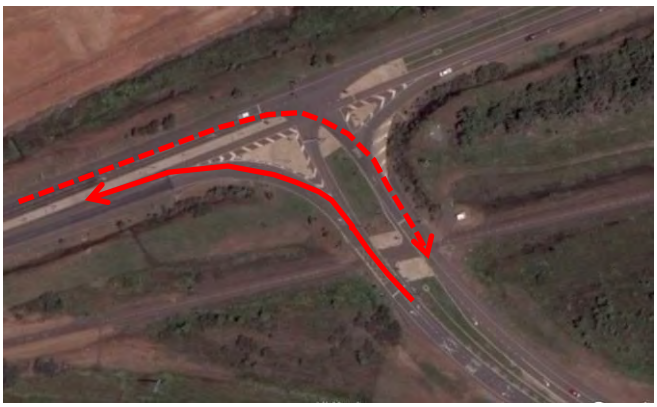
Stuart Highway – Jenkins Road

Wishart Road- Berrimah Road



Channel Island Rd – Jenkins Road

Elrundie Ave – Kirkland Road



Kirkland Road Wishart Road

Figure 8 Route 3 Turning Movements

(Solid Red Line – Loaded Direction, Dashed Red Line – Unloaded Direction)

4.2.4 Route 4 : Finn Road - Berrimah Road

Figure 9 illustrates the specifics of the haul route to be taken to Berrimah Road for this option.

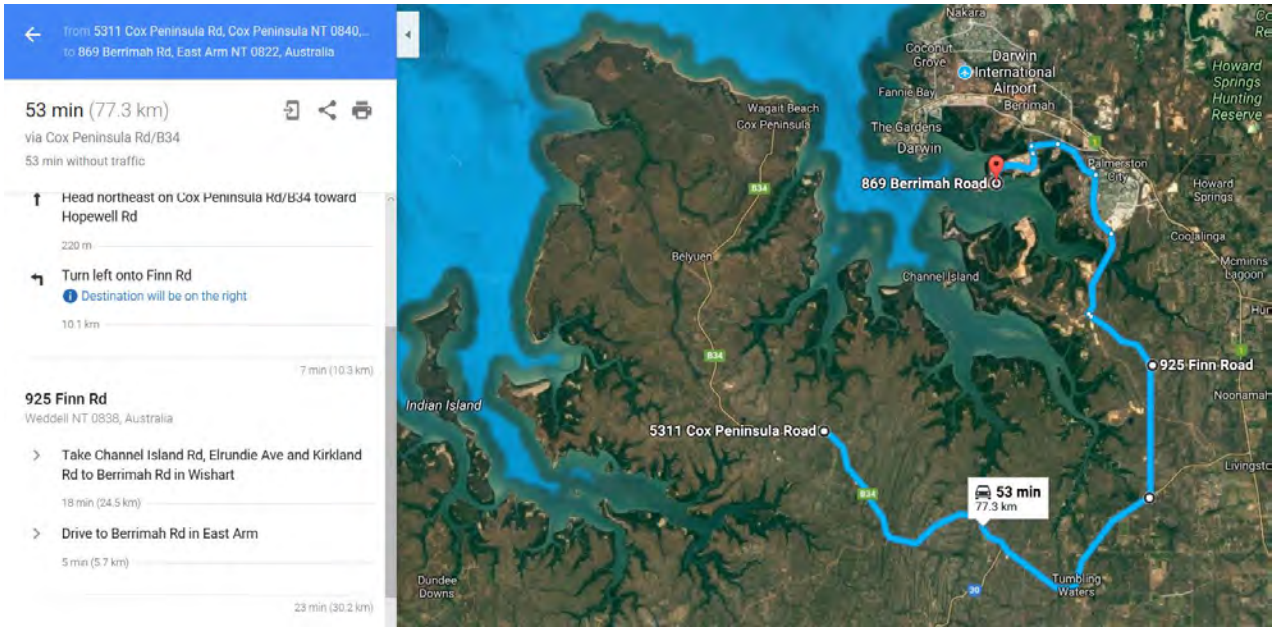


Figure 9 – Route 4 Finn Road - Berrimah Road

Total travel distance to the East Arm Wharf for Route 4 is calculated to be 77.94km. Key features / issues of this route are similar to Route 3. The only difference being access to Jenkins Road /; Channel Island Road via Finn Road and is 6km shorter the Route 1. This route introduces one additional running movement at the intersection of Finn Road and Jenkins Road which is accessed via a left turn at the intersection of Cox Peninsula Road and Finn Road, thereby avoiding the need to enter the Stuart Highway. Finn Road is not gazetted as a road train route and as such is generally under width.

Key features / issues of this route include:

- The intersection of Finn Road and Cox Peninsula Road is not configured to cater for the movement of quad road trains and would require significant upgrade to cater for this.
- The Litchfield Council may consider a potential defined term road train gazettal of the link on the basis of being able to keep the road train movements off the Stuart Highway which carries far higher traffic volumes.
- The route has one additional at grade crossing of rail on Finn Road resulting in a total of 5 at grade crossings.
- Like Route 3, Route 4 relies upon access to Berrimah Road via Elrundie Avenue which passes close by numerous sensitive receptors including urban development, a school and recreational facilities.

Figure 10 illustrates the intersection configurations and the direction of turning movements.

CPR – Finn Road Intersection

Finn Road – Jenkins Road Intersection

Figure 10 Route 4 Turning Movements in addition to Route 3

(Solid Red Line – Loaded Direction, Dashed Red Line – Unloaded Direction)

4.3 Potential Traffic Impacts

A further detailed analysis of traffic impacts arising from the preferred route will be analysed in a subsequent body of work to be delivered as another report.

Typically, road agencies nominate a threshold of traffic generation relative to the baseline, which acts as a first filter for determining whether a detailed analysis of traffic impacts is required. This threshold is typically adopted as 5% of the baseline traffic movements.

As a first pass assessment, baseline traffic data has been sourced from the NT Government and projected out to 2019 when the haulage operations will occur.

This was assessed to establish whether the 5% threshold for increase in traffic movements is generated.

Table 3 summarises the outcome of that review at locations where baseline traffic data is available. At some locations classified HV traffic data was available which allowed a direct comparison of baseline HV movements Vs the additional HV movements from Grants Mine.

Table 3 : Summary of Traffic Increase from Haulage Operations

Road Counter Location	Direction of Travel	% Increase Development Traffic	Road Counter Location	Direction of Travel	% Increase Development Traffic
Berrimah Road (UDVDP029)	Inbound	3.5	Stuart Highway 500 m West of Howard Springs Rd UDVDP017	Inbound	0.1
	Outbound	3.4		Outbound	0.1
	Both	1.7		Both	0.1
	HV Inbound	**6.0**	Stuart Highway 100 m North of Henning Rd UDVDC021	Inbound	0.2
	HV Outbound	**7.5**		Outbound	0.2
	HV Both	3.3		Both	0.1
Berrimah Road 400 m Sth of Tiger Brennan Drive (UDVDP028)	Inbound	0.3		HV Inbound	**5.1**
	Outbound	0.4		HV Outbound	3.8
	Both	0.2		HV Both	2.2
	HV Inbound	1.4	Stuart Highway 500 m North of Arnhem Hwy UDVDP020	Inbound	0.3
	HV Outbound	2.0		Outbound	0.3
	HV Both	0.9		Both	0.1
Berrimah Road 100 m South Marlow Road (UDVDP024)	Inbound	0.4	Stuart Highway 500 m North of Gulnare UDVDC051	Inbound	0.5
	Outbound	0.4		Outbound	0.5
	Both	0.2		Both	0.2
Tiger Brennan Dr (UDVDP022)	Inbound	0.2		HV Inbound	2.9
	Outbound	0.2		HV Outbound	4.3
	Both	0.1		HV Both	1.7
	HV Inbound	1.5			
	HV Outbound	1.3			
	HV Both	0.7			

Stuart Highway 500 m North of Cox Peninsula Rd RDVDC049	Inbound	0.5
	Outbound	0.6
	Both	0.3
	HV Inbound	**7.9**
	HV Outbound	3.0
	HV Both	2.1
Cox Penisula Road 4 km West of Stuart Hwy RDVDP009	Inbound	1.7
	Outbound	1.6
	Both	0.8
	HV Inbound	**11.5**
	HV Outbound	**17.6**
	HV Both	**7.0**
Cox Peninsula Road At Blackmore River Bridge RDVDC030	Inbound	**5.0**
	Outbound	**5.2**
	Both	2.6
Cox Peninsula Road At Pioneer Creek Bridge RDVDP010	Inbound	**6.4**
	Outbound	**6.3**
	Both	3.2
	HV Inbound	**50.0**
	HV Outbound	**42.9**
	HV Both	**25.0**
Cox Peninsula Road 500 m West of Fog Bay Rd RDVDC033	Inbound	**18.8**
	Outbound	**18.8**
	Both	**9.4**

The above indicates that there are several locations particularly on the Cox Peninsula Road that exceed the 5% threshold and will require further consideration as to the traffic and pavement impacts arising from the haulage operations from Grants Mine.

5.0 ROUTE OPTIONS SELECTION CRITERIA

The identification of a preferred route requires that those issues of important to the haulage stakeholders are considered and identified as Criteria to be used for the selection process. Often the relative importance of the criteria will differ and this needs to be reflected in the decision making process.

The following selection criteria have been identified as being issues that will differentiate the options and the selection of a preferred solution:

- Road Suitability
- Approvals Authority Logistics
- Stakeholder Impacts and Benefits
- Value for Money
- Technical Risk

Table 4 provides an overview commentary on each of the Routes as they relate to these criteria. (It should be noted that potential issues on Cox Peninsula Road are not considered as the Cox Peninsula Road is common to all of the route options and hence is not a differentiator. Impacts on Cox Peninsula Road will be examined in the second report to be prepared covering traffic impacts and issues on the preferred route.

Table 4 – Assessment Criteria Commentary

	Assessment Criteria				
	Road Suitability	**Approvals Agency Logistics**	**Stakeholder Impacts and Benefits**	**Value for Money**	**Technical Risk**
Route 1	• *This section is quad road train approved route.* • *High standard road geometry.* • *No rail crossings* • *Only 2 left turning movements through intersections.*	• *Only one road agency to deal with as the entire route falls under the authority of NT DIPL.*	• *Minimal impact on the route from Stuart Highway north.* • *Safety of other road users will be negligibly impacted.* • *Heavy vehicles are kept to dedicated road train routes.* • *Minimal turn movements* • *No exposure to potential collisions with train movements.*	• *Capital investment in infrastructure upgrades from Stuart Highway north will be nil.* • *Infrastructure is designed to sustain quad road train movements and impact on lifecycle costs will be negligible.*	• *Infrastructure is designed to sustain quad road train movements and meets national highway standards.* • *Risks in relation to bridge capacity, flood immunity, pavement integrity and traffic behaviours are well understood.*

	Assessment Criteria				
	Road Suitability	**Approvals Agency Logistics**	**Stakeholder Impacts and Benefits**	**Value for Money**	**Technical Risk**
Route 2	• *This section is aquad road train approved route.* • *High standard road geometry.* • *3 left turning movements through intersections.* • *Nil at grade rail crossings* • *Wishart Road has numerous access on frontage which results in higher potential for accidents.*	• *Only one road agency to deal with as the entire route falls under the authority of NT DIPL.*	• *Minimal impact on the route from Stuart Highway north.* • *Safety of other road users will be negligibly impacted.* • *Heavy vehicles are kept to dedicated road train routes.* • *One additional turning movement then Route 1.* • *Wishart Road has frontage to commercial operators with direct access that may create safety concerns.*	• *Capital investment in infrastructure upgrades from Stuart Highway north will be nil.* • *Infrastructure is designed to sustain quad road train movements and impact on lifecycle costs will be negligible.*	• *Infrastructure is designed to sustain quad road train movements and meets national highway standards.* • *Risks in relation to bridge capacity, flood immunity, pavement integrity and traffic behaviours are well understood.*
Route 3	• *This section is a quad road train approved route.* • *4 rail crossings* • *5 left and right turning movements through intersections.* • *Route less safe than Routes 1 and 2 due to number of crossing movements at uncontrolled intersections.*	• *Only one road agency to deal with as the entire route falls under the authority of NT DIPL.*	• *Reduced impact on the route from Stuart Highway north as traffic deviates onto a low volume road network.* • *Safety of other road users will be reduced due to standard of the route and more conflict movements..* • *4 additional turning movement then Route 1.* • *Sensitive community receptors on Elrundie Avenue.*	• *Capital investment in infrastructure likely to be nil.* • *Infrastructure is designed to sustain quad road train movements and impact on lifecycle costs may be negligible.*	• *Infrastructure is designed to sustain quad road train movements.* • *Risks in relation to bridge capacity, flood immunity, pavement integrity and traffic behaviours are not well understood.*
Route 4	• *This section is not a quad road train approved route.* • *The road cross section on Finn Road is substandard.*	• *Two road agencies to deal with as Finn Road is under the management and control of Litchfield*	• *Reduced impact on the route from Stuart Highway north as traffic does not enter the highway..* • *Safety of other*	• *Capital investment in infrastructure upgrades from Finn Road will likely be needed.* • *Infrastructure is*	• *Infrastructure is not designed to sustain quad road train movements and meets national highway standards.*

	Assessment Criteria				
	Road Suitability	**Approvals Agency Logistics**	**Stakeholder Impacts and Benefits**	**Value for Money**	**Technical Risk**
	• *5 rail crossings* • *6 left and right turning movements through intersections.* • *Route less safe than Routes 1 and 2 due to number of crossing movements at uncontrolled intersections.*	*Council.*	*road users will be reduced due to standard of the route and more conflict movements..* • *Route would require a temporary / short term quad road train gazettal to support the haulage.* • *4 additional turning movement then Route 1.* • *Sensitive community receptors on Elrundie Avenue.*	*not designed to sustain quad road train movements and will impact on lifecycle costs of pavements.*	• *Risks in relation to bridge capacity, flood immunity, pavement integrity and traffic behaviours are not well understood.*

6.0 SELECTION OF A PREFERRED ROUTE

To facilitate the selection of a preferred haulage route, a Multi Criteria Analysis has been used to assess each of the routes against the assessment criteria utilising a comparative scoring of the route options against the criteria.

