



Mapping future transport for improved planning and operation

GISERA Project S.16

Caroline Bruce, Nick Smolanko, Andrew Higgins,
Steve McFallan, Artiom Bondarenko, Adam
McKeown | Aug 31, 2021

Australia's National Science Agency



Presentation overview

- Project aim
- Project phases
- TraNSIT – overview and previous applications
- Project findings
 - Baseline (current)
 - Reference baselines (construction, operation)
 - Scenarios
- Implications and conclusions

Project aim

- Aim: to map out key impacts of road and rail network development for gas wells before onshore gas construction occurs in the Beetaloo Sub-basin
 - The Scientific Inquiry into Hydraulic Fracturing in the NT recommends that: ‘the Government assesses the impact any heavy vehicle traffic, associated with any onshore shale gas industry, will have on the NT’s transport system and develops a management plan to mitigate such impacts’.
- Impacts:
 - changes in traffic flows due to heavy freight
 - construction and operational phases
 - transport options through scenarios
- Outputs: information for decision-makers to help inform road upgrades, potential damage, road safety, etc



Project phases

1. Apply the Transport Network Strategic Investment Tool (TraNSIT) to produce a baseline map of freight volumes across road and rail networks.
2. Through a series of workshops and interviews, capture data on logistics, construction phase inputs and sources, freight task and supply chains throughout the proposed development.
3. Model projected heavy vehicle movements across NT road networks based on the data from point 2 above.
4. Validate modelling outputs and identify interventions that may reduce impacts.
5. Use TraNSIT to test a range of intervention options identified by stakeholders.

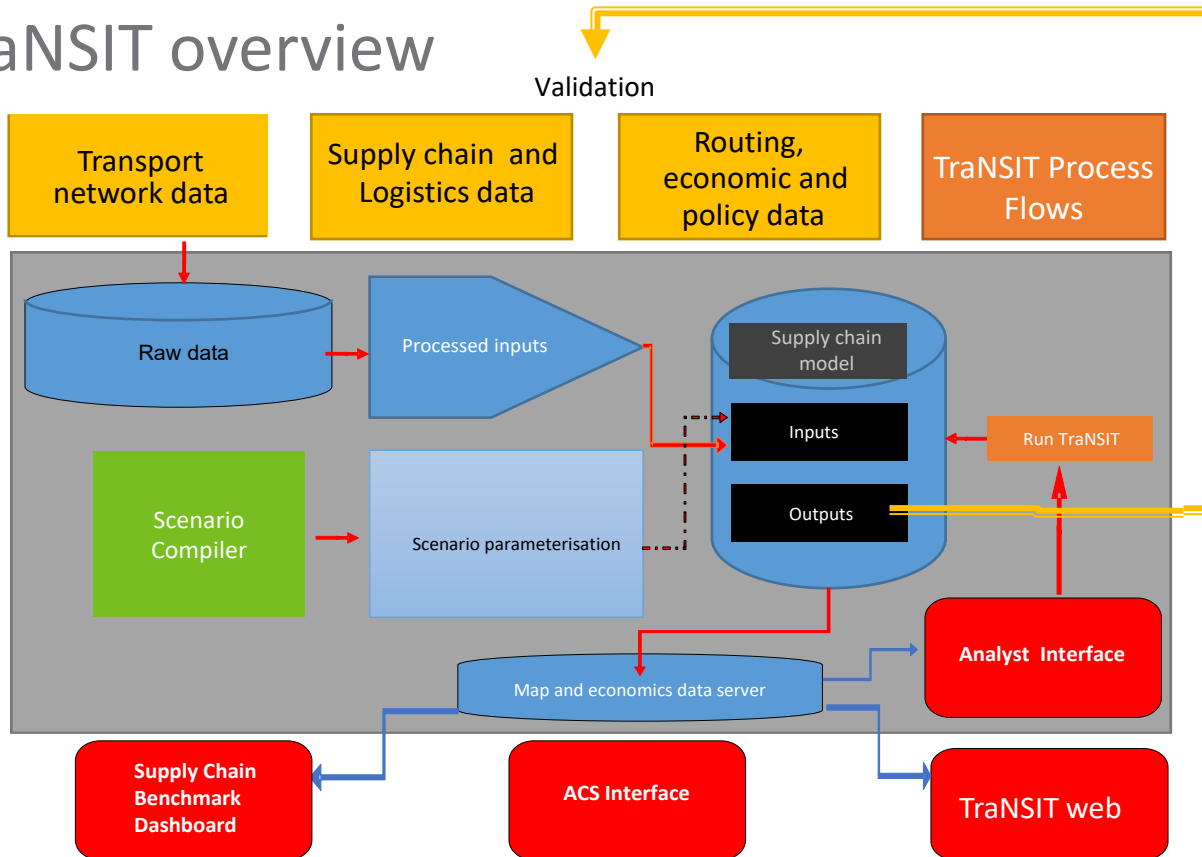


TraNSIT overview

- What is TraNSIT?
 - Computer-based tool that maps freight routes from origin to destination
 - Calculates transport route, **costs** (by mode) and vehicle choice
- What questions does TraNSIT inform?
 - **What** are the transport cost savings (per year) from infrastructure investment and regulatory changes?
 - **Where** should investment be targeted across a range of options?
 - **Which** enterprises and supply chains are impacted, and how?



TraNSIT overview





Applications of TraNSIT

- **Commonwealth Government**

- Inland Rail
- Roads of Strategic Importance
- Beef Roads

- **State government**

- Cattle tick line
- Prioritising bridge investments
- High productivity vehicle access around and through towns

- **Local government and ROCs**

- Most extensive applications – over 30 local governments

- Regional freight planning

- Various road upgrades

- Intermodal and processing facilities

- **Industry**

- Supply chain mapping to ports and last mile upgrades

- Rail network planning and intermodal upgrades

- **International**

- Indonesia, Vietnam, Solomon Islands and NE Africa

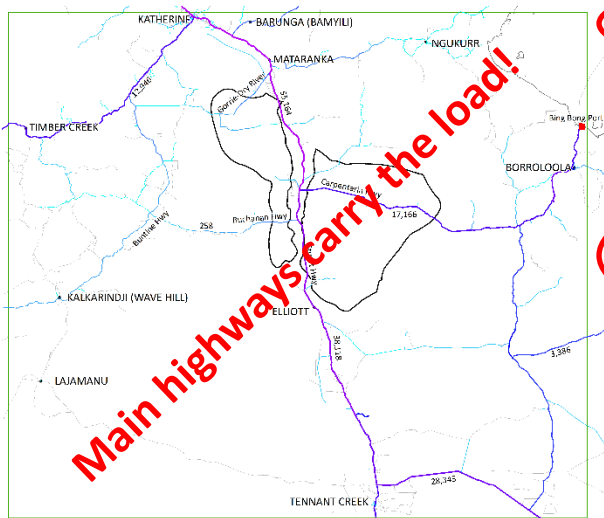


Project findings

- Baseline (current)
- Reference baselines (construction, operation)
- Scenarios

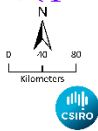
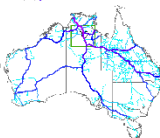
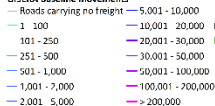


Project findings: baseline road



Road freight density (trailers)

