Inland Rail Information Paper

Information to support assessment of routes for Inland Rail in the Border to Gowrie project section

31 August 2020

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

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Table 1-1 Summary of key data and information

Inland Rail Service Offering Metric	Reference Design Route	Via Cecil Plains & Wellcamp	Via Cecil Plains & Kingsthorpe
Distance	206.9km	232.8km	234.7km
Distance difference	Baseline	+25.9km	+27.8km
Number of intermediate crossing loops	5	6	6
Transit time north (Hrs:Mins:Secs)[1]	02:49:37	03:08:49	03:06:49
Added transit time (north)	Baseline	+00:19:12	+00:17:12
Transit time south (Hrs:Mins:Secs)[1]	02:40:32	03:00:11	02:59:19
Added transit time (south)	Baseline	+00:19:39	+00:18:47
Reliability	98%	97%	97%
Availability	Baseline	Reduced	Reduced
Length of all floodplains crossed	14.2km	36.7km	38.6km
Length of Condamine floodplain crossed	12.5km	33.0km	33.0km
Length of Condamine floodplain bridges	6.1km	6.3km	6.3km
Length of Condamine floodplain embankment (with culverts)	6.4km	10.0km	10.0km
Length of Condamine floodplain embankment (without culverts)[2]	0.0km	16.7km	16.7km
Construction cost[3]	Baseline	+$281.9m	+$303.5m
Operations cost[4]	Baseline	+$93.7m	+$98.1m
Maintenance cost[4]	Baseline	+$96.9m	+$104.1m
Economic cost of longer transit time4	Baseline	+$150.7m	+$127.3m
Value of land impacted	Baseline	-$30.7m	-$25.4m
Construction start[5]	August 2022	August 2024	August 2024
Full Inland Rail Operational start[5]	Baseline	+24 months	+24 months
Total additional direct cost	**Baseline**	**+$592.5m**	**+$607.6m**

Additional Information Metrics	Reference Design Route	Via Cecil Plains & Wellcamp	Via Cecil Plains & Kingsthorpe
Number of residences within 200m	104	134	234
Number newly impacted (not on the Reference Design route)	-	86	191
Number of commercial premises within 200m	58	62	65
Number newly impacted (not on the Reference Design route)	-	45	53
Area of cropping land impacted (ha) – assumes 60-metre wide rail corridor along length of route	407.7ha	222.6ha	197.5ha
Area of irrigated cropping impacted (ha) - assumes 60-metre rail corridor along route	32.8ha	89.4ha	83.2ha

[1] Modelled from RailSys on basis of Inland Rail Reference Train operating in 2039/40 when the network is at capacity

[2] The nature of the ‘ Condamine Valley’ floodplain in this area is such that significant areas within the broad floodplain remain dry in a 1% AEP event (formerly known as a 1 in a 100 year event) as they are not contiguous so the rail line in these localised areas of the floodplain would not require culverts or bridges/viaducts

[3] Includes 7.5km spur line required on the route via Kingsthorpe to connect the existing QR line to Wellcamp at cost of $12.7m per km = added cost of $95.3m

[4] Net Present Cost calculated for period to 30 June 2075. Economic cost of longer transit time is the freight value of time impacts to end customers over the period.

[5] The 24-month delay in construction start assumes a 1 September 2020 decision by the Australian Government to route Inland Rail via Cecil Plains and reflects an estimated 30 months from that date to undertake all planning and studies and time required to obtain primary project approvals and for construction to commence. Construction periods are assumed to be same for the purposes of this paper, but longer routes typically will take longer to construct assuming the same construction methodology and challenges. A 30-month delay in commencement of construction of the Border to Gowrie (B2G) project delays commencement of Inland Rail full operations by 24 months as B2G is currently scheduled to be completed six months prior to the Gowrie to Helidon project (the current program critical path), so a delay in the B2G project would mean the project becomes the overall program critical path project.

Table 1-2 Summary of comparative ability of routes to enhance the Inland Rail Service Offering

Inland Rail Service Offering Measure	Reference Design Route	Via Cecil Plains & Wellcamp	Via Cecil Plains & Kingsthorpe
Transit Time	Baseline	X	X
Reliability	Baseline	X	X
Availability	Baseline	X	X
Cost: Construction, Maintenance & Operations	Baseline	X	X

Note: X denotes being inferior to the Reference Design route in relation to the specific attributes of the Inland Rail Service Offering

2 Route Assessment: Introduction and Methodology

By letter dated 29 June 2020, the Deputy Prime Minister confirmed to the Chair of the Millmerran Rail Group that the Deputy Prime Minister had

> *…asked for an immediate review of the "forestry route" via Cecil Plains in the Border to Gowrie section of Inland Rail against the selected [Inland Rail] route to assess its ability to meet the business case requirements including transit time, reliability, cost competitiveness and availability.*

The letter also enclosed a map (Appendix A) showing the routes to be assessed and stated that the Department of Infrastructure, Transport, Regional Development & Communications (DITRDC) would

> *…engage an independent consultant to review the assessment process. The independent consultant will ensure that ARTC has used like-for-like methodologies when assessing the service offering attributes of the routes. Following this, the assessment will be presented to the Australian Government for consideration.*

In terms of compiling the data that will enable the comparative assessment of the routes, ARTC has been requested to provide clear documentation as to the like-for-like methodologies. In considering the cost competitiveness of the routes, this includes data in relation to the estimated direct construction costs of each route together with forecast maintenance and operations costs on each route (all expressed as a differential from the 'baseline' of the Reference Design route). Data is also provided on the number of properties and businesses impacted by each route and on the valuation at a high-level of these impacts.

2.1 'Like for Like' methodological approach

Given that the Reference Design route for Inland Rail has been the result of significant study and associated modelling and design development work since September 2017, it has obviously not been possible to gain the same level of detailed knowledge and understanding of the two routes via Cecil Plains. Nevertheless, as has been required by the Australian Government, to the greatest extent possible a comparison of the routes has been undertaken on a 'like-for-like' basis. This has been undertaken primarily through the application of information gained from a range of publicly available data sources as follows:

- Queensland Government 2012 + 2014 LiDAR datasets
- Shuttle Radar Topography Mission (SRTM) (2009)
- Queensland Land Use Mapping Program (2017)
- Queensland Valuer-General valuations (unimproved value of land).

Where more appropriate, the following specific information/data sets or methodologies have been applied in a consistent manner across the different routes being assessed:

- GIS strings for each route [developed by FFJV + ARTC]
- RailSys modelling of transit time [conducted by Arup]
- Existing Condamine floodplain flood model developed for the Reference Design [FFJV + ARTC].

2.2 Methodology for comparing transit times and ability to meet the Inland Rail Service Offering

The route transit times have been calculated using the RailSys model, which has been developed in RailSys software and covers the entire Inland Rail route between Melbourne and Brisbane and assesses the capability of the routes to accommodate the expected 2039/40 train plan.[1]

In developing the modelling, the technical advisors (Arup) utilised both the *Inland Rail Concept of Service Capability and Feasibility Report* and the *Assumptions, Parameters and Methodology Report*[2] that set out the input assumptions and parameters underpinning the modelling, and the methodology followed to calculate the model outputs.

The modelling of transit times took account of the following factors:

- length of route
- number and distancing of crossing loops
- lengths of any sections within active qr rail corridor
- gradients or speed restrictions impacting transit time.

Transit time for each route has also been incorporated into an assessment of how the project section transit time impacts on the overall Melbourne – Brisbane transit time, reliability and availability.

2.3 Methodology for comparing Condamine floodplain crossings

The modelling approach used for the crossing of the Condamine floodplain near Cecil Plains was similar to that used for the Condamine floodplain crossing on the Reference Design route whereby the underlying baseline hydrology was established and then the alignment design was introduced to assess impacts. All modelling work has been done using the URBS and TUFLOW software and a mix of publicly available LiDAR and SRTM shuttle data has been used for the terrain model.

For the crossing of the Condamine floodplain near Cecil Plains a new model was created that utilised the data/parameters from the reference design model as an input. The new model takes the output flows from the Reference Design modelling and includes those flows for a new downstream model that incorporates the extra catchment for the crossing near Cecil Plains. The crossing near Cecil Plains was the same whether the route went from Cecil Plains to join the existing QR corridor between Oakey and Kingsthorpe or more directly to join the Reference Design route near Wellcamp.

[1] The 2015 Inland Rail Programme Business Case assumed 2039/40 as the year of maximum train numbers on the network as it was assumed that from that year there would be a gradual move to longer trains, up to 3600 metres in length.

[2] These documents are not public documents but internal working documents, referenced to demonstrate transparency and consistency in assessing the routes via Cecil Plains compared with the Reference Design route and other Inland Rail project routes.

2.4 Methodology for comparing property impacts

Property impacts of the three routes are assessed in the following ways:

- the number and broad categorisation of properties identified as being 'intersected' by the alignment of each route (the actual Reference Design alignment and notional 'centre-line alignment' for the routes via Cecil Plains)
- the number of residential and commercial sensitive receptors within 200 metres of the route alignments (as per above)
- the area occupied by an average 60-metre wide rail corridor along the length of each route (alignments determined as above) across 25 categories of land type
- a high-level assessment of the value of land impacted (compared back to the Reference Design route as the 'baseline').

Property categorisations and land classifications are drawn from the publicly available datasets referenced previously in this section.

2.5 Methodology for comparing direct construction costs

Due to the data available for the assessment of the route alignments via Cecil Plains, ARTC has focussed the cost comparison of the routes to include the main drivers of the Border to Gowrie Project Reference Design estimated direct construction cost. Construction costs assessed on a dollar per km rate include direct construction costs and exclude risk, escalation, contingency, property and indirect client costs[3]. Due to the concept level of assessment the overall cost comparison results are estimates and final costs for the routes via Cecil Plains would be subject to further design development in the event that the Government determined that either route should be adopted as the route for Inland Rail.

Table 2-1 lists the five major drivers of overall estimated direct construction costs.

Table 2-1 Major construction cost drivers

Construction element	Percentage of Total Estimated Construction Cost
Civil Earthworks & Track Construction	93%
Bridges	
Culverts	
Road – Rail interfaces	
Materials (e.g. rail, ballast, turnouts)	

[3] Estimated values of land impacts for each route are considered separately, hence they are not included in the construction cost estimate.

As the above five main drivers have the greatest influence on the total estimated direct construction cost, it is reasonable to expect that comparison of these elements will demonstrate any notable cost differential (either positive or negative impact) between routes. For the purposes of the assessment, all other construction elements have been considered cost drivers that are unlikely to cause significant cost differentials between routes. For example, contingency costs are relatively the same across all routes.

In undertaking the cost comparisons, the Reference Design quantities and costs have been baselined to net zero for probity reasons and remain commercial in confidence.[4] The results presented show comparative quantity and cost (increases or decreases) for the two route options via Cecil Plains. Differences are expressed in 2020 dollars and percentage differentials are not given as to do so would enable a 'back calculation' of estimated construction costs on the Reference Design route.