Each of the criteria are assigned a weighting based upon relative importance For each criteria, a further suite of sub-criteria with associated weightings have been assigned as a means of refining the MCA process.

Table 5 shows the criteria weightings and additional sub-criteria assigned.

Table 5 : MCA Criteria and Sub-Criteria

Criteria	Sub-Criteria	Criteria Weighting
ROAD SUITABILITY	Road Train Approved	30%
	Geometry	20%
	Length	10%
	Intersections and Rail Crossings	15%
	Congestion	10%
	Travel Time	15%
30%	**Total Sub-Criteria Weighting**	**100%**
APPROVALS AGENCY LOGISTICS	Planned Upgrade Impacts	30%
	Approvals	40%
	Number of Authorities	30%
15%	**Total Sub-Criteria Weighting**	**100%**
STAKEHOLDER BENEFITS AND IMPACTS	Operational Safety	40%
	Local Traffic Impacts/Delays	20%
	Compliments Local Network Function	15%
	Impacts on local Businesses	15%
	Compatibility with Cycle and Ped Needs	10%
20%	**Total Sub-Criteria Weighting**	**100%**
VALUE FOR MONEY	Capital Costs	60%
	Lifecycle Costs	40%
20%	**Total Criteria Weighting**	**100%**
TECHNICAL RISK AND OPPORTUNITY	Bridges	25%
	Floodways	25%
	Pavements	25%
	Traffic	25%
15%	**Total Criteria Weighting**	**100%**

Based upon a sliding scale of 1 to 5 (1 is worst and 5 is best), each of the sub-criteria were scored as the basis of establishing ranking of the route options.

A full copy of the MCA analysis is provided in **Appendix A**

Table 6 provides a summary of the weighted scores and ranking for each option.

	Route 1 Stuart Highway - Berrimah Rd	Route 2 Stuart Highway - - Wishart Rd - Berrimah Rd	Route 3 Jenkins Rd - Berrimah Road	Route 4 Finn Rd - Berrimah Rd
ROAD SUITABILITY	1.35	1.25	1.35	1.35
APPROVALS AGENCY LOGISTICS	0.75	0.71	0.54	0.24
STAKEHOLDERS	0.85	0.68	0.31	0.28
VALUE FOR MONEY	1.00	1.00	0.92	0.40
TECHNICAL RISK	0.90	0.71	0.45	0.30
Total	**4.85**	**4.34**	**3.57**	**2.57**
RANK	1	2	3	4

The MCA analysis suggests that ***Route 1*** is the preferred option for the haulage of DSO from Grants Mine to the East Arm Wharf.

This assessment is supported by engineering judgement by the report author.

7.0 SUMMARY AND RECOMMENDATIONS

The Grants Mine proposes to export 1.8m tonnes of Direct Shipping Ore from the mine lease situated on the Cox Peninsula Road to the East Arm Wharf at the Port of Darwin.

It is proposed to transport the ore over a 2 year period (operating 12hours/day / 7 days per week) utilising quad road trains.

A route selection assessment has been undertaken that identified four routes that has the potential to meet the needs of Grants Mine in transport the DSO to export.

The four routes are referred to as:

- **Route 1 :** Stuart Highway – Berrimah Road (88.31km)
- **Route 2 :** Stuart Highway – Wishart Road – Berrimah Road (88.13km)
- **Route 3 :** Jenkins Road – Berrimah Road (90.18km)
- **Route 4 :** Finn Road – Berrimah Road. (77.94km)

Assessment criteria were derived (and weighted by importance) as a means of measuring the comparative merits of each of the routes which were described as:

- Road Suitability (30%)
- Approvals Authority Logistics (15%)
- Stakeholder Impacts and Benefits (20%)
- Value for Money (20%)
- Technical Risk (15%)

A Multi Criteria Analysis was used to score and rank the four transport route options which were:

- **1st : Route 1 :** Stuart Highway – Berrimah Road (88.31km)
- **2nd : Route 2 :** Stuart Highway – Wishart Road – Berrimah Road (88.13km)
- **3rd : Route 3 :** Jenkins Road – Berrimah Road (90.18km)
- **4th: Route 4 :** Finn Road – Berrimah Road. (77.94km)

It is recommended that Route 1 be adopted as the preferred route for haulage of DSO from Grants Mine to East Arm Wharf, and that upon acceptance of this recommendation, a traffic review be undertaken on those sections of the network that reach the 5% trigger for increase in traffic volume.

APPENDIX A- MCA ANALYSIS SPEADSHEET

Grants Mine Haul Routes

Comparison of Alignment Options

HAULAGE OPTIONS

LEGEND:
5 = Very Good
4 = Good
3 = Average
2 = Fair

☺

☹

LEGEND:
5 = Very Good
4 = Good
3 = Average
2 = Fair

Value	Criteria	Criteria Weighting	Comment Defining a Score of 5	Option 1A Stuart Highway - Berrimah Rd Score	Option 1B Stuart Highway - Wishart Rd - Berrimah Rd Score	Option 2 Jenkins Rd - Berrimah Road Score	Option 3 Finn Rd - Berrimah Rd Score	Comment Defining a Score of 1
Road Suitability	Road Train Approved	30%	All Sections Quad Road Train Approved	5.0	5.0	3.0	1.0	No Sections Quad Road Train Approved
	Geometry	20%	Vertical and Horizontal Compliant for Quad Road Trains	5.0	5.0	4.0	2.0	Vertical and Horizontal Not Compliant for Quad Road Trains
	Length	10%	Shortest Route	3.0	2.0	4.0	5.0	Longest Route
	Intersections and Rail Crossings	15%	Minimal High Volume Unsignalised/Signalised Intersections	5.0	5.0	2.0	2.0	High Number of High Volume Unsignalised/Signalised Intersections
	Congestion	10%	Minimal Congestion on all Sections	5.0	4.0	2.0	2.0	High Level of Congestion on all Sections
	Time	15%	Lowest Average Travel Time	3	2	3	4	Highest Average Travel Time
30%	**Total Criteria Weighting**	**100%**	**Weighted Score**	**1.35**	**1.25**	**1.35**	**1.35**	
Road Authority	Planned Upgrade Impacts	30%	No Planned Road Works during the Haul Period	5.0	4.0	3.0	3.0	Significant Sections of Roadworks during the Haul Period
	Approvals	40%	Approved Quad Road Train Route	5.0	5.0	3.0	1.0	Multiple Approvals Required for Quad Road Train Route
	Number of Authoriies	30%	Minimal Number of Authorities	5.0	5.0	5.0	3.0	High Number of Authorities
15%	**Total Criteria Weighting**	**100%**	**Weighted Score**	**0.75**	**0.71**	**0.54**	**0.33**	
STAKEHOLDER BENEFITS AND IMPACTS	Operational Safety	40%	Low accident likelihood and/or severity	5.0	4.0	2.0	2.0	Increase in accident likelihood and/or severity
	Local Traffic Impacts/Delays	20%	Positive impacts on adjoining local street network	5.0	4.0	3.0	2.0	Significant impact on traffic movements during Construction
	Compliments Local Network Function	15%	Minimal impacts on access to and operation	5.0	4.0	3.0	2.0	Negative impacts on adjoining local street network
	Impacts on local Businesses	15%						High impacts on access to and operation
	Compatibility with Cycle and Ped Needs	10%	Cycle and ped needs are effectively integrated	5.0	5.0	4.0	2.0	Cycle and ped needs are poorly integrated
20%	**Total Criteria Weighting**	**100%**	**Weighted Score**	**0.85**	**0.70**	**0.45**	**0.34**	
VALUE FOR MONEY	Capital Costs	60%	Lowest cost of construction	5.0	5.0	5.0	2.0	Highest Cost of Construction
	Lifecycle Costs	40%	Lowest recurrent cost of rehab and maintenance	5.0	5.0	4.0	2.0	Highest recurrent cost of rehab and maintenance
20%	**Total Criteria Weighting**	**100%**	**Weighted Score**	**1.00**	**1.00**	**0.92**	**0.40**	
TECHNICAL RISK AND OPPORTUNITY	Bridges	25%	Bridge risks are well understood and have low potential to impact the option through the BC	5.0	5.0	5.0	5.0	Bridge risks are not well understood and have high potential to impact the option through the BC
	Floodways	25%	Hydraulics risks are well understood and have low potential to impact the option through the BC	5.0	5.0	3.0	2.0	Hydraulics risks are not well understood and have high potential to impact the option through the BC
	Pavements	25%	Pavement risks are well understood and have low potential to impact the option through the BC	5.0	5.0	3.0	2.0	Pavement risks are not well understood and have high potential to impact the option through the BC
	Traffic	25%	Traffic risks are well understood and have low potential to impact the option through the BC	5.0	4.0	3.0	3.0	Traffic risks are not well understood and have high potential to impact the option through the BC
15%	**Total Criteria Weighting**	**100%**	**Weighted Score**	**0.90**	**0.71**	**0.53**	**0.45**	
100%			**Overall Weighted Score**	**4.85**	**4.36**	**3.79**	**2.87**	

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APPENDIX: B

Background Traffic and Traffic Generation Calculations

Project: Grants Mine
Project No.: 4966-01
Task Manager: Rohan Langworthy
Date: 2/08/2018
Description: Traffic Generation Calculations
Calculations By: Russell Burns
Reviewed By: Ian McNichol

Note:

Haulage forecast from information provided by Core Exploration (via email "RE: Cox peninsula Road" from B. Duncan on 27 July 2018 at 11:36 AM). Background traffic information from the Annual Traffic Report 2015 by Territory Asset Management Services.

Calcualtions based on the preferred haulage route (as per the findings of R-RL0131-Grants Mine dated 27 October 2018) and the use of quad road trains with a capacity to haul 95t of material per trip.