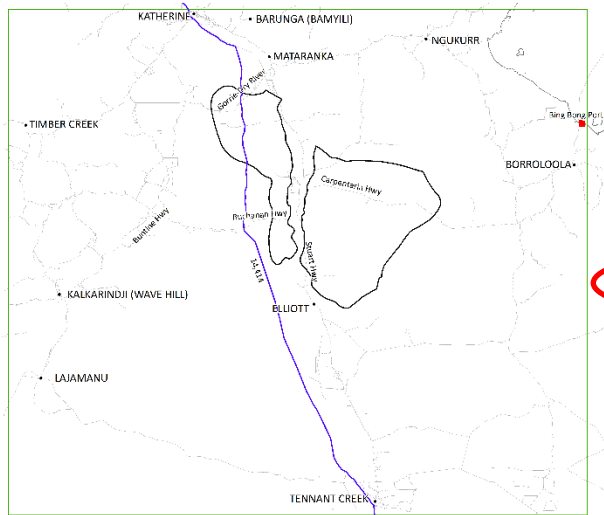
GISERA Baseline movements



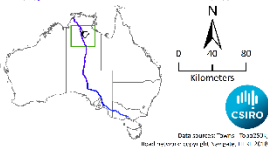
Data sources: "Data" (2015/16),
Road network copyright Transport, 2016

COMMODITY	TOTAL COST (\$)	TONNES	COST PER TONNE (\$/T)	TRANSPORT DISTANCE (KM)	ONE WAY TRAVEL TIME (HRS)	TRAILERS
Cropping	\$28,852,834	62,380	\$462.53	4,257	42.1	2,933
Fuel	\$52,425,576	737,769	\$71.06	727	7.8	29,755
General	\$96,758,816	202,485	\$477.86	3,078	30.7	12,058
Horticulture	\$52,671,285	86,945	\$605.80	3,466	36.5	4,922
Livestock	\$48,823,879	349,850	\$139.56	1,012	13.4	18,229
Mining	\$35,709,281	779,000	\$45.84	475	5.7	28,881
Processed Food	\$33,612,584	30,902	\$861.83	3,657	38.4	2,940
Vehicles	\$45,821,840	24,758	\$1,850.76	3,655	37.7	4,126
Waste	\$211,123	13,176	\$16.02	22	0.4	1,318
Wood Product	\$29,095,893	57,641	\$504.77	3,815	42.0	3,124
Grand Total	\$423,983,109	2,352,908	\$180.20	1,234	13.5	108,286

Project findings: baseline rail



COMMODITY	TOTAL COST (\$)	TONNES	COST PER TONNE (\$/T)	TRANSPORT DISTANCE (KM)	ONE WAY TRAVEL TIME (HRS)	WAGONS
General	\$4,026,998	14,534	\$277.07	3,254	47.1	1,020
Horticulture	\$1,054,232	5,063	\$208.22	3,304	48.1	251
Mining	\$12,907,053	104,583	\$123.41	2,121	28.6	2,229
Processed Food	\$217,286	1,137	\$191.16	3,029	42.9	56
Vehicles	\$2,336,408	2,429	\$961.86	3,520	52.2	607
Wood Product	\$2,602,150	11,518	\$225.92	3,239	46.8	642
Grand Total	\$23,144,126	139,264	\$166.19	2,407	33.3	4,805



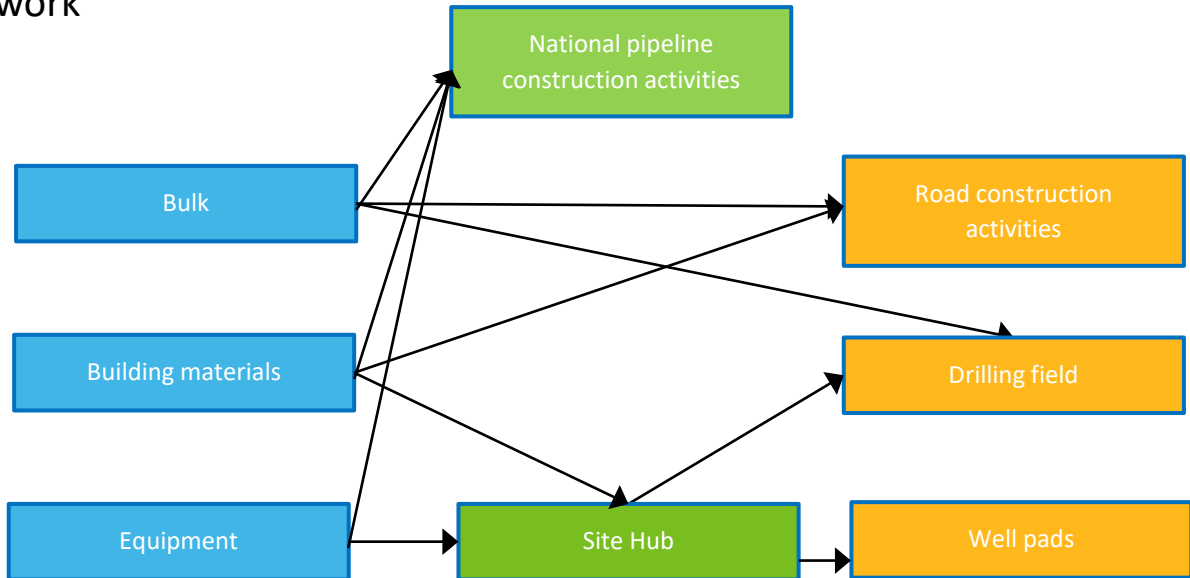


Project findings

- Baseline (current)
- Reference baselines (construction, operation)
 - Additional dust generation
 - Critical link analyses
- Scenarios

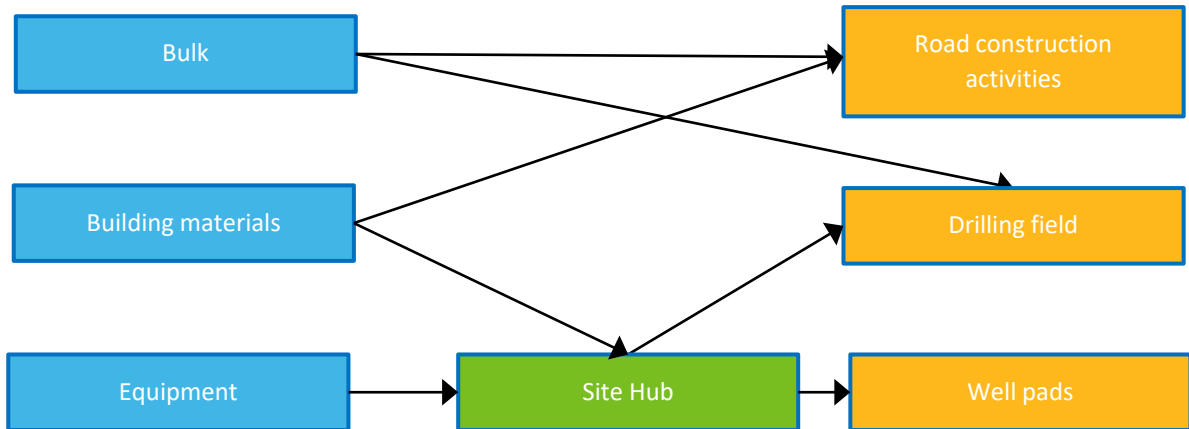
Supply chain map – construction yr 1 (incl. pipes)

Construction of gas field infrastructure and extension/duplication of national pipeline network



