Appendix P3 – Recommended Road Safety Policies and Practices – CASR

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Recommended road safety policies and practices for Kangaroo Island Plantation Timbers

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Recommended road safety policies and practices for Kangaroo Island Plantation Timbers

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ABSTRACT

On Tuesday October 3 2017, a workshop was conducted at CASR to discuss haulage operations for a plantation forestry business (Kangaroo Island Plantation Timbers) about to commence on Kangaroo Island. Representatives of CASR met with representatives of KIPT to discuss various options for enhancing the safety of the road transport aspect of the business. The aim of this report is to provide a summary of the discussion at the workshop. Specifically, it is designed to highlight the recommended policies and practices that KIPT could consider to achieve a high level of safety for its haulage operations on KI. Policies and practices likely to yield safety benefits are listed so that KIPT can choose those within its organisational, environmental and budgetary capacity. In order to aid interpretation of the report, it is structured in terms of four 'pillars' of the Safe System, which is the current best practice philosophy guiding road safety: safer roads, safer road users, safer vehicles, and safer speeds.

KEYWORDS

Heavy vehicle, safety, telematics, occupational safety, safer road users, safer roads, safer vehicles, safer speeds

Summary

KIPT is a private company planning to commence a plantation forestry operation on Kangaroo Island, with the aim of direct exports to the Asian market, firstly of timber, then of wood chips. In order to export its products, KIPT needs to transport timber or wood chips from its plantations at various locations on Kangaroo Island to the proposed facility at Smith Bay. KIPT wishes to undertake this operation in a way that is safe, both for those working within the business but also for all other road users. In order to investigate options available to achieve a high level of safety for its haulage operation, KIPT sought the input of the Centre for Automotive Safety Research (CASR) at the University of Adelaide.

A workshop was held at the offices of CASR on Tuesday October 3 2017, during which four representatives of CASR (Assoc Prof Jeremy Woolley, Assoc Prof Paul Hutchinson, Dr Matthew Baldock, Dr Jamie Mackenzie) met with Peter Lockett (Approvals Manager, KIPT), Anna Osman (Principal, Osman Solutions), and David Winterburn (Environmental Engineer, Approvals, KIPT). Various options for achieving a high level of safety for the haulage operation were discussed. To summarise these briefly, the following suggestions can be made. These are organised according to the Safe System pillar to which they belong.

Safer roads

If feasible, seal all roads used for the freight operation, and apply safety treatments such as wide centrelines and roadside barriers.

If road sealing is not feasible, upgrade roads used for the freight operation, including necessary road widening, vegetation clearing, and the use of crossfalls and shoulders suitable for heavy vehicles.

Where necessary, upgrade any bridges on the roads used for the haulage operation so they are suitable for heavy vehicles.

Consider trialling virtual fences in wildlife hotspots.

Consider sealing major intersections on the route used for the freight operation in order to maximise intersection visibility.

Use intelligent electronic active warning systems and temporary lower speed limits when a truck is approaching intersections on the freight route. Consider signage that can indicate if a particular road is currently active with haulage operations.

Safer road users - KIPT drivers

Contract transport operations to a company with well-developed policies and a good record regarding fatigue management and overall safety. Also, require the use of telematics in the trucks that are able to operate in the area on KI where the harvesting and freight will be operating. Telematics can monitor many aspects of the freight operations, including safety related factors such as work hours and travelling speed.

Provide quality facilities at the proposed depot on McBrides Rd to facilitate rest breaks.

Consider the use of devices such as Driver State Screening to manage fatigue.

Consider the use of in-vehicle cameras to assist with managing fatigue, driver distraction, restraint use etc. When applicable, use footage to investigate incidents, and prioritise education of drivers rather

than punishment. Conduct regular meetings individually and in groups that reinforce a safe driving culture using audit information as triggers or examples.

Use policies and practices (including workplace testing) to ensure that no driving is undertaken when a driver is impaired by alcohol or other drugs.

Pay drivers high wages and per time worked, rather than per load or distance driven.

Safer road users - other road users

Consider providing devices to other fleet vehicles on KI (e.g. school buses) to alert drivers of the presence of trucks.

Attempt to divert cyclists and tourists away from the freight route; if diversion is not possible seek to provide segregated facilities.

Consider using Bluetooth nodes to alert other road users of the presence/number of trucks.

Consider making all driving and safety-related data publicly available.

Safer vehicles

Use High Productivity Vehicles (HPVs) if possible.

Require trucks to be fitted with the latest suite of safety technologies available at the time of purchase; at present autonomous emergency braking, electronic stability control, and side viewing video cameras should be adopted.

Require trucks to be fitted with under-run protection (front, rear and sides).

Require trucks to have a conspicuous livery.

Consider also applying all safety-related requirements to the water carts and other vehicles used in the operation.

Safer speeds

As indicated above, use intelligent electronic active warning systems and temporary lower speed limits when a truck is approaching intersections on the freight route. Active warning systems might also be used to warn the truck to pull over until passengers have alighted from school or tourist buses.

As above, monitor driving speeds with telematics.

Apply speed limiting to the trucks, choosing a speed appropriate to the roads being used.

It may be appropriate to operate the trucks at speeds lower than the posted speed limit where high risk is involved, such as at significant intersections.

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1 Introduction

1.1 Kangaroo Island Plantation Timbers (KIPT)

KIPT is a private company planning to commence a plantation forestry operation on Kangaroo Island, with the aim of direct exports to the Asian market, firstly of timber, then of wood chips. In order to export its products, KIPT needs to transport timber or wood chips from its plantations at various locations on Kangaroo Island to the proposed facility at Smith Bay. KIPT wishes to undertake this operation in a way is safe, both for those working within the business but also for residents of KI interacting with KIPT transport operators. In order to investigate options available to achieve a high level of safety for its haulage operation, KIPT sought the input of the Centre for Automotive Safety Research (CASR) at the University of Adelaide.

A workshop was held at the offices of CASR on Tuesday October 3 2017, during which four representatives of CASR (Assoc Prof Jeremy Woolley, Assoc Prof Paul Hutchinson, Dr Matthew Baldock, Dr Jamie Mackenzie) met with Peter Lockett (Approvals Manager, KIPT), Anna Osman (Principal, Osman Solutions), and David Winterburn (Environmental Engineer, Approvals, KIPT). Various options for achieving a high level of safety for the haulage operation were discussed.

1.2 This report

The aim of this report is to provide a summary of the discussion at the workshop. Specifically, it is designed to highlight the recommended policies and practices that KIPT could consider to achieve a high level of safety for its haulage operations on KI. As CASR is not privy to the budget available for KIPT operations, it is not in a position to make direct recommendations. Rather, policies and practices likely to yield safety benefits are listed so that KIPT can choose those within its organisational, environmental and budgetary capacity.

In order to aid interpretation of the report, it is structured in terms of four 'pillars' of the Safe System, which is the current best practice philosophy guiding road safety: safer roads, safer road users, safer vehicles, and safer speeds.

2 Safer roads

One of the chief challenges of the KIPT operations will be the necessity of using the Kangaroo Island road system, which features a high proportion of roads unsuitable for major haulage operations that utilise large trucks such as A doubles. It was stated that the roads on KI in the vicinity of the plantations and port 'must be fixed'.

Most of the roads to be used by KIPT are unsealed, in many cases quite narrow, and are often surfaced with limestone. When a vehicle travels on such roads, this limestone surface creates clouds of 'white dust' that can markedly affect visibility for anyone following. Considerable maintenance of these roads is required. Water trucks may need to be employed to reduce dust, and routine dust suppressant treatments, including polymer sealants, may need to be applied.

One obvious solution is to seal all the roads linking plantations to the port. Sealed roads would provide a firmer surface with greater traction, with likely safety benefits. Sealed roads also provide the opportunity to incorporate a number of safety features absent on unsealed roads, such as vibrating edge lines and wide centrelines or centre barriers (which reduce head on, and some roadside collisions). Issues with dust from unsealed roads would be eliminated and maintenance costs would also be reduced; the suggested lifespan of the new roads would be in the vicinity of 14 to 18 years if completed to a high standard.

However, undertaking the sealing of all necessary roads would require complete re-engineering and reconstruction of the roads, plus all additional related processes, such as examining all road curvature for appropriate speed advisories. It is thought that this is prohibitively expensive.

As conversion of all haulage routes to sealed roads is viewed as impractical at this time, other less costly road-based interventions are required.

If roads are to remain unsealed, major upgrades to the roads will still be necessary. Some roads will need to be widened, vegetation cleared (with associated re-planting as required by relevant environmental policies), and both crossfalls and shoulders tailored to heavy vehicles. Current crossfalls on many roads are currently 6%, becoming 5% after compacting of the surface, which is still steep for large trucks. A crossfall of 3% is considered appropriate on sealed roads. If crossfalls are to be designed to suit heavy vehicles, drainage elements need to be incorporated to maintain the usability of the roads. In regard to shoulders, there are currently steep batter slopes in place along many roads (e.g.1:6), which could cause truck rollovers. Consideration should be given to providing recoverable areas for heavy vehicles where practicable; this in turn should provide sufficiently forgiving areas also for light vehicles. Also, adequate drainage will be an important consideration, as the roads in some situations dip into waterways. Where it is not feasible to remove vegetation or achieve sufficiently gentle slopes in recovery areas, crash barriers should be considered but it is acknowledged that barriers commonly used in rural areas will predominantly benefit light vehicles rather than heavy vehicles (i.e. steel W-beam or wire rope).

One particular issue that was raised during the workshop was the inadequacy of some of the bridges on KI. Any possible route taken to the port requires crossing the Cygnet River. This means that all routes require crossing a bridge. Bridges need to meet a range of structural standards in order to be capable of supporting heavy vehicles. Many of those on KI that span the Cygnet River do not currently meet these standards. Most were built in the 1950s and 1960s, meaning that there is a possibility that they have weakened over time. It is understood that the bridge that would be used on the preferred KIPT route is regularly used by tourist coaches and other large vehicles, but it would still be advisable for this bridge, and others that may be used by KIPT heavy vehicles, to be examined by suitably

qualified engineers and any necessary upgrades undertaken. Barrier systems may also need to be added or upgraded on the approaches to protect road users from injury in collisions with the bridge structure (including deck rails) and also prevent damage to the bridge structure itself.

Another issue that is problematic in the region of the plantations and haulage routes is the presence of wildlife. Various native Australian animals, especially kangaroos, can encroach on the roads, causing a hazard. In some instances, there may be in excess of 20 kangaroos crossing the road at one time. Although dead animals by the roadside are a common sight on many roads in KI, it is desirable that haulage operations do not contribute to this. One option is so-called virtual fencing, which is being trialled in a number of locations, including Kangaroo Island. Such virtual fences could be used at locations where wildlife is known to be particularly prevalent. Assuming that even virtual fences do not eradicate the problem, some kind of management of wildlife deaths may be necessary as part of the operation (e.g. use water carts to also pick up any dead animals). It is also worth noting that the use of High Productivity Vehicles like A doubles (see Section 4) to reduce the number of trucks on the road will reduce this problem to a degree.

Another animal-related issue is livestock. Sheep farming remains one of the largest agricultural industries on Kangaroo Island and the movement of flocks of sheep across haulage routes will need to be managed. KIPT will need to establish good relationships with farmers in the area and negotiate livestock movement patterns that minimise disruption to haulage, and minimise risks to the livestock.

Heavy vehicles can have difficulties when negotiating steeply sloping roads. The topography on Kangaroo Island does include some hills, which could cause some problems for the KIPT fleet. When climbing a steep slope, an A-double or B-double will travel slowly, which could hold up any following vehicles. This could result in drivers making dangerous overtaking decisions. A different problem occurs on down slopes. Long, sustained down slopes can lead to brake fade if the truck enters the descent in too high a gear. Such problems can occur, for example, on the South Eastern Freeway as it approaches Adelaide. One particular down slope that will be encountered by the KIPT fleet will be the descent into Smith Bay at the end of the haulage route. This slope apparently covers a distance of 400m. This is not long enough to pose a major risk of brake fade on any individual run. However, drivers should be trained in regard to the appropriate gear for making this descent, and in-vehicle telematics systems (see Section 3) should be monitored to ensure compliance with this mandated gear choice. Some run-out areas might also provide additional redundancy if they can be incorporated.

A major source of crash risk in the transport system is related to the conflicts that occur at intersections or other road junctions. If another vehicle fails to give way and is struck by a fast moving heavy vehicle, the results can be catastrophic. Another risk is right turning vehicles that have a layer of dust over their brake lights – the driver of a following heavy vehicle may not realise that a vehicle in front is slowing to execute a turn. Therefore, risks of collisions need to be minimised at intersections. Risks can be mitigated by making the intersection more obvious, by ensuring good visibility at the intersection so as to increase the likelihood of detection of other vehicles, by controlling speeds at the intersection, and by providing channelization (dedicated lanes for certain manoeuvres - sealed roads only).

One means of making the intersection more obvious on unsealed roads is to seal the intersection. This could be considered for the most major intersections on the haulage route. This could be combined with the use of geometric treatments that slow the traffic, such as tear shaped islands, raised tables or chicanes on the side approaches.

Four-way Stop signs can also be used to both signpost the intersection and control speeds. Four way Stop Signs require all vehicles to stop before proceeding, regardless of which road they are travelling

on as they approach the intersection. There is evidence that four way Stop signs reduce crashes (Guyano-Cardona, Sylvester & Jenkins, 2002; Lovell & Hauer, 1986; Persaud, Hauer, Retting, Vallurupalli & Mucsi, 1997) and approach speeds, especially on the more major road approaching the intersection (Eck & Biega, 1988).

However, low levels of enforcement and habituation to historically low traffic volumes on KI could result in low compliance. A better approach could be to use intelligent systems that detect the presence of an approaching truck and activate electronic signs. These signs could warn of the approaching truck (i.e. a variable message sign) and/or could temporarily reduce the speed limit. If drivers see that a speed limit has reduced, they may be more likely to comply with it than a permanent speed limit reduction, as a temporarily reduced limit provides an indication of the presence of some form of hazard. It has recently been reported that a trial of an electronic rural road intersection active warning system resulted in a 79% reduction in fatal and serious injury crash rates at 10 trial sites in New Zealand (Mackie, Brodie, Scott, Hirsch, Tate, Russell & Holst, 2017).

A final point that can be made is in regard to route choice. Generally, a safer route will be one involving fewer turning manoeuvres, and fewer intersections.

3 Safer road users

The discussion at the workshop touched on a number of issues related to safer road users. These included not only the drivers of the KIPT trucks but also other road users on KI likely to interact with KIPT vehicles. Clearly, there is a need for management systems that optimise driver behaviour among the KIPT drivers but other road users also need to be considered.

3.1 KIPT drivers

It is understood that KIPT plans to contract the haulage operation out to an established transport company, which may then subcontract some of the work to smaller operators based on KI. Although the drivers will therefore not be direct employees of KIPT, it is still possible to stipulate conditions in the contract concerning the hiring of drivers and various policies and practices applying to the transport operation itself.