Haulage Forecast

Item	Units	Month 0	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	Month 13	Month 14
Mining		1/06/2019	1/07/2019	1/08/2019	1/09/2019	1/10/2019	1/11/2019	1/12/2019	1/01/2020	1/02/2020	1/03/2020	1/04/2020	1/05/2020	1/06/2020	1/07/2020	1/08/2020
Total Mined	bcm		689,850	689,850	574,875	1,034,775	1,092,263	804,825	761,709	531,759	492,360	459,900	459,900	459,900	344,925	344,925
Waste Mined	bcm		689,850	689,850	574,875	1,031,693	1,054,977	757,965	703,457	463,139	463,770	446,159	438,617	414,338	298,896	293,593
Ore Mined	bcm		-	-	-	3,082	37,286	46,860	58,252	68,620	28,590	13,741	21,283	45,562	46,029	51,332
Ore Mined	t's		-	-	-	8,507	102,910	129,332	160,775	189,391	78,905	37,926	58,741	125,753	127,041	141,676
Ore Grade	(Li_2O%)		0.00%	0.00%	0.00%	1.45%	1.47%	1.51%	1.50%	1.51%	1.53%	1.37%	1.35%	1.45%	1.48%	1.49%
Processing																
Mine Ore Crush & Screen	t's				-	-	25,000	50,000	85,000	85,000	85,000	85,000	85,000	85,000	85,000	85,000
Grade	(Li_2O%)				0.00%	1.45%	1.47%	1.51%	1.50%	1.51%	1.53%	1.37%	1.35%	1.45%	#VALUE!	1.49%
Recovery	%				76.06%	76.06%	76.06%	76.06%	76.06%	76.06%	76.06%	76.06%	76.06%	76.06%	76.06%	76.06%
DMS Output	t's				-	-	5,579	11,459	19,423	19,463	19,765	17,742	17,440	18,798	#VALUE!	19,323
Grade	(Li_2O%)				5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Haulage																
Product Hauled	t's					-	5,000	10,000	10,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Hauled Grade	(Li_2O%)					5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Run Rate	Mtpa					-	0.06	0.12	0.12	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Shipped																
Ore Shipped	t's					-	-	10,000	15,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Shipped Grade	(Li_2O%)					0.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
# of ships						-	-	1	1	1	1	1	1	1	1	1
Run Rate	Mtpa					-	-	0.12	0.18	0.24	0.24	0.24	0.24	0.24	0	0

Development Traffic Generation

	Year 1														
	Month 0	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	Month 13	Month 14
Assumed Trip Duration (1 way)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Assumed Trip Duration (return)	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Assumed Length of Working Day	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Number of Trips (per month)	0	0	0	0	0	53	106	106	211	211	211	211	211	211	211
Number of Trips (per day)	0	0	0	0	0	2	4	4	8	8	8	8	8	8	8
Number of Trips (per hour)	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
Minimum Size of Truck Fleet	0	0	0	0	0	1	2	2	3	3	3	3	3	3	3

Note:

Haulage forecast from information provided by Core Exploration (via email "RE: Co

Calcualtions based on the preferred haulage route (as per the findings of R-RL0131

Haulage Forecast

Item	Units	Year 2														
		Month 15	Month 16	Month 17	Month 18	Month 19	Month 20	Month 21	Month 22	Month 23	Month 24	Month 25	Month 26	Month 27	Month 28	Month 29
Mining		1/09/2020	1/10/2020	1/11/2020	1/12/2020	1/01/2021	1/02/2021	1/03/2021	1/04/2021	1/05/2021	1/06/2021	1/07/2021	1/08/2021	1/09/2021	1/10/2021	1/11/2021
Total Mined	bcm	172,462	172,462	114,975	114,975	114,975	114,975	18,428	-	-	-	-	-	-	-	-
Waste Mined	bcm	143,357	138,880	87,526	84,460	79,278	62,456	3,626	-	-	-	-	-	-	-	-
Ore Mined	bcm	29,105	33,582	27,449	30,515	35,697	52,519	14,802	-	-	-	-	-	-	-	-
Ore Mined	t's	80,330	92,686	75,759	84,222	98,523	144,952	40,854	-	-	-	-	-	-	-	-
Ore Grade	(Li_2O%)	1.51%	1.52%	1.52%	1.51%	1.47%	1.41%	1.39%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Processing																
Mine Ore Crush & Screen	t's	85,000	85,000	85,000	85,000	85,000	85,000	85,000	85,000	85,000	85,000	85,000	88,283	-	-	-
Grade	(Li_2O%)	1.51%	1.52%	1.52%	1.51%	1.47%	1.41%	1.39%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Recovery	%	76.06%	76.06%	76.06%	76.06%	76.06%	76.06%	76.06%	76.06%	76.06%	76.06%	76.06%	76.06%	76.06%	76.06%	76.06%
DMS Output	t's	19,538	19,680	19,693	19,472	18,988	18,282	17,956	-	-	-	-	-	-	-	-
Grade	(Li_2O%)	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Haulage																
Product Hauled	t's	20,000	20,000	15,000	20,000	20,000	20,000	20,000	15,000	20,000	20,000	20,000	25,083	-	-	-
Hauled Grade	(Li_2O%)	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Run Rate	Mtpa	0.24	0.24	0.18	0.24	0.24	0.24	0.24	0.18	0.24	0.24	0.24	0.30	-	-	-
Shipped																
Ore Shipped	t's	20,000	20,000	15,000	20,000	20,000	20,000	20,000	15,000	20,000	20,000	20,000	25,083	-	-	-
Shipped Grade	(Li_2O%)	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	0.00%	0.00%	0.00%
# of ships		1	1	1	1	1	1	1	1	1	1	1	1	-	-	-
Run Rate	Mtpa	0.24	0.24	0.18	0.24	0.24	0.24	0.24	0.18	0.24	0.24	0.24	0.30	-	-	-

Development Traffic Generation

	Year 2														
	Month 15	Month 16	Month 17	Month 18	Month 19	Month 20	Month 21	Month 22	Month 23	Month 24	Month 25	Month 26	Month 27	Month 28	Month 29
Assumed Trip Duration (1 way)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Assumed Trip Duration (return)	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Assumed Length of Working Day	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Number of Trips (per month)	211	211	158	211	211	211	211	158	211	211	211	265	0	0	0
Number of Trips (per day)	8	8	6	8	8	8	8	6	8	8	8	9	0	0	0
Number of Trips (per hour)	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
Minimum Size of Truck Fleet	3	3	2	3	3	3	3	2	3	3	3	3	0	0	0

Note:

Haulage forecast from information provided by Core Exploration (via email "RE: Co

Calcualtions based on the preferred haulage route (as per the findings of R-RL0131

Haulage Forecast

Item	Units	Year 3							Yr 1 - 2019	Yr 2 - 2020	Yr 3 - 2021	Total
		Month 30	Month 31	Month 32	Month 33	Month 34	Month 35	Month 36				
Mining		1/12/2021	1/01/2022	1/02/2022	1/03/2022	1/04/2022	1/05/2022	1/06/2022				
Total Mined	bcm	-	-	-	-	-	-	-	8,051,966	1,513,102	0	9,565,068
Waste Mined	bcm	-	-	-	-	-	-	-	7,728,690	1,192,072	0	8,920,762
Ore Mined	bcm	-	-	-	-	-	-	-	323,276	321,030	0	644,306
Ore Mined	t's	-	-	-	-	-	-	-	892,240	886,043	0	1,778,283
Ore Grade	(Li_2O%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.48%	1.48%	0.00%	1.48%
Processing												
Mine Ore Crush & Screen	t's	-	-	-	-	-	-	-	585,000	1,020,000	173,283	1,778,283
Grade	(Li_2O%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.46%	#VALUE!	0.00%	#VALUE!
Recovery	%	76.06%	76.06%	76.06%	76.06%	76.06%	76.06%	76.06%				
DMS Output	t's	-	-	-	-	-	-	-	129,669	#VALUE!	0	#VALUE!
Grade	(Li_2O%)	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	#VALUE!	0.00%	#VALUE!
Haulage												
Product Hauled	t's	-	-	-	-	-	-	-	125,000	230,000	45,083	400,083
Hauled Grade	(Li_2O%)	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Run Rate	Mtpa	-	-	-	-	-	-	-	0.125	0.230	0.045	0.25
Shipped												
Ore Shipped	t's	-	-	-	-	-	-	-	125,000	230,000	45,083	400,083
Shipped Grade	(Li_2O%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.00%	5.00%	5.00%	5.00%
# of ships		-	-	-	-	-	-	-	7	12	2	21
Run Rate	Mtpa	-	-	-	-	-	-	-	0.125	0.230	0.045	0.25

Development Traffic Generation

	Year 3							Minimum	Maximum
	Month 30	Month 31	Month 32	Month 33	Month 34	Month 35	Month 36		
Assumed Trip Duration (1 way)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Assumed Trip Duration (return)	3	3	3	3	3	3	3	3	3
Assumed Length of Working Day	10	10	10	10	10	10	10	10	10
Number of Trips (per month)	0	0	0	0	0	0	0	0	265
Number of Trips (per day)	0	0	0	0	0	0	0	0	9
Number of Trips (per hour)	0	0	0	0	0	0	0	0	1
Minimum Size of Truck Fleet	0	0	0	0	0	0	0	0	3

Project: Grants Mine
Project No.: 4966-01
Task Manager: Rohan Langworthy
Date: 2/08/2018
Description: Traffic Generation Calculations
Calculations By: Russell Burns
Reviewed By: Ian McNichol

Background Traffic

LEGEND	
XXX	Value from TAMS Report
XXX	Value Extrapolated from Data in TAMS Report
XXX	Value Calculated Using Assumed Parameters
XXX	Development Traffic Within 5% Threshold
XXX	Development Traffic Exceeds 5% Threshold

PARAMETERS	
Assumed Growth Rate	3%
Assumed Proportion HVs	20%
Assumed Peak Hour Proportion	15%