Supply chain map – construction yr 2

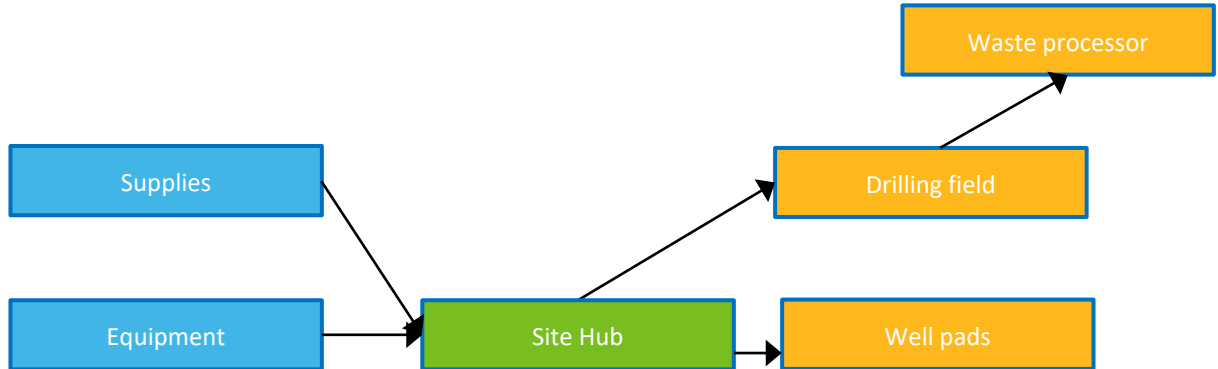
Construction of gas field infrastructure



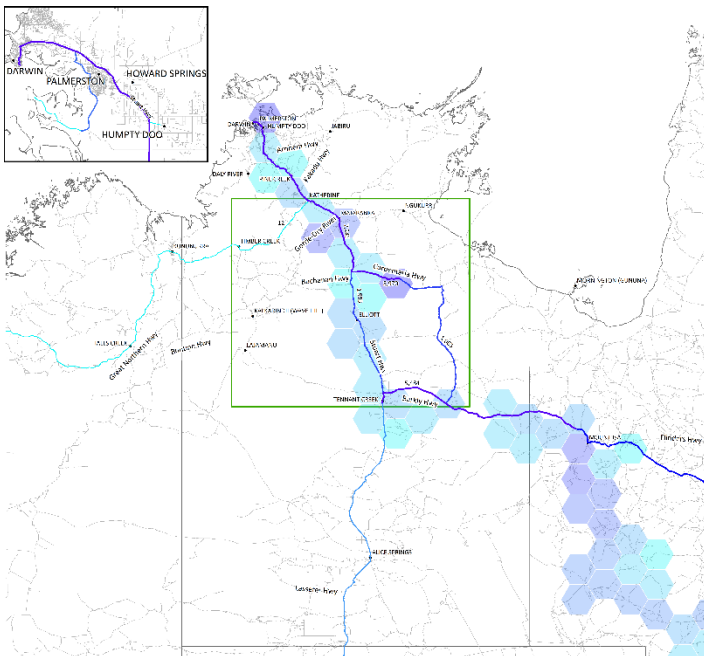
Supply chain map – peak* operation, operation

Well operation, maintenance, waste extraction

* Peak operation occurs about yr6 of operation

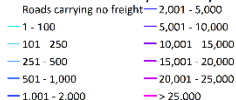


Construction yr 1 & pipelines

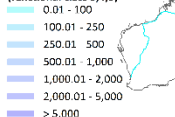


Road freight density (trailers)

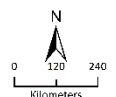
Roads carrying no freight



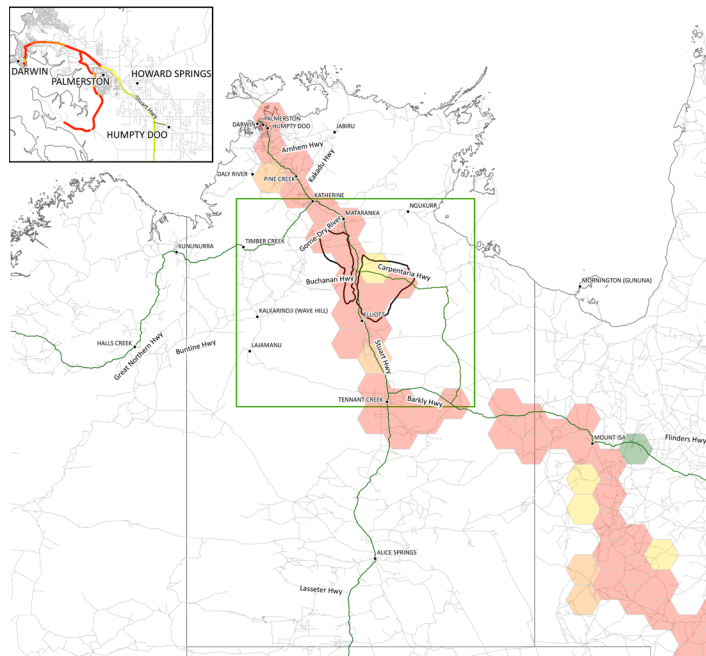
Maximum trailer value within cell (functional class 3,4,5)



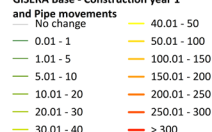
Beetaloo Sub-basin • Towns GISERA large study region Bing Bong Port Facility



Data sources: 100m 1:50,000 Topo250k
Road network: copyright Navigare, HERE 2018

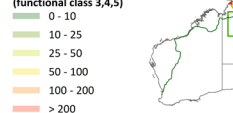


Road freight density increase (%) GISERA Base - Construction year 1 and Pipe movements

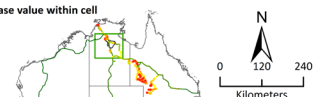


Beetaloo Sub-basin • Towns

Maximum percent increase value within cell (functional class 3,4,5)