2.6 Methodology for comparing cost competitiveness with road freight: operating, maintenance and 'value of time' costs

One of the core elements of the Inland Rail Service Offering is to offer an ability for freight transported by rail to be cost competitive with road. The key factors impacting the cost competitiveness of rail with road over time are maintenance and operating costs and a 'value of time' associated with whether there is a saving or loss in transit time.

ARTC's "Commercial Value of Scope Change" model was used to calculate the maintenance and operating costs associated with each of the three routes. The model calculates the above and below rail capital and operating cost change as a result of a change to route length and/or transit time, including the inferred value to the intercapital intermodal market of changes to cut-off / availability times. The ARTC cost-benefit model estimates the direct cost impacts of route length/transit time on a range of factors:

- train crewing costs
- fuel consumption
- locomotive and wagon maintenance
- locomotive and wagon utilisation (capital)
- track maintenance and network operations

Unit rates used in the modelling are from ARTC's standard rail operating cost model used for analysing above rail operations. Unit rates are multiplied by the annual number of trains (consistent with the Inland Rail Programme Business Case) and the incremental change in either or both distance and time, as relevant to the specific factor. Present values of the costs are calculated over an evaluation period to 30 June 2075 at a 4% discount rate, being the core discount rate in the 2015 Inland Rail Programme BusinessCase.

'Value of time' savings/costs are also assessed in the cost competitiveness with road freight. These costs are derived using values from ARTC's elasticity (demand) modelling that is also used across the ARTC network. Present values of the future stream of benefits/disbenefits have been calculated for the two routes via Cecil Plains in comparison with the Reference Design route over an evaluation period to 30 June 2075 at a 4% discount rate, being the core discount rate in the 2015 Inland Rail Programme Business Case.

[4] The Reference Design route costs have been provided on a confidential basis to the Government's consultant.

3 A Brief History of the Inland Rail Route in South East Queensland

The 2006 North-South Corridor Study identified a wide area in South East Queensland as part of the Far Western Sub-Corridor, extending from Goondiwindi, and bounded by Toowoomba and Warwick, towards Brisbane. In the 2010 Inland Rail Alignment Study (IRAS), two main route options were considered for Inland Rail in Queensland, one going to Brisbane via Toowoomba and the other via Warwick and Rathdowney. While the option via Warwick provided some reduction in transit time, the route via Toowoomba had lower capital cost and significantly higher demand/revenue. The Toowoomba route was therefore preferred by the Australian Government.

Since the 2010 IRAS, it has also become evident that the Toowoomba option is better positioned to take advantage of economic growth opportunities (such as the developing the Charlton-Wellcamp precinct and the InterlinkSQ intermodal development).

The 2015 Inland Rail Implementation Group (IRIG) Report noted further hydrological and geotechnical assessments would be required between North Star and Toowoomba and could result in a final alignment to the east or west of the 2010 IRAS alignment.

Following on from the 2015 IRIG Report, ARTC continued iterative development of a route between Yelarbon and Toowoomba (known as the Base Case Modified route) that headed in a generally north-easterly direction via Millmerran, Brookstead and Mount Tyson until it joined the QR West Moreton Line near Kingsthorpe.

In October 2016, the Australian Government announced there would be an assessment of alternative corridors in this section. The four options were:

- Corridor 1: Base Case Modified from Yelarbon to Gowrie via Millmerran and Mt Tyson
- Corridor 2: Base Case Modified with a deviation to pass close to Wellcamp and Charlton
- Corridor 3: Yelarbon to Gowrie via Karara, Leyburn and Felton
- Corridor 4: Yelarbon to Gowrie via Karara, Clifton and Wyreema and utilising the existing rail line close to Warwick.

The alternative corridor assessment process was conducted by independent consultants Aurecon and AECOM and overseen by the Yelarbon to Gowrie Project Reference Group, consisting of community and industry representatives with an independent Chairman, Mr Bruce Wilson AM. The assessment compared the three alternative corridors against the Base Case Modified corridor on a like-for-like basis.

The assessment work was summarised in the Corridor Options Report dated 21 April 2017 and made publicly available by the Australian Government and Inland Rail on 21 September 2017.

4 The Routes Assessed

The proposed routes via Cecil Plains depart from the current Reference Design route in the vicinity of Inglewood and traverse a combination of state forest land and private property to the south and west of the Reference Design route, proceeding to Cecil Plains. There were three routes via Cecil Plains considered as possible alternatives to the existing Reference Design route:

1. Via Cecil plains to join the existing QR line near Oakey
2. Via Cecil Plains to join the existing QR line closer to Kingsthorpe
3. Via Cecil Plains then direct via a greenfields route to join the Reference Design route near Wellcamp

The route proposed from Cecil Plains that follows the current disused rail line and joins the existing QR West Moreton line between Kingsthorpe and Gowrie, passes between 7.5km and 8.0km to the west of Wellcamp Airport and so would require a 'spur line' of that distance to be constructed in order to tap into the economic potential offered by Wellcamp Airport or adjacent industrial precinct, benefits that were identified as a key issue in the Government's determination of the route in September 2017.

On the basis that ARTC has been requested to ensure the assessment is undertaken as much as possible on a 'like-for-like' basis, ARTC Inland Rail has also considered a route from Cecil Plains that then follows a more direct greenfields line to join the Reference Design route near Wellcamp and obviates the need therefore to go via Kingsthorpe or to build a 'spur line'.

Table 4-1 shows the respective route lengths of the Reference Design route and routes via Cecil Plains.

Table 4-1 Track lengths of the routes

Description	Track Length		Difference in Track Length	
B2G Reference Design	206.95	km	Baseline	km
Via Cecil Plains direct to Wellcamp	232.80	km	+25.85	km
Via Cecil Plains and Kingsthorpe	234.70	km	+27.75	km
Via Cecil Plains to near Oakey	239.80	km	+32.85	km

Track lengths of the routes

From Cecil Plains, the route proposed to follow the current disused rail line and join the QR West Moreton system closer to Oakey would require construction within the constrained corridor at Kingsthorpe, which was identified as a significant issue in 2017. The route has a track length in the order of 7km longer than the route that goes direct from Cecil Plains to Wellcamp and 5km longer than that which joins the existing QR system closer to Kingsthorpe. It is also approximately 33km longer than the Reference Design route. The route also impacted more private landowners than either of the other two routes via Cecil Plains as a result of its proximity to the township of Oakey.

As a result of the above combined factors, the route via Cecil Plains to near Oakey was discounted from further assessment on the basis that the route offered no advantages compared with either of the other routes via Cecil Plains and was the least likely to meet the Inland Rail service offering.

4.1 Major elements of the routes assessed

Following is a brief overview of the major elements of each of the three routes assessed.

B2G Reference Design

The Reference Design alignment includes:

- a combined 71.2km of brownfields alignment reconstruction across the QR South Western Line and Millmerran Branch
- a combined 135.75km of Greenfields alignment
- total track length of 206.95km
- 15.2km of track that traverses through state forest and an additional 39.2km of track that traverses properties directly adjacent to Forestry
- 12.5km Condamine Crossing (6.1km of bridge structure and 540 Culverts)
- significant challenging topography in the Athol - Wellcamp area.

Via Cecil Plains and Wellcamp

- a combined (approx.) 78km of brownfields alignment reconstruction across the QR South Western Line and Cecil Plains Branch Line
- a combined (approx.) 155km of greenfields alignment
- approximately 90km of alignment that traverses through state forest
- total track length of 232.8km (25.85km longer than Reference Design)
- 33km Condamine crossing (estimated 6.3km of bridge structure and 2030 culverts)
- 16.8km of challenging topography in the Mt Tyson - Wellcamp area, 10.8km of which is common to the Reference Design and an additional 6km in this section that has comparable topography and associated earthworks.

Via Cecil Plains and Kingsthorpe

- a combined (approx.) 87km of brownfields alignment reconstruction across the QR South Western Line, QR West Moreton Line and the Cecil Plains Branch Line
- a combined (approx.) 147.7km of greenfields alignment
- approximately 90km of alignment that traverses through state forest
- total track length of 234.7km (27.75km longer than Reference Design)
- 33km Condamine crossing (estimated 6.3km of bridge structure and 2030 culverts).

A long section showing the vertical rail height overlayed for all three routes assessed is included at Appendix B**.**

5 The Inland Rail Service Offering

5.1 The Inland Rail Service Offering

To reflect the priorities of freight customers, the Inland Rail scope has been defined based on a target service offering to ensure a customer focus on outcomes as opposed to an infrastructure or engineering focus on outcomes. The target service offering was developed in consultation with key market participants, stakeholders and potential users (rail operators, freight forwarders and end customers).

Inland Rail provides a significant opportunity to change the fundamentals of the freight logistics supply chain in Australia and deliver economic and social benefits long into the future.

The service offering is central to the delivery and competitiveness of Inland Rail and reflects the priorities of freight customers. It was developed in consultation with key market participants and stakeholders and represents the key elements to be addressed by Inland Rail to enable a competitive and complementary service offering compared to other modes, including road transport.

Engagement included an industry survey, one-on-one interviews and two stakeholder reference forums with key market participants, stakeholders and potential users (rail operators, freight forwarders and end customers) convened by the then Department of Infrastructure and Regional Development.

Based on the objectives of Inland Rail, and feedback from freight customers, a target service offering has been defined by reference to the four key service characteristics of reliability, price, transit time and availability.

5.2 Assessing the routes against the Inland Rail Service Offering

The three routes examined in detail (the Inland Rail Reference Design and two routes via Cecil Plains) have been examined against the major criteria in the Inland Rail Service Offering ("the business case requirements" referred to in the letter from the Deputy Prime Minister to the Chair of the Millmerran Rail Group dated 29 June 2020).

There are four key service attributes that have been identified as underpinning the market requirements for improved rail freight services on the Inland Rail route and competitiveness with road freight transport, namely:

- transit time
- reliability
- availability
- cost competitiveness.

Transit time is defined as the time taken to get from Point A to Point B. In terms of Inland Rail, the specific measure is for an 'Inland Rail Reference Train' to get from a terminal in Melbourne to a terminal in Brisbane or vice-versa in 24 hours or less (referred to as line-haul transit time). The Inland Rail Reference Train is defined as being 1,800m long with a Power/Weight ratio of 2.7hp/tonne.

Reliability is defined as the percentage of goods available to be picked up at the rail terminal or port when promised.

Availability relates to the availability of suitable train paths at the times that suit the needs of the market. It refers to the percentage of available departure and arrival services that are convenient for customers, which depends on cut-off and transit times, and is calculated for the Inland Rail Reference Train.

To ensure a door-to-door competitiveness of Inland Rail with road freight, the following are assumed in the Inland Rail Business Case in addition to the 24-hour line-haul transit time: pick-up and delivery (PUD) activities add approximately four hours, a time of two hours between cut-off and train departure is allocated and the buffer to ensure reliability of delivery is expected to add a further 3.7 hours.