Counter	Direction	2014	2015	2016	2017	2018	2019	2020	2021	2018 Peak Hour	2021 Peak Hour	Percentage of Development Traffic
Berrimah Road (UDVDP029)	Inbound	779	515	531	547	564	581	599	617	85	93	1.08%
	Outbound	901	529	545	562	579	597	615	634	87	96	1.04%
	Both	1680	1044	1076	1109	1143	1178	1214	1251	172	188	1.06%
	HV Inbound	455	301	311	321	331	341	352	363	50	55	1.82%
	HV Outbound	414	243	251	259	267	276	285	294	41	45	2.22%
	HV Both	874	543	560	577	595	613	632	651	90	98	2.04%
Berrimah Road 400 m Sth of Tiger Brennan Drive (UDVDP028)	Inbound	5277	6035	6217	6404	6597	6795	6999	7209	990	1082	0.09%
	Outbound	4509	4144	4269	4398	4530	4666	4806	4951	680	743	0.13%
	Both	9786	9179	9455	9739	10032	10333	10643	10963	1505	1645	0.12%
	HV Inbound	1111	1271	1310	1350	1391	1433	1476	1521	209	229	0.44%
	HV Outbound	994	914	942	971	1001	1032	1063	1095	151	165	0.61%
	HV Both	2104	1973	2033	2094	2157	2222	2289	2358	324	354	0.56%
Berrimah Road 100 m South Marlow Road (UDVDP024)	Inbound	4926	4178	4304	4434	4568	4706	4848	4994	686	750	0.13%
	Outbound	3491	4119	4243	4371	4503	4639	4779	4923	676	739	0.14%
	Both	8417	8297	8546	8803	9068	9341	9622	9911	1361	1487	0.13%
	HV Inbound	986	836	862	888	915	943	972	1002	138	151	0.66%
	HV Outbound	699	824	849	875	902	930	958	987	136	149	0.67%
	HV Both	1684	1660	1710	1762	1815	1870	1927	1985	273	298	0.67%
Tiger Brennan Dr (UDVDP022)	Inbound	9989	8681	8942	9211	9488	9773	10067	10370	1424	1556	0.06%
	Outbound	8676	8156	8401	8654	8914	9182	9458	9742	1338	1462	0.07%
	Both	18665	16837	17343	17864	18400	18952	19521	20107	2760	3017	0.07%
	HV Inbound	1433	1245	1283	1322	1362	1403	1446	1490	205	224	0.45%
	HV Outbound	1504	1414	1457	1501	1547	1594	1642	1692	233	254	0.39%
	HV Both	2965	2674	2755	2838	2924	3012	3103	3197	439	480	0.42%
Stuart Highway Midway Yarrawonga & Tulagi Rds UDVDC079	Inbound	12618	11647	11997	12357	12728	13110	13504	13910	1910	2087	0.05%
	Outbound	10772	10500	10815	11140	11475	11820	12175	12541	1722	1882	0.05%
	Both	23390	22147	22812	23497	24202	24929	25677	26448	3631	3968	0.05%
	HV Inbound	2524	2330	2400	2472	2547	2624	2703	2785	383	418	0.24%
	HV Outbound	2155	2100	2163	2228	2295	2364	2435	2509	345	377	0.27%
	HV Both	4678	4430	4563	4700	4841	4987	5137	5292	727	794	0.25%
Temple Terrace 100 m South of Stuart Highway UDVDP024	Inbound	5810	5904	6082	6265	6453	6647	6847	7053	968	1058	0.09%
	Outbound	5236	5239	5397	5559	5726	5898	6075	6258	859	939	0.11%
	Both	11046	11143	11478	11823	12178	12544	12921	13309	1827	1997	0.10%
	HV Inbound	1162	1181	1217	1254	1292	1331	1371	1413	194	212	0.47%
	HV Outbound	1048	1048	1080	1113	1147	1182	1218	1255	173	189	0.53%
	HV Both	2210	2229	2296	2365	2436	2510	2586	2664	366	400	0.50%
Stuart Highway 500 m West of Howard Springs Rd UDVDP017	Inbound	12705	12767	13151	13546	13953	14372	14804	15249	2093	2288	0.04%
	Outbound	12172	12630	13009	13400	13802	14217	14644	15084	2071	2263	0.04%
	Both	24877	25397	26159	26944	27753	28586	29444	30328	4163	4550	0.04%
	HV Inbound	2541	2554	2631	2710	2792	2876	2963	3052	419	458	0.22%
	HV Outbound	2435	2526	2602	2681	2762	2845	2931	3019	415	453	0.22%
	HV Both	4976	5080	5233	5390	5552	5719	5891	6068	833	911	0.22%
Lambrick Avenue 200 m West of Stuart Highway UDVDP023	Inbound	5141	5419	5582	5750	5923	6101	6285	6474	889	972	0.10%
	Outbound	4795	5187	5343	5504	5670	5841	6017	6198	851	930	0.11%
	Both	9936	10606	10925	11253	11591	11939	12298	12667	1739	1901	0.11%
	HV Inbound	764	805	830	855	881	908	936	965	133	145	0.69%
	HV Outbound	395	427	440	454	468	483	498	513	71	77	1.30%
	HV Both	1179	1258	1296	1335	1376	1418	1461	1505	207	226	0.88%
Howard Springs Road 500 m East of Stuart Hwy UDVDP018	Inbound	4960	5037	5189	5345	5506	5672	5843	6019	826	903	0.11%
	Outbound	5064	5061	5213	5370	5532	5698	5869	6046	830	907	0.11%
	Both	10024	10098	10401	10714	11036	11368	11710	12062	1656	1810	0.11%
	HV Inbound	56	56	58	60	62	64	66	68	10	11	9.09%
	HV Outbound	73	73	76	79	82	85	88	91	13	14	7.14%
	HV Both	129	130	134	139	144	149	154	159	22	24	8.33%
Stuart Highway 100 m North of Henning Rd UDVDC021	Inbound	8746	8701	8963	9232	9509	9795	10089	10392	1427	1559	0.06%
	Outbound	8231	8123	8367	8619	8878	9145	9420	9703	1332	1456	0.07%
	Both	16977	16824	17329	17849	18385	18937	19506	20092	2758	3014	0.07%
	HV Inbound	358	356	367	379	391	403	416	429	59	65	1.54%
	HV Outbound	490	484	499	514	530	546	563	580	80	87	1.15%
	HV Both	853	845	871	898	925	953	982	1012	139	152	1.32%
Stuart Highway 500 m North of Arnhem Hwy UDVDP020	Inbound	5826	5786	5960	6139	6324	6514	6710	6912	949	1037	0.10%
	Outbound	6522	6490	6685	6886	7093	7306	7526	7752	1064	1163	0.09%
	Both	12348	12276	12645	13025	13416	13819	14234	14662	2013	2200	0.09%
	HV Inbound	1166	1158	1193	1229	1266	1304	1344	1385	190	208	0.48%
	HV Outbound	1305	1298	1337	1378	1420	1463	1507	1553	213	233	0.43%
	HV Both	2470	2456	2530	2606	2685	2766	2849	2935	403	441	0.45%
Arnhem Hwy 500 m East of Stuart Hwy UDVDP019	Inbound	3789	3865	3981	4101	4225	4352	4483	4618	634	693	0.14%
	Outbound	3808	3859	3975	4095	4218	4345	4476	4611	633	692	0.14%
	Both	7597	7724	7956	8195	8441	8695	8956	9225	1267	1384	0.14%
	HV Inbound	758	773	797	821	846	872	899	926	127	139	0.72%
	HV Outbound	762	772	796	820	845	871	898	925	127	139	0.72%
	HV Both	1520	1545	1592	1640	1690	1741	1794	1848	254	278	0.72%
Stuart Highway 500 m North of Gulnare UDVDC051	Inbound	3752	4023	4144	4269	4398	4530	4666	4806	660	721	0.14%
	Outbound	3800	3827	3942	4061	4183	4309	4439	4573	628	686	0.15%
	Both	7552	7850	8086	8329	8579	8837	9103	9377	1287	1407	0.14%
	HV Inbound	751	805	830	855	881	908	936	965	133	145	0.69%
	HV Outbound	760	766	789	813	838	864	890	917	126	138	0.72%
	HV Both	1511	1570	1618	1667	1718	1770	1824	1879	258	282	0.71%
Stuart Highway 500 m North of Cox Peninsula Rd RDVDC049	Inbound	2895	3452	3556	3663	3773	3887	4004	4125	566	619	0.16%
	Outbound	2861	2921	3009	3100	3193	3289	3388	3490	479	524	0.19%
	Both	5756	6373	6565	6762	6965	7174	7390	7612	1045	1142	0.18%
	HV Inbound	579	691	712	734	757	780	804	829	114	125	0.80%
	HV Outbound	573	585	603	622	641	661	681	702	97	106	0.94%
	HV Both	1152	1275	1314	1354	1395	1437	1481	1526	210	229	0.87%
Stuart Highway 500 m South of Cox Peninsula Rd RDVDC091	Inbound	2136	2410	2483	2558	2635	2715	2797	2881	396	433	0.23%
	Outbound	2105	2204	2271	2340	2411	2484	2559	2636	362	396	0.25%
	Both	4241	4614	4753	4896	5043	5195	5351	5512	757	827	0.24%
	HV Inbound	428	482	497	512	528	544	561	578	80	87	1.15%
	HV Outbound	421	441	455	469	484	499	514	530	73	80	1.25%
	HV Both	849	923	951	980	1010	1041	1073	1106	152	166	1.20%
Cox Penisula Road 4 km West of Stuart Hwy RDVDP009	Inbound	973	1051	1083	1116	1150	1185	1221	1258	173	189	0.53%
	Outbound	1020	1115	1149	1184	1220	1257	1295	1334	183	201	0.50%
	Both	1993	2166	2231	2298	2367	2439	2513	2589	356	389	0.51%
	HV Inbound	195	211	218	225	232	239	247	255	35	39	2.56%
	HV Outbound	204	223	230	237	245	253	261	269	37	41	2.44%
	HV Both	399	434	448	462	476	491	506	522	72	79	2.53%
Darwin River Rd 3 km West of Cox Peninsula Rd RDVDC036	Inbound	355	366	377	389	401	414	427	440	61	66	1.52%
	Outbound	351	362	373	385	397	409	422	435	60	66	1.52%
	Both	706	728	750	773	797	821	846	872	120	131	1.53%
	HV Inbound	71	74	77	80	83	86	89	92	13	14	7.14%
	HV Outbound	71	74	77	80	83	86	89	92	13	14	7.14%
	HV Both	142	147	152	157	162	167	173	179	25	27	7.41%

FLANAGAN CONSULTING GROUP
Trusted Advisor to Northern Australia

Project: Grants Mine
Project No.: 4966-01
Task Manager: Rohan Langworthy
Date: 2/08/2018
Description: Traffic Generation Calculations
Calculations By: Russell Burns
Reviewed By: Ian McNichol

Cox Penisula Road At Blackmore River Bridge RDVDC030	Inbound	350	361	372	384	396	408	421	434	60	66	1.52%
	Outbound	342	353	364	375	387	399	411	424	59	64	1.56%
	Both	692	713	735	758	781	805	830	855	118	129	1.55%
	HV Inbound	70	73	76	79	82	85	88	91	13	14	7.14%
	HV Outbound	69	72	75	78	81	84	87	90	13	14	7.14%
	HV Both	139	144	149	154	159	164	169	175	24	27	7.41%
Litchfield Park Road 2 km West of Cox Peninsula Road RDVDP014	Inbound	62	74	77	80	83	86	89	92	13	14	7.14%
	Outbound	47	60	62	64	66	68	71	74	10	12	8.33%
	Both	109	134	139	144	149	154	159	164	23	25	8.00%
	HV Inbound	13	15	16	17	18	19	20	21	3	4	25.00%
	HV Outbound	9	11	12	13	14	15	16	17	3	3	33.33%
	HV Both	21	26	27	28	29	30	31	32	5	5	40.00%
Cox Peninsula Road At Pioneer Creek Bridge RDVDP010	Inbound	263	284	293	302	312	322	332	342	47	52	1.92%
	Outbound	268	288	297	306	316	326	336	347	48	53	1.89%
	Both	531	572	590	608	627	646	666	686	95	103	1.94%
	HV Inbound	30	32	33	34	36	38	40	42	6	7	14.29%
	HV Outbound	37	40	42	44	46	48	50	52	7	8	12.50%
	HV Both	67	72	75	78	81	84	87	90	13	14	14.29%
Fog Bay Road 2 Km West of Cox Peninsula Road RDVDP032	Inbound	175	183	189	195	201	208	215	222	31	34	2.94%
	Outbound	176	190	196	202	209	216	223	230	32	35	2.86%
	Both	351	373	385	397	409	422	435	449	62	68	2.94%
	HV Inbound	32	34	36	38	40	42	44	46	6	7	14.29%
	HV Outbound	22	24	25	26	27	28	29	30	5	5	20.00%
	HV Both	54	57	59	61	63	65	67	70	10	11	18.18%
Cox Penisula Road 500 m West of Fog Bay Rd RDVDC033	Inbound	93	96	99	102	106	110	114	118	16	18	5.56%
	Outbound	94	97	100	103	107	111	115	119	17	18	5.56%
	Both	187	193	199	205	212	219	226	233	32	35	5.71%
	HV Inbound	19	20	21	22	23	24	25	26	4	4	25.00%
	HV Outbound	19	20	21	22	23	24	25	26	4	4	25.00%
	HV Both	38	40	42	44	46	48	50	52	7	8	25.00%

Project: Grants Mine
Project No.: 4966-01
Task Manager: Rohan Langworthy
Date: 5/09/2018
Description: Initial Traffic Impact Assessment
Calculations By: Russell Burns
Reviewed By: Ian McNichol

Traffic volumes taken as 2018 peak hour volumes in both directions from "Grants Lithium Project Logistics Analysis." Warrented Intersections based on Figure 4.9 (attached) from the Austroads Guide to Road Design Part 4A (2nd edition - dated 2010).

Intersection No.	Intersection Major Road	Intersection Minor Road	Major Road Traffic Volume - Q_M (Veh/hr)	Turning Traffic Volume - Q_L or Q_R (Veh/hr)	Current Intersection Treatment	Current Warrented Intersection Treatment	Future Warrented Intersection Treatment	Upgrade Required?	Further Analysis Required?	Comments
1	Cox Peninsula Road	Various Minor Access Roads Prior to Fog Bay Road	32	<30	BAR/BAL	BAR/BAL	BAR/BAL	NO	NO	Major traffic from Counter RDVDC033. Turning traffic assumed
2	Cox Peninsula Road	Fog Bay Road	32	64	BAR/AUL	BAR/BAL	BAR/BAL	NO	NO	Major traffic from Counter RDVDC033. Turning traffic from Counter RDVDP032
3	Cox Peninsula Road	Litchfield Park Road	117	22	BAR/AUL	BAR/BAL	BAR/BAL	NO	NO	Major traffic from Counter RDVDC030. Turning traffic from Counter RDVDP014
4	Cox Peninsula Road	Stockwell Road	117	64	CHR/BAL	BAR/BAL	BAR/BAL	NO	NO	Major traffic from Counter RDVDC030. Minor traffic assuming 1 veh per lot (based on aerial image). Intersection has been recently upgraded due to new subdivision on Stockwell Road.
5	Cox Peninsula Road	Lawton Road	117	<30	BAR/BAL	BAR/BAL	BAR/BAL	NO	NO	Major traffic from Counter RDVDC030. Turning traffic assumed
6	Cox Peninsula Road	Letchford Road	117	<30	BAR/BAL	BAR/BAL	BAR/BAL	NO	NO	Major traffic from Counter RDVDC030. Turning traffic assumed
7	Cox Peninsula Road	Mira Road	117	50	AUR/AUL	BAR/BAL	BAR/BAL	NO	NO	Major traffic from Counter RDVDC030. Turning traffic assumed
8	Cox Peninsula Road	Darwin River Road	117	120	AUR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major traffic from Counter RDVDC030. Turning traffic from Counter RDVDC036. Current warrented treatment is boarderline AUR/AUL.
9	Cox Peninsula Road	Various Minor Access Roads between Darwin River Road and Stuart Highway	356	<5	BAR/BAL	BAR/BAL	BAR/BAL	NO	NO	Major traffic from Counter RDVDP009. Turning traffic assumed
10	Cox Peninsula Road	Southport Road	250	50	AUR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic is sum of Counter RDVDC030 and RDVDC036. Turning traffic assumed based on number of properties along road. Increase in truck volumes will definitely require an auxilary left lane to be installed.
11	Cox Peninsula Road	Kentish Road	250	<10	BAR/BAL	BAR/BAL	BAR/BAL	NO	NO	Major Traffic is sum of Counter RDVDC030 and RDVDC036. Turning traffic assumed based on dirt road
12	Cox Peninsula Road	Carveth Road	250	<10	BAR/BAL	BAR/BAL	BAR/BAL	NO	NO	Major Traffic is sum of Counter RDVDC030 and RDVDC036. Turning traffic assumed based on dirt road
13	Cox Peninsula Road	Reedbeds Road	250	50	BAR/AUL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic is sum of Counter RDVDC030 and RDVDC036. Turning traffic assumed based on properties along road
14	Cox Peninsula Road	Cyrus Road	250	<10	BAR/BAL	BAR/BAL	BAR/BAL	NO	NO	Major Traffic is sum of Counter RDVDC030 and RDVDC036. Turning traffic assumed based on dirt road
15	Cox Peninsula Road	School Access Road	356	260	CHR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	YES	Major Traffic from Counter RDVDP009. Turning traffic calculated based on 260 students. Sensitive usage so model will be required
16	Cox Peninsula Road	Territory Wildlife Park Access Road	356	20	AUR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic from Counter RDVDP009. Turning traffic to match Berry Springs Nature Park
17	Cox Peninsula Road	Access Road	356	5	AUR/BAL	BAR/BAL	BAR/BAL	NO	NO	Major Traffic from Counter RDVDP009. Turning traffic calculated based on number of houses
18	Cox Peninsula Road	Berry Springs Nature Park Access Road	356	20	AUR/AUL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic from Counter RDVDP009. Turning traffic calculated based on number of carparks
19	Cox Peninsula Road	Hopewell Road	356	55	CHR/AUL	AUR/AUL	AUR/AUL	NO	NO	Major Traffic from Counter RDVDP009. Turning traffic calculated based on number of houses
20	Cox Peninsula Road	Finn Road	356	34	CHR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic from Counter RDVDP009. Turning traffic calculated based on number of houses
21	Cox Peninsula Road	Oxford Road	356	<20	BAR/BAL	BAR/BAL	BAR/BAL	NO	NO	Major Traffic from Counter RDVDP009. Turning traffic calculated assumed based on dirt road

Project: Grants Mine
Project No.: 4966-01
Task Manager: Rohan Langworthy
Date: 5/09/2018
Description: Initial Traffic Impact Assessment
Calculations By: Russell Burns
Reviewed By: Ian McNichol

Traffic volumes taken as 2018 peak hour volumes in both directions from "Grants Lithium Project Logistics Analysis." Warrented Intersections based on Figure 4.9 (attached) from the Austroads Guide to Road Design Part 4A (2nd edition - dated 2010).