Some of the driver-related issues that can affect the safety of transport operations are: fatigue or sleepiness, alcohol and other drugs, speed violations, and driver distraction. Note that 'fatigue' and 'sleepiness' are terms that are often used interchangeably but actually mean different things. 'Fatigue' refers to the physiological effects and degradations in performance arising from a long period of performing a particular task. Sleepiness refers to the desire to go to sleep, which can be affected by various factors such as amount and quality of recent sleep, time of day, length of time awake, various medical conditions etc. Nonetheless, for the sake of simplicity, and in keeping with much of the literature, the term 'fatigue' here will be used to refer to both fatigue and sleepiness.

One of the characteristics of the planned haulage operations that will mitigate the risks of fatigue-related incidents is the decision not to drive at night. Law and Jones (2016) report that the total number of what they call 'fatigue events' for a large transport company is highest between midnight and 5am, with a particular peak around 4am. The most marked circadian trough, when the body is naturally at its most sleepy, occurs between 2am and 4am. However, there is another smaller circadian dip after lunch (around 2pm to 4pm), so fatigue still needs to be considered even during a daytime only operation.

Any major transport company with experience with heavy vehicles should be well-versed in the necessary policies and practices that should apply to fatigue management. In reviewing tenders for the transport operation contract, consideration needs to be given to the tendering company's policies and record in fatigue management. Of particular interest will be the company's use of telematics and in-vehicle technology to manage fatigue and comply with regulations. Telematics can be used to monitor work hours and drive time, and can include electronic work diaries that ensure compliance with legislation. Furthermore, such systems can provide warnings to drivers and operators if a driver is in need of a rest break. Intelligent systems can even provide indications of available spaces at rest stops. An issue that may need to be examined, however, is any gaps in telecommunication capability on KI that may negatively affect the potential use of such technology.

In regard to rest breaks, it was indicated in the workshop that there will be a preference for drivers to rest at the proposed McBrides Rd depot rather than the Smith Bay facility. It will be important to provide adequate facilities for the drivers at the depot, both in terms of space but also quality, and amenities. Individual trips within the operation are not too long (mostly an hour, may increase to around two hours) so rest breaks from the activity of driving will necessarily be built into the operation. It was suggested that most drivers will live on KI rather than be fly in fly out workers. If so, it may be possible for a drop-home transport service to be provided, ensuring that drivers travel between home and the work site safely at the beginning and end of their shift.

In addition to telematics, more direct monitoring of fatigue can be accomplished through the use of in-vehicle cameras and specific fatigue detection products. One such fatigue detection product is the Driver State Screening (DSS) Machine, sold by a company called Seeing Machines. This is used by Toll Resources and Government Logistics (TRGL) (Law & Jones, 2016). This device captures eyelid and head motion through cameras mounted at eye level. When a micro-sleep is detected, audio and tactile warnings are given to the driver, video footage is captured and sent to a monitoring team, and then any necessary actions can be taken by the relevant site supervisor (e.g. require the driver to take a break). The use of this system has been reported to be associated with a substantial drop in fatigue events among the TRGL driver group, although it was noted that the introduction of the system coincided with a broader package of anti-fatigue measures, including the provision of health and wellbeing information (e.g. diet, exercise, sleep) to the company's drivers (Law & Jones, 2016).

In-vehicle cameras can also be used to monitor other driver-related behaviours. Toll NQX (long distance road freight group operating in northern Australia) has incorporated cameras in their heavy vehicles and has found them useful (Smith & Jones, 2016). Toll NQX monitor speeding compliance in their fleet and have graded responses to speeding breaches according to the seriousness of the breach and the number of times a particular driver has exceeded the mandated limit previously. This has been done using telematics systems. Telematics, however, were not able to provide a context for the behaviour. So cameras were installed, facing the road and facing the driver. Various events can trigger the recording of the camera footage and drivers can also activate recording when they sense that an issue or event is about to unfold. It was found at Toll NQX that the camera footage often provided a context to explain the behaviour of drivers which the telematics system may otherwise have recorded as an offence. In fact, often the camera footage was able to demonstrate examples of drivers taking important evasive action to avoid incidents when other road users had placed themselves at risk through unlawful or negligent actions. Such footage, it was argued by Smith and Jones (2016) could be used in 'share the road' campaigns. Most importantly, drivers have come to accept the presence of the cameras in their vehicles, and motor vehicle incidents have been trending downward since the introduction of the cameras in 2011. When incidents have occurred, the presence of the cameras has markedly reduced investigation times and cost.

Also of interest in the experience of Toll NQX with the cameras was that driver distraction was identified as an issue, matching the seriousness of the usual concerns of speed or fatigue. Various causes of driver distraction have been noted and remedial action, such as redesign of elements of driver cabins, have been undertaken. Additionally, the cameras have been able to detect non-use of seatbelts, following too close, and cornering too fast. A key component of the cameras is that they should be used as a tool for education of drivers, or for 'driver assistance', rather than in a punitive way.

The use of alcohol and other drugs is also an important issue within any transport operation. As is the case for fatigue management, any major transport company that will bid for the KIPT contract should have well-developed policies in regard to alcohol and other drugs. Any policies should be strictly applied. Of particular importance is that every effort should be made to prevent drivers from working when affected by alcohol or other drugs. Some level of workplace drug testing will be needed, ideally conducted in such a way that likely impairment can be determined (i.e. testing of oral fluid rather than urine for drugs; breath testing for alcohol).

Another means of affecting driver behaviour is the choice of the basis for pay rates. The traditional basis for payment in the transport industry has been to pay per distance driven or by delivery of the load. However, a number of studies have found negative effects of such pay rates, including greater propensity to speed, to travel longer distances, to work longer hours, to experience greater levels of fatigue, and to use illegal stimulants (Edwards, Davey & Armstrong, 2016; Williamson, 2007;

Williamson & Friswell, 2013). A pay system that removes the incentive to speed is payment per unit time of working. Knowing that they are being paid while at work, drivers are then able to make safety-based choices in the workplace and on the road. It has also been found that higher pay rates are associated with better safety outcomes (e.g. Belzer, Rodriguez & Sedo, 2002).

A final issue worth addressing is driver training. There is relatively little evidence in support of advanced driver training as a means of improving safety. Furthermore, there is evidence that advanced training which focuses on skills training (e.g. controlling the vehicle in emergency situations) may increase crash risk. Therefore, it is recommended that driver behaviour is addressed through overall policies, backed up with in-vehicle telematics, rather than spending money on so-called advanced driver training.

3.2 Other road users

In regard to road users other than the KIPT drivers, KI is characterised by large numbers of tourists, including international tourists, as well as a local population that is used to driving with very little risk of encountering enforcement (e.g. speed enforcement, random breath testing). Tourists can be problematic because they may be inexperienced in driving on unsealed roads, distracted by wildlife and the scenery, and in some cases not used to driving on the left side of the road. The lack of enforcement can mean higher levels of offending (speeding, drink driving) among local drivers. There are also growing numbers of tourist coaches, trail bike users and bicyclists. Other challenges include farmers driving tractors and other farming equipment, and school buses. Given the nature of many of the roads on KI and, residents often drive older vehicles, which are less likely to have modern safety technology.

An overarching consideration in regard to other road users is that the farming and tourism industries pre-date the KIPT operation and so it is incumbent on KIPT to consider the needs of these groups. The KIPT operation will chiefly be situated in an area north of the main tourist routes but interactions with tourists may still occur. Farmers will need to be consulted in regard to when they prefer to move their stock and their equipment, with some negotiation necessary to reach compromises. Telematics could potentially be used to alert drivers to the hazardous presence of livestock. Other road user groups with fleets of vehicles (e.g. local tourist coach operators and car hire businesses) could benefit from the provision of devices that alert them when a truck is approaching. This would be seen as a benefit for these groups and would also aid safety.

KIPT operations could conflict with school buses picking up and dropping off children. Currently, trucks need to pull over and stop when in the vicinity of buses. It would be worth KIPT meeting with school bus operators and getting detailed information on bus routes, so that any conflicts can be carefully managed. Again, it would be ideal if the buses could be fitted with technology alerting drivers to the presence of trucks, or devices allowing some form of communication between the two. This sharing of technology could assist with cooperation over road use and safety. It was also noted at the workshop that upgrades to communal pick up points on the bus route could also be beneficial, including relocation to reduce exposure of children to risk.

Cyclist numbers on KI are increasing and a number of roads have been developed to attract cyclists to use them. It would be preferable if cyclists could be directed to these roads and discouraged from using KIPT freight routes.

In regard to other general road users, it would be possible to set up Bluetooth nodes which detect the presence of trucks and alert other road users to their presence using variable message signs. Again, it would be preferable if recreational road users (e.g. tourists) could be discouraged from using KIPT routes.

Another suggestion made during the workshop was for KIPT to make its driving and safety data publicly available. Doing so would publicise the good safety record of the company and enhance its public image through demonstration of corporate transparency.

4 Safer vehicles

As noted in Section 3, KIPT is planning to sub-contract its haulage operation to a well-established transport company that will then manage this part of the operation, potentially including KI-based owner operators. This means that KIPT will not itself own any heavy vehicles. However, through the process of choosing the contracting transport company, KIPT will be in a position to stipulate the requirements of all vehicles used in its operations. That is, KIPT will be able to specify the types of vehicles used by any contracting or sub-contracting company, as well as any relevant characteristics of the vehicles, such as the safety technologies fitted to them.

In terms of vehicle type, KIPT's current plans are based on B-doubles, although the company has expressed a preference for A-doubles. A-doubles are classed, more broadly, as High Productivity Vehicles (HPVs). A recent report by Austroads (2014) examined the benefits of using HPVs. It was determined that substantial savings could be made in Australian industry through wider use of HPVs. The use of these vehicles leads to fewer fatalities, fewer crash claims, environmental benefits (e.g. fewer carbon emissions, reductions in greenhouse gas), and fewer cargo kilometres travelled. These benefits chiefly occur through a reduction in the number of vehicles on the road. Austroads estimated a benefit to Australia by 2030 of $12.6 billion through the use of HPVs. Jones (2016) noted that HPVs are often viewed with concern by the public due to their size, so if they are used by KIPT, there may need to be some readiness to publicly assuage community concerns regarding HPVs. It can be emphasised that HPVs mean that there will be fewer trucks on the road, which, in turn, will mean less disruption to normal traffic on KI, that overall safety risks to the community will be lower, and that the environmental impact of the traffic operation (not only emissions but also an direct effects on roads and the surrounding environment, including wildlife) will be lower.

One issue with A-doubles, however, is that roads need to meet particular standards before these trucks are permitted to use them (the State Government needs to provide its approval). Road upgrades would need to be undertaken in a manner that is mindful of requirements for the HPVs that KIPT is planning on using. It is worth noting that the road upgrades required for A doubles and B doubles are very similar, so being able to use A doubles will mean a similar level of expenditure on road upgrades but less wear on the roads due to a lower number of vehicles using them.

Another issue is that long combination vehicles may be difficult to overtake and policy options to manage the safe overtaking by other road users should be explored. Differing practices may be required in differing parts of the route depending on topography, road alignment and road facilities. There may be greater propensity for other road users to be more patient if they knew that the KIPT drivers cooperate and assist with opportunities to overtake for example, something quite achievable with the low volume of traffic expected.

Being able to specify the characteristics of vehicles used for the haulage operations on KI allows KIPT to request the presence of various safety technologies now available on heavy vehicles. Hoelzl (2015) estimated the likely fatality savings possible through uptake of various vehicle safety technologies, nominating autonomous emergency braking as the technology likely to have the greatest benefit, followed by lane departure warning, electronic stability control and fatigue warning system. KIPT's operation would be aided by requiring vehicles with autonomous emergency braking capabilities and electronic stability control.

Section 3, concerned with safer road users, also includes suggestions for in-vehicle technologies to maintain safety through influencing driver behaviour, such as in-vehicle cameras, driver state screening, and telematics. Camera systems may also be used for other purposes, such as providing the driver with a view of his or her blind spot, and of the trailers.

There has been recent advocacy for greater use of Co-operative Intelligent Transport Systems (C-ITS), including vehicle to vehicle (V2V) systems. Although this is likely to be of considerable value to heavy vehicle safety, the use of telematics within the KIPT fleet would remove the need for V2V systems, as central administration will be aware of where all the vehicles are at any point in time and is well placed to communicate or respond to any hazards on the haulage route.

Another emerging technology is that of autonomous, or driverless, trucks. Realisation of autonomous transport requires advanced vehicle technology in combination with appropriate road and digital infrastructure. One issue with the region where KIPT will be operating is that digital maps may be insufficient to support autonomous driving. Before driverless trucks can be considered, appropriate digital maps and network coverage will be necessary. It was also noted that, although some mining companies use driverless trucks, or trucks controlled remotely, this all occurs only at the mine sites, not on public roads. Nonetheless, the option of operating autonomous or partially autonomous heavy vehicles on a dedicated controlled access route into the future should not be ruled out.

Another safety feature that is used on many heavy vehicles is under-run protection. This involves the fitting of structural beams (often covered with panels) on the side and rear of trucks to prevent smaller vehicles 'running under' the truck, a situation that often results in severe impacts and injuries. Side under-run protection would also be advantageous when interactions with pedestrians, cyclists and motorcycles occur. Under-run protection would be a desirable component of the vehicles in the KIPT fleet, as it would demonstrate a commitment to ensuring the safety of other road users.

Another issue related to the vehicle fleet is its livery. The livery of a vehicle fleet provides a means of establishing corporate branding as well as aiding safety through enhanced conspicuity. First, in regard to conspicuity, it is ideal if the vehicles are of a colour that contrasts visually with the typical background (i.e. the local vegetation, road surface, sky). Fluorescent greens and yellows are commonly chosen these days to maximise conspicuity. Such choices apply to modern ambulances but also to the required attire of all road or roadside workers in Australia. Such colours are rare in nature (so a contrast with the background is likely), are bright and 'attention-grabbing', and are highly visible in both day and night time conditions (the brightness of various portions of the visible light spectrum varies with ambient illumination - e.g. red is less visible at night). However, any colour that is bright and which contrasts with the local environment throughout KI is likely to be beneficial for conspicuity, and therefore for safety. A consistent livery for all vehicles also assists with corporate branding and makes the conduct of a company's drivers more visible to other road users. Safe, appropriate driving practices exhibited in vehicles all similarly branded would be expected to assist with reinforcing overall corporate integrity and encouraging ongoing community support for the business.

One final consideration in regard to the vehicle fleet being used for the KIPT operation is the possible need for water carts already noted in Section 2. Heavy vehicles will likely create substantial clouds of white dust, which could cause damage to adjacent vegetation, hamper visibility for drivers of other vehicles, and cause degradation to the road surface. It therefore may be necessary to use water carts to drop water on the roads and reduce the dust problem. The potential requirement for water carts adds to the fleet requirements for the overall operation, and will presumably be a component of the tender for the transport company operating the haulage contract. Many of the safety considerations outlined throughout this report will also apply to the drivers and vehicles applying water to the roads.

5 Safer speeds

The travelling speeds of vehicles are an inherent component of the relative safety of the transport system, and are directly connected to various policies and practices in the Safe System pillars of safer roads, road users and vehicles. The speeds of vehicles can be affected by choice of speed limits; driver behaviour measures, including monitoring of speed choices through in-vehicle telematics; and speed limiting of vehicles.