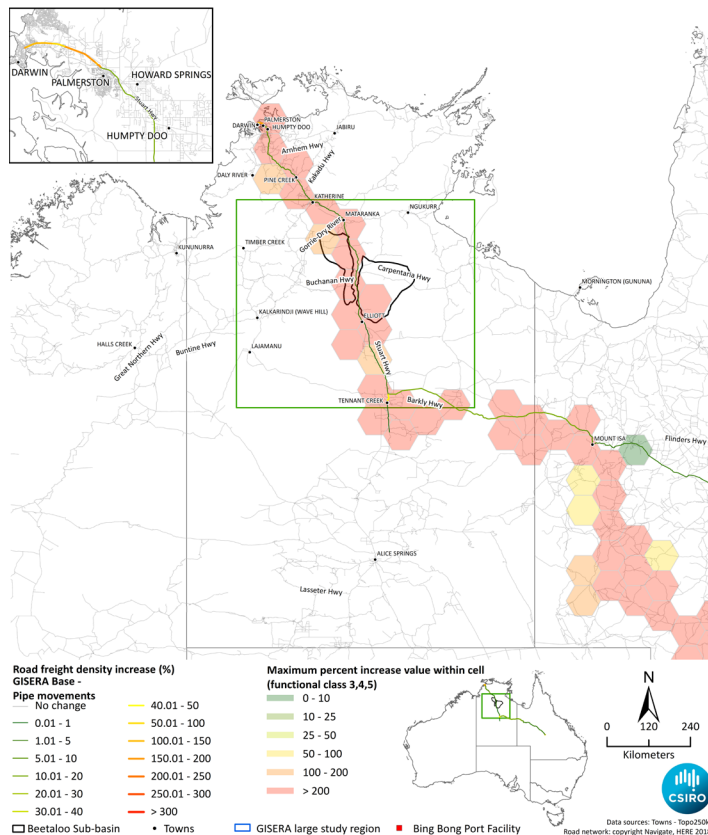
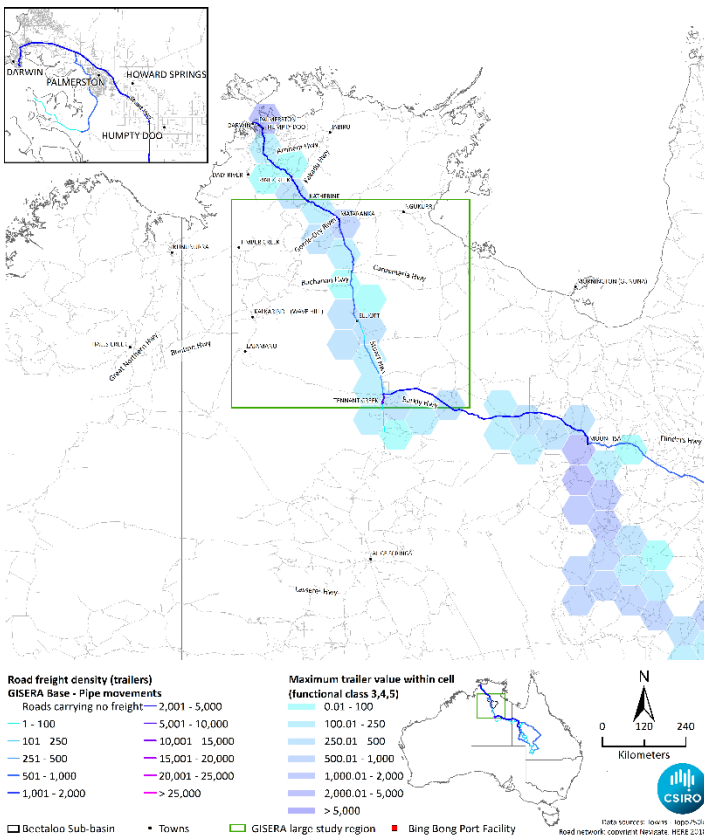


GISERA large study region Bing Bong Port Facility

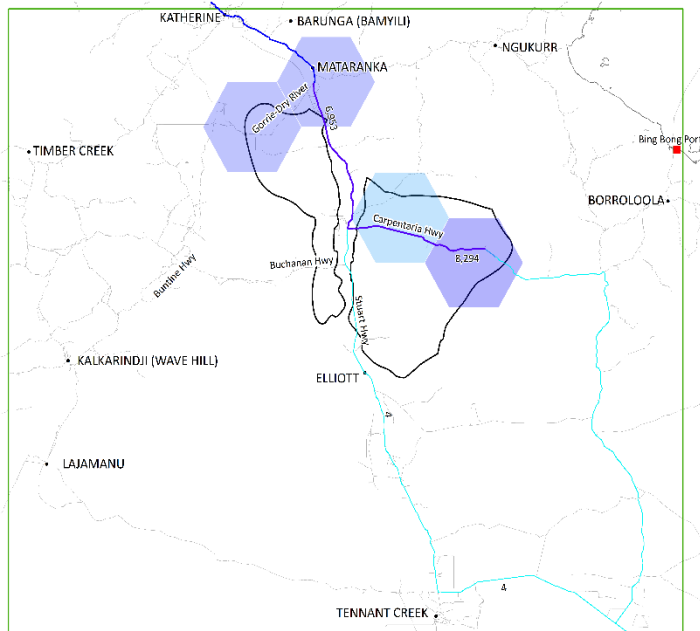


Data sources: Towns - Topo250k
Road network: copyright Navigare, HERE 2018

Pipelines



Construction yr 2

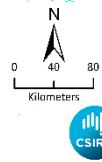
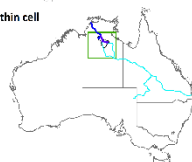


Road freight density (trailers)
GISERA Base - Construction year 2 movements

- Roads carrying no freight
- 1 - 100
- 101 - 250
- 251 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 5,000
- 5,001 - 10,000
- 10,001 - 15,000
- 15,001 - 20,000
- 20,001 - 25,000
- > 25,000

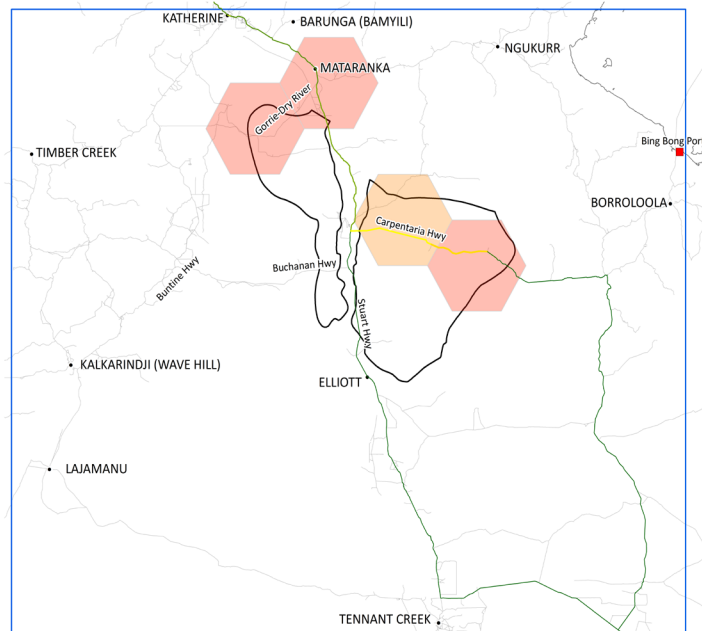
Maximum trailer value within cell (functional class 3,4,5)

- 0.01 - 100
- 100.01 - 250
- 250.01 - 500
- 500.01 - 1,000
- 1,000.01 - 2,000
- 2,000.01 - 5,000
- > 5,000



Units sources: [Ikonos](#) - [Topo250c](#)
Road network: copyright [Ningbo](#), [AUS](#) 2018

Beetaloo Sub-basin • Towns GISERA large study region Bing Bong Port Facility

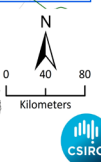
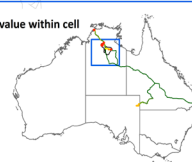


Road freight density (trailers)
GISERA Base - Construction year 2 movements

- No change
- 0.01 - 1
- 1.01 - 5
- 5.01 - 10
- 10.01 - 20
- 20.01 - 30
- 30.01 - 40
- 40.01 - 50
- 50.01 - 100
- 100.01 - 150
- 150.01 - 200
- 200.01 - 250
- 250.01 - 300
- > 300

Maximum percent increase value within cell (functional class 3,4,5)