Intersection No.	Intersection Major Road	Intersection Minor Road	Major Road Traffic Volume - Q_M (Veh/hr)	Turning Traffic Volume - Q_L or Q_R (Veh/hr)	Current Intersection Treatment	Current Warrented Intersection Treatment	Future Warrented Intersection Treatment	Upgrade Required?	Further Analysis Required?	Comments
22	Cox Peninsula Road	Doris Road	356	205	AUR/AUL	AUR/AUL	AUR/AUL	NO	NO	Major Traffic from Counter RDVDP009. Turning Traffic based on supermarket trip generation from DPTI (SA Gov) guidelines (13.65 peak hour trips / 100 sq.m)
23	Cox Peninsula Road	Berry Springs Mechanical/Tavern Access Road	356	50	AUR/AUL	AUR/AUL	AUR/AUL	NO	YES	Major Traffic from Counter RDVDP009. Turning Traffic based on number of carparks. Further analysis requested by DIPL
24	Cox Peninsula Road	Dump Access Road	356	60	AUR/BAL	AUR/AUL	AUR/AUL	NO	NO	Major Traffic from Counter RDVDP009. Turning Traffic based on commercial trip generation from DPTI (SA Gov) guidelines (2.02 peak hour trips / 100 sq.m)
25	Cox Peninsula Road	Mala Plains Road	356	43	AUR/AUL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic from Counter RDVDP009. Turning Traffic based on number of houses
26	Cox Peninsula Road	Middle Arm Road	356	32	BAR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic from Counter RDVDP009. Turning Traffic based on number of houses
27	Cox Peninsula Road	Bradley Road	356	18	BAR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic from Counter RDVDP009. Turning Traffic based on number of houses
28	Stuart Highway	Cox Peninsula Road	1045	356	CHR/CHL	CHR/CHL	CHR/CHL	NO	NO	Major Traffic from Counter RDVDC049. Turning Traffic from Counter RDVDP009.
29	Tiger Brennan Drive	Berrimah Road	2760	1505	Signalised	CHR/CHL	CHR/CHL	NO	NO	Major Traffic from Counter UDVDP024. Turning Traffic from UDVDP028.
30	Berrimah Road	McFarland Road	1505	60	BAL	BAL	BAL	NO	NO	Left in Left out intersection. Major Traffic from Counter UDVDP028. Turning Traffic based on number of carparks.
31	Berrimah Road	Wishart Road	1505	1688	AUR/CHL	CHR/CHL	CHR/CHL	NO	NO	Major Traffic from Counter UDVDP028. Turning Traffic from Counter UDVDP085.
32	Berrimah Road	Export Road	1505	1300	CHR/CHL	CHR/CHL	CHR/CHL	NO	NO	Major Traffic from Counter UDVDP028. Turning Traffic assumed as Counter UDVDP028 minus Counter UDVDP029
33	Berrimah Road	Cochrane Road	172	150	AUR/AUL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic from Counter UDVDP029. Turning Traffic assumed.
34	Berrimah Road	Casey Street	172	150	CHR/AUL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic from Counter UDVDP029. Turning Traffic assumed.
35	Berrimah Road	O'Sullivan Circuit	172	150	CHR/CHL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic from Counter UDVDP029. Turning Traffic assumed.
36	Berrimah Road	Salloo Street	172	150	CHR/CHL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic from Counter UDVDP029. Turning Traffic assumed.
37	Berrimah Road	East Arm Port Access Road	172	8	AUR/AUL	BAR/BAL	BAR/BAL	NO	NO	Major Traffic from Counter UDVDP029. Turning Traffic from Grants Mine peak hour truck movements

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APPENDIX: C

Calculations for Wattanted Intersection Treatments Along Cox Peninsula Road

Project: Grants Mine
Project No.: 4966-01
Task Manager: Rohan Langworthy
Date: 5/09/2018
Description: Initial Traffic Impact Assessment
Calculations By: Russell Burns
Reviewed By: Ian McNichol

Traffic volumes taken as 2018 peak hour volumes in both directions from "Grants Lithium Project Logistics Analysis." Warrented Intersections based on Figure 4.9 (attached) from the Austroads Guide to Road Design Part 4A (2nd edition - dated 2010).

Intersection No.	Intersection Major Road	Intersection Minor Road	Major Road Traffic Volume - Q_M (Veh/hr)	Turning Traffic Volume - Q_L or Q_R (Veh/hr)	Current Intersection Treatment	Current Warrented Intersection Treatment	Future Warrented Intersection Treatment	Upgrade Required?	Further Analysis Required?	Comments
1	Cox Peninsula Road	Various Minor Access Roads Prior to Fog Bay Road	32	<30	BAR/BAL	BAR/BAL	BAR/BAL	NO	NO	Major traffic from Counter RDVDC033. Turning traffic assumed
2	Cox Peninsula Road	Fog Bay Road	32	64	BAR/AUL	BAR/BAL	BAR/BAL	NO	NO	Major traffic from Counter RDVDC033. Turning traffic from Counter RDVDP032
3	Cox Peninsula Road	Litchfield Park Road	117	22	BAR/AUL	BAR/BAL	BAR/BAL	NO	NO	Major traffic from Counter RDVDC030. Turning traffic from Counter RDVDP014
4	Cox Peninsula Road	Stockwell Road	117	64	CHR/BAL	BAR/BAL	BAR/BAL	NO	NO	Major traffic from Counter RDVDC030. Minor traffic assuming 1 veh per lot (based on aerial image). Intersection has been recently upgraded due to new subdivision on Stockwell Road.
5	Cox Peninsula Road	Lawton Road	117	<30	BAR/BAL	BAR/BAL	BAR/BAL	NO	NO	Major traffic from Counter RDVDC030. Turning traffic assumed
6	Cox Peninsula Road	Letchford Road	117	<30	BAR/BAL	BAR/BAL	BAR/BAL	NO	NO	Major traffic from Counter RDVDC030. Turning traffic assumed
7	Cox Peninsula Road	Mira Road	117	50	AUR/AUL	BAR/BAL	BAR/BAL	NO	NO	Major traffic from Counter RDVDC030. Turning traffic assumed
8	Cox Peninsula Road	Darwin River Road	117	120	AUR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major traffic from Counter RDVDC030. Turning traffic from Counter RDVDC036. Current warrented treatment is boarderline AUR/AUL.
9	Cox Peninsula Road	Various Minor Access Roads between Darwin River Road and Stuart Highway	356	<5	BAR/BAL	BAR/BAL	BAR/BAL	NO	NO	Major traffic from Counter RDVDP009. Turning traffic assumed
10	Cox Peninsula Road	Southport Road	250	50	AUR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic is sum of Counter RDVDC030 and RDVDC036. Turning traffic assumed based on number of properties along road. Increase in truck volumes will definitely require an auxilary left lane to be installed.
11	Cox Peninsula Road	Kentish Road	250	<10	BAR/BAL	BAR/BAL	BAR/BAL	NO	NO	Major Traffic is sum of Counter RDVDC030 and RDVDC036. Turning traffic assumed based on dirt road
12	Cox Peninsula Road	Carveth Road	250	<10	BAR/BAL	BAR/BAL	BAR/BAL	NO	NO	Major Traffic is sum of Counter RDVDC030 and RDVDC036. Turning traffic assumed based on dirt road
13	Cox Peninsula Road	Reedbeds Road	250	50	BAR/AUL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic is sum of Counter RDVDC030 and RDVDC036. Turning traffic assumed based on properties along road
14	Cox Peninsula Road	Cyrus Road	250	<10	BAR/BAL	BAR/BAL	BAR/BAL	NO	NO	Major Traffic is sum of Counter RDVDC030 and RDVDC036. Turning traffic assumed based on dirt road
15	Cox Peninsula Road	School Access Road	356	260	CHR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	YES	Major Traffic from Counter RDVDP009. Turning traffic calculated based on 260 students. Sensitive usage so model will be required
16	Cox Peninsula Road	Territory Wildlife Park Access Road	356	20	AUR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic from Counter RDVDP009. Turning traffic to match Berry Springs Nature Park
17	Cox Peninsula Road	Access Road	356	5	AUR/BAL	BAR/BAL	BAR/BAL	NO	NO	Major Traffic from Counter RDVDP009. Turning traffic calculated based on number of houses
18	Cox Peninsula Road	Berry Springs Nature Park Access Road	356	20	AUR/AUL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic from Counter RDVDP009. Turning traffic calculated based on number of carparks
19	Cox Peninsula Road	Hopewell Road	356	55	CHR/AUL	AUR/AUL	AUR/AUL	NO	NO	Major Traffic from Counter RDVDP009. Turning traffic calculated based on number of houses
20	Cox Peninsula Road	Finn Road	356	34	CHR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic from Counter RDVDP009. Turning traffic calculated based on number of houses
21	Cox Peninsula Road	Oxford Road	356	<20	BAR/BAL	BAR/BAL	BAR/BAL	NO	NO	Major Traffic from Counter RDVDP009. Turning traffic calculated assumed based on dirt road

Project: Grants Mine
Project No.: 4966-01
Task Manager: Rohan Langworthy
Date: 5/09/2018
Description: Initial Traffic Impact Assessment
Calculations By: Russell Burns
Reviewed By: Ian McNichol

Traffic volumes taken as 2018 peak hour volumes in both directions from "Grants Lithium Project Logistics Analysis." Warrented Intersections based on Figure 4.9 (attached) from the Austroads Guide to Road Design Part 4A (2nd edition - dated 2010).