Relative cost competitiveness with road freight transport is presented for non-bulk inter-capital freight (calculated on an assessed door to door basis).

5.3 Industry requires a 24-hours Melbourne – Brisbane transit time

A key pillar of the Inland Rail Service Offering is the ability to deliver a transit time of 24 hours or less for the Inland rail Reference Train. The Service Offering was developed across both 2010 and 2014 to ensure that Inland Rail delivered what the market requires. The market requirements for the 24-hour Melbourne – Brisbane transit time remains as strong in 2020 as ever, as can be attested to by the following quotes drawn from submissions to the Senate Rural and Regional Affairs and Transport References Committee Inquiry into the management of Inland Rail.

“Woolworths chief supply chain officer Paul Graham said... to get produce to market as fresh as possible he would like to see a transit time of 22 hours. James Dixon from Australia Post said 21 hours would be “fantastic”.

Dr. Phillip Laird
Submission to Inland Rail Inquiry, p3

“SCT recommends the inquiry ensure the project’s service offering is protected to allow for freight to be moved in less than 24 hours between Melbourne and Brisbane”

Greg Smith SCT
SCT Submission to Inland Rail Inquiry, p38

“Inland Rail will help re-balance Australia’s freight future - shifting volume onto rail; not to mention catering for future growth. To help compete with trucks, Australia needs rail freight transit across the country in under 24 hours.”

Dean Dalla Valle, CEO of Pacific National
Pacific National Submission to Inland Rail Inquiry, p3
ALC Submission to Inland Rail Inquiry, p8

“A transit time of less than 24 hours for freight moving via rail between Melbourne and Brisbane will be reflected in cheaper consumer prices, as rail transport costs become more competitive with road. This competition will advantage urban consumers as well as those living in regional communities.” Kirk Cunningham OAM, CEO of ALC.”

Kirk Conningham OAM, CEO
Australian Logistics Council Submission to LC
ALC Submission to Inland Rail Inquiry, p6

6 Comparative Route Transit Times

6.1 Modelling transit times

Operational modelling results are set out in this section in terms of transit times and weekly capacity utilisation (the minimum proportion of the week that a section is expected to be occupied, and unavailable to other trains).

The modelling is based on the targeted weekly capacity utilisation of 65% or lower for all single line sections based on the Inland Rail 2039/40 peak train plan, in order to ensure that sufficient capacity can be reliably provided across the network. The 65% utilisation target has been established to allow for a range of factors such as varying locomotive type and trailing loads, fluctuations in demand, infrastructure maintenance and recovery from operational delays.

Transit times have been modelled from RailSys and on basis of an Inland Rail Reference Train operating in 2039/40 with time calculated for a Reference Train travelling north and travelling south on the network at capacity.[5] Inland Rail's 24-hour terminal to terminal transit time target, as stated in the Service Offering, is based on the Intermodal Reference Train operating two services per day in each direction.

The 2039/40 year is selected as it is the year assumed in the 2015 Inland Rail Business Case when the Inland Rail network will be at maximum capacity.

Transit time is modelled on the following basis:

- a 'raw run time' [or 'non-stop'] is the simulated performance of the train given the topography and permanent speed restrictions and assuming no stops and that trains perform to their theoretical potential – it is a theoretical 'start-point' for calculating a transit time.

Taking the 'raw run time' as the base a transit time is then calculated by adding time for each of the following factors:

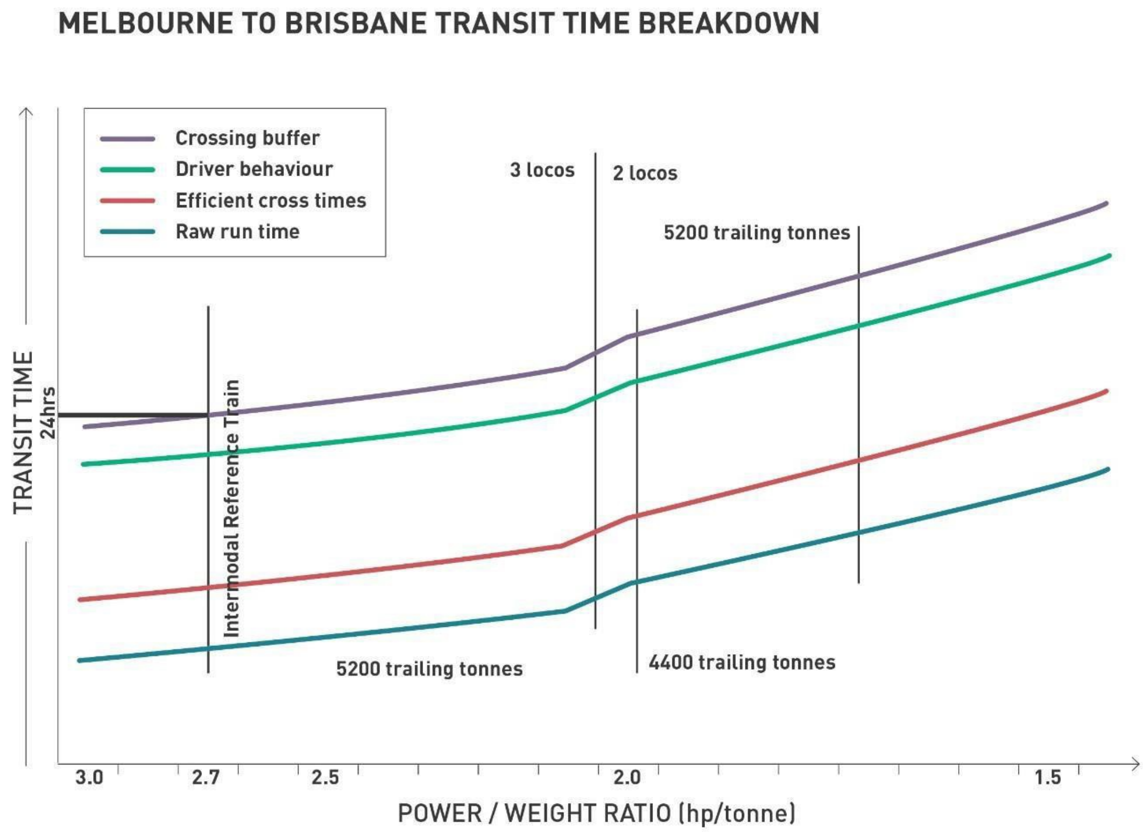
- an 'efficient cross time' adds a provision for train crosses based on a theoretical minimum delay given crossing loop locations and simulated train performance
- a further allowance is made for 'driver behaviour' is an adjustment to calibrate the theoretical simulated train performance to match actual observed train performance and is a combination of a reduced top speed and more gradual acceleration and braking than the train is capable of
- an added 'crossing buffer' reflects an additional adjustment that is added through the master train plan process to help with maintaining train reliability.

The methodological approach set out results in the currently forecast transit time of 23:30:00 for the Inland Rail Reference Train between Melbourne and Brisbane in 2039/40.

Figure 6.1 shows the building block approach to develop a modelled transit time for Melbourne - Brisbane reflective of 'real world' operations and gives an indication of likely transit time having regard to changing power to weight ratios of trains.

[5] The Inland Rail Reference Train is defined as being 1,800m long with a Power/Weight ratio of 2.7hp/tonne and 21 tonne axle-load, traveling at a maximum speed of 115km per hour.

Figure 6.1: Graphic representation of building transit time



An observation from Figure 6.1 is that there is considerable scope within the Inland Rail corridor for customers to target services that are costly but highly competitive with road on a transit offering or are highly productive from a cost perspective (lower power/weight ratio trains cost less to operate but take longer). The calculation of transit time for the Intermodal Reference Train assumes that trains get no special priority over each other.

It should be noted that a 'priority train path' would be a train path for which the train operator would be charged a premium, and preparedness to pay would be determined by the market and would not necessarily apply to all Intermodal Reference Train operations. A train with absolute priority could reduce the transit time between Melbourne and Brisbane by between two and three hours.

6.2 Transit times on the different routes

The route via Cecil Plains and Wellcamp and the route via Cecil Plains and Kingsthorpe are 25.9km and 27.8km longer respectively than the Reference Design route, which has resulted in an increase to the overall transit times for these routes.

An additional crossing loop is also required due to the longer alignment for each of the routes via Cecil Plains, which further increases modelled transit times.

Both the routes via Cecil Plains increase the transit time for the Inland Rail Reference train, both northbound and southbound, with the northbound journey being slower. It is thus the northbound route that determines the ability of a route to enhance or detract from the Inland Rail Service Offering, particularly with reference to the overall transit time.

The route via Cecil Plains and Kingsthorpe, while longer, is also flatter in areas than the route via Cecil Plains and Wellcamp. The respective average speeds for each of the routes is summarised in Table 6.1. However, even with slightly higher average speeds the longer routes via Cecil Plains mean overall slower transit times compared with the Reference Design route as can be seen in Table 6-1.

Table 6-1 Average speed comparisons across the routes (Intermodal Reference Train)

MEASURE	ROUTE		
	Reference Design Route	Via Cecil Plains & Wellcamp	Via Cecil Plains & Kingsthorpe
Average speed (northbound)	73.2kph	74.0kph	75.4kph

Both routes via Cecil Plains result in reductions in the 'spare' time available to deliver the 24-hour terminal to terminal transit time targeted in the Inland Rail Service Offering and are summarised in Table 6-2. This is an important consideration given that along the Inland Rail route between Melbourne and Brisbane detailed design and/or project approval conditions are only likely to result in time additions rather than subtractions when compared with reference designs.

6.3 Note on model outputs

The modelled 2039/40 transit times presented in this analysis are measured from the front of the train departing from the starter signal of one crossing loop, to the front of train arriving at the starter signal of the next crossing loop, but with no allowance for a dwell time in the crossing loop. As such the transit times indicated for each `single line section` include both the single line section itself and the adjacent crossing loop.

The 'stopping' runtimes as modelled for each of the routes via Cecil Plains show them to be longer in comparison with that for the Reference Design route as each is required to have an additional crossing loop due to their additional distance. In practice, the provision of an additional crossing loop does not mean that all services would be required to make an additional stop.

6.4 Longer transit time leads to increased truck movements

Work undertaken in support of the 2015 Inland Rail Business Case forecast that Inland Rail would remove just over 201,000 intercapital and regional freight truck movements off regional highways and roads each year from 2049/50. Modelling undertaken specifically for this Information Paper forecasts that increasing the overall transit time as do each of the routes via Cecil Plains will increase the number of truck movements as set out in Table 6-3.