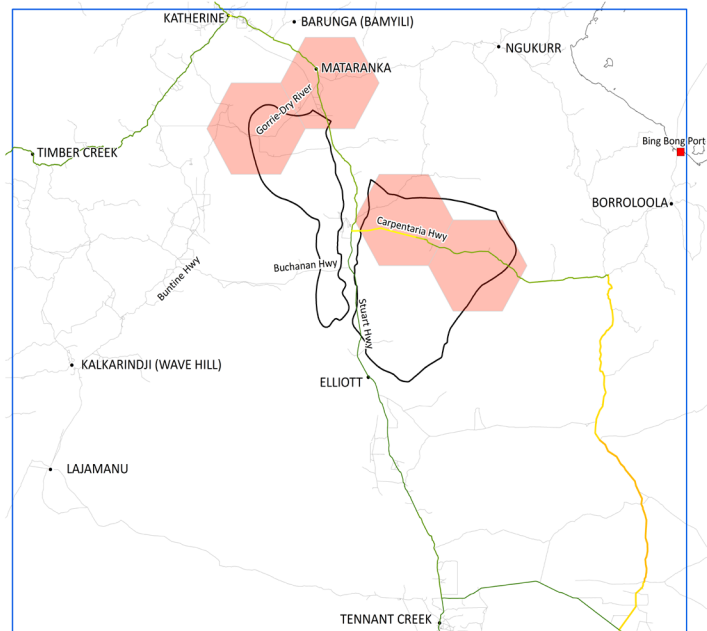
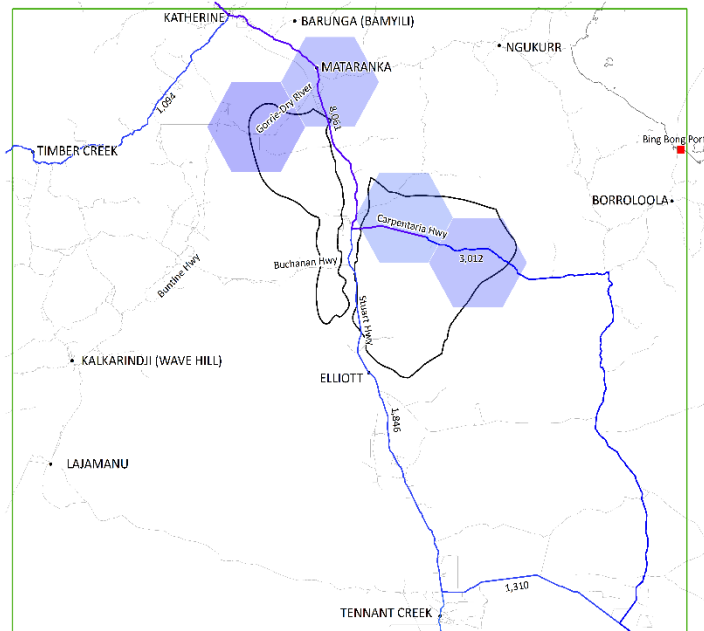
- 0 - 10
- 10 - 25
- 25 - 50
- 50 - 100
- 100 - 200
- > 200



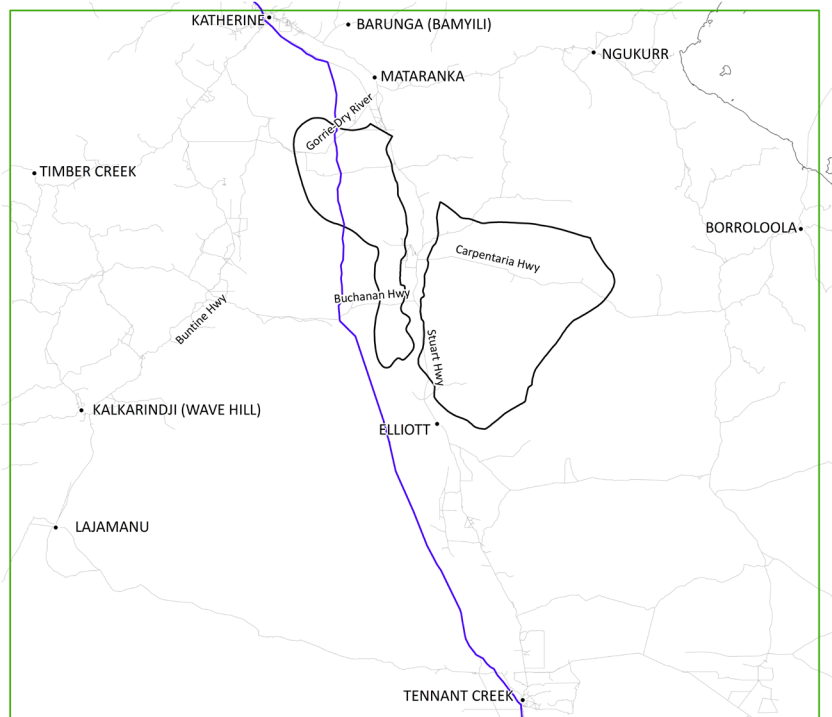
Data sources: [Towns](#) - [Topo250c](#)
Road network: copyright [Ningbo](#), [AUS](#) 2018

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Peak operation

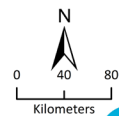
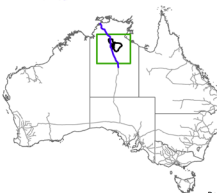
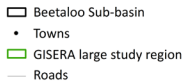
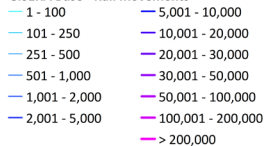


Rail, construction year 1



Rail freight density (wagons)

GISERA Base - Rail movements



Construction yr 1 & pipelines

COMMODITY	TOTAL COST (\$)	TONNES	COST PER TONNE (\$/T)	TRANSPORT DISTANCE (KM)	ONE WAY TRAVEL TIME (HRS)	TRAILERS
Ambulance	\$20,625	375	\$55.00	527	7.0	15
Camp	\$124,109	4,250	\$29.20	264	3.9	170
Drilling pipes	\$1,949,256	11,850	\$164.49	1,787	20.1	474
Fuel & storage tanks	\$468,980	11,700	\$40.08	377	5.4	468
Pipes	\$27,699,441	377625	75.61	1,707	11.2	16,350
Pond equipment	\$8,898,912	51,375	\$173.21	1,892	21.2	2,055
Processing facility equipment	\$8,554,081	127,500	\$67.09	732	7.7	5,100
Rig equipment	\$265,150	23,500	\$11.28	80	1.2	940
Grand Total	\$47,980,554	608,175	\$78.03	1420	10.9	25,572