In regard to speed limits, lower limits provide greater safety. Most of the roads on KI are unsealed and are presumably governed by the open road speed limit of 100 km/h in South Australia. One particular issue with the high speed limits on rural roads is that of conflicts at junctions. Drivers often have difficulty judging gaps when other vehicles are travelling at high speed, and high speed 'right angle' collisions often result in high levels of injury severity. As was noted earlier in the report, the use of variable speed limits that reduce when a truck is approaching a junction could provide the benefit of lower speeds, and greater speed compliance than a blanket lower limit.

Also noted earlier in the report, telematics can be used to monitor the travelling speeds of trucks and speeding events by the drivers. A graded response to speeding events is recommended, as practised by Toll NQX (Smith & Jones, 2016) (see Section 3).

A number of heavy vehicle-based transport companies limit their vehicles to speeds below the legislated 100 km/h. Lower travelling speeds often make little difference to travel times but save money through fewer road crashes, reduced fuel use and reduced maintenance costs. Toll NQX, for example, limit their B double trucks to 95 km/h (Smith & Jones, 2016). There can be concerns when heavy vehicles are speed limited that other vehicles will catch up to them and then feel compelled to overtake. On the other hand, a slower vehicle is easier and quicker to overtake. If KIPT decides to speed limit its vehicles, the speed chosen should be an appropriate one for the roads on which they will be driving.

6 Summary

The discussion at the workshop suggested that there are a number of options for achieving a high level of safety of KIPT's freight operation on KI. To summarise these briefly, the following suggestions can be made. These are organised according to the Safe System pillar to which they belong.

6.1 Safer roads

If feasible, seal all roads used for the freight operation, and apply safety treatments such as wide centrelines and roadside barriers.

If road sealing is not feasible, upgrade roads used for the freight operation, including necessary road widening, vegetation clearing, and the use of crossfalls and shoulders suitable for heavy vehicles.

Where necessary, upgrade any bridges on the roads used for the haulage operation so they are suitable for heavy vehicles.

Consider trialling virtual fences in wildlife hotspots.

Consider sealing major intersections on the route used for the freight operation in order to maximise intersection visibility.

Use intelligent electronic active warning systems and temporary lower speed limits when a truck is approaching intersections on the freight route. Consider signage that can indicate if a particular road is currently active with haulage operations.

6.2 Safer road users - KIPT drivers

Contract transport operations to a company with well-developed policies and a good record regarding fatigue management and overall safety. Also, require the use of telematics in the trucks that are able to operate in the area on KI where the harvesting and freight will be operating. Telematics can monitor many aspects of the freight operations, including safety related factors such as work hours and travelling speed.

Provide quality facilities at the proposed depot on McBrides Rd to facilitate rest breaks.

Consider the use of devices such as Driver State Screening to manage fatigue.

Consider the use of in-vehicle cameras to assist with managing fatigue, driver distraction, restraint use etc. When applicable, use footage to investigate incidents, and prioritise education of drivers rather than punishment. Conduct regular meetings individually and in groups that reinforce a safe driving culture using audit information as triggers or examples.

Use policies and practices (including workplace testing) to ensure that no driving is undertaken when a driver is impaired by alcohol or other drugs.

Pay drivers high wages and per time worked, rather than per load or distance driven.

6.3 Safer road users - other road users

Consider providing devices to other fleet vehicles on KI (e.g. school buses) to alert drivers of the presence of trucks.

Attempt to divert cyclists and tourists away from the freight route; if diversion is not possible seek to provide segregated facilities.

Consider using Bluetooth nodes to alert other road users of the presence/number of trucks.

Consider making all driving and safety-related data publicly available.

6.4 Safer vehicles

Use High Productivity Vehicles (HPVs) if possible.

Require trucks to be fitted with the latest suite of safety technologies available at the time of purchase; at present autonomous emergency braking, electronic stability control, and side viewing video cameras should be adopted.

Require trucks to be fitted with under-run protection (front, rear and sides).

Require trucks to have a conspicuous livery.

Consider also applying all safety-related requirements to the water carts and other vehicles used in the operation.

6.5 Safer speeds

As indicated in 6.1, use intelligent electronic active warning systems and temporary lower speed limits when a truck is approaching intersections on the freight route. Active warning systems might also be used to warn the truck to pull over until passengers have alighted from school or tourist buses.

As indicated in 6.2, monitor driving speeds with telematics.

Apply speed limiting to the trucks, choosing a speed appropriate to the roads being used.

It may be appropriate to operate the trucks at speeds lower than the posted speed limit where high risk is involved, such as at significant intersections.

Acknowledgements

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The views expressed in this report are those of the authors and do not necessarily represent those of the University of Adelaide or the funding organisations.

References

Austroads (2014). Quantifying the benefits of High Productivity Vehicles. AP-R465-14. Austroads, Sydney, NSW.

Belzer, M. Rodriguez, D. & Sedo, S. (2002). Paying for Safety: An Economic Analysis of the Effect of Compensation on Truck Driver Safety. Science Applications International Corporation, Federal Motor Carrier Safety Administration.

Eck, Ronald W, & Biega, James A. (1988). Field Evaluation of Two-Way Versus Four-Way Stop Sign Control at Low-Volume Intersections in Residential Areas.

Edwards, J. Davey, J. & Armstrong, K. (2016). Safety culture and speeding in the Australian heavy vehicle industry. Journal of the Australasian College of Road Safety 27(1), 18-26.

Guyano-Cardona, J, Sylvester, P, & Jenkins, I. (2002). Four-way stop signs: the Newcastle experience. Paper presented at the Australian Institute of Traffic Planning and Management (AITPM) National conference, 2002, Perth, Australia.

Hoelzl, R. (2015). 'An update on road freight network access' presentation to the Roads Australia network reliability workshop, Brisbane.

Jones, S. (2016). Driving heavy vehicle safety through technology: Challenges, results and lessons learned at Toll Group: a contextual review. Journal of the Australasian College of Road Safety 27(1), 42-47.

Law, B. & Jones, S. (2016). Driver State Sensing (DSS) machines at Toll Resources and Government Logistics. Journal of the Australasian College of Road Safety 27(1), 52-57.

Lovell, J, & Hauer, E. (1986). The safety effect of conversion to all-way stop control. Transportation research record, 1068, 103-107.

Mackie, H., Brodie, C., Scott, R., Hirsch, L., Tate, F., Russell, M. & Holst, K. (2017). The signs they are a-changin': Development and evaluation of New Zealand's rural intersection active warning system. Journal of the Australasian College of Road Safety 28(3), 11-21.

Persaud, Bhagwant, Hauer, Ezra, Retting, Richard, Vallurupalli, Rama, & Mucsi, Kornel. (1997). Crash reductions related to traffic signal removal in Philadelphia. Accident Analysis & Prevention, 29(6), 803-810.

Smith, G. & Jones, S. (2016). In-truck cameras at Toll NQX. Journal of the Australasian College of Road Safety 27(1), 47-51.

Willamson, A. (2007). Predictors of Psychostimulant Use by Long Distance Truck Drivers. American journal of epidemiology, 166(11), 1320-1326.

Williamson, A. & Friswell, R. (2013). The effect of external non-driving factors, payment type and waiting and queuing on fatigue in long distance trucking. Accident Analysis and Prevention, 58, 26-34.

Appendix P4 – KIPT Road Freight Route Options, Heavy Vehicle Route Assessment – HDS Australia

Kangaroo Island Council

KIPT FREIGHT ACCESS ROUTE OPTIONS

PBS Level 2B (30m A-Double) Heavy Vehicle Route Assessment

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March 2018

CONTENTS

APPENDICES

1.0 INTRODUCTION

This report results from an investigation into the safety aspects of a proposed Performance Based Standards (PBS) Level 2B route between the Kangaroo Island Plantation Timber (KIPT) hardwood timber plantations in the west of the island and KIPT's proposed new port at Smith Bay on the North Coast. The report focuses on two final options between Parndana and Smith Bay, along with extensions of the routes along Playford Highway and Mount Taylor Road. A total of nine options for the route between Parndana and Smith Bay were presented in earlier reports by KIPT and its consultants, but were reduced to two for consideration in the project brief received from Kangaroo Island Council.

Currently none of Option 2 and only a small part of Option 5 (refer to Section 3) are gazetted for any heavy vehicles, and then only for the limited use classification of 23m B-Double GML. Council believes the intended vehicle will be a 30m A-Double short road train and therefore this report will focus on PBS Level 2B vehicles. There is some potential for 26m B-Double vehicles to be used (which are PBS Level 2A vehicles) and which will still be able to be used if the route is gazetted for PBS Level 2B.

This assessment was requested by Nicki Putland, from the Kangaroo Island Council, in December 2017.

The route assessment was undertaken by two DPTI accredited senior road safety auditors and restricted access vehicle route assessors, namely:

Timothy Viner Smith
Senior Traffic and Transport Engineer
Senior Road Safety Auditor
RAV Route Assessor
HDS Australia Pty Ltd

Deshitha Senanayake
Senior Design Engineer
Senior Road Safety Auditor
RAV Route Assessor
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The project report was prepared by Tim Viner Smith and reviewed for draft release by:

Daniel Ahrens
Senior Roads and Infrastructure Engineer
Senior Road Safety Auditor
RAV Route Assessor
HDS Australia Pty Ltd

The final report was reviewed and approved for release by:

John Olson
Principal Engineer, Road Transport & Managing Director
HDS Australia Pty Ltd

2.0 METHODOLOGY

2.1 General

Assessment of the two proposed route options, plus two route extensions, was undertaken in accordance with the DPTI publication "Route Assessment Guidelines for Restricted Access Vehicles", published in October 2008 and the National Heavy Vehicle Regulator (NHVR) publication "The Performance Based Standards Scheme – Network Classification Guidelines", published in July 2007. The assessment included reference to the following standards and guides:

- AS1742.2-2009 "Manual of Uniform Traffic Control Devices – Part 2: Traffic control devices for general use";
- Austroads Guide to Road Safety Part 6: Road Safety Audit;
- Austroads Guide to Traffic Engineering Practice Series;
- Austroads Guide to Road Design Series;
- Austroads Guide to Traffic Management Series;
- DPTI RAVNET Website (http://maps.sa.gov.au/ravnet/index.html);
- NHVR (National Heavy Vehicle Regulator) Journey Planner (http://gis.nhvr.gov.au/journeyplanner)
- Pavement Marking Manual v4, May 2015 – DPTI; and
- Manual of Legal Responsibilities and Technical Requirements for Traffic Control Devices, May 2015 – DPTI.

A day time site inspection was undertaken by Tim Viner Smith and Deshitha Senanayake from HDS Australia on 8 and 9 January 2018. While there was no specified requirement under the original scope of works to carry out a night time inspection, the assessors subsequently deemed it necessary and completed a night time drive through of both main route options as well as the two route extensions. Weather conditions were dry and clear during the site inspections. Photographs showing key points of concern along the route are included as Appendix A.

Recommended upgrades to the two main route options and two extensions, considered necessary to meet minimum standards for a PBS Level 2B route, have been detailed in the four tables of findings to be found in Sections 14 to 17 of this report. It should be noted, however, that not all recommended upgrades may be required by the assessing authority, depending on the authority's risk appetite and level of risk acceptance.

2.2 Truck Turning Circles

Turning templates were used in the consideration of PBS Level 2B vehicle movements. Aerial photographs were used as backgrounds to complete preliminary turning movement analyses at four intersections along the Option 2 route, two intersections along the Option 5 route and at the Playford Highway / Mount Taylor Road intersection. Widths recorded during the site inspection were also added to the aerial photographs to improve the quality. Results are shown in Appendix B and are further discussed in the relevant findings table. The vehicle swept path used for PBS Level 2B is the 29.77m 30m Road Train vehicle.

2.3 Prioritisation of Risk Management Measures

This report examines critical elements of the proposed routes, with an assessment of shortcomings and possible risk management solutions. The risk assessment calculator in the DPTI Route Assessment for Restricted Access Vehicles book is used in the tables to calculate the risk associated with the items identified.

Risk management measures have been prioritised from P1 to P4, defined as below:

P1 (Priority 1)	*Very high risk*	required to be treated prior to the designated route being gazetted.
P2 (Priority 2)	*High risk*	conditional on risk acceptance by senior management to the approval process.
P3 (Priority 3)	*Moderate risk*	management responsibility to be specified.
P4 (Priority 4)	*Low risk*	

3.0 PROPOSED ROUTES

The two main route options are shown in Figure 1 on this page and Figure 2 on the next page. These route options comprise mainly two way, two lane roads, with an even split between sealed and unsealed roads. The abutting land is generally rural, with many farm house and farm gate access points.

Extensions to the route are shown in Figures 3 and 4. These extensions will apply regardless of the main route option which is finally adopted.

The Option 2 route which has been assessed is as follows:

1. Begin at the intersection of Playford Highway and Stokes Bay Road.
2. Travel north along Stokes Bay Road to the junction with Bark Hut Road (11.9 km).
3. Turn right onto Bark Hut Road and travel south-east to the intersection with McBrides Road (6.0 km).
4. Turn left onto McBrides Road and travel north to North Coast Road (7.1 km).
5. Turn right onto North Coast Road and travel north-east to Smith Bay (18.0 km).
6. Turn left into Smith Bay – Junction to be advised (note this junction does not currently exist and therefore has not been reviewed in this report).

The route will also be used in reverse and has a total length of approximately 43 km. This route can be seen below in Figure 1.

Figure 1 – Option 2

(courtesy: Google Earth, 2016)

The Option 5 route which has been assessed is as follows:

1. Begin at the intersection of Playford Highway and Stokes Bay Road.
2. Travel north-east along Playford Highway to the junction with Ropers Road (24.8 km).
3. Turn left onto Ropers Road and travel north to the intersection with Gum Creek Road (4.4 km).
4. Head straight across the intersection with Gum Creek Road onto Gap Road and continue north to North Coast Road (7.1 km).
5. Turn left onto North Coast Road and head north-west to Smith Bay (5.9 km).
6. Turn right into Smith Bay – Junction to be advised (note this junction does not currently exist and therefore has not been reviewed in this report).

The route will also be used in reverse and is approximately 42km long. This route can be seen below in Figure 2.

Figure 2 – Option 5

(courtesy: Google Earth, 2016)

The Playford Highway route extension between Stokes Bay Road and Burgess Lagoon, a length of approximately 24 km, has also be investigated for use in both directions. This can be seen in Figure 3 below.

Figure 3 – Playford Highway Extension

(courtesy: Google Earth, 2016)

The Mount Taylor Road extension between Playford Highway and Highgate Farmhouse, a length of approximately 18 km, has also be investigated for use in both directions. This can be seen in Figure 4 below.