Table 6-2 Transit time comparisons across the routes (Intermodal Reference Train)

MEASURE	ROUTE		
	Reference Design Route	Via Cecil Plains & Wellcamp	Via Cecil Plains & Kingsthorpe
Distance (km)	206.9	232.8	234.7
Distance difference (km)	Baseline	+25.9	+27.8
Number of intermediate crossing loops* (*plus one at either end of section)	5	6	6
Modelled 2039/40 transit time north for Reference Train (Hrs:Mins:Secs)	02:49:37	03:08:49	03:06:49
Transit time difference (north)	Baseline	+00:19:12	+00:17:12
Modelled 2039/40 transit time south for Reference Train (Hrs:Mins:Secs)	02:40:32	03:00:11	02:59:19
Transit time difference (south)	Baseline	+00:19:39	+00:18:47
Melbourne – Brisbane Reference Train Transit Time (Modelled 2039/40)	23:30:00		
Percentage of 24-hour target transit time	97.9%		
Melbourne – Brisbane Reference Train Transit Time (Via Cecil Plains routes)		23:49:39	23:47:12
Percentage of 24-hour target transit time		99.3%	99.1%

Table 6-3 Transit time and increased truck movements on routes via Cecil Plains

MEASURE	ROUTE		
	Reference Design Route	Via Cecil Plains & Wellcamp	Via Cecil Plains & Kingsthorpe
Cumulative increase in number of truck movements to 30/06/2075	Baseline	154,330	139,640

7 Construction Cost Comparisons

The information prepared for this paper was prepared to inform a concept level like for like comparison of cost estimates only of two routes via Cecil Plains compared with the current Reference Design route. The outcomes presented would likely be subject to change upon further design development based on:

- input from community consultation inclusive of landowners, councils, road authorities and relevant government agency feedback
- further technical and environmental studies, including site investigations
- road rail interface design and property access solutions

Further design development would only be required and undertaken if the Australian Government determined that either of the routes via Cecil Plains should be selected as the route for Inland Rail in the Border to Gowrie section. The construction costs for the three routes examined includes all direct construction costs.

7.1 ‘Like for Like’ Comparison of Construction Costs

For the purposes of this assessment the B2G Project Reference Design metrics have been used as a basis for developing a comparative like for like assessment of the concept designs developed for the Cecil Plains Forestry routes.

The B2G Reference Design is split into a work breakdown structure (WBS) that includes six discrete sections of track alignment along the full 206.9km and is the structure used to build the Bill of Quantities (BoQ) and cost estimate. The Reference Design WBS estimate has been reduced to a cost per kilometre average rate, which varies considerably due to broad changes in earthworks, bridges and culverts across the project. These elements are considered the major construction cost drivers and proportionally influence the dollar cost per km rate for the six discrete sections of track.

The underlying methodology of the like for like comparison involved assessing the Cecil Plains Forestry routes to identify comparable track sections against the Reference Design, then applying an appropriate dollar cost per km rate. The track sections for the Cecil Plains Forestry routes were developed according to the following interfaces and criteria:

- Common section of track for both Reference Design vs Cecil Plains option (e.g. QR South Western Line)
- The Condamine floodplain crossing
- Brownfields / Greenfields alignment
- Alignment interaction with areas of forestry
- Topography and rail elevation
- Embankment and cut profiles
- Road rail interfaces
- Grade separations.

The Reference Design Bill of Quantities (BoQ) was developed into a construction cost estimate using Expert Estimator software. The direct construction costs exclude risk and escalation and a number of other matters as referenced in Section 2.5. The elements included in the estimate used to develop the dollar cost per km rates for the Reference Design have been applied to the routes via Cecil Plains as per the methodology above.

Analysis of the Reference Design construction cost estimate indicates that ~93% of total construction cost is contained within and driven by the following main construction elements (as set out in Table 2-1):

- civil earthworks & track construction
- bridges
- culverts
- road – rail interfaces
- materials (e.g. rail, ballast, turnouts)

To ensure the like-for-like methodology was feasible, investigating the main construction elements for route specific outliers was undertaken. The results of the investigation have been detailed elsewhere in this Information Paper.

7.2 Civil earthworks and track construction

Civil earthworks and track construction combined costs are typically shown to be a main driver of total construction costs for rail projects and this is often even more evident on projects involving greenfields sections traversing undulating terrain. This is the by-product of minimum key technical criteria relating to the vertical rail grades in order to satisfy the Inland Rail transit time service offering. Rail elevation profiles have been developed (refer Appendix B) and were used to inform the assessment of the criteria regarding Cecil Plains Forestry route track sections and applicable cost rate.

Track construction cost for rail projects is directly proportional to the overall length of track to be constructed. The track lengths and differences are in Table 4-1.

7.3 Drainage structures (bridges and culverts)

Bridges and culverts are identified as a main driver of the estimated construction cost, noting that experience from the recent development of the Reference Design has shown that suitable hydrological and hydraulic modelling across the total length of the project ultimately results in more accurate estimates of the flood water behaviour, footprint and associated impacts of flood events.

While these modelling outputs would enable a more accurate quantifying of the length of bridges and number of culverts, the experience from progression of the reference Design is that the changes over time in number and sizing is not sufficient as to make a material difference, and accordingly it is considered not required or necessary to undertake further design work for the purposes of undertaking the 'like-for-like' assessment of indicative drainage structures across the proposed routes via Cecil Plains.

7.4 Assessment of the Condamine Crossing near Cecil Plains

As a standalone track section of the Reference Design route, the 12.5km Condamine floodplain crossing includes 20% of the total project culverts and 60% of bridge quantities, so this section represents a valuable comparison between the main drivers of construction cost. It is also considered a highly sensitive section due to the nature of the stakeholder issues and concerns.

There are two catchment systems that cross the proposed alignment. The main Condamine floodplain crosses the alignment to the immediate east of the Cecil Plains township. As the alignment continues to the north-east a sub-catchment also crosses the alignment and joins with the Condamine catchment downstream of the proposed alignment. Locals consulted as part of the preparation of this Information Paper and supporting data advised that collectively the two areas of floodplain are known colloquially as the 'Condamine Valley floodplain'.

All modelling work has been done using the URBS and TUFLOW software and a mix of available LiDAR and SRTM shuttle data has been used for the terrain model.

To assess flooding and drainage structures across the 'Condamine Valley' crossing, a new model was developed. The first step in the modelling methodology was a preliminary high-level investigation of the 1% AEP flood was undertaken to determine what type of bridge structures may be required to minimise any significant adverse hydraulic effects to landowners and infrastructure in the local area. Anecdotal evidence supplied by landowners and further hydraulic analysis during Reference Design indicated that, among other factors analysed, changes in flood levels in the Condamine floodplain are significantly influenced by any large obstruction placed in areas of concentrated flow. Therefore, the assessment of flood flux, which can be thought of as the force or energy of floodwaters, was a very good primary indicator of locating where large openings in the rail embankment (i.e. bridges) were needed.

The flood flux that passes the routes via Cecil Plains was assessed and compared to results obtained at the Reference Design alignment. The model results indicate that to keep changes to flood levels within acceptable thresholds during the 1% AEP event, a single 6.3km-long viaduct structure will be located at the Condamine River at Cecil Plains. Comparatively, the Reference Design alignment determined that three discrete bridge structures with a total length of 6.1km were required.

The second step of the modelling approach involved assessing the eastern catchment section, which is downstream of the Reference Design alignment. This is a 250km^2 catchment to the east of Cecil Plains that crosses the alignment and joins the Condamine River downstream of Cecil Plains. Its area is large enough to generate substantial runoff during the flood events. Shuttle Radar Terrain Mission (SRTM, 2003) data, which has a horizontal resolution of approximately 30m, has been adopted for this eastern catchment. The precision of any flood model's results is consistent with the resolution and currency of input topography data available.

The modelling methodology used during step two was similar to that for the Reference Design Condamine Crossing, whereby the underlying baseline hydrology was established (1% AEP) and then the alignment design was introduced to assess impacts. The new model takes the output flows from the Reference design modelling and includes those flows for a new downstream model that incorporates the eastern Cecil Plains catchment.

For the north-eastern sub-catchment, a number of embankment opening options were assessed and an estimate for culverts determined. There are some sensitive receptors close to the alignment (500m -1000m) and the Reference Design work done to date has demonstrated how sensitive the flat floodplain is to changes in flux. The indicative design solution (combining bridges with embankments and culverts) provides a reasonable balance in managing potential afflux impacts on these sensitive receptors.

The flood depths are relatively shallow and slow moving, and the proposed culvert size cater for the flood depth. Were either route via Cecil Plains selected by the Australian Government as the route for Inland Rail, an additional assessment of blockage and debris management would be required in line with Australian Rainfall and Runoff (ARR) guidelines and through community engagement as has occurred with the Reference Design crossing.[6]

As summary of the crossing structures for each route is shown in Table 7-1.

Table 7-1 Condamine floodplain metrics

Metrics	Reference Design	Cecil Plains – Option 1 (via Wellcamp Airport)	Cecil Plains – Option 2 (via Kingsthorpe)
Length of floodplain crossed	12.5km Condamine 1.7km Westbrook	33.0km Condamine 2.0km Mt Tyson area 1.7km Westbrook	33.0km Condamine 2.0km Mt Tyson area 2.3km Westbrook 1.3km Gowrie
Total	**14.2km**	**36.7km**	**38.6km**
Length of viaduct across floodplain	6.1km Condamine 0.6km Westbrook	6.3km Condamine 0.6km Westbrook	6.3km Condamine 0.9km Westbrook 0.4km Gowrie
Sub-total	**6.7km**	**6.9km**	**7.6km**
Length of embankment crossing floodplain requiring culverts (balancing / cross culverts)	6.4km Condamine 1.1km Westbrook	10.0km Condamine 2.0km Mt Tyson area 1.1km Westbrook	10.0km Condamine 2.0km Mt Tyson area 1.4km Westbrook 0.9km Gowrie
Sub-total	**7.5km**	**13.1km**	**14.3km**
Length of embankment crossing floodplain not requiring culverts	**0km**	**16.7km**	**16.7km**

In the floodplain to the east of the Condamine River, the flood behaviour is relatively shallow sheet flow. Preliminary pre-concept estimates of required culvert sizes indicate the necessary size of culvert is dictated by the width of the flow path, not the depth. The culverts could be distributed more evenly across the floodplain, as opposed to clustered into 25 discrete locations, but the number required would still be similar.

[6] Full details of the modelling methodology and results are outlined in FFJV Technical Note the “2-0001-310-CAL-02-TN-0016” provided to the independent consultant and which describes how the assessment was undertaken and quantities of bridges and culverts estimated.

Table 7-2 Summary of 'Condamine Valley' Culvert Numbers and Sizes

Adopted RCP diameter (mm)	Number
900mm	2,000
1,200mm	30

The following assumptions were considered when calculating the dollar cost per km rate for the 'Condamine Valley' crossing:

- Culvert rate is determined by the type, size, length and scour.
  - 2000 x 900mm diameter
  - 30 x 1200mm diameter
- Bridge rate assumes the same design configuration for all alignments.
  - 6.3km bridge – applicable for both routes
  - Linear averaged dollar cost per km rate adopted.
    - +266m increased bridge length compared with Reference Design route
- Earthworks rate used for all sections except for bridge locations.
  - 10.0km culverts and earthworks
  - 16.7km earthworks without bridges or culverts
  - Total = 26.7km of earthwork rates application
    - All other elements applicable for a reference design applied for the entire 33km Condamine length.