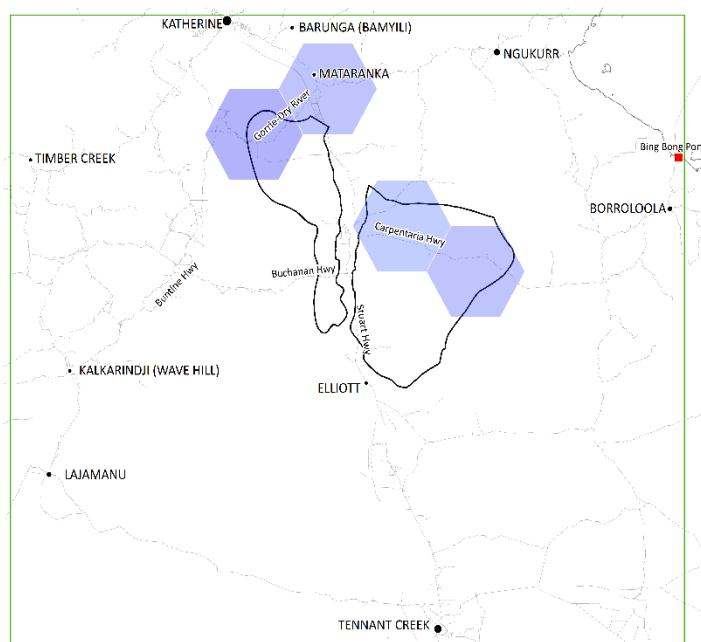
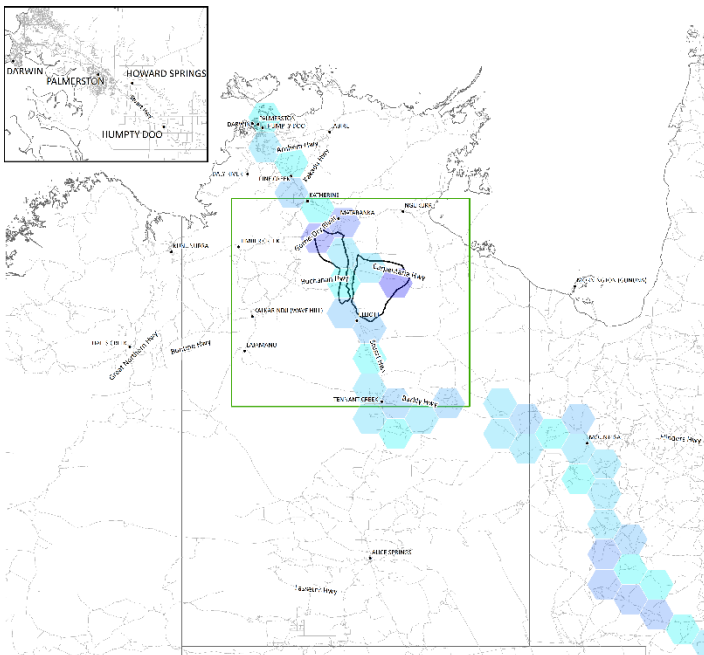
Construction yr 2

COMMODITY	TOTAL COST (\$)	TONNES	COST PER TONNE (\$/T)	TRANSPORT DISTANCE (KM)	ONE WAY TRAVEL TIME (HRS)	TRAILERS
Pipes Road Leg	\$17,461,957	253,125	\$68.99	663	8.4	10,125
Pipes Rail Leg	\$10,237,484	124,500	\$82.23	1,044	14.0	6,225
Grand Total	\$27,699,441	377625	75.61	1,707	11.2	16,350

Peak operation

COMMODITY	TOTAL COST (\$)	TONNES	COST PER TONNE (\$/T)	TRANSPORT DISTANCE (KM)	ONE WAY TRAVEL TIME (HRS)	TRAILERS
Casing, tubing, pup joints	\$3,858,021	93,250	\$41.37	425	5.1	3,730
Core samples	\$1,087,693	5,625	\$193.37	2,017	22.8	225
Crane lifts	\$67,101	9,150	\$7.33	39	0.8	366
Drilling accessories	\$121,066	12,250	\$9.88	71	1.0	490
Drilling containers	\$2,104,928	13,500	\$155.92	1,548	21.6	540
Fishing equipment	\$3,579,432	19,575	\$182.86	2,002	22.0	783
Float equipment	\$595,754	13,325	\$44.71	463	5.0	533
Fuel - diesel	\$4,046,467	34,500	\$117.29	1,219	14.8	1,380
Geological equipment	\$1,008,555	9,375	\$107.58	1,158	12.8	375
Medical supplies	\$32,110	950	\$33.80	325	3.9	38
Muds	\$8,372,071	165,475	\$50.59	501	6.8	6,619
Pup joints	\$1,832,916	5,800	\$316.02	2,985	32.1	232
Specialised equipment	\$8,915,030	33,600	\$265.33	2,849	30.0	1,344
Stimulation equipment	\$10,440,018	48,725	\$214.26	2,362	26.2	1,949
Water samples	\$1,299,796	3,850	\$337.61	3,616	38.8	154
Wellhead equipment	\$1,987,880	13,950	\$142.50	1,518	16.3	558
Grand Total	\$49,348,837	482,900	\$102.19	1,072	12.4	19,316

Dust – construction yr 1, peak operation



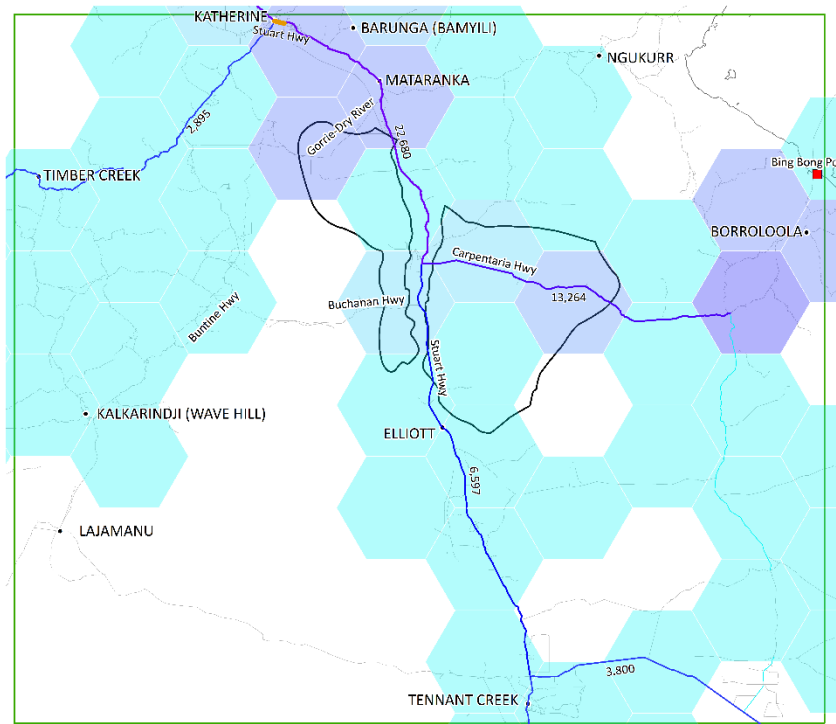
Critical link analysis

Number of trailers...

Road			Number of Trailers					Critical link analysis
	Road Ranking	Paved	National baseline	Construction yr1	Construction yr2	Operation	Peak operation	
Carpentaria Hwy	2	Y	16,507	5,566	6,949	3,413	7,177	Y
Gorrie-Dry River	4	N	678	787	2,274	1,792	3,573	Y
Stuart Hwy-Humpty Doo	1	Y	23,441	5,423	4,683	3,518	7,393	
Stuart Hwy-Katherine	1	Y	20,749	5,435	4,683	4,077	8,485	Y
Tiger Brennan Dr	3	Y	19,209	-	-	3,305	6,945	
Victoria Hwy	1	Y	13,931	12	-	547	1,094	

Also: number of freight paths, average travel distance

Critical link analysis



Road freight density (trailers), Critical link analysis
GISERA Baseline and Operation movements

- Roads carrying no freight
- 1 - 100
- 101 - 250
- 251 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 5,000
- 5,001 - 10,000
- 10,001 - 20,000
- 20,001 - 30,000
- 30,001 - 50,000
- 50,001 - 100,000
- 100,001 - 200,000
- > 200,000