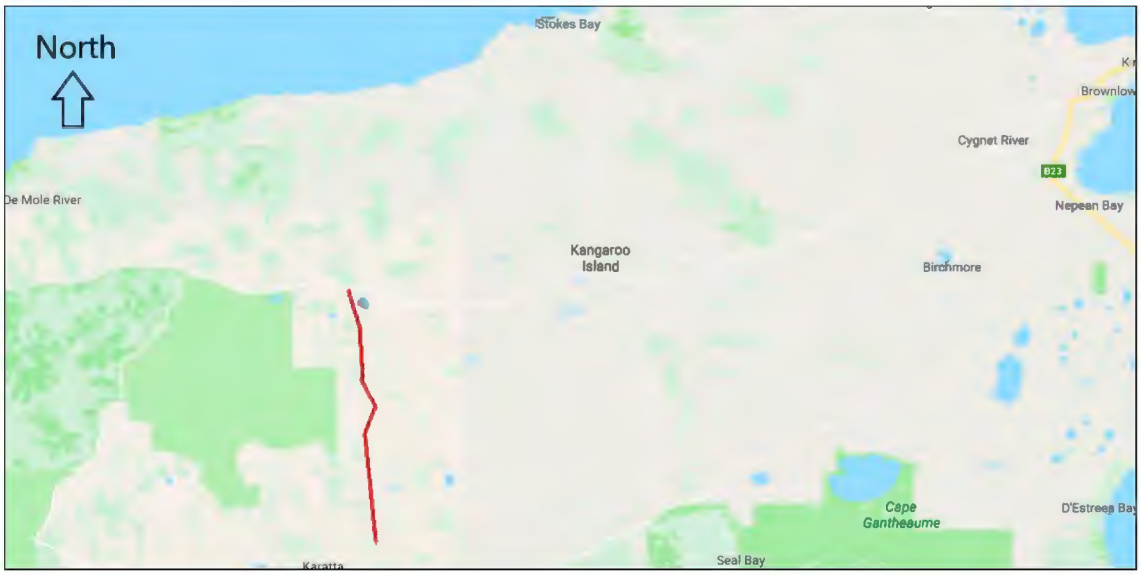

Figure 4 – Mount Taylor Road

(courtesy: Google Earth, 2016)

4.0 TRAFFIC DATA

Traffic data was provided by Kangaroo Island Council on 2 January 2018 for the subject roads. It shows the following volumes:

Road	Traffic Count Per day	Date
Playford Highway (near Stokes Bay Rd)	470	2015
Ropers Road	48	Spring 2017
Gap Road	53	Spring 2017
Stokes Bay Road	150	Summer 2017
Bark Hut Road	55	Winter 2017
McBrides Road	13	Spring 2017
North Coast Road	160	Summer 2017

Additional traffic data for Playford Highway was extracted from the DPTI website at http://www.dpti.sa.gov.au/traffic_volumes on 11 January 2018. This showed that the eastern end of Playford Highway has an AADT of 500 vehicles, with a commercial vehicle content of 12%. To the west of Parndana, the Playford Highway has an AADT of 470 vehicles, with a commercial vehicle content of 17%.

No estimates have been made of the potential increase in volume of Level 2B vehicles that may use this route following gazettal. Similarly, no estimate of traffic growth has been made. It is noted that larger volumes can result in a requirement for wider traffic lanes, and that by ignoring the projected volumes the tolerance on the estimated rate of exposure for estimating risk score is large. Where volumes are borderline, the higher category has been used to provide an additional level of safety.

5.0 CRASH STATISTICS

Crash data from the last five years (i.e. 2012 to 2016) was provided by DPTI on 28 December 2017.

Option 2 has had four recorded crashes in the past five years, with one serious injury recorded. The four crash types were: hit fixed object, hit animal, left road out of control and hit fixed object. The crashes were all put down to inattention.

Option 5 has had eight recorded crashes in the past five years, with no fatalities recorded but two serious injuries. Five of the crashes were hit fixed object, with one each a roll over, side swipe and right angle. The causes were put down to inattention in five of the crashes, DUI in two of the crashes and a fail to give way crash.

On the Playford Highway route extension, there was only one recorded crash, which was a serious injury crash. The crash was a roll over crash and the apparent error was DUI.

6.0 ADJACENT LAND USE AND AMENITY

The area surrounding the majority of the route is rural farmland. There are numerous access points along the rural sections of the route to both farmhouses and farm gates. The issue of stock and farm machinery crossing the road has been raised by local farmers, in particular those on Stokes Bay Road. These conflicts are not ideal especially for heavy vehicles. This issue is addressed in the findings table.

The Playford Highway bypasses the township of Parndana. There is a speed reduction to 80km/h past the town.

7.0 ENVIRONMENTAL FACTORS

There will be some environmental impacts on the road associated with an increase in heavy vehicle traffic generating pollution.

The Option 5 route passes Parndana. Noise monitoring and modelling should be undertaken to ascertain the effect of the heavy vehicles on the community amenities.

8.0 OVERTAKING OPPORTUNITIES

Overtaking opportunities are not required for roads with an AADT of less than 100 vehicles according to Table 9 of the PBS Guidelines. This is the case for the majority of roads which make up the two main route options, as well as the Mount Taylor Road extension. Only Stokes Bay Road, North Coast Road and Playford Highway have AADTs over 100 vehicles.

Stokes Bay Road and North Coast Road fall into the next category of roads with AADTs between 100 and 500 vehicles. They require an average distance between overtaking opportunities of 30 km, with a maximum distance between overtaking opportunities of 50 km. There is potential for some overtaking on Stokes Bay Road, but the length of opportunity is limited and the heavy vehicles would have to be travelling very slowly. This is not seen as an issue, as the Stokes Bay Road section of Option 2 is only 11.5 km. There are presently no overtaking opportunities on North Coast Road. However, vehicles will only be on this road for 15.9 km (Option 2) and 6.8 km (Option 5), so this is also not an issue.

Playford Highway (east of Parndana) currently falls into the category of AADT between 500 and 1000 vehicles. Playford Highway (west of Parndana) will fall into the same category once additional heavy vehicles associated with the KIPT proposal start using the road. This requires an average distance between overtaking opportunities of 15 km, with a maximum distance between overtaking opportunities of 30 km. The length of Playford Highway being reviewed in this report is only 24 km under Option 2, but increases to 49 km (Ropers Road to Burgess Lagoon) under Option 5. Table 8 in the PBS Guidelines states that, for Level 2B vehicles in a 100 km/h speed zone, an establishment sight distance of 1100m and continuation sight distance of 490m is required for overtaking. At least three locations on Playford Highway met these conditions, which comfortably meets the requirements for overtaking without the need to specifically construct an overtaking lane.

9.0 REST AREAS

There are no rest areas along any of the route options. It should be noted that the PBS Guidelines require rest areas to be provided every 80 km. Given each trip from KIPT plantations to the port at Smith Bay is likely to be less than 80 km, a rest area is deemed unnecessary.

10.0 SIGNALISED INTERSECTIONS

There are no signalised intersections along the route.

11.0 RAILWAY LEVEL CROSSINGS

There are no railway crossings along the route.

12.0 STRUCTURES

The structural integrity of culverts and bridges along the two main route options and two route extensions has not been investigated as part of this report. PBS Level 2B vehicles will place additional loads on these structures given they are of higher total mass than vehicles currently using the routes. It is also not yet clear if GML or HML vehicles will be used. Maximum axle loading for GML vehicles will be consistent with current users of the proposed routes, whereas maximum axle loading for HML vehicles is higher. It is recommended that structural checks of existing culverts and bridges are performed once a final decision on the main route option is made, to confirm suitability for the HML classification generally associated with PBS Level 2B vehicles. Alternatively, it may be feasible to negotiate with KIPT for axle loads to be restricted to a GML classification, thereby avoiding culvert or bridge upgrades that are solely the result of having a structural condition insufficient to cope with HML axle loads.

While consideration of structural integrity was outside the scope of this heavy vehicle route assessment, specific locations were identified where other safety issues related to the structures will necessitate an upgrade, regardless of structural condition. In these instances, Council should check available records or undertake further investigation to confirm structural integrity prior to any final decision regarding the extent of upgrade required for the structure. One example of this is the single lane bridge on Ropers Road, which has been identified as having inadequate width for two way movement. However, continued use of the bridge under one way movement may be feasible, provided its total mass carrying capacity is checked. Numerous culverts have also been identified, some polymer based ones and many with very little cover. Again, these should be checked to ensure they can withstand the additional load of a HML vehicle.

13.0 GEOMETRIC CONSTRAINTS

The PBS Guidelines provide a number of geometric constraints for Level 2 vehicles based on the road's AADT and road surface. Key constraints are:

- Table 3 of the PBS Guidelines specifies a 3.1m wide traffic lane and 1.2m wide shoulder for Level 2 vehicles on a sealed road with an AADT of 500 to 1500 vehicles.
- Table 4 of the PBS Guidelines specifies a carriageway of 7.2m for Level 2 vehicles on an unsealed road with an AADT of less than 100 vehicles and a carriageway of 7.7m for an unsealed road with an AADT of over 100 vehicles.
- Table 5 of the PBS Guidelines specifies curve widening for Level 2 vehicles where the radius of the curve is less than 700m.
- Table 6 of the PBS Guidelines specifies minimum trafficable width across a bridge for Level 2 vehicles where the AADT is less than 150 vehicles is 4m (single lane bridges). For two lane bridges, roads with an AADT of less than 500 vehicles require 7.2m width while roads with an AADT of greater than 500 vehicles require a width of 8.4m.
- Table 8 of the PBS Guidelines specifies establishment sight distances and continuation sight distances for Level 2 vehicles. For a 100 km/h speed limit, an establishment sight distance of 1100m is required, while a continuation sight distance of 490m is required.
- Table 9 of the PBS Guidelines specifies desirable maximum distances between sight distance overtaking opportunities, including overtaking lanes. For Level 2 vehicles, and an AADT between 100 and 500 vehicles, the average distance specified in the PBS Guidelines between overtaking opportunities is 30 km, while the maximum distance is 50 km. It should be noted that for roads with AADT of less than 100 vehicles, there is no requirement for overtaking.
- Table 14 of the PBS Guidelines specifies the minimum length of an entry lane onto a main road or highway. For a Level 2 vehicle, with an operating speed of 110 km/hr, a minimum length of entry lane of 1620m is required on a level grade or 630m for a 2% downgrade.
- Table 15 of the PBS Guidelines specifies stopping sight distance for Level 2 vehicles in a 100 km/h operating speed zone of 238m on level ground.
- Table 17 of the PBS Guidelines specifies spacing for off-road parking. For Level 2 vehicles, the maximum spacing is 80 km.

14.0 OPTION 2 FINDINGS

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
14.1	**Stokes Bay Road** Section of Stokes Bay Road between Playford Highway (Ch 0.0) and Bark Hut Road (Ch 11.9km).			
1.	The 30m A-Double Short Road Train PBS Level 2B turning movement at the intersection of Playford Highway and Stokes Bay Road is shown on Drawing SK03 in Appendix B. It identifies that this junction has insufficient width to accommodate all turning movements. There is a culvert close to the junction on Stokes Bay Road which may need to be widened to accommodate the movements. Currently there is only 9.6m between the headwalls of the culverts. Sight distance along Playford Highway from Stokes Bay Road is reasonable in both directions at approximately 17s to the right and similar to the left, vegetation clearance would improve it. See Photo No. 1.	**Possibility** Unusual but Possible **Exposure** Frequent **Consequences** Very Serious **Risk Score** P2	A significant upgrade is required for this junction to be able to accommodate PBS Level 2B turning movements safely. Considerable widening is required, along with the lengthening of culverts.	$300,000 Residual Risk P3

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
2.	Table 3 in the PBS Guidelines indicates that for a L2 vehicle on a road with an AADT of between 150 and 500 vehicles (Stokes Bay Road has an AADT of 150 vehicles), 2.8m lanes are required and 1.0m shoulders for straight sections. The shoulder width requirement includes sealed and unsealed portions. It is strongly recommended that a 0.5m sealed shoulder is provided in line with Austroads guidelines. There is a short section along Stokes Bay Road from Ch 0.0 to 1.5 where the seal width is between 6.4m and 6.3m. This is below the required 6.6m. Along the rest of the road, the required seal width is met but the lane widths are generally 3m plus, meaning insufficient sealed shoulder is provided. See Photo No. 2.	**Possibility** Unusual but Possible **Exposure** Frequent **Consequences** Very Serious **Risk Score** P2	Shoulder sealing is required for the initial 1.5km section of road to bring the width up to the required seal. Consideration should be given to re-linemarking the reminder of the road to provide consistent lane width and shoulder widths.	$25,000 Residual Risk P4 0.2m x 1.5km = 300m2 shoulder sealing
3.	There are numerous locations along Stokes Bay Road where guardfence has been used close to the road to protect culverts. Examples are: • Ch 1.0 – guardfence 1.6m and 1.2m from edgeline • Ch 1.9 – guardfence 1.7m and 1.1m from edgeline • Ch 2.2 and 2.3 sections of guardfence • Ch 2.8 – guardfence 1.1m and 0.9m from edgeline protecting large culvert • Ch 3.6 more guardfence • Ch 9.7 – guardfence 1.3m to 1.5m from edgelines Guardfence will not stop heavy vehicles and generally the headwalls of the culverts that the guardfence is protecting are very close behind and deep. See Photo No. 3.	**Possibility** Likely **Exposure** Frequent **Consequences** Fatality **Risk Score** P1	Serious consideration needs to be given to widening the culverts outside of the clear zone so the guardfence can be removed. Guardfence will not stop heavy vehicles such as PBS Level 2B trucks. Extend culvert to 3m from edge of carriageway as a minimum.	$200,000 Residual Risk P3

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
4.	Ch 5.1 there is a large slope and tight vertical curve. There is warning signs and the slope is posted at 6%. The downhill section is approximately 400m long. There is a culvert at the bottom with only 8m between the guardfence. The culvert is 3m deep and there are steep batters either side of the culvert. The vertical curve is very tight and it is unclear if PBS L2B vehicles will be able to undertake the curve at speed. See Photo No. 4 and 5.	**Possibility** Likely **Exposure** Rare **Consequences** Fatality **Risk Score** P2	Consideration should be given to improving the vertical alignment of this section of road. The gradient should be lowered or additional lanes added to allow for heavy vehicles to use low gears. A trial run may be required to see if the vertical curve at the bottom can handle PBS Level 2B vehicles.	$250,000 Residual Risk P3
5.	At Ch 7.0 there are some steep batters that are quite high, trucks would not be able to transverse them. The edgeline stops at this point on the road.	**Possibility** Likely **Exposure** Rare **Consequences** Serious **Risk Score** P3	Consideration should be given to flattening out these batters to make them traversable for heavy vehicles.	
6.	At Ch 11.1 there is vegetation very close to the edgeline.	**Possibility** Unusual but Possible **Exposure** Rare **Consequences** Important **Risk Score** P4	Trim back vegetation to improve sight lines.	