It should be noted that the nature of the 'Condamine Valley' floodplain in this area is such that significant areas within the broad floodplain remain dry in a 1% AEP event as they are not contiguous so the rail line in these areas would not require culverts or bridges/viaducts.

Three maps showing the 1% AEP flood flux are attached at Appendix D. The map of the floodplain crossing in the vicinity of Cecil Plains clearly shows the non-contiguous nature of the areas that remain dry in a 1% AEP event.

7.5 Stream Order Assessment

Within the Condamine floodplain catchment there is a full set of modelled hydrology data available to assess the entire lengths of the Cecil Plains alignment options. A desktop assessment identifying all the stream crossings (rated as High and Major requiring large culverts and bridges) has indicated that, outside the Condamine crossing, there is a minor difference between the Reference Design and the routes via Cecil Plains (see Table 7-3).

Table 7-3 Stream Order Assessment

Risk of Impact	Reference Design Alignment	Via Cecil Plains & Wellcamp	Via Cecil Plains & Kingsthorpe
High	7	5	5
Major	9	10	13
Total crossings	16	15	18

It is important to note that bridge lengths and number of culverts could be estimated with a higher degree of accuracy by advancing hydrology modelling and analysis across the full length of each route via Cecil Plains, work that would be required only in the event that the Australian Government selected either route as the Inland Rail route in this section.

7.6 Road Rail Interfaces

7.6.1 Level Crossings

As shown in Table 7-4, this element indicates reductions in the road-rail interfaces for the two routes via Cecil Plains for public roads, but a significant increase in access tracks. These access tracks are related to the forestry section of the routes via Cecil Plains and are required for leaseholder access, designated logging, maintenance and/or firefighting. Assessment data is based on the following assumptions:

- roads intersected – assumed active level crossings for public roads and costed at higher rate than access tracks intersected
- access tracks intersected – similar treatment to a private level crossing
- no road changes or realignments have been included within the rates.

Table 7-4 Level Crossing numbers

Elements	Reference Design	Via Cecil Plains & Wellcamp	Via Cecil Plains & Kingsthorpe
	Qty	Qty	Qty
Public Road	75	58	55
Access/Tracks	15	66	66

It should be noted that while Access/Tracks are not designated roads, they are still required to be maintained in an appropriate condition for a number of reasons, including fire-fighting and emergency access as well as access to the number of small privately owned properties that are located throughout the area. Accordingly, they would require formal assessment for an appropriate level of crossing treatment.

7.6.2 Grade Separations

The other component of road-rail interfaces element includes grade separations of highways. An assessment of the grade separations (representing 2.6% of total project construction costs) required for highways indicates three highways are intersected and, under the ARTC policy, trigger grade separations for all route options as detailed in Table 7-5.

Table 7-5 Highway Intersections

Highway Intersections	Route Alignment		
	Reference Design	Via Cecil Plains & Wellcamp	Via Cecil Plains & Kingsthorpe
Cunningham Highway	✓	✓	✓
Warrego Highway	✓	✓	✓
Gore Highway	✓	✓	✓

With no difference between the number of Highways intersected, this is not considered to be an element that would result in an overall, or significant, change in the relativity of total project costs for all options assessed.

7.7 Construction cost comparisons

Table 7-6 summarises the construction cost comparisons of the routes via Cecil Plains referenced against the current Inland Rail Reference Design route which is baselined. Common dollar costs per km were used across the three routes on the basis of the following:

- bridges/viaducts
- embankments with culverts
- embankments without culverts
- terrain (relatively flat)
- terrain (undulating)

The comparison has been provided as much as possible on a like-for-like basis according to comparable sections of the respective routes. The cost details are contained in spreadsheet that is commercial in confidence and is made available for the Australian Government's independent consultant to verify the integrity of the numbers and basis for calculations. The spreadsheet is not appended to this Information Paper.

Table 7-6 Construction cost: Routes via Cecil Plains compared with Reference Design route

	Reference Design	Via Cecil Plains & Wellcamp	Via Cecil Plains & Kingsthorpe
Added route construction cost	Baseline	+$281,935,889	+$208,067,309
Added cost to connect to Wellcamp	Baseline	-	+$95,448,250
Total added construction cost	Baseline	+$281,935,889	+$303,515,509

8 Property and Land Impacts

8.1 Sensitive receptors impacted by routes

To further underpin appropriate assessment of route options, data was collected on property impacts, including the proximity of residential and commercial 'sensitive receptors' to the notional centre-line of respective routes.

A desktop study was performed to identify residential and commercial sensitive receptors along the two Cecil Plains routes. To provide a like-for-like assessment against the Reference Design alignment, a check of the Reference Design Phase 2 noise and vibration sensitive receptors was performed to ensure consistency of the sensitive receptor assessment between phases of development of the Reference Design. On the basis that there were no changes in the phases, confidence could be gained in the application at a concept level of this approach across the route options. Sensitive receptors which were 200m from the centre line of each alignment option were identified and marked as either residential or commercial, and the numerical results of this investigation can be found in Table 8-1.

A description of how residential and commercial sensitive receptors were identified in this study can be seen below:

- Residential sensitive receptors - were identified as buildings or infrastructure which appear to be residential from visual inspection (e.g. have a driveway, have water tanks attached to the house for drinking water, normally green grass around the perimeter or balconies/ verandas attached to the house).
- Commercial sensitive receptors - were identified as buildings or infrastructure which appear to be commercial from visual inspection (e.g. large sheds, buildings with carparks for large numbers of vehicles, grain silos or buildings which do not appear to be set up for residents to livein).

It should be noted that multiple sensitive receptors can be located on individual lots, which can be either residential or commercial. The sensitive receptor numbers are summarised by route in Table 8.1. Of note also is that while there are some residential and commercial sensitive receptors that are common across the Reference Design route and the routes via Cecil Plains, there are a number of businesses and residences that would be newly impacted were either of the routes via Cecil Plains adopted, as is shown in Table 8.1.

Table 8-1 Number of newly impacted business and residences on the routes via Cecil Plains

MEASURE	ROUTE		
	Reference Design Route	Via Cecil Plains & Wellcamp	Via Cecil Plains & Kingsthorpe
Number of residences within 200m	104	134	234
Number newly impacted (not on the Reference Design route)	-	86	191
Number of commercial premises within 200m	58	62	65
Number newly impacted (not on the Reference Design route)	-	45	53

8.2 Area impacted by land type on each route

Data was also compiled on the area of land impacted by each route, calculated on an assumed 60m wide corridor, and identified by land type. The data is summarised in Table 8-2.

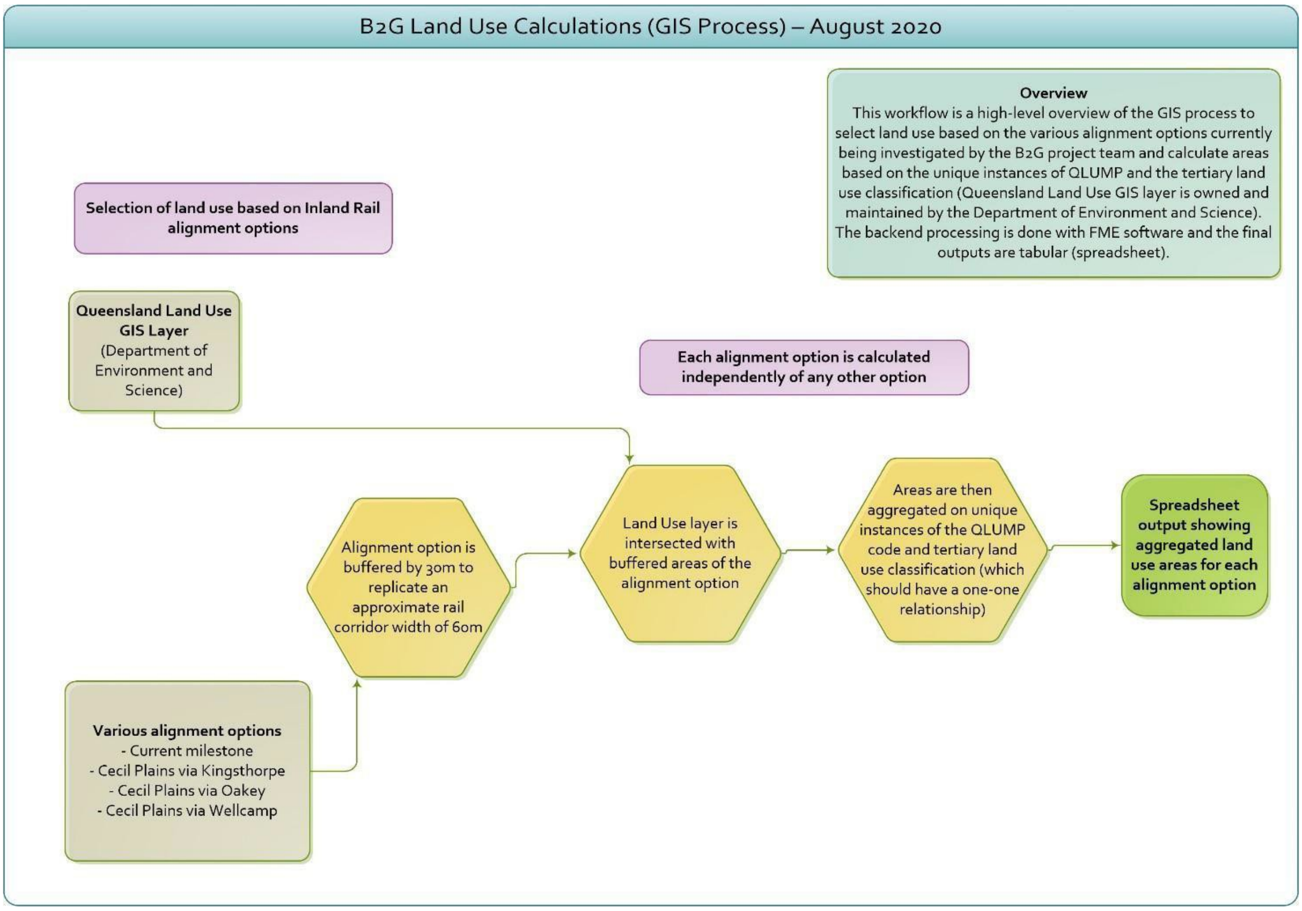
Table 8-2 Estimated land use impacts by area across the routes assessed

*Current Land use (QLUMP, tertiary level) crossed by alignment.	B2G Reference Design	Cecil Plains & Wellcamp	Cecil Plains & Kingsthorpe
ITEM	**Landuse Area (ha)**	**Landuse Area (ha)**	**Landuse Area (ha)**
Other minimal use	73.4	68.0	68.8
Residual native cover	0.0	1.3	1.3
Grazing native vegetation	618.2	421.0	467.1
Production native forests	86.5	534.8	534.8
Grazing modified pastures	5.1	5.6	0.0
Cropping	407.7	222.6	197.5
Land in transition	1.9	1.9	1.9
Irrigated cropping	32.8	89.4	83.2
Irrigated cotton	8.2	28.7	28.7
Irrigated perennial horticulture	3.9	0.0	0.0
Intensive animal production	0.2	0.2	0.2
Horse studs	3.9	0.0	0.0
Manufacturing and industrial	1.8	4.1	4.1
Residential and farm infrastructure	0.0	0.2	0.2
Urban residential	1.2	1.1	1.3
Rural residential with agriculture	6.4	2.3	1.1
Rural residential without agriculture	1.4	1.9	3.1
Farm buildings/infrastructure	0.2	2.9	2.9
Services	0.7	4.0	4.0
Commercial services	0.1	0.0	1.1
Recreation and culture	0.0	4.2	4.2
Roads	2.2	0.3	0.7
Quarries	0.8	2.2	2.2
Reservoir/dam	0.0	0.0	0.0
River	0.0	0.3	0.3
Total (ha)	1256.9	1397.1	1408.7

**Notional 60m wide corridor used for each alignment.*

A diagrammatic representation of the methodology applied for determining respective land impacts is provided at Figure 8.1 below.