Maximum trailer value within cell
(functional class 3,4,5)

- 0.01 - 100
- 100.01 - 250
- 250.01 - 500
- 500.01 - 1,000
- 1,000.01 - 2,000
- 2,000.01 - 5,000
- > 5,000

Beetaloo Sub-basin

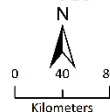
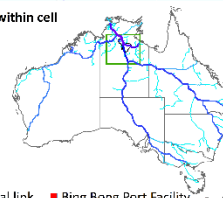
Towns

GISERA large study region

Critical link

Bing Bong Port Facility

Data sources: Towns - Topo250k;
 Road network: copyright Navigato, ICRG 2018;

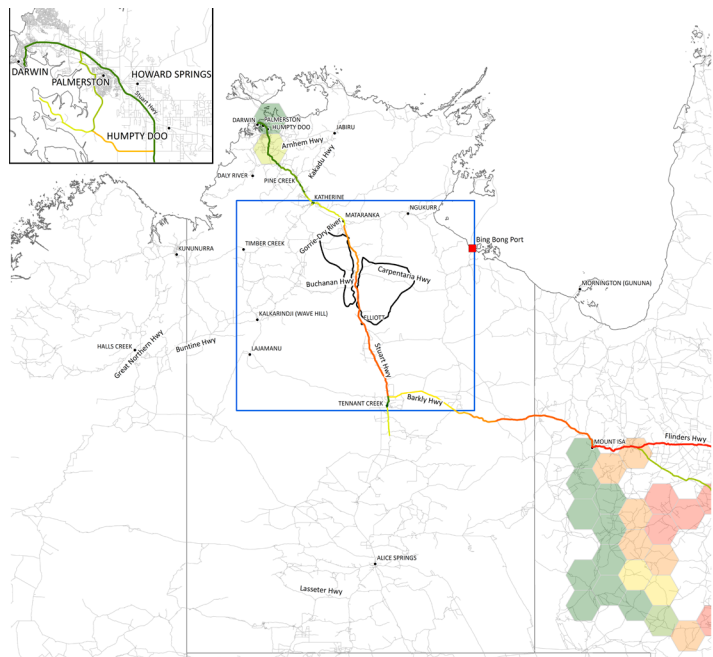
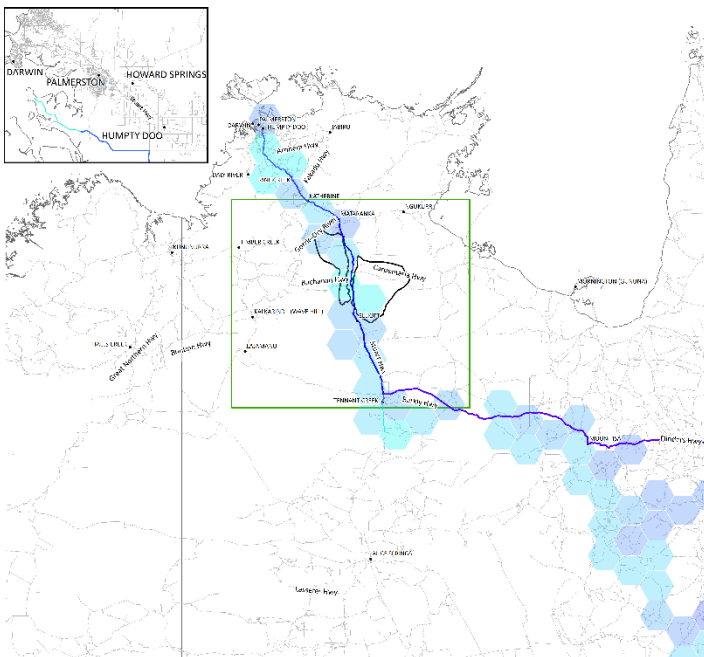




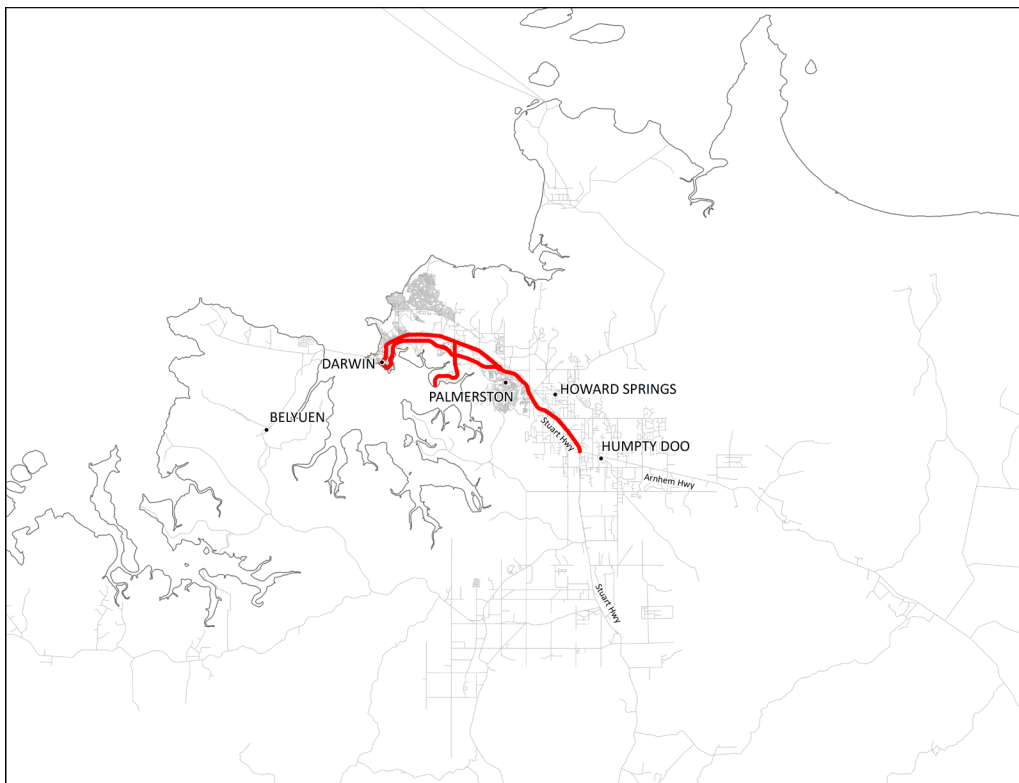
Project findings

- Baseline (current)
- Reference baselines (construction, operation)
- Scenarios
 - Pipes from Townsville Port
 - Key roads congestion
 - Wet season road closures