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
7.	Ch 11.8 there is a cut batter with 1:1 slope for approximately 100m on both sides of the road, it is 1.5m high. The batter is only 2m from the edge of the seal.	**Possibility** Likely **Exposure** Rare **Consequences** Serious **Risk Score** P2	Consideration should be given to flattening out these batters to make them traversable for heavy vehicles.	$100,000 Residual Risk P4
8.	A night time site inspection was undertaken on Stokes Bay Road, delineation was very good. RRPMs are installed on the centreline (yellow) and edgeline (only visible to direction of travel). Guideposts are installed and guardfence delineators stand out clearly. Some width markers are hidden by overhanging vegetation.	**Possibility** Unusual but Possible **Exposure** Rare **Consequences** Important **Risk Score** P4	Trim back vegetation to improve delineation at night.	
9.	Currently stock and farm machinery regularly cross Stokes Bay Road. One farm in particular has raised concerns with 4 or 5 crossings per day. This conflict is not safe with heavy haulage trucks.	**Possibility** Likely **Exposure** Rare **Consequences** Serious **Risk Score** P2	Consideration should be given to providing a tunnel under Stokes Bay Road. This will eliminate the risk entirely. An alternative option may be to consider operational controls such as two way communication between farm workers and truck drivers however it is not clear how reliable or effective this will be.	$150,000 Residual Risk - none

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
14.2 Bark Hut Road Section of Bark Hut Road between Stokes Bay Road (Ch 0.0) and McBrides Road (Ch 6.0km).				
10.	Turning templates at the Stokes Bay Road and Bark Hut Road junction for a PBS Level 2B vehicle are shown on Drawing SK04 in Appendix B. They show that the junction is not wide enough to accommodate the movements. Significant junction widening is required. Sight distance for vehicles exiting Bark Hut Road to the right is sufficient, provided some vegetation is removed. Sight distance to the left is poor and drivers can only see approximately 100m. This is important since if PBS Level 2 vehicles could see properly, they would be much safer crossing the centreline on Stokes Bay Road. However this is not the case. The throat of Bark Hut Road is sealed. See Photo No. 6.	**Possibility** Likely **Exposure** Frequent **Consequences** Fatality **Risk Score** P1	A significant upgrade is required for this junction to be able to accommodate PBS Level 2B turning movements safely. Considerable widening is required.	$200,000 Residual Risk P3
11.	Table 4 in the PBS Guidelines indicates for an AADT of less than 100 vehicles for a Level 2B vehicle a 7.2m carriageway should be provided. Examples of the carriageway width are shown below: • Ch 0.0 – 7.8m • Ch 0.6 – 7.0m • Ch 2.8 – 8.9m • Ch 5.3 – 7.7m Generally the required width is met along Bark Hut Road. However, there are some locations and structures where the width is not met. Additionally, the road is often not graded to full width and therefore the useable width is significantly reduced.	**Possibility** Unusual but Possible **Exposure** Rare **Consequences** Serious **Risk Score** P3	Increase usable road width to meet minimum standards by 0.2m along initial 2km section.	

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
12.	At Ch 0.6 there is a steep gradient downhill to a culvert, where there is 8.6m between the guardfence protecting the culvert. The guardfence is low and the 4m deep culvert headwall is located just behind it. See Photo No. 7.	**Possibility** Likely **Exposure** Frequent **Consequences** Serious **Risk Score** P2	The culvert should be extended so the headwalls are outside of the clear zone. If this is not to be improved, the height of the guardfence should be checked for standard vehicles.	$50,000 Residual Risk P3
13.	There are tight horizontal curves at Ch 0.7 and 1.1 with estimated radius of 400m and 260m respectively, and a carriageway width of 7.5m. Table 5 of the PBS Guidelines requires curve widening of 0.2m per lane and 0.35m per lane respectively, which requires overall widths of 7.6m and 7.9m which are not met.	**Possibility** Likely **Exposure** Rare **Consequences** Serious **Risk Score** P3	Minor widening of the road as recommended will ensure vehicles are able to travel on the appropriate side of the road and avoid head on crashes.	
14.	At Ch 2.0 there is a culvert, the carriageway is 7.7m wide and the headwalls are 2m from the edge of the carriageway. The headwalls are 0.5m high.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Serious **Risk Score** P3	These culverts should be extended so the headwalls are outside of the clear zone.	
15.	At Ch 2.4 there is a large tree 2m from the edge of the carriageway, and again at Ch 2.8 there is a large tree 4m from the edge of the carriageway.	**Possibility** Likely **Exposure** Rare **Consequences** Serious **Risk Score** P3	Removal of all non-frangible trees within the clear zone is recommended. It is recommended that as a minimum 3m of clear zone is provided to reduce the risk to P3.	

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
16.	At Ch 3.7 there is a culvert with a 1.5m drop off, the carriageway is only 6.9m wide and the headwalls are 3m from the edge of the carriageway. There are similar culverts at Ch 4.4, 4.8, 5.1 and 5.7.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Serious **Risk Score** P3	These culverts should be extended so the headwalls are outside of the clear zone.	
17.	At Ch 5.2 there is a ramp on the northern side of the road. It is a 1.5m high drain and needs to be reshaped.	**Possibility** Very Unlikely **Exposure** Rare **Consequences** Serious **Risk Score** P3	Drain should be reshaped to reduce risk of vehicles launching on them.	
18.	A night time site inspection was undertaken on Bark Hut Road. Guideposts were installed regularly along the road to provide some delineation. No guideposts were installed at the junction with McBrides Road.	**Possibility** Likely **Exposure** Frequent **Consequences** Important **Risk Score** P3	Install guideposts at the junction of Bark Hut Road and McBrides Road to improve delineation.	

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
14.3	**McBrides Road** Section of McBrides Road between Bark Hut Road (Ch 0.0) and North Coast Road (Ch 7.1km).			
19.	Turning templates at the Bark Hut Road and McBrides Road junction for a PBS Level 2B vehicle are shown on Drawing SK05 in Appendix B. The templates show the junction is not wide enough for the movements to be completed. Sight distances from McBrides Road are good, 13s to the right and 10s to the left were observed for vehicles. There is a hazard board missing at this junction. See Photo No. 8.	**Possibility** Unusual but Possible **Exposure** Frequent **Consequences** Fatality **Risk Score** P1	A significant upgrade is required for this junction to be able to accommodate PBS Level 2B turning movements safely. Considerable widening is required.	$200,000 Residual Risk P3
20.	Table 4 in the PBS Guidelines indicates that for Level 2B vehicles on a road with an AADT fewer than 100 vehicles a carriageway of 7.2m must be provided. McBrides Road is well below this width, examples are provided below: • Ch 0.6 – 5.0m wide carriageway • Ch 2.0 – 5.1m wide carriageway • Ch 4.2 – 5.6m wide carriageway • Ch 5.6 – 5.4m carriageway • Ch 6.2 – 5.0m wide carriageway It should be noted that the AADT on McBrides Road is 13 vehicles, which is very low. However, with gazettal the numbers are expected to increase and the tight geometry and lane widths combined with poor sight distance lead to many instances where head on type crashes are likely. See Photo No. 9.	**Possibility** Very Likely **Exposure** Frequent **Consequences** Very Serious **Risk Score** P1	Widening of the road as recommended will ensure vehicles are able to travel on the appropriate side of the road and avoid head on crashes. If McBrides Road was to be used as a one way option the road width on areas with good sight distance would only require an additional 1m widening. Areas with sight distance issues would require full widening to 7.2m.	Average 2m widening over 7km at a rate of $30/m2 14,000 m2 of pavement required $420,000 Residual Risk P4 1m widening over 7km plus additional 1m widening over 1km 8,000 m2 of pavement required $240,000

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
21.	The horizontal alignment of McBrides is generally good. Two curves with radii less than or equal to 400m were recorded. At Ch 3.7 a horizontal curve with an estimated radius of 180m and at Ch 4.2 another horizontal curve with an estimated radius of 160m were recorded. The carriageway is 5.6m wide at this location. Curve widening of 0.6m and 0.5m per lane is required for each lane, therefore on top of the recommended width the carriageway should be 8.4m and 8.2m respectively. No warning signage is provided for these curves.	**Possibility** Unusual but Possible **Exposure** Frequent **Consequences** Very Serious **Risk Score** P2	Widening of the pavement by 2.8m is required on this curve to provide required curve widening.	$10,000 Residual Risk P4
22.	The vertical alignment of McBrides Road is very tight, there are numerous hills along this section of road with poor sight lines over the crests. This combined with the narrow width is a dangerous mix and can lead to head on type crashes. Locations of the crests are: • Ch 2.0 – tight vertical crest • Ch 2.4 – top of hill, poor sight lines • Ch 4.7 – top of hill • Ch 5.6 – top of hill, tight crest • Ch 6.2 to 6.7 – steep ascent and then another hill All of these ascents and descents are not ideal for heavy vehicles. See Photo No. 10.	**Possibility** Possible **Exposure** Frequent **Consequences** Very Serious **Risk Score** P2	Widening the road as previously recommended will reduce the risk of head on type crashes. Improving the vertical alignment will eliminate the risk.	Cost covered under road widening Residual Risk P3
23.	There were some pot holes observed in the pavement. Additionally drainage pathways were running across the road which indicates this may not be an all-weather road.	**Possibility** Likely **Exposure** Rare **Consequences** Serious **Risk Score** P3	Ensure appropriate warning is provided if this road is not useable in winter. An upgrade to existing drainage may be required to ensure road can be used all year.	

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
24.	Vegetation was observed right up to the edge of the carriageway. This was mainly frangible however it should still be cleared back.	**Possibility** Unusual but Possible **Exposure** Rare **Consequences** Important **Risk Score** P4	Trim vegetation back at least 3m from edgeline.	
25.	Ch 6.0 is the bottom of a curve and the road is 5.5m wide, there is a culvert with headwalls only 1m from the edge of the road.	**Possibility** Possible **Exposure** Rare **Consequences** Serious **Risk Score** P3	The culvert should be extended so the headwalls are outside of the clear zone.	
26.	A night time site inspection was undertaken and no delineation is provided along McBrides Road except for a single set of guideposts at the culvert at Ch 6.0 and at Ch 7.0 one white guidepost is provided.	**Possibility** Likely **Exposure** Frequent **Consequences** Important **Risk Score** P3	Install guide posts to improve delineation at night time.	

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
14.4	**North Coast Road** Section of North Coast Road between McBrides Road (Ch 0.0) and Smith Bay (Ch 18.0km). No signage is provided at Smith Bay but Yamba Aquiculture was noted as the location of Smith Bay.			
27.	Turning templates at the McBrides Road and North Coast Road junction for a PBS Level 2B vehicle are shown on Drawing SK06 in Appendix B. It shows that the vehicles cannot complete the movements and significant road widening is required. Sight distance was measured at 15s to the left and is excellent to the right for vehicles on McBrides Road. See Photo No. 11.	**Possibility** Unusual but Possible **Exposure** Frequent **Consequences** Fatality **Risk Score** P1	A significant upgrade is required for this junction to be able to accommodate PBS Level 2B turning movements safely. Considerable widening is required.	$200,000 Residual Risk P3
28.	Table 4 in the PBS Guidelines indicates for a Level 2 vehicle on a road with an AADT over 100 vehicles (North Coast Road has an AADT of 160 vehicles) a 7.7m carriageway should be provided. The width of North Coast Road is generally below this, examples of the road width are: • Ch 0.7 – 7.2m carriageway • Ch 2.5 – 7.8m carriageway • Ch 3.1 – 6.2m carriageway • Ch 4.1 – 5.4m carriageway • Ch 6.1 – 6.9m carriageway • Ch 7.5 – 7.4m carriageway • Ch 10.0 – 7.4m carriageway • Ch 12.1 – 8.1m carriageway • Ch 16.0 – 8.3 carriageway • Ch 18.0 – 8.0m carriageway The first 12km of this section is under the required 7.7m width. It did appear that some sections were not graded to full width however. See Photo No. 12.	**Possibility** Unusual but Possible **Exposure** Frequent **Consequences** Very Serious **Risk Score** P2	The first 12km of this section should have the pavement widened to 7.7m to meet minimum standards. Given the high tourist volumes on this road consideration should be given to widening it to Austroads standards of 8.2m which would give a residual risk of P4 for an additional cost of $100,000.	$500,000 Residual Risk P3 Average 1.4m widening over 12km = 16,800m2 of pavement

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
29.	The alignment of North Coast Road is poor, horizontal curve deficiencies are curves with radii 400m and below. Further details are provided below. There is a horizontal curve at Ch 0.7, estimated radius 210m, with 7.7m carriageway. Table 5 in the PBS Guidelines indicates a 0.45m curve widening per lane, therefore a 8.6m carriageway width should be provided around this curve (7.7 + 0.45 + 0.45). Superelevation is provided on this curve.	**Possibility** Unusual but Possible **Exposure** Frequent **Consequences** Serious **Risk Score** P3	Widening of the pavement by 0.9m is required on this curve to provide required curve widening.	
30.	There is a horizontal curve at Ch 2.0, estimated radius 200m, with 7.7m carriageway. Table 5 in the PBS Guidelines indicates a 0.45m curve widening per lane, therefore a 8.6m carriageway width should be provided around this curve. The curve length is several hundred metres.	**Possibility** Unusual but Possible **Exposure** Frequent **Consequences** Serious **Risk Score** P3	Widening of the pavement by 0.9m is required on this curve to provide required curve widening.	
31.	There is a horizontal curve at Ch 2.5, estimated radius 170m, with 7.8m carriageway. Table 5 in the PBS Guidelines indicates a 0.55m curve widening per lane, therefore an 8.8m carriageway width should be provided around this curve. The curve is long and on a rise.	**Possibility** Unusual but Possible **Exposure** Frequent **Consequences** Serious **Risk Score** P3	Widening of the pavement by 1.0m is required on this curve to provide required curve widening.	
32.	There is a horizontal curve at Ch 3.1, estimated radius 190m, with 6.2m carriageway. Table 5 in the PBS Guidelines indicates a 0.5m curve widening per lane, therefore a 8.7m carriageway width should be provided around this curve.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Serious **Risk Score** P3	Widening of the pavement by 2.5m is required on this curve to provide required curve widening.	

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
33.	There is a series of reverse horizontal curves between Ch 4.1 and 4.8, estimated tightest radius 180m, with 5.9m carriageway. Table 5 in the PBS Guidelines indicates a 0.5m curve widening per lane, therefore a 8.7m carriageway width should be provided around this curve.	**Possibility** Possible **Exposure** Rare **Consequences** Very Serious **Risk Score** P2	Widening of the pavement by 2.8m is required on this curve to provide required curve widening.	$15,000 Residual Risk P4 2.8m x 0.7km = 1,960m2 of pavement
34.	There is a horizontal curve at Ch 6.1, estimated radius 180m, with 6.9m carriageway. Table 5 in the PBS Guidelines indicates a 0.5m curve widening per lane, therefore a 8.7m carriageway width should be provided around this curve.	**Possibility** Possible **Exposure** Rare **Consequences** Serious **Risk Score** P3	Widening of the pavement by 1.8m is required on this curve to provide required curve widening.	
35.	There is a horizontal curve at Ch 6.8, estimated radius 100m, with 7.1m carriageway. Table 5 in the PBS Guidelines indicates a 0.9m curve widening per lane, therefore a 9.5m carriageway width should be provided around this curve. The curve is very short.	**Possibility** Possible **Exposure** Rare **Consequences** Very Serious **Risk Score** P2	Widening of the pavement by 2.4m is required on this curve to provide required curve widening.	$10,000 Residual Risk P4 2.4m x 300m = 720m2
36.	There is a series of horizontal curves at Ch 7.5, estimated radius 200m (worst case), with 7.4m carriageway. Table 5 in the PBS Guidelines indicates a 0.45m curve widening per lane, therefore a 8.6m carriageway width should be provided around the curves.	**Possibility** Possible **Exposure** Rare **Consequences** Serious **Risk Score** P3	Widening of the pavement by 1.2m is required on this curve to provide required curve widening.	