Figure 8.1: Diagrammatic representation of methodology to calculate land use impacts



8.3 Estimated value of land impacted

Estimates were made of the total value of land impacted by each route and the differences are summarised in Table 8-3. Given the scope of the assessment, a number of assumptions have had to be made in estimating the value of land impacted by the routes as follows:

- the land area is based on a 60m corridor width and hence lower disturbance footprint (i.e. B2G Reference Design route)
- all land within the 60m corridor width is assumed to be taken
- calculations of land value are based on a desktop assessment by applying an assumed value rate per hectare according to land type/use, the rates based on previous desktop valuation advice
- in addition to land value, other compensable items such as Injurious Affection, Severance and Disturbance is percentage based, and has not been analysed per land parcel
- no allowance for Biodiversity offsets
- a 1:5 offset has been assumed for revocation of state forest as required in Queensland
- no allowance for Native Title extinguishment compensation
- no allowance for sale of surplus land.

While it is acknowledged that desktop assessments carry a greater degree of risk of variation than would be expected from a detailed physical inspection of the impacted properties along the project alignments, given that the same methodology has been applied across all three routes this should not make any material difference. The final alignment and design are not known until detailed design occurs and this impacts on ability to assess actual compensation at this point.

Having said that, there is a sound appreciation of the likely total compensable cost for land impacted by the Reference Design route and it is not considered that the total would make a material difference to the assessment of cost competitiveness of the routes via Cecil Plains. For example, each additional $10 million of total compensable cost for the Reference Design route represents less than 2% of the additional total direct construction, operating, maintenance and value of time costs for each of the two routes via Cecil Plains.

To manage the risk of variations from actual compensation estimates and other indirect costs (e.g. services relocations, road realignments) a negotiation allowance (elasticity) has been included within the estimate, and while the value estimates are based on historical transactional evidence a detailed market analysis has not been undertaken. There is consequently a risk that land rates will increase into the future, therefore the actual compensation at the time of land resumption may be higher than assumed in the current estimating.

Table 8-3 Estimates value of land impacted by routes

B2G Reference Design	Cecil Plains & Wellcamp	Cecil Plains & Kingsthorpe
Baseline	-$30.7m	-$25.4m

9 Route Impacts on the Inland Rail Service Offering: Cost Competitiveness with Road Freight

The information in this section has been compiled using ARTC's "Commercial Value of Scope Change" model to permit an assessment of the cost competitiveness with road freight of the routes via Cecil Plains using an economic methodology developed to assist in evaluating incremental changes to Inland Rail scope. This uses a benefit-cost approach to examine the incremental costs of the change in either or both of transit time and distance.

9.1 Rail freight operating and track maintenance costs

Changes in transit time and route distance have a direct impact across a broad range of cost factors:

- Train crewing costs – directly affected by transit time
- Fuel consumption – influenced by both distance and transit time
- Locomotive and wagon maintenance – longer distance increases the maintenance requirement
- Locomotive and wagon utilisation (capital) – utilisation is proportionate to transit time so slower transit times reduce rolling stock utilisation and require a larger fleet to carry the same amount of freight
- Track maintenance and network operations – a function of distance and train tonnage

Freight operating and maintenance costs are variously determined by the increase in distance or transit time, as shown in Table 9-1. Fuel consumption is predominantly determined by distance but also has a time-related component.

Table 9-1 Distance and time factors that drive operating and maintenance costs

Factor	Driven by	
	Distance	Transit Time
Train crewing		✓
Fuel consumption	✓	✓
Loco and wagon maintenance	✓	
Loco and wagon capital		✓
Track maintenance / network operations	✓	
Freight 'value of time'		✓

The methodology does not include 'externality' effects such as changes in safety (accident rates) or greenhouse gas emissions, although these are included in the broader 2015 Inland Rail Programme Business Case on a whole of program basis.

Unit rates used in the modelling are from ARTC's "Commercial Value of Scope Change" model for analysing above rail operations and have been applied in the same manner to each of the routes. Unit rates are multiplied by the annual number of trains (consistent with the Inland Rail Business Case) and the incremental change in either distance or time, as relevant to the specific factor. Present values of the future stream of benefits / disbenefits are calculated over an evaluation period to 2075 at a 4% discount rate, being the core discount rate in the 2015 Inland Rail Programme Business Case.

The factors taken into consideration in the model represent 100% of the factors considered when calculating the operating costs.

Disaggregated results for the two routes via Cecil Plains when compared with the current Reference Design route are shown in Tables 9-2 and 9-3. Note that the figures in Tables 9-2 and 9-3 are the resultant increased costs associated with longer distance and transit time, taking the Reference Design route as the baseline point of comparison.

Table 9-2 Increase in operating and maintenance costs of route via Cecil Plains and Wellcamp

Summary – Route via Cecil Plains and Wellcamp			
	Time cost ($)	Distance cost ($)	Total Cost ($)
Freight operating cost increases compared with Reference Design route to 30/06/2075			
Subtotal – train operation costs	$11,385,651	$82,316,437	$93,702,088
Below rail (ARTC) cost increases compared with Reference Design route to 30/06/2075			
Track maintenance	-	$96,887,952	$96,887,952
Total Above + Below Rail cost increases	$11,385,651	$179,204,389	$190,590,040

Table 9-3 Increase in operating and maintenance costs of route via Cecil Plains and Kingsthorpe

Summary – Route via Cecil Plains and Kingsthorpe			
	Time cost ($)	Distance cost ($)	Total Cost ($)
Freight operating cost increases compared with Reference Design route to 30/06/2075			
Subtotal – train operation costs	$9,617,009	$88,468,199	$98,085,208
Below rail (ARTC) cost increases compared with Reference Design route to 30/06/2075			
Track maintenance	-	$104,128,689	$104,128,689
Total Above + Below Rail cost increases	$9,617,009	$192,596,888	$202,213,897

9.2 'Value of time' savings for freight users

This relates to the value placed by freight customers on having time sensitive freight delivered earlier than delivery times offered by alternative options. Lower transit times generates value within the relevant supply chain of decreased cost (e.g. through lower inventory requirements) and increased willingness by customers to pay for an earlier delivery.

'Value of time' savings are derived using values from ARTC's elasticity (demand) modelling that are also used across the ARTC network. The resultant increases for each of the two routes via Cecil Plains when compared with the current Reference Design route are summarised in Table 9-4. The 'value of time' calculation is derived from a weighted average of the number of trains per week, based on the Inland Rail 2039/40 peak train plan.

Table 9-4 Increase in freight value of time costs of routes via Cecil Plains to 30/06/2075

Summary – Route via Cecil Plains and Wellcamp			
	Time cost ($)	**Distance cost ($)**	**Total cost ($)**
Freight value of time cost (end customers)	+$150,722,709	-	+$150,722,709
Summary – Route via Cecil Plains and Kingsthorpe			
Freight value of time cost (end customers)	+$127,309,512	-	+$127,309,512

9.3 Impact on reliability

Reliability refers to the achievement of the advertised time for pick-up of freight at the destination terminal. The 2015 Inland Rail Programme Business Case set a target of 98% reliability, which means that 98% of the time freight will be able to be picked up by the customer or their delivery agent at the time advertised by the train operator.

Reliability is directly linked to transit time (and hence distance) and any added time impacts the ability of a route to meet the 98% reliability target.

In support of the 2015 Inland Rail Programme Business case, ACIL Allen developed and applied its "Reliability Buffer Model" which was developed based on real-world data supplied by ARTC from performance on the interstate coastal route between Melbourne and Brisbane. The model was developed to calculate overall reliability performance from the time a train departed a terminal until the time freight departed the receiving terminal via truck or train.

Applying model to the two routes via Cecil Plains resulted in each route delivering reliability performance of 97%, below (albeit marginally) the reliability target set for the Inland Rail Reference Train and which is met/supported by the Reference Design route.

9.4 Impact on availability

Availability relates to the availability of suitable train paths at the times that suit the needs of the market. It refers to the percentage of available departure and arrival services that are convenient for customers, which depends on cut-off and transit times, and is calculated for the Inland Rail Reference Train.

To ensure a door-to-door competitiveness of Inland Rail with road freight, the following are assumed in the Inland Rail Business Case in addition to the 24-hour line-haul transit time: pick-up and delivery (PUD) activities add approximately four hours, a time of two hours between cut-off and train departure is allocated and the buffer to ensure reliability of delivery is expected to add a further 3.7 hours.

Any increase in line-haul transit time by definition therefore impacts freight availability, as was recognised by the 2015 Inland Rail Programme Business Case [refer Table 5.2 on p.98 of the Business Case].

Table 9-5 shows the impact of increased transit time on freight availability performance.

Table 9-5 Impact of increased transit time on freight availability performance

Inland Rail – Impact of transit time on Availability		
	Transit Time (hrs) (2025)	**Availability (%)**
Inland Rail	21.3	95%
Coastal Rail	32.9	54%
Change	**11.6**	**-41%**
Impact of change in transit time (linear interpolation)		
+30 minutes	0.5	-1.8%
+1 hour	1.0	-3.5%
+2.5 hours	2.5	-8.8%
+5 hours	5.0	-17.7%
+7.5 hours	7.5	-26.5%
+10 hours	10.0	-35.3%

9.5 Impact of delay in Inland Rail becoming fully operational

A decision by the Australian Government to direct ARTC to cease progressing the current Reference Design route in favour of one or other of the routes via Cecil Plains would incur significant delays and additional costs. For example, were such a decision by the Australian Government to be made on 1 September 2020, it would delay the current schedule for the Border to Gowrie project by 30 months (minimum) resulting from:

- requirement to assess route to be included within any Initial Advice Statement to the Office of the Coordinator-General – 6 months
- consideration by the Office of the Coordinator-General and development of draft, then finalised, Terms of Reference for a project Environmental Impact Statement – 6 months
- preparation and finalisation of Environmental Impact Statement – 18 months (minimum).