Intersection No.	Intersection Major Road	Intersection Minor Road	Major Road Traffic Volume - Q_M (Veh/hr)	Turning Traffic Volume - Q_L or Q_R (Veh/hr)	Current Intersection Treatment	Current Warrented Intersection Treatment	Future Warrented Intersection Treatment	Upgrade Required?	Further Analysis Required?	Comments
22	Cox Peninsula Road	Doris Road	356	205	AUR/AUL	AUR/AUL	AUR/AUL	NO	NO	Major Traffic from Counter RDVDP009. Turning Traffic based on supermarket trip generation from DPTI (SA Gov) guidelines (13.65 peak hour trips / 100 sq.m)
23	Cox Peninsula Road	Berry Springs Mechanical/Tavern Access Road	356	50	AUR/AUL	AUR/AUL	AUR/AUL	NO	YES	Major Traffic from Counter RDVDP009. Turning Traffic based on number of carparks. Further analysis requested by DIPL
24	Cox Peninsula Road	Dump Access Road	356	60	AUR/BAL	AUR/AUL	AUR/AUL	NO	NO	Major Traffic from Counter RDVDP009. Turning Traffic based on commercial trip generation from DPTI (SA Gov) guidelines (2.02 peak hour trips / 100 sq.m)
25	Cox Peninsula Road	Mala Plains Road	356	43	AUR/AUL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic from Counter RDVDP009. Turning Traffic based on number of houses
26	Cox Peninsula Road	Middle Arm Road	356	32	BAR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic from Counter RDVDP009. Turning Traffic based on number of houses
27	Cox Peninsula Road	Bradley Road	356	18	BAR/BAL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic from Counter RDVDP009. Turning Traffic based on number of houses
28	Stuart Highway	Cox Peninsula Road	1045	356	CHR/CHL	CHR/CHL	CHR/CHL	NO	NO	Major Traffic from Counter RDVDC049. Turning Traffic from Counter RDVDP009.
29	Tiger Brennan Drive	Berrimah Road	2760	1505	Signalised	CHR/CHL	CHR/CHL	NO	NO	Major Traffic from Counter UDVDP024. Turning Traffic from UDVDP028.
30	Berrimah Road	McFarland Road	1505	60	BAL	BAL	BAL	NO	NO	Left in Left out intersection. Major Traffic from Counter UDVDP028. Turning Traffic based on number of carparks.
31	Berrimah Road	Wishart Road	1505	1688	AUR/CHL	CHR/CHL	CHR/CHL	NO	NO	Major Traffic from Counter UDVDP028. Turning Traffic from Counter UDVDP085.
32	Berrimah Road	Export Road	1505	1300	CHR/CHL	CHR/CHL	CHR/CHL	NO	NO	Major Traffic from Counter UDVDP028. Turning Traffic assumed as Counter UDVDP028 minus Counter UDVDP029
33	Berrimah Road	Cochrane Road	172	150	AUR/AUL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic from Counter UDVDP029. Turning Traffic assumed.
34	Berrimah Road	Casey Street	172	150	CHR/AUL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic from Counter UDVDP029. Turning Traffic assumed.
35	Berrimah Road	O'Sullivan Circuit	172	150	CHR/CHL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic from Counter UDVDP029. Turning Traffic assumed.
36	Berrimah Road	Salloo Street	172	150	CHR/CHL	AUR(S)/AUL(S)	AUR(S)/AUL(S)	NO	NO	Major Traffic from Counter UDVDP029. Turning Traffic assumed.
37	Berrimah Road	East Arm Port Access Road	172	8	AUR/AUL	BAR/BAL	BAR/BAL	NO	NO	Major Traffic from Counter UDVDP029. Turning Traffic from Grants Mine peak hour truck movements

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APPENDIX: D

Calculations of Pavement Impacts

Project: Grants Mine
Project No.: 4966-01
Task Manager: Rohan Langworthy
Date: 10/05/2018
Description: Pavement Impacts
Calculations By: Russell Burns
Reviewed By: Ian McNichol

Assessment based on Section 8 of Guide to Pavement Technology Part 2: Pavement Structural Design. Traffic volumes taken as 2018 peak hour volumes in one direction from "Grants Lithium Project Logistics Analysis."

New thickness for same design life

Parameter	Adopted Value	Comment
Subgrade CBR	10.00	Assumed value. Based on minimum allowable CBR from DIPL.
Original Design life	30.00	Assumed value.
Current AADT	1,200.00	From counter RDVDP009
Increase in AADT	29.00	Based on previous trip generation
DF	1.00	1 directional traffic taken
%HV	20.00	Conservate number based on information provided in counter RDVDP009
LDF	1.00	Only one lane so all HV in design lane
Growth rate	3.00	To match previous analysis
CGF	47.58	Equation 15 from Austroads Guide to Pavement Technology Part 2
NHVAG	9.00	Assumed all HV are quad road trains
Original NDT	37,508,457.74	Equation 14 from Austroads Guide to Pavement Technology Part 2
Increase in NDT	285,795.00	Equation 14 from Austroads Guide to Pavement Technology Part 3
ESA/HVAG	2.33	21 axles per quad road train
Current DESA	87,519,734.73	Equation 17 from Austroads Guide to Pavement Technology Part 2
Increase in DESA	666,855.00	Equation 17 from Austroads Guide to Pavement Technology Part 3
New DSEA	88,186,589.73	Equation 17 from Austroads Guide to Pavement Technology Part 4
Original t	386.95	Equation given in Figure 8 of Austroads Guide to Pavement Technology Part 4
New t	387.17	Equation given in Figure 8 of Austroads Guide to Pavement Technology Part 5
increase in t	0.217572672	

New design life for same thickness

Parameter	Adopted Value	Comment
Subgrade CBR	10.00	Assumed value. Based on minimum allowable CBR from DIPL.
Original Design life	29.85	Calculated using goal seek
Current AADT	1,200.00	From counter RDVDP009
Increase in AADT	29.00	Based on previous trip generation
DF	1.00	1 directional traffic taken
%HV	20.00	Conservate number based on information provided in counter RDVDP009
LDF	1.00	Only one lane so all HV in design lane
Growth rate	3.00	To match previous analysis
CGF	47.21	Equation 15 from Austroads Guide to Pavement Technology Part 2
NHVAG	9.00	Assumed all HV are quad road trains
Original NDT	37,218,684.68	Equation 14 from Austroads Guide to Pavement Technology Part 2
Increase in NDT	285,795.00	Equation 14 from Austroads Guide to Pavement Technology Part 3
ESA/HVAG	2.33	21 axles per quad road train
Current DESA	86,843,597.60	Equation 17 from Austroads Guide to Pavement Technology Part 2
Increase in DESA	666,855.00	Equation 17 from Austroads Guide to Pavement Technology Part 3
New DSEA	87,510,452.60	Equation 17 from Austroads Guide to Pavement Technology Part 4
thickness	386.95	Equation given in Figure 8 of Austroads Guide to Pavement Technology Part 5

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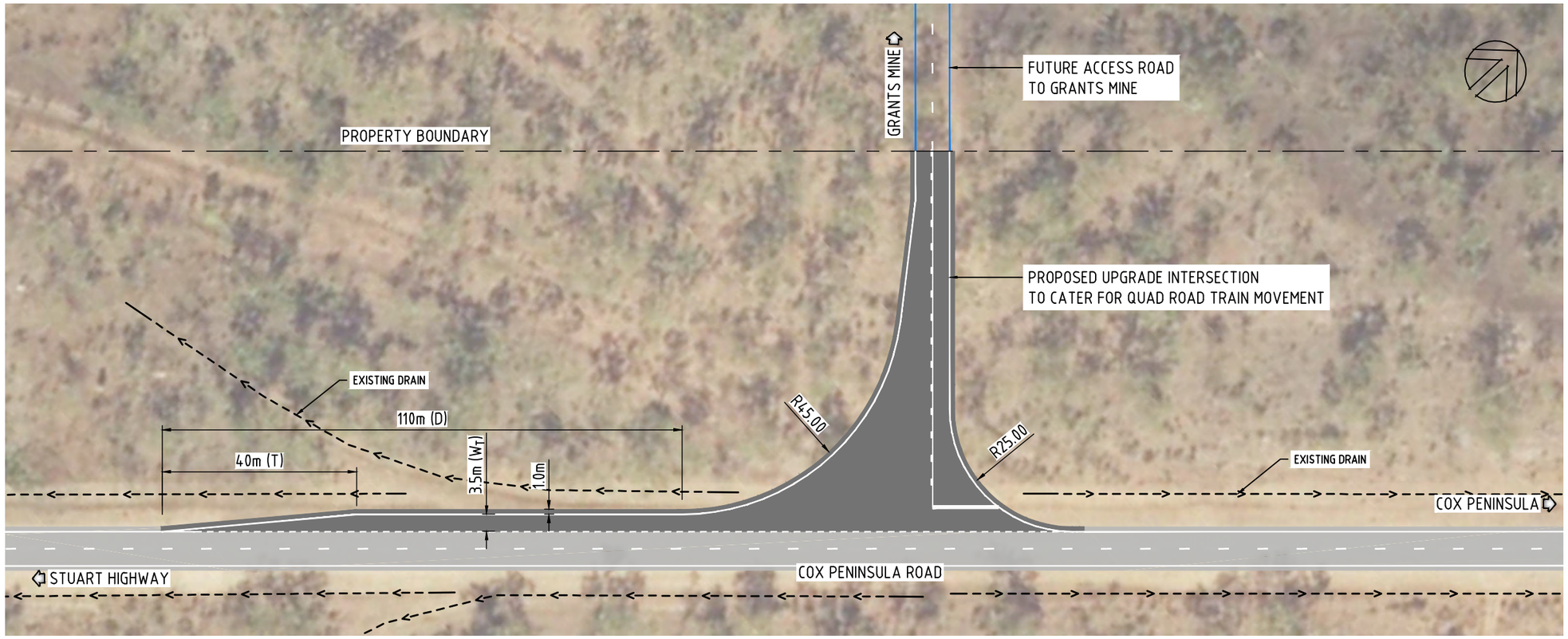
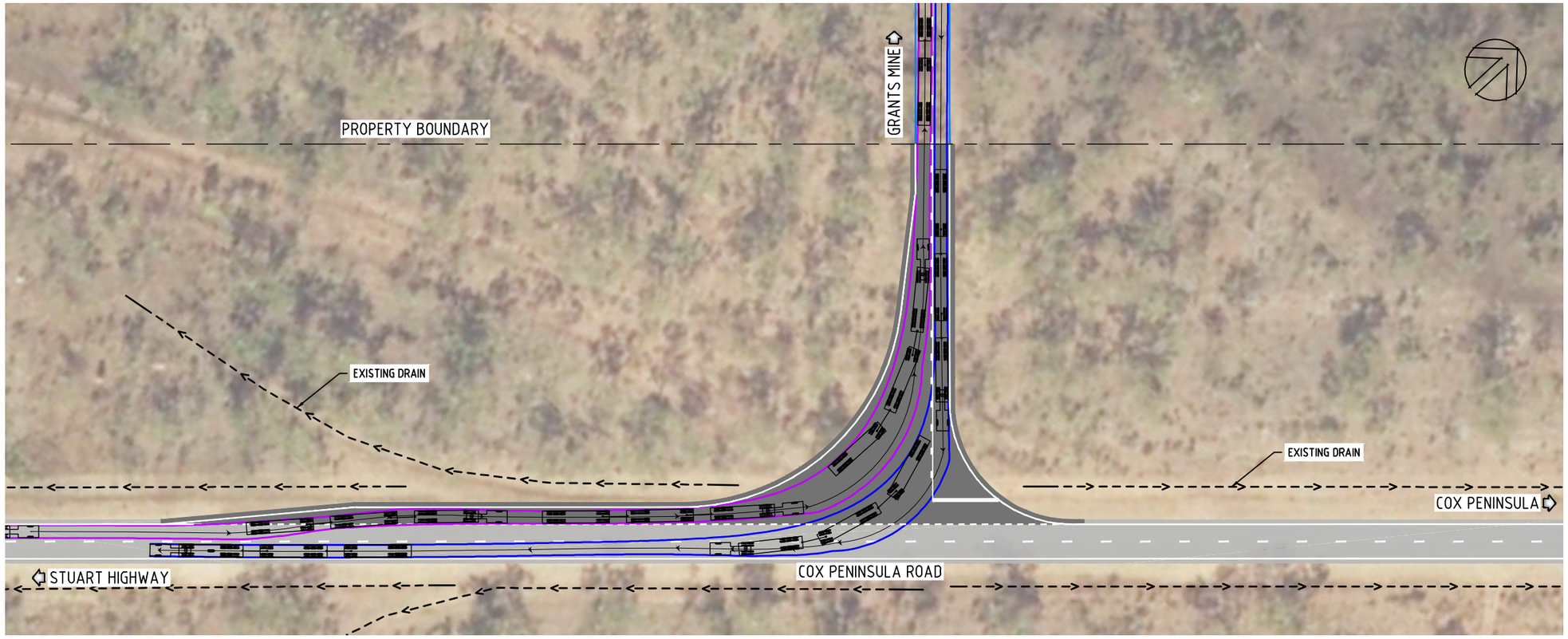
APPENDIX: E

Concept Drawing for Access into Grants Mine

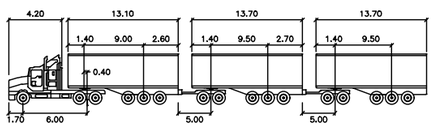
Notes





BASIS OF DESIGN

- DESIGN SPEED: 120 km/h (COX PENINSULA ROAD)
- VEHICLE TYPE: QUAD ROAD TRAIN
- INTERSECTION TYPE: RURAL AUL(S)
- ENTRY SPEED INTO TURN LANE: 90km/h
- $T=0.33VW_T / 3.6$ (PART 4A, TABLE 5.2)
- D - BASED ON 30 km/h CURVED SPEED (PART 4A, TABLE 5.2)



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GRANTS MINE INTERSECTION

CONCEPT DESIGN
Sheet 1 of 1

4966-SK003_A 1:500 A1 Full Size

Acad No. 4966 26 July 2018

FILE LOCATION: \\fcgcns-dcsvr\projects\3000-4999\4900-4999\4966 Grant Mine\Design Data\Acad\Sketches & Figures\4966-SK003_A.dwg

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APPENDIX: F

Blast Management Plan

1 Purpose

To provide an overview of the Grants Lithium Projects Blast Management requirements and to facilitate further development of all relevant management plans, processes, and the supporting procedures for operations. These management plans and systems include but are not limited to the following;

- Risk Management processes
- Security Risk Assessment and Management of Security Sensitive Ammonium Nitrate
- Blast Management Plan
- Traffic Management Plan
- Emergency Response Plan
- Crisis Management Plan
- Employment, and training and competency processes
- Legislative licensing requirements
- Auditing, compliance and reporting processes
- Incident and Accident Reporting
- Change Management
- Contractor Management
- Stakeholder (including community) consultation processes

The site management plans, processes and supporting procedures will apply to all employees, contractor sand visitors to the Grants Lithium Project. In relation to Blast Management, they will cover design requirements, operational requirements and security requirements for management of explosives and ammonium nitrate solid and emulsion, specifically:

- management requirements for explosives and ammonium nitrate;
- emergency response requirements for credible emergency events involving explosives and ammonium nitrate;
- security requirements for explosives and ammonium nitrate;
- training requirements for safe use, transport and storage of explosives and ammonium nitrate;
- auditing and inspection of the use, storage and transport of explosives and ammonium nitrate; and
- a summary of change management and document control requirements.