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
37.	There is a horizontal curve at Ch 8.1, estimated radius 140m, with 8.1m carriageway. Table 5 in the PBS Guidelines indicates a 0.7m curve widening per lane, therefore a 9.1m carriageway width should be provided around this curve. This curve is short but it is just after a tight dip and is likely to surprise drivers, no warning is provided.	**Possibility** Possible **Exposure** Rare **Consequences** Serious **Risk Score** P3	Widening of the pavement by 1.0m is required on this curve to provide required curve widening.	
38.	There is a series of horizontal curves at Ch 10.0, estimated radius 150m (worst case), with 7.4m carriageway. Table 5 in the PBS Guidelines indicates a 0.65m curve widening per lane, therefore a 9.0m carriageway width should be provided around this curve.	**Possibility** Possible **Exposure** Rare **Consequences** Serious **Risk Score** P3	Widening of the pavement by 1.6m is required on this curve to provide required curve widening.	
39.	There is a horizontal curve at Ch 13.3, estimated radius 120m, with 8.1m carriageway. Table 5 in the PBS Guidelines indicates a 0.8m curve widening per lane, therefore a 9.3m carriageway width should be provided around this curve.	**Possibility** Possible **Exposure** Rare **Consequences** Serious **Risk Score** P3	Widening of the pavement by 1.2m is required on this curve to provide required curve widening.	
40.	There is a horizontal curve at Ch 14.5, estimated radius 110m, with 8.1m carriageway. Table 5 in the PBS Guidelines indicates a 0.85m curve widening per lane, therefore a 9.4m carriageway width should be provided around this curve.	**Possibility** Possible **Exposure** Rare **Consequences** Serious **Risk Score** P3	Widening of the pavement by 1.3m is required on this curve to provide required curve widening.	

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
41.	At Ch 14.8 there is a 'steep gradient' warning sign. The vertical alignment is tight here along with the horizontal alignment.	**Possibility** Possible **Exposure** Frequent **Consequences** Very Serious **Risk Score** P2	Consideration should be given to improving the gradient. Additional warning and carriageway widening will reduce the risk.	Cost covered under road widening component. Residual Risk P3
42.	There are two horizontal curves at Ch 15.0 and 15.5, estimated radius 200m, with 7.2m carriageway. Table 5 in the PBS Guidelines indicates a 0.45m curve widening per lane, therefore a 8.6m carriageway width should be provided around this curve.	**Possibility** Possible **Exposure** Rare **Consequences** Serious **Risk Score** P3	Widening of the pavement by 1.4m is required on this curve to provide required curve widening.	
43.	At Ch 15.5 there is a bridge that is protected by guardfence. The carriageway is 7.2m and the distance between the guardfence is 8.1m. The guardfence does not cover the batters and no delineators are provided. See Photo No. 13.	**Possibility** Possible **Exposure** Occasional **Consequences** Very Serious **Risk Score** P2	Either appropriate bridge barrier needs to be installed or the culverts widened to reduce the risk. Guardfence will not stop heavy vehicles.	$30,000 Residual Risk P3
44.	There is a horizontal curve at Ch 16.0, estimated radius 80m (worst section), with 8.3m carriageway. Table 5 in the PBS Guidelines indicates a 1.15m curve widening per lane, therefore a 10.0m carriageway width should be provided around this curve. This is a dangerous curve with a crest also present, trees 2.5m from the edge and some CAMs provided. See Photo No. 14.	**Possibility** Possible **Exposure** Rare **Consequences** Very Serious **Risk Score** P2	Widening of the pavement by 1.7m is required on this curve to provide required curve widening. Consideration should be given to improving the alignment along this section of road, this is a very tight radius.	$15,000 Residual Risk P3 1.7m x 300m = 510m2

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
45.	There are two horizontal curves at Ch 17.5 and 18.0, estimated radius 100m, with 8.0m carriageway. Table 5 in the PBS Guidelines indicates a 0.9m curve widening per lane, therefore a 9.5m carriageway width should be provided around these curves. Both of these curves are very short.	**Possibility** Possible **Exposure** Rare **Consequences** Serious **Risk Score** P3	Widening of the pavement by 1.5m is required on this curve to provide required curve widening.	
46.	A night time inspection of North Coast Road was undertaken. Guideposts are provided along the road. There are no delineators on the guardfence. Some of the guideposts are missing or in poor condition in some locations.	**Possibility** Possible **Exposure** Frequent **Consequences** Important **Risk Score** P3	Ensure guideposts are provided along the length of the route.	
47.	Yamba Aquiculture entrance was recorded as the end of this route.		Comment only.	

15.0 OPTION 5 FINDINGS

The route has been described in Section 3.0 as Stokes Bay Road to Smith Bay however our assessment has been done in reverse order.

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
15.1 North Coast Road Section of North Coast Road between Smith Bay (Yamba Aquiculture entrance) (Ch 0.0) and Gap Road (Ch 5.9km).				
48.	Table 4 in the PBS Guidelines recommends a 7.7m carriageway for an AADT over 100 vehicles for Level 2 vehicles. This is met along this section on North Coast Road.		Comment only.	
49.	There is a horizontal curve at Ch 1.3, estimated radius 180m, with 7.7m carriageway. Table 5 in the PBS Guidelines indicates a 0.5m curve widening per lane, therefore an 8.7m carriageway width should be provided around this curve.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Serious **Risk Score** P3	Curve widening of 1.0m should be provided for this horizontal curve.	
50.	At Ch 1.8 there is a steep batter with 1:1 slope, approximately 1m off the carriageway and 2m deep. The batter is approximately 100m long. The carriageway is 7.7m wide at this location.	**Possibility** Unusual but Possible **Exposure** Rare **Consequences** Serious **Risk Score** P3	Consideration should be given to flattening out the batter slope.	

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
51.	At Ch 3.2 there are non-frangible trees 1m from the edge of the carriageway. See Photo No. 15.	**Possibility** Unusual but Possible **Exposure** Rare **Consequences** Very Serious **Risk Score** P2	Removal of all non-frangible trees within the clear zone is recommended. It would be recommended that as a minimum 3m of clear zone is provided to reduce the risk to P3.	$20,000 Residual Risk – P3
52.	There is a horizontal curve at Ch 4.2, estimated radius 220m, with 8.4m carriageway. Table 5 in the PBS Guidelines indicates a 0.4m curve widening per lane, therefore an 8.5m carriageway width should be provided around this curve. Advanced warning signs are provided.	**Possibility** Unusual but Possible **Exposure** Rare **Consequences** Important **Risk Score** P4	Minor widening of the pavement of 0.1m is required on this curve to provide required curve widening.	
53.	A night time site inspection was undertaken on this part of North Coast Road. Some of the red delineators were in poor condition but the guideposts provided delineation. The bright lights at the aquaculture farm have the potential to mislead motorists.	**Possibility** Unusual but Possible **Exposure** Rare **Consequences** Important **Risk Score** P4	Ensure guideposts are effective and in good condition.	

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
15.2 Gap Road Section of Gap Road between North Coast Road (Ch 0.0) and Ropers Road (Ch 7.1km).				
54.	Turning templates at the North Coast Road and Gap Road junction for a PBS Level 2B vehicle are shown on Drawing SK02 in Appendix B. The templates show that the movement cannot be undertaken, mainly due to the narrow width of Gap Road. Gap Road has a give way sign and sight distance is good to the right but poor to the left due to a vertical curve. See Photo No. 16.	**Possibility** Unusual but Possible **Exposure** Frequent **Consequences** Fatality **Risk Score** P1	A significant upgrade is required for this junction to be able to accommodate PBS Level 2B turning movements safely. Considerable widening is required, along with the lengthening of culverts.	$200,000 Residual Risk – P3
55.	Table 4 in the PBS Guidelines indicates for an unsealed road with an AADT of less than 100 vehicles a 7.2m carriageway is required. Gap Road is generally well below this, examples are: • Ch 0.1 – 5.6m carriageway • Ch 1.4 – 6.5m carriageway • Ch 3.4 – 6.1m carriageway • Ch 6.6 – 5.5m carriageway The carriageway width needs to be increased to meet the minimum standard. See Photo No. 17.	**Possibility** Very Likely **Exposure** Occasional **Consequences** Very Serious **Risk Score** P2	This road requires significant widening to accommodate PBS Level 2B vehicles. In general approximately 1.5m of pavement widening is required along the 7km section.	At a rate of $50,000/km $350,000 Residual Risk P4 1.5m x 7km = 10,500 m2
56.	Ch 0.3 it was noted that there were large trees close to the edge of the carriageway, within 3m.	**Possibility** Unusual but Possible **Exposure** Rare **Consequences** Very Serious **Risk Score** P2	Removal of all non-frangible trees within the clear zone is recommended. It is recommended that as a minimum 3m of clear zone is provided to reduce the risk to P3.	$20,000 Residual Risk P3

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
57.	There were many minor culverts along this section of road, details are provided: • Ch 0.0 – 7.3m long culvert • Ch 0.1 – culvert end 2m from carriageway which is 5.6m wide • Ch 2.0 – culvert 0.5m deep on edge of carriageway (5.3m wide) • Ch 4.4 and 4.8 – small culverts within clear zone • Ch 6.9 – polymer culvert only 100mm to 200mm cover, ends 0.5m from carriageway More significant culverts are detailed further by individual items.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Serious **Risk Score** P3	These culverts should be extended so the headwalls are outside of the clear zone.	
58.	Ch 2.3 there is a tight crest with sight line issues.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Fatality **Risk Score** P2	Widening of the road as recommended will ensure vehicles are able to travel on the appropriate side of the road and avoid head on crashes. Consideration should be given to improving the vertical alignment of the road.	Cost covered under road widening Residual Risk P3
59.	Ch 2.8 there is a large culvert that is approximately 4m deep. The carriageway is 5.9m wide and the culvert 8.2m wide. See Photo No. 18.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Fatality **Risk Score** P2	The culvert should be extended outside of the clear zone. Extend culvert to 3m from edge of seal as a minimum.	$30,000 Residual Risk P3

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
60.	Ch 3.1 is the junction with Springs Road. Gap Road has a 'give way' sign. Sight distance in each direction is approximately 200m but can be improved by the removal of vegetation for south bound drivers. Sight distance for north bound drivers is much better.	**Possibility** Unusual but Possible **Exposure** Rare **Consequences** Serious **Risk Score** P3	Trim back vegetation to improve sight lines. Reverse the junction priority so that Springs Road has 'give way' signs and Gap Road is the through route.	
61.	Ch 4.1 there is a 2m deep culvert. The carriageway is 6.6m wide and there is 8.2m between the headwalls (0.8m from carriageway). See Photo No. 19.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Fatality **Risk Score** P2	The culvert should be extended outside of the clear zone. Extend culvert to 3m from edge of seal as a minimum.	$20,000 Residual Risk P3
62.	Ch 5.1 there is a crest with sight line issues.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Fatality **Risk Score** P2	Widening of the road as recommended will ensure vehicles are able to travel on the appropriate side of the road and avoid head on crashes. Consideration should be given to improving the vertical alignment of the road.	Cost covered under road widening Residual Risk P3
63.	Ch 5.3 there is a 1.5m deep culvert. The carriageway is 5.8m and head wall to head wall is 7.3m.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Fatality **Risk Score** P2	The culvert should be extended outside of the clear zone. Extend culvert to 3m from edge of seal as a minimum.	$20,000 Residual Risk P3

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
64.	Ch 6.8 there is a 30m wide and 4m deep culvert. The carriageway is 5.4m and there is 1.1m and 1.0m clearance to the culvert.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Fatality **Risk Score** P2	The culvert should be extended outside of the clear zone. Extend culvert to 3m from edge of seal as a minimum.	$50,000 Residual Risk P3
65.	A night time site inspection was undertaken on Gap Road. Guideposts were used to provide delineation. There were some gaps where no guideposts were provided.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Important **Risk Score** P4	Ensure appropriate guideposts are provided.	
15.3 Ropers Road Section of Ropers Road between Gap Road (Ch 0.0) and Playford Highway (Ch 4.4km).				
66.	Ch 0.0 is the five way junction with Gum Creek Road and Duck Lagoon Road, where vehicles will go straight across to Ropers Road. For south bound vehicles sight distance to the left is good but to the right is short due to a vertical crest. This is the same for the opposite direction.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Fatality **Risk Score** P2	Consideration should be given to improving the vertical alignment of the side road. Additionally, if this road is to become a major freight route consideration should be given to changing priority to the Ropers Road / Gap Road movement.	$50,000 Residual Risk P3

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
67.	Table 4 in the PBS Guidelines indicates for unsealed roads with an AADT of less than 100 vehicles a 7.2m carriageway should be provided. This section of Ropers Road is generally very narrow, examples of recorded widths are: • Ch 0.9 – 5.7m carriageway • Ch 2.6 – 5.3m carriageway • Ch 3.3 – 4.3m carriageway • Ch 4.4 – 6.4m carriageway See Photo No. 20.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Fatality **Risk Score** P2	The carriageway needs to be widened by approximately 2m to 3m along the 4.4km length. If Ropers Road is to be used as part of a one way loop, it can be argued the road width should only be increased to 6m on sections of the road with good sight distance.	At a rate of $100,000/km $440,000 2.5m x 4.4km = 11,000m2 Residual Risk P4 1.5m x 4.4km = 6,600m2
68.	Ch 0.3 there is a small culvert with ends 0.3m from the edge of the carriageway. A similar culvert is also located at Ch 0.9 and Ch 2.4.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Serious **Risk Score** P3	These culverts should be extended so the headwalls are outside of the clear zone.	
69.	At Ch 3.1 there is a bridge, the sign warns that it is only 'one lane' width on the bridge, kerb to kerb is 3.5m, the bridge is 18m long. Sight distance is alright mainly given vehicles are travelling very slowly, one of the approaches to the bridge has an estimated radius of 300m. See Photo No. 21.	**Possibility** Likely **Exposure** Frequent **Consequences** Fatality **Risk Score** P1	The bridge requires widening to bring it up to the correct width to allow two vehicles to pass each other at the same time.	$350,000 Residual Risk P3

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
70.	There is a horizontal curve at Ch 3.3, estimated radius 200m, with 3.4m carriageway. Table 5 in the PBS Guidelines indicates a 0.45m curve widening per lane, therefore an 8.1m carriageway width should be provided around this curve. See Photo No. 22.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Very Serious **Risk Score** P2	This curve requires significant carriageway widening, approximately 4.5m, to meet requirements.	$20,000 Residual Risk P4
71.	A 'floodway' sign was posted at Ch 3.3. It is unclear how often the area floods, but it indicates this may not be an all-weather road.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Serious **Risk Score** P3	Ensure appropriate warning is provided if this road is not useable in winter. An upgrade to existing drainage may be required to ensure the road can be used all year.	
72.	Ch 3.6 there is a stobie pole within the clear zone. Trees were also observed within the clear zone along this section of road. See Photo No. 22.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Serious **Risk Score** P2	Removal of all non-frangible trees within the clear zone is recommended. As a minimum 3m of clear zone should be provided to reduce the risk to P3.	$20,000 P3
73.	A night time inspection was undertaken on Ropers Road. Minimal use of guideposts meant that there was little delineation. Width markers are provided on the bridge.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Important **Risk Score** P4	Ensure appropriate guideposts are provided.	