These timeframes are comparable to those that applied to the development of the Reference Design route and are unlikely to be able to be shortened – if anything, the time period for finalising the draft EIS and maintaining the coordinated project status is likely to take longer than 18 months, given the experience with the current Reference Design route.

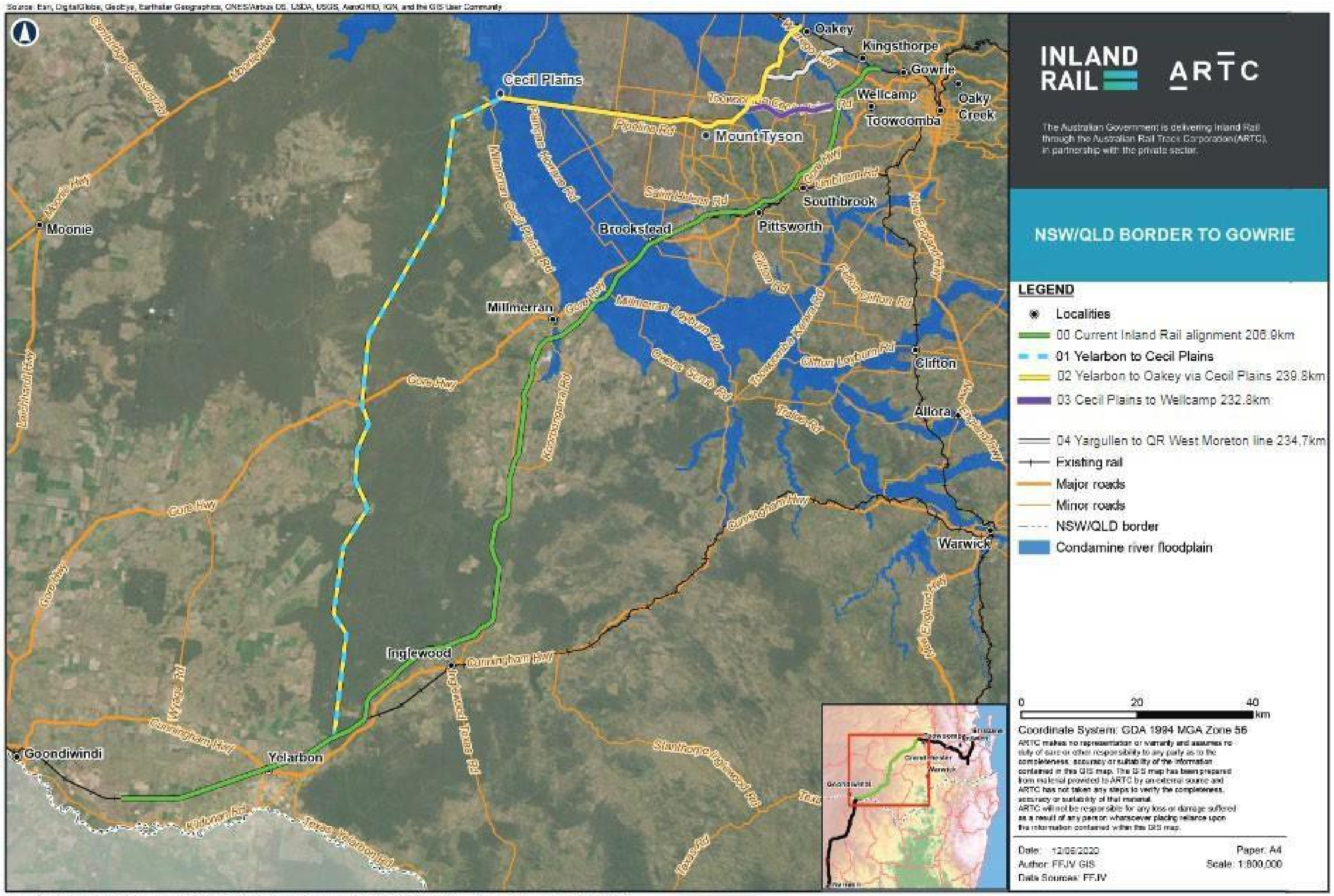
Based on the current schedule for the Reference Design route within Border to Gowrie, such a delay to the project would therefore make the completion of the Border to Gowrie project the program critical path and would see overall completion date for Inland Rail delayed by two years (approximate minimum delay). This is due to the fact that, as at August 2020, the completion date for the Border to Gowrie project is six months behind the critical path for the overall Inland Rail program (completion of the Gowrie to Helidon project which is one of the three projects to be delivered through the Public Private Partnership (PPP) in Queensland), and hence a 30-month delay in the project will delay the overall program by two years. Such a delay incurs real costs.

A two-year delay in commencement of full operations caused by a delay in the Border to Gowrie project will have the effect that for such period the three projects between Gowrie and Kagaru to be delivered by the PPP will be stranded assets, built and with liabilities accruing.

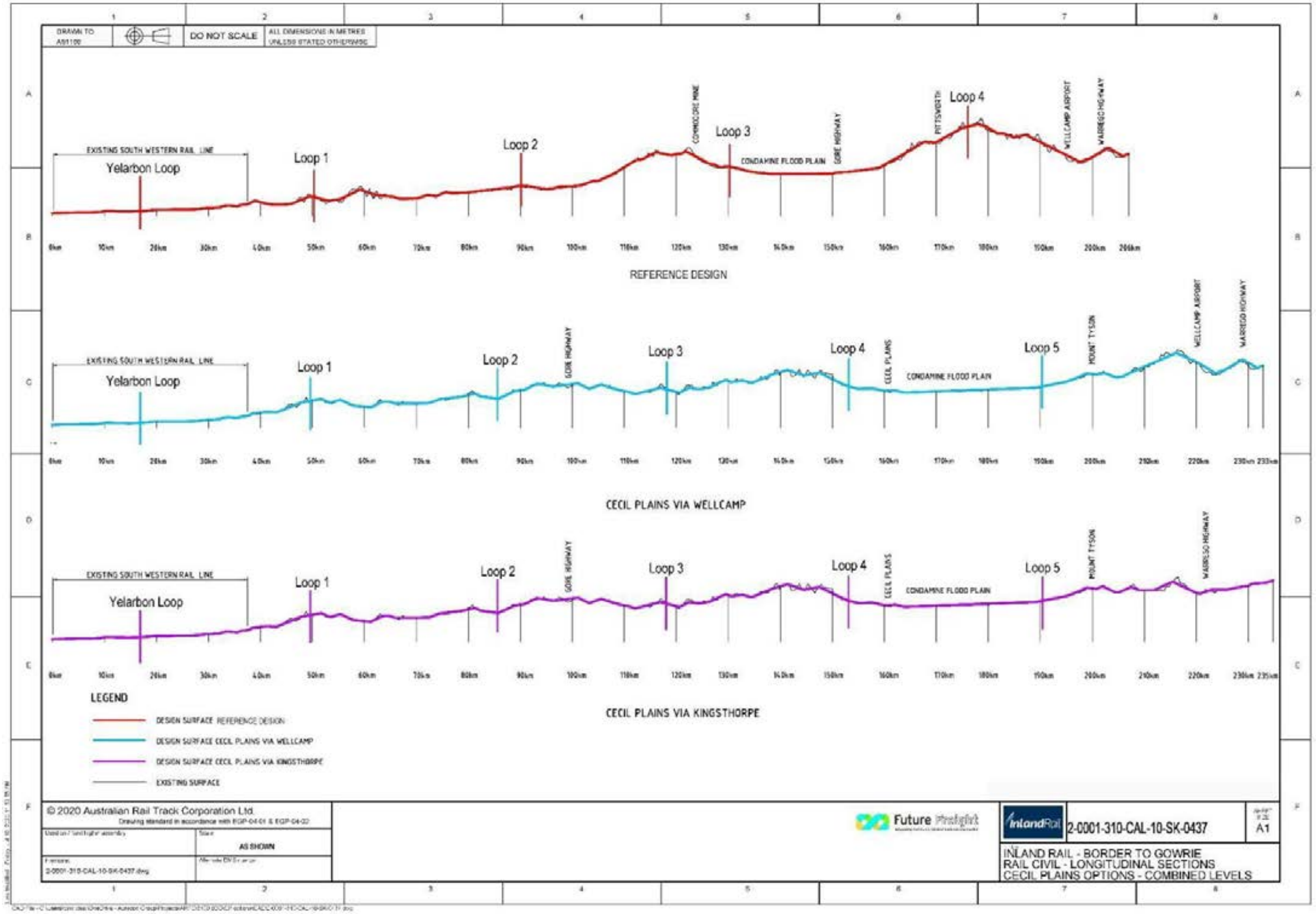
As the specifics of the above referenced costs are considered commercial-in-confidence they have not been included within this Information Paper. However, the referenced costs have been provided to the independent consultant engaged by the Department of Infrastructure, Transport, Regional Development and Communications.

The 2015 Inland Rail Programme Business Case modelling indicated that the net benefits of Inland Rail would flow immediately from commencement of full. So, delaying the operation of Inland Rail by two years would reduce the overall economic benefits of the Inland Rail program for the period to 30 June 2075. The quantum of such reduced economic benefits has not been included within this Information Paper.

Appendix A : Map Showing Routes Assessed With Distances



Appendix B : Long Section Showing the Vertical Rail Height Overlayed for all Three Routes



Appendix C : Notes on 'optimisation' of routes via Cecil Plains

In compiling the data contained in this Information Paper, ARTC was cognisant of the fact that the proposal to examine the feasibility of a route via Cecil Plains commenced as a 'line on a map' that had not been engineered or optimised.

Accordingly, in preparing the data for the route through the state forestry to Cecil Plains, and then for each of the routes from Cecil Plains, the GIS strings were prepared by a qualified rail engineer who examined factors such as gradients and curvatures in developing the routes. So, in that sense the route has already been 'optimised' from that originally proposed.

In addition, ARTC considered whether there may be opportunities to 'improve' the route via Cecil Plains at the southern end in the vicinity of Inglewood or at the northern end in the vicinity of Cecil Plains.

It was considered that there is no practical way to improve the proposed route to Cecil Plains at the southern end, as moving west would take the route into more undulating terrain while taking the route to the east would take it away from the state forest and effectively replicate the Reference Design route in this section. AECOM and Aurecon in 2016 had assessed eight alternative routes proposed at the time and assessed each as being inferior to the then 2016 Base Case (Modified) route.

At the northern end of the route to Cecil Plains, two different options for potentially improving the route were considered as shown in Figure C1:

1. a route that deviated from the 'forestry route' approximately 19.6km south of Cecil Plains (the light blue line in Map C1) that totals 45.6km in length; and

2. a route that deviated from the 'forestry route' approximately 24.8km south of Cecil Plains (the red line in Map C1) that totals 42.3km in length.

Figure C1: Map showing two alternative routes considered near Cecil Plains

By comparison, the route via Cecil Plains from the point at which Option B deviates to the point at which it intersects again with the Option B route is 53.2km in length.