Core Lithium's Management Plans and Processes will be an overarching requirement to all site-specific management plans, processes and operating procedures developed by authorised suppliers and appointed mining contractors. All site procedures will be approved by the Mine Manager.

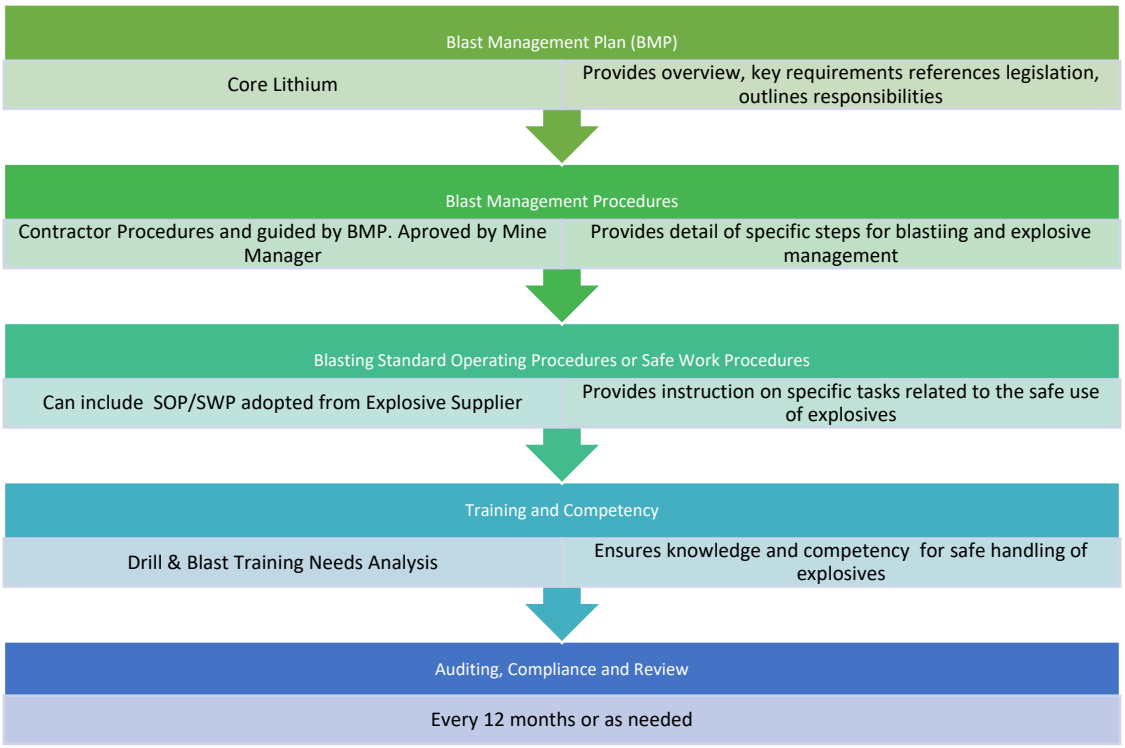

Figure 1: Example Blast Management Framework

2 Legislative Requirements

The Grants Lithium Project Blast Management requirements need to comply with obligations outlined within the following Northern Territory legislation and relevant codes of practice:

- Dangerous Goods Act and Regulations
- Mine Management Act (Part 4 – Mining Activities)
- Work Health and Safety (National Uniform Legislation) Act and Regulations
- Control of Roads Act
- Traffic Act and Regulations
- Australian Code for the Transport of Explosives by Road and Rail (AE Code)
- Australian Dangerous Goods Code (ADG Code)
- AS2187.1 – 1998: Explosives – Storage, Transport and Use - Part 1 – Storage
- AS2187.2 – 2006: Explosives – Storage, Transport and Use - Part 2 – Use of Explosives
- Australasian Explosives Industry Safety Group (AEISG) Codes of Practice;
    - Storage and Handling of Ammonium Nitrate Emulsions, Suspensions and Gels
    - Mobile Processing Units
    - Blast Guarding in an Open Cut Mining Environment
    - Elevated Temperature and Reactive Ground
    - Prevention and Management of Blast Generated NOx Gases in Surface Blasting
    - Segregation Barriers for Transporting Mixed Loads of Detonators and High Explosives
    - On-Bench Practices for Open Cut Mines and Quarries

3 Project Location

The Grants Lithium Project is located on the Cox Peninsula of the Northern Territory, approximately 20km south of Darwin (Figure 2). Grants is accessible by Darwin from the Stuart Highway and Cox Peninsula Road, with the main access to site coming off the located approximately 500 m from the pit edge. The proposed intersection with the mine access road is shown in Figure 3.

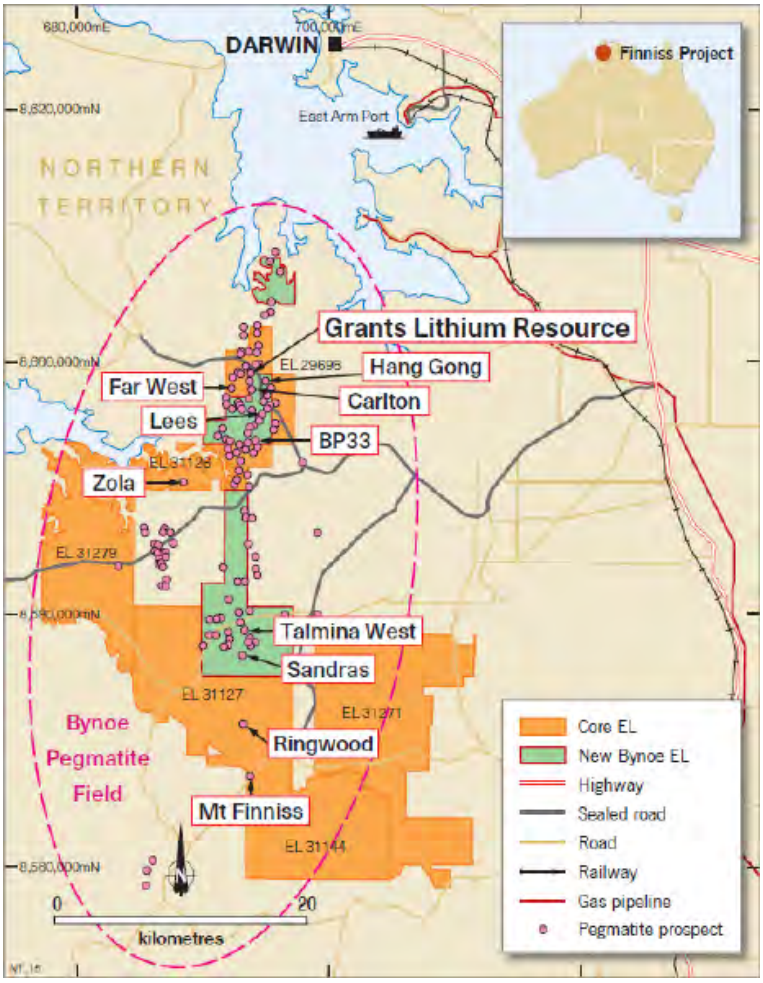

Figure 2: Location of the Finniss Lithium Project area

Figure 3: Proposed Intersection – Grants Project Access and Cox Peninsula Road

4 Blasting Activities

Blasting activities at Grants will be conventional open pit blasting techniques using a combination of Ammonium Nitrate Fuel Oil (ANFO) and Ammonium Nitrate Emulsions (ANE) as bulk explosive products, as well as a variety of high explosive (HE) and detonator products to facilitate the sites blasting requirements.

Blasting within the open pit will occur on a regular basis to achieve the mine production and ore processing requirements. On average, blasting in the Grants Open pit is likely to occur every 2 to 4 days. Initial mining activities are unlikely to require blasting due to the weathered nature of the materials making free digging possible. As the pit approaches the base of the weathered zone (approx. 30 – 40 m below surface) blasting requirements will increase and then become a necessity once fresh rock is encountered.

Given the location of the project, blasting is intended to be carried out during daylight hours any day of the week. All other blasting practices will be undertaken according to the site's approval conditions, Blast Management Plan, and supporting management plans, processes and operating procedures.

4.1 Key Positions

The following is an example of the key positions required to fulfil the Blast Management requirements onsite:

- Mine Manager
- Project Manager
- Shotfirer
- Blast Coordinator
    - May be undertaken by the Shotfirer
- D&B Supervisor
- D&B Engineer
- Blast Guards (sentries)
- Magazine Keeper
- Traffic Controller

The Mine Manager has overall responsibility for mining activities at the project, with the Shotfirer responsible for all blast related activities under the appointment by the Mine Manager.

4.2 Blasting Hazards

The following are the main identified hazards anticipated from blasting activities;

- fire (external and in magazines);
- severe weather;
- electrical storm;
- unauthorised use;
- untrained and /or incompetent personnel;
- unplanned and unexpected initiation;
- unexplained loss;
- unauthorised access (Magazine, blast area, and exclusion zone);
- flyrock;
- Nitrous Oxide (NOx) gases;
- air overpressure;
- proximity of infrastructure and personnel workplaces;
- public safety;
- explosives and ammonium nitrate transport vehicle incident; and
- Theft.

The Blast Management system will address all hazards identified in relation to the sites blasting activities.

4.3 Key Blasting Procedures

The key (or main) blasting procedures requiring development for operations will cover the following components;

- Transport and deliveries
- Storage
- Use
- Disposal

Blasting procedures as discussed earlier will achieve all the of the obligations required by legislative requirements. Primarily for the Northern Territory, this involves adherence to the Australian Standard (AS2187), and the referenced Code of Practices.

4.3.1 Exclusion Zones and Public Road

Typical blasting exclusion zones for the size and nature of the blasting activities at Grants are:

- 300m for all personnel
- 500m for buildings, office areas, and public spaces

Exclusion zones are risk based on blast plans and other influencing factors. They may be changed as determined by risk assessment completed for every blast as reproved by the Shotfirer and Mine Manager.

The Grants Open Pit area is in close proximity to the main access road (a public road) and supporting Mine Operations Centre (MOC) and Processing facilities (Figure 4). Given the proximity, some blasting activities may require the evacuation of some facilities, and the temporary closure of the Cox Peninsula Road, although, given the pit design and development sequence, and pit blasting requirements, the evacuation and road closure requirements are only likely to be required occasionally with that frequency quickly reducing as the pit develops deeper.

Figure 4 shows the 300m and 500m blast exclusion zones based on the pit edge, with the 500m exclusion zone is only just encroaching on the Cox Peninsula Road.