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
15.4	**Playford Highway** Section of Playford Highway between Ropers Road (Ch 0.0) and Stokes Bay Road (Ch 24.8km).			
74.	Turning templates at the Ropers Road and Playford Highway junction for a PBS Level 2B vehicle are shown on Drawing SK01 in Appendix B. They show that this junction has insufficient width to accommodate the turning movements. There are some culverts close to the junction which may need to be widened to accommodate the movements. Sight distance along Playford Highway from Ropers Road is very good. Vehicles were observed from 17s away to the right and further to the left. See Photo No. 23.	**Possibility** Unusual but Possible **Exposure** Frequent **Consequences** Very Serious **Risk Score** P2	A significant upgrade is required for this junction to be able to accommodate PBS Level 2B turning movements safely. Considerable widening is required, along with the lengthening of culverts and sealing of the throat of Ropers Road.	$300,000 Residual Risk P3
75.	Table 3 in the PBS Guidelines indicates that for a L2 vehicle on a road with an AADT of between 500 and 1500 vehicles, 3.1m lanes are required and 1.2m shoulders for straight sections. The shoulder includes sealed and unsealed portions. It is strongly recommended that a 0.5m sealed shoulder is provided in line with Austroads guidelines. Lane widths, seal width and shoulders vary along this section of Playford Highway. Between Ch 0.0 and 7.0 the seal width varies between 6.3m and 6.8m. There are no edge lines but the shoulders are between 2m and 3m unsealed. See Photo No. 24.	**Possibility** Unusual but Possible **Exposure** Frequent **Consequences** Very Serious **Risk Score** P2	Shoulder sealing is required to meet minimum standards of 7.2m sealed width. This is an increase of between 0.9m and 0.4m. Edgelines should also be provided.	At a rate of $60/m2 $250,000 Residual Risk P4 0.6m x 7km = 4,200m2

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
76.	At Ch 4.0 there is a large tree located 3m from the edge of seal. Generally the clear zone is clear of non-frangible objects however there are some trees still present.	**Possibility** Very Unlikely **Exposure** Rare **Consequences** Very Serious **Risk Score** P2	Non-frangible vegetation within the clear zone should be removed. It is essential trees within 3m of the edge of carriageway be removed.	$5,000 Residual Risk P3
77.	At Ch 5.5 there is a large culvert at the bottom of the vertical curve. The culvert is 15m wide and approximately 2m deep. The seal is 7.4m wide and the headwalls are located 3m and 3.4m from the edge of seal. This is within the clear zone. See Photo No. 25.	**Possibility** Very Unlikely **Exposure** Rare **Consequences** Very Serious **Risk Score** P2	The culvert should be extended outside of the clear zone. Extend culvert to 3m from edge of carriageway as a minimum.	$30,000 Residual Risk P3
78.	Ch 5.8 there is a long steep ascent that is approximately 1km long. A 'reduce speed' sign has been placed in the opposite direction. Towards the bottom of the vertical curve there is a horizontal curve with radius approximately 300m (85 km/h advisory speed sign) and the junction with Bark Hut Road. At the top, there is a radius of approximately 350m. This section is seen as highly dangerous for heavy vehicles. See Photo No. 26 and 27.	**Possibility** Unusual but Possible **Exposure** Frequent **Consequences** Very Serious **Risk Score** P2	This area needs to be upgraded to allow for PBS Level 2B vehicles to use it safely. IN the long term, consideration should be given to improving the horizontal and vertical alignment for a 1.5km section. In the short term, there is also merit in considering a slow vehicle turnout on each side to allow faster vehicles to safely pass heavy vehicles which are ascending or descending the hill in low gears.	$280,000 Residual Risk P3 2 x 3.5m x 200m = 1,400m2 @ $200/m2

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
79.	Ch 7.0 to Ch 21.5 there are edgelines with some sealed shoulder provided. The seal width starts at 7.7m and is down to 7.0m by the end of the section, unsealed shoulders are generally good and wide enough. It is recommended that 7.2m wide seal is provided (3.1m lanes and 0.5m shoulder).	**Possibility** Unusual but Possible **Exposure** Rare **Consequences** Serious **Risk Score** P3	Some minor shoulder sealing is required to bring the sealed shoulders up to the required 0.5m width.	
80.	There is a horizontal curve at Ch 8.6, estimated radius 350m, which has 7.7m of seal. This is the minimum required with 7.2m recommended plus 0.25m per lane of curve widening as per Table 5 in the PBS Guidelines. Lane widths are 3.3m and 3.1m, with sealed shoulders 0.6m and 0.7m at this location.	**Possibility** Unusual but Possible **Exposure** Rare **Consequences** Important **Risk Score** P4	The curve should be re-lined with 3.35m lanes and 0.5m sealed shoulders to allow trucks to properly follow the lines and ensure no crossing of the centreline.	
81.	There is a horizontal curve at Ch 9.8, estimated radius 380m, with 7.3m of seal. Table 5 in the PBS Guidelines indicates a 0.25m curve widening per lane, therefore 7.7m of seal should be provided around this curve.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Important **Risk Score** P3	Shoulder sealing is required to provide additional curve widening around this horizontal curve. Carriageway is sufficiently wide.	
82.	There are back to back horizontal curves at Ch 12.0, estimated radii are 250m and 220m, with 7.1m of seal. 75 km/h speed advisory signs are provided. Table 5 in the PBS Guidelines indicates a 0.45m curve widening per lane, therefore 8.1m of seal should be provided around these curves.	**Possibility** Unusual but Possible **Exposure** Frequent **Consequences** Serious **Risk Score** P3	Shoulder sealing is required to provide additional curve widening around this horizontal curve. Carriageway is sufficiently wide.	

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
83.	Ch 16.4 there is a large culvert 1.5m deep with the headwalls 2m from the edgelines. The two lanes total only 6.2m width at this location. Additionally there is a steep batter 2m from the edgeline approximately 2m high and with a 1:2 slope on the southern side of Playford Highway.	**Possibility** Unusual but Possible **Exposure** Rare **Consequences** Very Serious **Risk Score** P2	Culvert should be increased in length so headwalls are outside of the clear zone. The culvert should be extended outside of the clear zone. Extend culvert to 3m from edge of carriageway as a minimum.	$40,000 Residual Risk P3
84.	There is a horizontal curve at Ch 18.9, estimated radius 380m, with 7.0m of seal. Table 5 in the PBS Guidelines indicates a 0.25m curve widening per lane, therefore a 7.7m of seal should be provided around this curve. Additionally on this curve there is a batter 4m from the edgeline approximately 1m deep with a slope of 1:2.	**Possibility** Unusual but Possible **Exposure** Rare **Consequences** Important **Risk Score** P4	Shoulder sealing is required to provide additional curve widening around this horizontal curve. Carriageway is sufficiently wide. Batter should be flattened out.	
85.	Between Ch 20.3 and Ch 21.0 there is an 80 km/h speed zone. This is due to the township of Parndana however the road essentially bypasses the town with access to the town via two main junctions on the southern side of the road. There are some property accesses on the northern side of the highway. Compliance may be an issue especially for larger vehicles.		The warrant of this 80km/h speed zone should be checked.	
86.	Ch 21.5 to Ch 24.8 there are no edgelines and the seal width is only 6.3m wide. Unsealed shoulders are generally in good condition and 1.5m plus in width. It is recommended that 7.2m wide seal is provided (3.1m lanes and 0.5m shoulder). See Photo No. 28.	**Possibility** Very Likely **Exposure** Continuous **Consequences** Very Serious **Risk Score** P2	Shoulder sealing is required to increase seal width to 7.2m. This is approximately 0.45m on each side of the carriageway. Edgelines should also be marked once sealing is completed.	$135,000 Residual Risk P4 0.9m x 3.3km = 2,970m2

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
87.	There are reverse curves at Ch 22.2 and Ch 22.8, estimated radius are 320m and 360m, with 6.3m of seal. Table 5 in the PBS Guidelines indicates a 0.3m curve widening per lane, therefore a 7.8m of seal should be provided around this curve. Superelevation is very steep on the second curve.	**Possibility** Possible **Exposure** Infrequent **Consequences** Serious **Risk Score** P3	Shoulder sealing is required to provide additional curve widening around this horizontal curve. Carriageway is sufficiently wide.	
88.	Ch 24.8 is the junction with Stokes Bay Road, as part of this option no heavy vehicle turning movements will occur here.		Comment only.	
89.	A night time site inspection was undertaken on this section of Playford Highway. There is no edgeline for the first 7km or the last 5km. There are guideposts and delineators however many are not reflective. The centreline is often in poor condition.	**Possibility** Very Likely **Exposure** Frequent **Consequences** Serious **Risk Score** P3	It is recommended that an edgeline is introduced and all linemarking upgraded. Additional delineation should be reviewed and upgraded if not reflective.	

16.0 PLAYFORD HIGHWAY EXTENSION FINDINGS

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
16.1	**Playford Highway** Section of Playford Highway between Stokes Bay Road (Ch 0.0) and Burgess Lagoon (Ch 24.0km).			
90.	Table 3 in the PBS Guidelines indicates that for a sealed road for L2 vehicles a 5.6m carriageway should be provided with 1.0m shoulders. This would therefore require a 6.6m seal to provide 0.5m sealed shoulders. Given the expected increase in traffic volumes on Kangaroo Island, it is worth considering the 500 – 1500 vehicle category which requires 7.2m seal width (3.1m lane with 0.5m sealed shoulder) which is met in large sections of this part of Playford Highway. Some examples of the width at the various chainages are provided (unsealed shoulder, lane width, lane width, unsealed shoulder) no edgelines were marked in this section: • Ch 0.3 – 1.8, 3.2, 3.1,1.5 (6.3m seal) • Ch 3.2 – 1.5, 3.2, 3.0, 1.3 (6.2m seal) • Ch 7.7 – 1.7, 3.0, 3.5, 1.3 (6.5m seal) • Ch 11.7 – 1.3, 3.3, 3.3, 1.2 (6.6m seal) • Ch 13.2 – 0.9, 3.6, 2.6, 1.2 (7.2m seal) • Ch 16.2 – 1.1, 3.4, 3.5, 1.5 (6.9m seal) • Ch 18.9 – 1.5, 3.6, 3.5, 1.7 (7.1m seal) • Ch 23.0 – 1.3, 3.5, 3.8, 0.9 (7.3m seal) See Photo No. 29.	**Possibility** Likely **Exposure** Frequent **Consequences** Serious **Risk Score** P2	Road sections that are not up to the minimum 6.6m seal required should be widened. Consideration should be given to widening the entire length to 7.2m seal with 0.7m unsealed shoulders to meet the higher volume classification. Installation of edge lines would significantly improve delineation for drivers.	$250,000 Residual Risk P3 Additional widening will be required in the future 1m widening of seal for 23km at a rate of $50/m2 $1,150,000

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
91.	It was noted during the site inspection that bins were placed along Playford Highway for collection. This has the potential to be very dangerous in a 110km/h posted speed zone. It was observed that the shoulders are wide however many bins were placed so the garbage truck would not have to leave the road. This is dangerous especially for drivers unfamiliar with the road and trucks who will not wish to stop behind a garbage truck and may attempt to overtake at a poor location.	**Possibility** Very Unlikely **Exposure** Rare **Consequences** Serious **Risk Score** P2	Large shoulders are provided, educate residents to locate bins away from seal on the edge of the shoulder to allow room for garbage trucks to pull off the road as much as possible.	$5,000 Residual Risk P3
92.	Ch 0.6 and Ch 16.2 had a 'children crossing' symbolic sign, one is on a horizontal curve. Playford Highway is expected to be a school bus route which is not ideal for a heavy vehicle route.	**Possibility** Very Unlikely **Exposure** Rare **Consequences** Serious **Risk Score** P2	Ensure appropriate areas are provided for school buses to pull off highway and that crossing points are located with sufficient sight distance.	$10,000 Residual Risk P3
93.	There is a curve on Playford Highway at Ch 3.0, estimated radius 350m, with traffic lanes 3.2 and 3.0m. An advisory 95km/h sign is provided along with superelevation, some grass is growing on the shoulder. Table 5 in the PBS Guidelines indicates 0.25m shoulder widening should be added to each lane, the minimum width for each lane is 2.8m therefore 3.05m wide lanes are required which can be met with the realignment of the centreline.	**Possibility** Unusual but Possible **Exposure** Rare **Consequences** Important **Risk Score** P4	Consideration should be given to realigning the centreline to even out the lanes.	

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
94.	Ch 14.8 has a curve radius of approximately 350m, Ch 16.9 has a curve radius of approximately 380m, Ch 18.0 has a curve radius of approximately 400m all meet the minimum required curve widening based on the lower traffic volumes. Additionally, they have sufficient curve widening for the higher volumes however all three curves would need the centreline moved to even up the lane widths to meet the minimum requirements. Additionally all three curves have speed advisory signs.	**Possibility** Unusual but Possible **Exposure** Rare **Consequences** Important **Risk Score** P4	Consideration should be given to realigning the centreline to even out the lanes.	
95.	There is a culvert at Ch 19.2 that is approximately 3m deep. The seal is 7.2m wide and the headwalls are located 2.5m and 2.7m from the edge of seal. This is within the clear zone. The culvert is approximately 10m wide and has steep batters on both sides.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Very Serious **Risk Score** P2	The culvert should be extended so the headwalls are outside of the clear zone. Extend culvert to 3m from edge of carriageway as a minimum.	$20,000 Residual Risk P3
96.	At Ch 21.3 there is a 2m deep culvert. The seal is 6.9m wide and the headwalls are 2.3m and 3.0m from the edge of seal. The culvert is 10m wide and well within the clear zone.	**Possibility** Unusual but Possible **Exposure** Infrequent **Consequences** Very Serious **Risk Score** P2	The culvert should be extended so the headwalls are outside of the clear zone.	$15,000 Residual Risk P3
97.	It was noted that the clear zone is generally good however there are some non-frangible trees approximately 6-7m from the edge of seal. This is within the clear zone. Additionally there was vegetation up to the edge of seal around Ch 20.7.	**Possibility** Likely **Exposure** Rare **Consequences** Serious **Risk Score** P3	Removal of all non-frangible trees within the clear zone is recommended. It is recommended that as a minimum 3m of clear zone is provided to reduce the risk to P3. Trim vegetation back at least 3m from edgeline.	

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
98.	Some batter issues were noted along this section of the Playford Highway, details are: • Ch 7.7 – approximately 250m long batter on outside of curve, 3m from edge of seal 1:2 slope and 2m high • Ch 18.3 – small batter 1:4 80m long • Ch 18.9 – 1m high batter, 1:2 slope 3m from edge of seal approximately 200m long on outside of curve • Ch 23.0 – batter 3m from edge of seal, 1m high 1:3 slope approx.. 100m long	**Possibility** Likely **Exposure** Frequent **Consequences** Serious **Risk Score** P2	Consideration should be given to flattening out these batters to make them traversable for heavy vehicles.	$100,000 Residual Risk P3
99.	A night time inspection was undertaken on this section of Playford Highway. There is no edgeline, no RRPMs are provided and the centreline is faded. Guideposts are provided.	**Possibility** Likely **Exposure** Frequent **Consequences** Important **Risk Score** P4	The centreline needs to be re-linemarked. Installation of an edgeline and RRPMs would significantly improve the delineation along this route.	