It was considered preferable, in order to represent as positive a comparison with the Reference Design route as possible, that each route option should cross the Condamine floodplain on an angle as close to 90^{o} as feasible. As a result, each 'route option' was aligned in the same general north-west direction from its respective point of deviation and continued to join with the existing disused rail corridor at a common location approximately 28km from Cecil Plains.

The alternative routes did reduce overall distance in comparison with the 'forestry route via Cecil Plains', by a distance of 7.6km ('route option A as described above) and 10.9km (route option B as described above). Each route resulted in a slightly improved transit time relative to the 'forestry route via Cecil Plains' as shown in Table C1 but the transit times on each route option remained slower than for the Reference Design route.

Table C1: Relative transit time of route options considered against the route via Cecil Plains

MEASURE	ROUTE		
	Forestry Route via Cecil Plains	Option A Deviation (19.6km south of Cecil Plains)	Option B Deviation (24.8km south of Cecil Plains)
Distance	53.2km	45.6km	42.3km
Transit time differential (northbound) versus route via Cecil Plains*	Baseline	-00:06:02	-00:08:40
Transit time differential (northbound) versus Reference Design	+00:19:12	+00:13:10	+00:10:32

**Based on application of an average speed of 75.4kph which is the average speed for the route via Cecil Plains and Kingsthorpe*

The indicative positives and negatives of each of the two 'route options' compared with the 'forestry route via Cecil Plains' are set out in Table C2.

While the two 'route options' offered potential construction cost savings in terms of the overall length of track this potential cost saving was almost entirely offset (>%95) in each case by the longer bridges and embankments with culverts required.

The original rationale proposed in February 2017 for consideration of the 'forestry route via Cecil Plains' was that such a route potentially impacted fewer private landowners and also potentially offered a superior crossing of the floodplain. Considered against this original rationale, each of the two 'route options' was considered significantly inferior to the 'forestry route via Cecil Plains', and hence against the Reference Design route.

Table C2: Relative performance of route options considered against the route via Cecil Plains

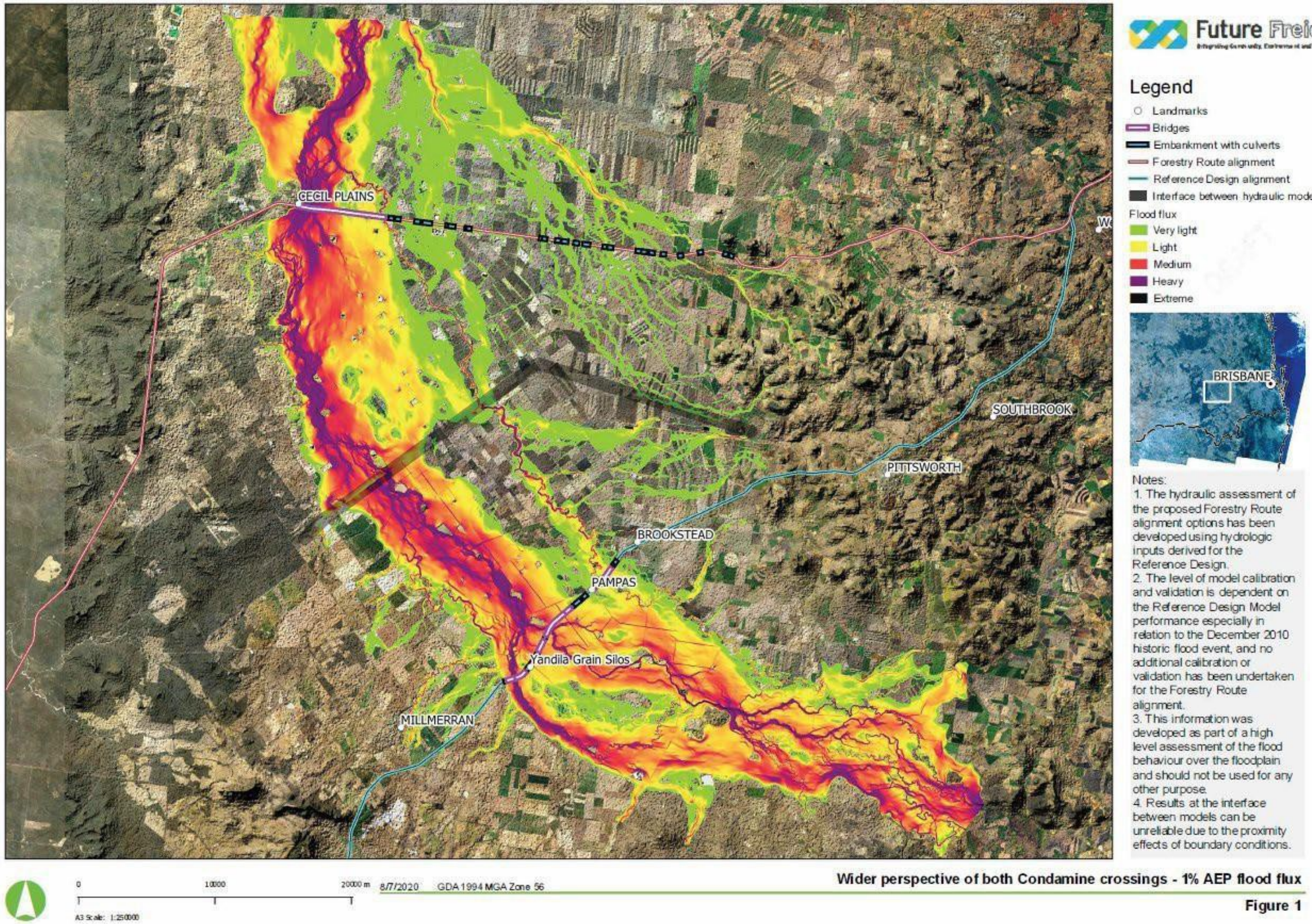
MEASURE	ROUTE		
	Forestry Route via Cecil Plains	Option A Deviation (19.6km south of Cecil Plains)	Option B Deviation (24.8km south of Cecil Plains)
Distance	X	✓	✓
Transit time	X	✓	✓
Length of track in existing (disused) rail corridor	✓	X	X
Length of track in greenfield corridor	✓	X	X
Length of Condamine Valley floodplain crossed	✓	X	X
Length of bridge required	✓	X	X
Length of embankments (with culverts)	✓	X	X

MEASURE	ROUTE		
	Forestry Route via Cecil Plains	**Option A Deviation (19.6km south of Cecil Plains)**	**Option B Deviation (24.8km south of Cecil Plains)**
Private properties requiring severance	✓	X	X

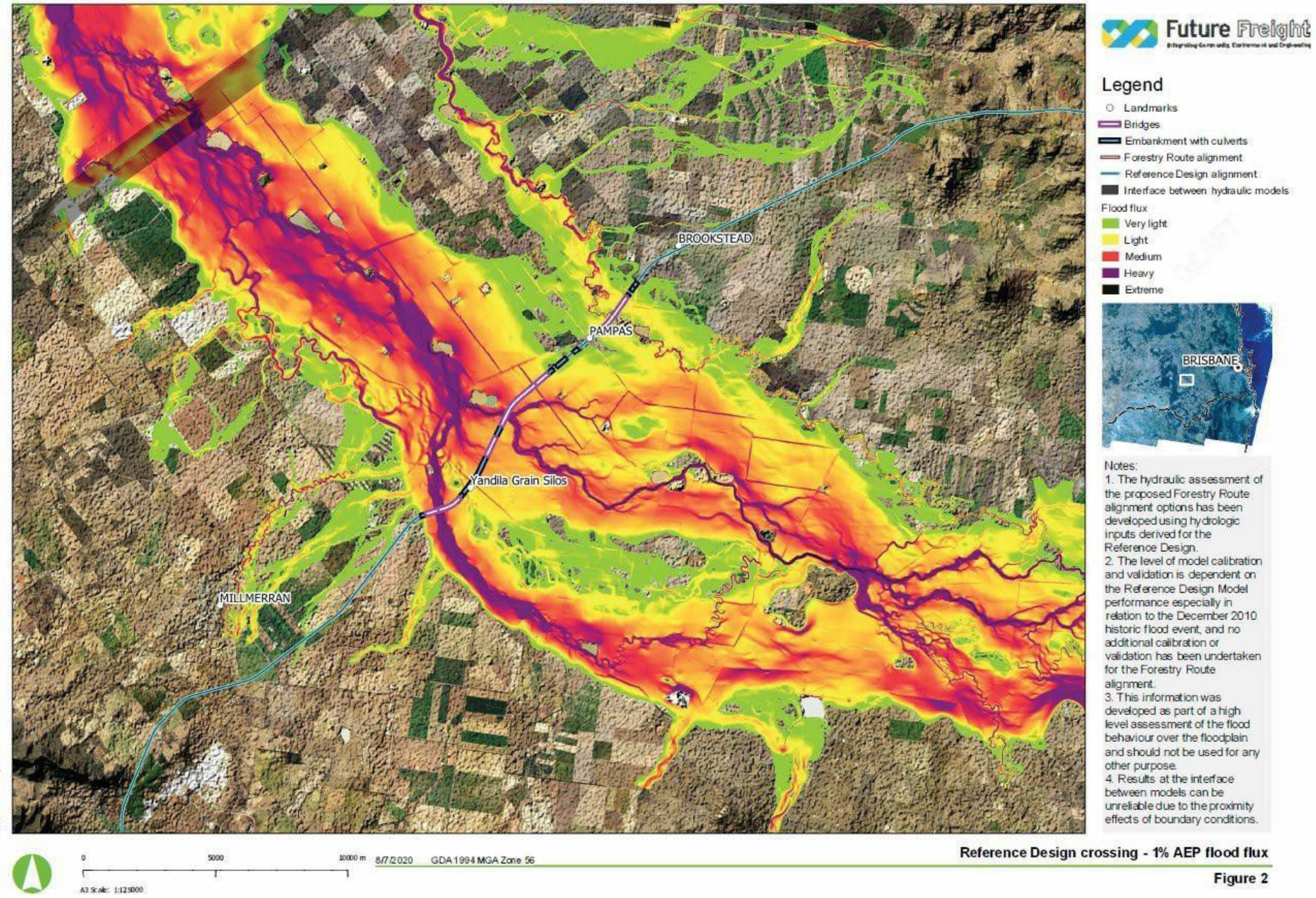
On the basis of the above, and considerations summarised in Table C2, it was not considered that it would be possible to undertake sufficient additional ‘optimisation’ of the route via Cecil Plains and Wellcamp so as to make a material difference to the assessment of the route in comparison with the Reference Design route.

Appendix D : Three Maps Showing Extent of 1% AEP Flood Flux in Condamine Floodplains Crossed by the Routes Assessed

Map D1: Wider perspective of both Condamine crossings – 1% AEP flood flux



Map D2: Reference design crossing – 1% AEP flood flux



Map D3: Forestry route via Cecil Plains – 1% AEP flood flux