Scenario 1 – Pipes from Townsville Port

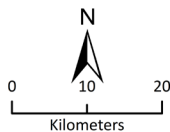


Scenario 2 – Key roads congestion

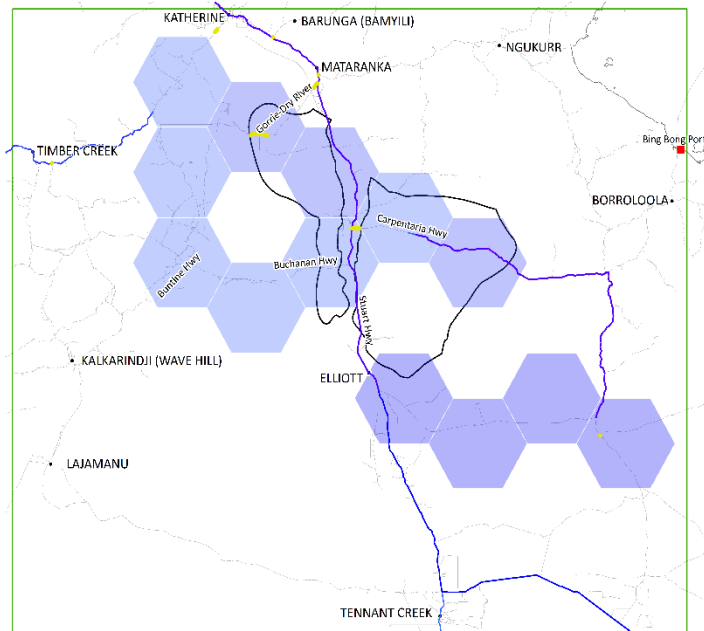


Scenario 2 - Key roads congestion

- Towns
- Congested roads
- Roads

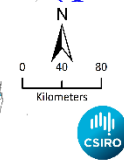
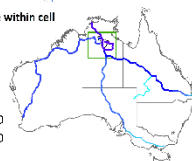


Scenario 3 – Wet season road closures



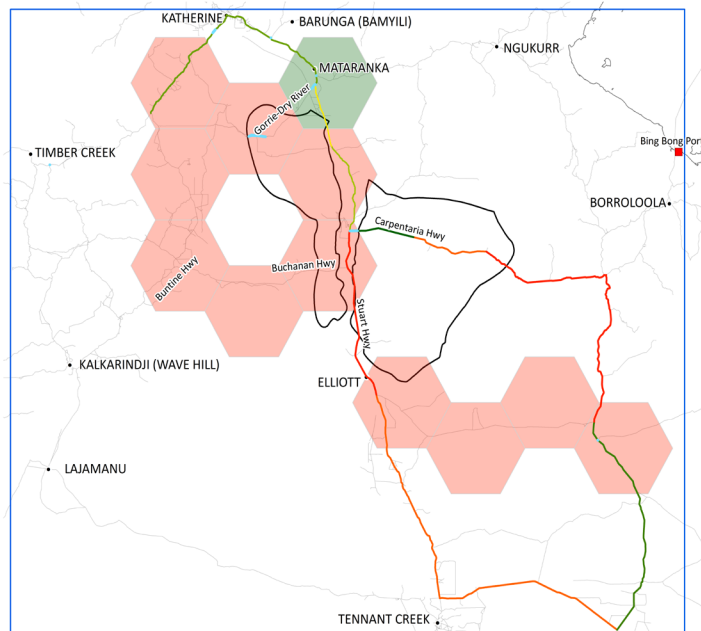
Road freight density (trailers)
GISERA Road Closures - Operation peak movements
 — Roads carrying no freight 2,001 - 5,000
 — 1 - 100 — 5,001 - 10,000
 — 101 - 250 — 10,001 - 15,000
 — 251 - 500 — 15,001 - 20,000
 — 501 - 1,000 — 20,001 - 25,000
 — 1,001 - 2,000 — > 25,000

Maximum trailer value within cell (functional class 3,4,5)
 — 0.01 - 100
 — 100.01 - 250
 — 250.01 - 500
 — 500.01 - 1,000
 — 1,000.01 - 2,000
 — 2,000.01 - 5,000
 — > 5,000



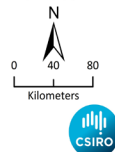
Beetaloo Sub-basin • Towns GISERA large study region Road closures Bing Bong Port Facility

Units sources: km/hr - Topo250k
 Road network: copyright © Bing Bong Port Facility



Road freight density change (trailers)
GISERA Road Closures vs Base - Operation peak movements
 — No change 0 - 500
 — < -5,000 — 500 - 1,000
 — -5,000 - -2,000 — 1,000 - 2,000
 — -2,000 - -1,000 — 2,000 - 5,000
 — -1,000 - -500 — > 5,000
 — -500 - 0

Maximum trailer difference within cell (functional class 3,4,5)
 — < -500
 — -500 - -100
 — -100 - 0
 — 0 - 100
 — 100 - 500
 — > 500



Beetaloo Sub-basin • Towns GISERA large study region Road closures Bing Bong Port Facility

Data sources: Towns - Topo250k
 Road network: copyright Navigare, HERE 2018



Implications and conclusions

- TraNSIT a valuable tool for modelling potential scenarios
 - Location, magnitude and cost of freight volume changes
- Good data is critical
- Ongoing improvements to TraNSIT model
- Evidence base to plan management interventions
 - Road damage
 - High usage areas
 - Dust -> environmental and community effects
 - Network upgrades and supply chain investments



Thank you

Land and Water

Caroline Bruce

+61 457 549 338

caroline.bruce@csiro.au

Land and Water

Andrew Higgins

+61 409 661 364

andrew.higgins@csiro.au



TraNSIT Road

PBS Level 1

Semitrailer



PBS Level 2A

B-Double



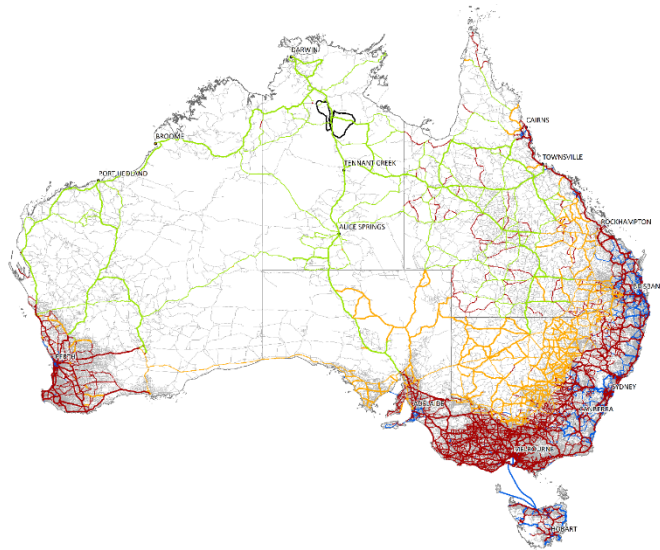
PBS Level 3A

Type 1



PBS Level 4A

Type 2



Maximum heavy vehicle size allowed, Functional class

Single-Trailer Truck

B-Double Truck

Type 1 Road Train

Type 2 Road Train

Beetaloo Sub-basin

Towns

Roads

FC 1,2; ST

FC 3,4; ST

FC 5; ST

FC 1,2; BD

FC 3,4; BD

FC 5; BD

FC 1,2; T1

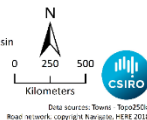
FC 3,4; T1

FC 5; T1

FC 1,2; T2

FC 3,4; T2

FC 5; T2



- Vehicle operating cost model - variables
 - Vehicle type – 4 vehicle types
 - Fuel price
 - Fuel cost model
 - Incline, international roughness index, speed, tare and gross mass
 - Distance per segment, year
 - Travel time per segment, year
 - Tyres, maintenance costs
 - Driver costs
 - Fixed costs
 - Capital and depreciation



TraNSIT Rail

- Rail operating cost model - variables

- 60+ train configurations
- Distance
- Track conditions – travel time, TAL etc
- Rolling stock and train length
- Wagon capacity and load efficiency
- Track access charges
- Backloading
- Rolling stock maintenance
- Fuel and crew costs
- Capital costs
- Overheads