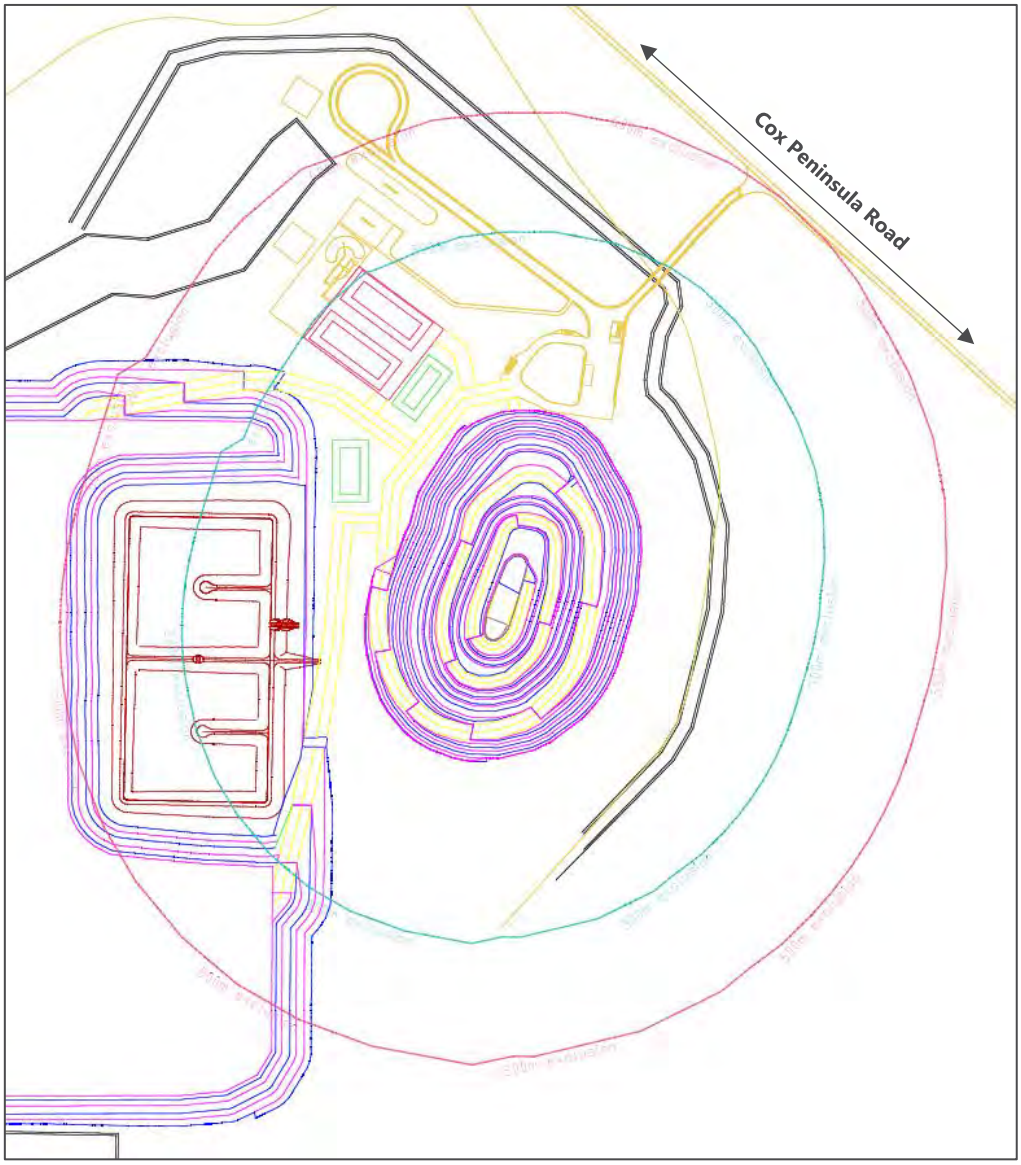

Figure 4: Blast Exclusion Zones from Grants Pit Edge (500m in red)

Closure of the road will require the use of qualified person(s) as required by Northern Territory legislation and may also require the approval DIPL in each instance.

4.3.2 Blast Management Controls

Core is committed to implementing best practice blasting measures at the Grants Lithium Project. Relevant blast management controls are outlined in the following sections.

4.3.2.1 Hours of Operation

Although there are no residential sensitive receivers in the immediate vicinity of the Grants Lithium Project, noise amenity impacts will be managed through operational controls, including defined operating hours. The hours of operation at the Grants Lithium Project are shown in table XX below.

Table 1 – Hours of Operation

Activity	Proposed Hours of Operation	Days of the week
Mining, processing & overburden management	Dayshift: 6:00am to 5:00pm Nightshift: 6:00pm to 5:00am	Monday – Sunday inclusive
Blasting – that requires the Cox Peninsula Road to be closed for Public Safety reasons.	Only to occur during daylight hours. Nominal Blasting times: 13:00pm to 13:15pm 17:00pm to 17:15pm Shot only to be tied in on the same day as the firing.	Monday – Friday Not on week ends Not on Public Holidays
Blasting – that does not require the Cox Peninsula Road to be closed for Public Safety reasons.	Only to occur during daylight hours. Nominal Blasting times: 13:00pm to 13:15pm 17:00pm to 17:15pm Shot may be tied in the day before.	Monday – Sunday inclusive
Loading & dispatch, Stockpile management, Maintenance of plant and equipment	Dayshift: 6:00am to 5:00pm Nightshift: 6:00pm to 5:00am	Monday – Sunday inclusive

If a mis-fire is discovered and the Blast Controller determines that the Cox Peninsula Road needs to be secured to protect the public when the mis-fire is refired then it will be treated as a separate blast adhering to the notifications and times outlined in this Blast Management Framework.

4.3.2.2 General Operational Controls

Core will implement the following blast management practices over the life of the Grants Lithium Project:

- Blasting at Core Lithium Project will occur on the days & times outlined in Table 1
- Detailed design will be undertaken for each blast in order to maximise the blast efficiency, minimise dust, fumes, ground vibration and air blast, the potential for fly rock and to ensure compliance with site specific blasting conditions.
- An exclusion zone will be established for each blast to protect the safety of operations personnel and any wildlife.
- Core will monitor blasts as mine development progresses (refer to Section 4.3.3), so that blast prediction site laws can be further refined and future blast designs can be optimised based on more detailed site information.

4.3.3 Blast Monitoring

Blast monitoring of all blasts at the Grants Lithium Project will be monitored. Blast monitoring locations will be selected based upon their spatial appropriateness in terms of capturing representative airblast and vibration signals nearby to the open pit.

Monitoring will also be undertaken by video camera. During each monitoring event, the following will be recorded:

- coordinates of the blast and each monitoring location;
- measured vibration and overpressure at each monitoring location;
- maximum instantaneous charge;
- number of holes;
- blast type; and
- meteorological conditions.

Fume monitoring and post blasting assessments will be undertaken at Grants Lithium Project. Fume monitoring requirements include the following:

- visual assessment and analysis of each blasting event to determine whether excessive fume was generated as a result of the blast. All blasts undertaken at Grants Lithium Project will be video recorded to provide a record of the blast;
- in the event that any blast at Grants Lithium Project leads to the development of excessive fume an analysis of the blast will be undertaken to determine the cause of the blast fume development and whether the blast fume travelled off site; and
- meteorological monitoring to determine the potential offsite impact of nitrogen oxide fumes.

Meteorological data will be obtained from an Automated Weather Station (AWS) installed on-site.

4.3.4 Reporting and Review

A report will be prepared for each blast at the Grants Lithium Project. The monthly Site Management Report will aggregate blast monitoring results. The following information is expected to be reported in the Site Management Reports:

- include a comprehensive review of the blast results & monitoring results;
- identify any trends in the monitoring data over the life of the development;
- identify any discrepancies between the predicted and actual blast results, and analyse the potential cause of any significant discrepancies; and
- prescribe what measures will be implemented over the current calendar year to improve the blasting performance

Appendix 1

Road Closure Plan for blasting at Grants Lithium Project adjacent to Cox Peninsula Road

Purpose

To provide a Management Plan and Operating Procedure for the temporary closure of Cox Peninsula Road, whenever blasting occurs at Grants Lithium Project.

Procedure

This document provides a Road Closure Management plan, and Operating Procedure, the key aspects of the document include:

- the notification of affected parties
- a protocol for the passage of emergency vehicles

Notification

Landholders within a 2km radius of Grants Lithium Project shall be notified two days prior to Blasting.
The communities of Belyuen & Wagait Beach shall be notified two days prior to blasting.

Traffic Management

An authorised and competent traffic management company will be contracted to manage each road closure in accordance with Department of Infrastructure Planning and Logistics (DIPL) requirements, including:

- The correct placement of signage on the day of the blast
- Certified controllers will be used for all road closures and must be familiar with the road closure procedures, be accredited by DIPL, wear reflective vests and carry an operable hand-held radio on the same frequency as Blast Co-ordinator
- Traffic controllers must be set up and in position thirty minutes prior to the anticipated firing time, and able to make radio contact with the Blast Co-ordinator until the blast has been cleared. All traffic controllers must be at least 300m from the boundary of the blast and public road traffic halted 500m from the blast zone.
- The traffic controllers shall close the road prior to blasting, when advised by the Blast Co-ordinator. All traffic and personnel must then be cleared from the affected area by a competent person and the Blast Co-ordinator advised when this has been completed. Physical barriers should then be placed across the road to prevent access as per the Traffic Control Plan.
- All traffic must be halted for the duration of the blast. In the case of emergency traffic refer below**: Emergency Vehicle Passage**
- The traffic controllers shall not re-open the road until advised by the Blast Coordinator that it is safe to do so. Prior to re-opening, the road shall be inspected to ensure it is in a safe and trafficable condition. Any damage, fly-rock or other traffic hazards shall be rectified, with personnel and ancillary equipment available on standby for immediate road clearing purposes when deemed necessary. When the blast has been cleared and the road inspected, normal traffic can be resumed and signage removed.

Shot Firing Procedure

This procedure shall apply to all blasting at Grants Lithium Project where fly-rock is considered to present a potential risk to traffic on Cox Peninsula Road or when it is otherwise considered necessary to close that road. The approximate area of affected blasting shall be illustrated on the blast sentry plan and include a

300 metre exclusion zone. The Shot Firer shall fire the blast according to Australian Standard's and in accordance with other applicable blasting and environmental procedures, with the following exceptions:

- If passage of emergency vehicle is necessary
- Blasting will not take place at times when adverse conditions (or other prevailing conditions) make road closure hazardous.
- All blasts that require the closure of Cox Peninsula Road will be tied up on the day of firing and must not be left tied up overnight.
- All blasts that require the closure of Cox Peninsula Road and will not be tied up if weather conditions are expected to prevent blasting within the required time frame.
- Misfires identified while Cox Peninsula Road is closed will be treated as separate blasts in order to prevent lengthy road closures.
- After firing, the Blast Co-ordinator shall advise the traffic controllers and sentries when it is safe to check the road for damage/fly-rock and if traffic flow can be permitted (under supervision) prior to final clearance. Radio silence must be maintained, and traffic controllers remain in position until the blast has been cleared and the road inspected.

Emergency Vehicle Passage

- If traffic controllers or sentries encounter emergency vehicles (Police, Ambulance or Fire) requiring immediate access along Lowes Mount Road, it may be necessary to abort the blast.
- Traffic controllers and/or sentries must break radio silence and inform the Blast Co-ordinator if access is required (or has occurred) once the shot firing is in progress. If the blast can be halted, emergency vehicles can be allowed to pass and the shot firing procedure recommenced once the road is clear and secured.

Role	Accountabilities for this document
Site supervisor	Oversee the review of process and procedure Review and approve procedure Ensure a process for training of relevant personnel Complete the road closure checklist and submit required notifications Review procedure Ensure a process for training of relevant personnel
Drill and Blast Supervisor	Complete the road closure checklist and submit required notifications To assist in the procedure development where required Supervise and document the provision of procedure training Ensure procedure is communicated, understood and followed by all personnel
Traffic Controller	Position and remove required signage according to RTA guidelines and approved traffic control plan. Prevent access to the closed area while blasting in progress and until notified by the Blast Co-ordinator
Sentries	Prevent access to the closed area while blasting in progress and until the blast has been cleared.
Blast Co-ordinator	To assist in the procedure development where required. Ensure procedure is followed and blasting is carried out in accordance with shot firing and road closure procedures. Remain in contact with the traffic controllers and sentries during the shot firing process. Report any deficiencies with the procedure.

Road Closure Plan

An example of road signage for road closure due to blasting.

Glossary of terms

Airblast	The airborne shock wave or acoustic transient generated by an explosion

Blast	The action of breaking and displacing rock by means of explosives
Blast area	The area of a blast within the influence of flying rock missiles, gases, and concussion
Blast monitor	An instrument that measures seismic waves along three mutually perpendicular axes (x, y, z) to determine Peak Particle Velocity
Decibel (dB)	A unit of sound measurement which quantifies pressure fluctuations associated with noise and overpressure dB (Lin Peak) Decibel associated with the maximum excess pressure in the overpressure wave. Lin represents linear – indicating that no weighted or adjustment is made to the measurement
Flyrock	Rocks or any other debris propelled from the blast area by the force of an explosion
Fumes	The gaseous products of an explosion. For the purpose of fume classification, only poisonous or toxic gases, such as carbon monoxide, hydrogen sulphide, and nitrogen oxides are considered
Ground vibration	Motion of ground caused by the passage of seismic waves originating from a blast. The rate of the ground vibration movement is referred to as Peak Particle Velocity (PPV) and is measured in millimetres per second (mm/s)
Maximum Instantaneous Charge	The maximum permissible charge weight allowed to ensure the radial propagation of vibration does not exceed assessment criteria at a receiver distant from the blast site
Mis-fire	A blast that fails to detonate completely after an attempt at initiation, also the explosive material itself that failed to detonate as planned
Overpressure	A pressure wave in the atmosphere which is caused by the detonation of explosives. Overpressure consists of both an audible (noise) and inaudible energy. The energy of the overpressure is measured in decibels (Lin Peak).
Sound Level Meter	An instrument that measures sound pressure levels in decibels
Stemming	Inert material used to maximise the effect of an explosion by filling the remainder of hole after they have been charged with explosives

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