17.0 MOUNT TAYLOR ROAD FINDINGS

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
17.1 Mount Taylor Road Section of Mount Taylor Road between Playford Highway (Ch 0.0) and Highgate Farmhouse (Ch 17.8km).				
100.	Turning templates at the Playford Highway and Mount Taylor Road junction for a PBS Level 2B vehicle are shown on Drawing SK07 in Appendix B. They show significant overlap between the vehicles and that considerable widening is required. See Photo No. 30.	**Possibility** Unusual but Possible **Exposure** Frequent **Consequences** Fatality **Risk Score** P1	A significant upgrade is required for this junction to be able to accommodate PBS Level 2B turning movements safely. Considerable widening is required, consideration should be given to a BAR treatment on Playford Highway given traffic volumes.	$200,000 Residual Risk P3

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
101.	No traffic volumes were available for Mount Taylor Road however it is expected they would be well below an AADT of 100 vehicles. Table 4 in the PBS Guidelines indicates that for an unsealed road for L2 vehicles a 7.2m carriageway should be provided. Mount Taylor Road is below the minimum width required. Some examples of the width at the various chainages are provided below: • Ch 0.1 – 6.6m • Ch 1.4 – 7.0m • Ch 2.3 – 5.9m • Ch 3.3 – 5.3m • Ch 4.7 – 6.6m • Ch 5.5 – 5.5m • Ch 7.0 – 6.2m • Ch 8.6 – 6.3m • Ch 10.1 – 7.6m • Ch 11.4 – 7.2m • Ch 15.7 – 6.5m • Ch 17.0 – 6.8m There are some locations where the road has not been graded to the full carriageway width making the width narrower than is necessary. See Photo No. 31.	For widths under 6m: **Possibility** Likely **Exposure** Frequent **Consequences** Fatality **Risk Score** P1 For widths over 6m under 7.2m: **Possibility** Unusual but Possible **Exposure** Frequent **Consequences** Very Serious **Risk Score** P2	Grade road to full width to ensure maximum pavement can be utilised. Widen carriageway to 7.2m for length of Mount Taylor Road that will be used by PBS Level 2B vehicles.	Average 1.5m widening for 2km at a rate of $65,000/km $130,000 Residual Risk P3 Average 1.2m widening for 15km at a rate of $50,000/km $750,000 Residual Risk P3

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
102.	There are numerous culverts along this section of Mount Taylor Road that are narrow and have significant drop offs close to the road. Table 6 in the PBS Guidelines indicates that the minimum width for a bridge (culvert) is 7.2m for a two lane bridge. A single lane bridge can be only 4m wide however there are other risks associated with this width so the two lane bridge is recommended. Examples of insufficient culverts: • Ch 1.6 – 6.4m wide road, 1m deep, 1.6m from edge • Ch 3.3 – 5.3m wide road, ends exposed 1.7m and 1.2m from edge • Ch 5.1 – 5.5m wide road, ends exposed 0.6m and 1m from edge • Ch 6.1 – 5.7m wide road, ends exposed 1.2m and 1.7m from edge, 0.5m drop off • Ch 6.7 – 5.6m wide road, ends exposed 0.6m and 0.7m from edge • Ch8.0 – 5.5m wide road, ends exposed 0.9 and 1.0m from edge • Ch 9.6 – 6.3m wide road, ends exposed 0.8 and 3.2m from edge • Ch 11.0, 11.1 and 11.7 – 6.6m wide road, ends exposed 1.9m and 2.6m off edge • Ch 12.2 and 15.3 – narrow road, needs improvement • Ch 13.9 – 4.3m wide road, ends exposed 0.8m and 1.1m from edge • Ch 16.0, 16.3 and 16.6 – 5.7m wide road, ends exposed 0.8 and 1.1m from edge • Ch 17.4 – 5.5m wide road, ends exposed 0.5m and 1.1m from edge, 1.5m deep	**Possibility** Likely **Exposure** Frequent **Consequences** Serious **Risk Score** P3	These culverts should be extended so the headwalls are outside of the clear zone.	

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
103.	On the approach to the Playford Highway junction there is a symbolic 'T' sign but the hazard board on the opposite side of Playford Highway is difficult to see.	**Possibility** Likely **Exposure** Rare **Consequences** Serious **Risk Score** P3	Relocate sign to make easier to see from further down Mount Taylor Road. Clear vegetation if required.	
104.	The pavement is corrugated and there are significant amounts of loose material on the surface. The loose material is especially dangerous and grading is required. There are instances where the road has not been graded to full width hence reducing the useable width. See Photo No. 32.	**Possibility** Likely **Exposure** Frequent **Consequences** Serious **Risk Score** P2	Ensure that regular grading of the road occurs. If the road is gazetted, additional grading will be required due to the increase in volumes and the heavy vehicle movements having a greater impact on the pavement.	$15,000 Residual Risk P4
105.	The 'stock crossing' sign at Ch 4.0 is in poor condition.	**Possibility** Very Unlikely **Exposure** Rare **Consequences** Important **Risk Score** P4	The validity of the sign needs to be checked and the sign should be replaced if the warrants are met.	

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
106.	There are several culverts that have very little cover running under the road. At Ch 5.1 and 6.1 the culverts had approximately 100mm cover. The addition of Level 2B vehicles (with HML axle loading) on this road will place additional load pressure on these structures and failure of them may be dangerous.	**Possibility** Likely **Exposure** Frequent **Consequences** Fatality **Risk Score** P2	The minimum cover requirements for these culverts should be checked along with the structural integrity. The culvert should be extended outside of the clear zone. Extend culvert to 3m from edge of carriageway as a minimum.	$20,000 Residual Risk P4
107.	The northern end of the road has had the vegetation cleared from the edges of the pavement for approximately 2m however the southern section still has many overhanging branches. Notably Ch 7.4 has significant overhanging branches. At Ch 9.4 for several hundred meters the vegetation was observed to be along the edge of the road. Large trees were also observed on the edge of the carriageway. See Photo No. 33.	**Possibility** Likely **Exposure** Frequent **Consequences** Serious **Risk Score** P3	Trim vegetation back from the edge of the carriageway to approximately 3m.	
108.	Many drainage cut outs were observed along the edge of the road, some of them quite deep. In particular one was observed at Ch 17.0 on the outside of a curve and appeared to be very dangerous potentially leading to a launching crash.	**Possibility** Likely **Exposure** Rare **Consequences** Very Serious **Risk Score** P2	Drain should be reshaped to reduce risk of vehicles launching on them.	$5,000 Residual Risk P4

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
109.	The vertical alignment is generally good however there are some steep curves at Ch 12.8 and 13.3. The carriageway is only 6.2m wide at the top of the crest which may lead to head on type crashes. There are some additional crests that were noted as being lower risk, the widening of the road to the required minimum will ensure the risk drops further: • Ch 3.5 – crest width only 6.3m • Ch 5.8 – crest with sight line issues • Ch 9.6 – crest • Ch 11.2 – crest • Ch 14.1 and 14.4 – crests • Ch 17.8 – crest at Highgate Farmhouse	**Possibility** Likely **Exposure** Frequent **Consequences** Serious **Risk Score** P2	Widening road to minimum width as previously recommended will reduce risk slightly. Ultimately, improving vertical alignment to ensure all sight lines is preferred.	Cost covered under road widening component Residual Risk P3
110.	A night time inspection was undertaken on Mount Taylor Road. Generally there is minimal delineation with guideposts only used to delineate narrow culverts, approximately 10 sets were observed on the length of the road. Additionally two white guideposts were observed at Ch 13.9 indicating one had been installed facing the wrong direction. There was minimal warning signage with only two CAMs used and one curve advisory sign.	**Possibility** Likely **Exposure** Rare **Consequences** Important **Risk Score** P4	Guideposts along the length of the route would add significantly to the delineation for night time drivers.	
111.	There is a horizontal curve at Ch 1.4, estimated radius 300m, with 7.0m carriageway. Table 5 in the PBS Guidelines indicates a 0.3m curve widening per lane, therefore a 7.8m carriageway width should be provided around this curve.	**Possibility** Likely **Exposure** Rare **Consequences** Serious **Risk Score** P3	The carriageway needs to be increased by 0.8m to meet curve widening requirements.	

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
112.	There is a horizontal curve at Ch 2.3, estimated radius 220m, with 6.4m carriageway. Table 5 in the PBS Guidelines indicates a 0.4m curve widening per lane, therefore a 8.0m carriageway width should be provided around this curve.	**Possibility** Likely **Exposure** Frequent **Consequences** Serious **Risk Score** P2	The carriageway needs to be increased by 2.6m to meet curve widening requirements.	$10,000 Residual Risk P3
113.	There is a horizontal curve at CH 2.9, estimated radius 100m, with 6.1m carriageway. The curve length is short and vegetation has been removed on the inside to improve sight lines. Table 5 in the PBS Guidelines indicates a 0.9m curve widening per lane, therefore a 9.0m carriageway width should be provided around this curve.	**Possibility** Likely **Exposure** Frequent **Consequences** Serious **Risk Score** P2	The carriageway needs to be increased by 2.9m to meet curve widening requirements.	$10,000 Residual Risk P3
114.	There is a horizontal curve at Ch 3.5, estimated radius 230m, with 6.3m carriageway. Table 5 in the PBS Guidelines indicates a 0.3m curve widening per lane, therefore a 8.0m carriageway width should be provided around this curve.	**Possibility** Likely **Exposure** Rare **Consequences** Serious **Risk Score** P3	The carriageway needs to be increased by 1.7m to meet curve widening requirements.	
115.	There is a horizontal curve at Ch 4.7, estimated radius 350m, with 6.6m carriageway. Superelevation is provided and the inside of the curve has been cleared to improve sight lines. Table 5 in the PBS Guidelines indicates a 0.25m curve widening per lane, therefore a 7.7m carriageway width should be provided around this curve.	**Possibility** Likely **Exposure** Rare **Consequences** Serious **Risk Score** P3	The carriageway needs to be increased by 1.1m to meet curve widening requirements.	

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
116.	There is a horizontal curve at Ch 7.0, estimated radius 200m, with 6.2m carriageway. Superelevation has been provided but there is no advanced warning and sight lines are poor. Table 5 in the PBS Guidelines indicates a 0.45m curve widening per lane, therefore a 8.1m carriageway width should be provided around this curve.	**Possibility** Likely **Exposure** Rare **Consequences** Serious **Risk Score** P3	The carriageway needs to be increased by 1.9m to meet curve widening requirements.	
117.	There is a horizontal curve at Ch 8.6, estimated radius 70m, with 6.3m carriageway. This is also the location of the junction with East West Highway One, there are a lot of guideposts provided and the curve length is short. Table 5 in the PBS Guidelines indicates a 1.3m curve widening per lane, therefore a 9.8m carriageway width should be provided around this curve.	**Possibility** Likely **Exposure** Frequent **Consequences** Serious **Risk Score** P2	The carriageway needs to be increased by 3.3m to meet curve widening requirements.	$10,000 Residual Risk P3
118.	There is a horizontal curve at Ch 9.4, estimated radius 200m, with 7.2m carriageway. Table 5 in the PBS Guidelines indicates a 0.45m curve widening per lane, therefore a 8.1m carriageway width should be provided around this curve.	**Possibility** Likely **Exposure** Rare **Consequences** Serious **Risk Score** P3	The carriageway needs to be increased by 0.9m to meet curve widening requirements.	
119.	There is a horizontal curve at Ch 10.1, estimated radius 140m, with 7.6m carriageway. Two CAMs have been provided on the curve. Table 5 in the PBS Guidelines indicates a 0.7m curve widening per lane, therefore a 8.6m carriageway width should be provided around this curve.	**Possibility** Likely **Exposure** Rare **Consequences** Serious **Risk Score** P3	The carriageway needs to be increased by 1.0m to meet curve widening requirements. A minimum of three CAMs should be provided when they are used.	

Item	Audit Findings	Risk Assessment	Recommendations	Cost/ Residual Risk
120.	There is a horizontal curve at Ch 17.0, estimated radius 200m, with 6.8m carriageway. Table 5 in the PBS Guidelines indicates a 0.45m curve widening per lane, therefore a 8.1m carriageway width should be provided around this curve.	**Possibility** Unusual but Possible **Exposure** Frequent **Consequences** Serious **Risk Score** P3	Widening of the pavement by 1.3m is required on this curve to provide required curve widening.	

18.0 ROAD PAVEMENT CONSIDERATIONS

The standard heavy vehicle route assessment process does not require the assessor to examine pavement condition, nor comment on the need to upgrade pavement capacity, particularly in the case of unsealed versus sealed road considerations. This is because the assessment process is focussed on the capacity of a proposed route to safely accommodate individual higher classification PBS vehicles (in this case B-Doubles or 30m A-Double short road trains).

Consideration of the quantity of heavy vehicles being introduced to a proposed route, particularly where unsealed roads are involved, is a separate but highly important issue when it comes to whole-of-life management of the road's condition. An unsealed road will rapidly deteriorate under higher numbers of heavy vehicles – but this will be the case regardless of vehicle classification, since flexible road pavement capacity and deterioration is a function of equivalent standard axle (ESA) loadings over the life of the pavement. These ESAs can come from semi-trailers, B-Doubles, 30m short road trains or larger vehicles – the number of movements is not relevant, the total tonnage on the road is.

Given the very large tonnages to be moved, as proposed by KIPT, it is reasonable to assume that it will not be cost effective in the medium term to maintain any of the existing unsealed roads (except perhaps Mount Taylor Road) as unsealed in the future, necessitating a capital works program to seal all unsealed roads forming part of the selected main route option (i.e. Option 2 or Option 5). This is a subjective observation based upon indicative tonnages to be moved and the likely condition of unsealed pavements on Kangaroo Island. It is not a quantitative assessment of existing unsealed pavement condition. A full geotechnical investigation along the final selected route is recommended, so that a properly engineered sealed pavement design can be prepared, capable of handling projected loads over the minimum 20 year predicted life of the project (including second harvest).

Where the heavy vehicle route assessment process can be used to support road pavement considerations is in determining the minimum sealed carriageway and shoulder widths required to achieve a residual risk of P3 or lower under the PBS Level 2B classification.

In the tables in Sections 14 to 17, minimum carriageway widths required under PBS Guidelines for existing unsealed roads to carry the likely two way traffic volume once KIPT projected haulage is added in (at a residual risk level of P3 i.e moderate risk) are specified as follows:

Bark Hut Road (refer Item 11) – 7.2m.
McBrides Road (refer Item 20) – 7.2m.
North Coast Road (refer Items 28 and 48) – 7.7m.
Gap Road (refer Item 55) – 7.2m.
Ropers Road (refer Item 67) – 7.2m.
Mount Taylor Road (refer Item 101) – 7.2m.

Traffic volumes used in the above assessments were based upon existing counts supplied by Council combined with a predicted additional 75 movements per day (37 in each direction) supplied in the Osman Solutions report. This shows that Bark Hut Road, McBrides Road, Gap Road, Ropers Road and Mount Taylor Road will all remain at an AADT of under 150 vehicles per day (vpd) once the KIPT operations are

underway. On the other hand, North Coast Road fits in the AADT of 150 to 500 vpd category.

Upgrading any or all of the above unsealed roads to sealed roads would clearly improve the durability of the roads.

Table 3 in the PBS Guidelines states that for L2 vehicle routes with two way volumes under 150 vpd, a 3.4m seal can be provided on a 7.2m formation. Effectively this provides a sealed central lane on the previously unsealed road. While this solution is technically acceptable, its application is normally reserved for very lightly trafficked roads in areas of good visibility, because it relies upon on-coming vehicles seeing each other in sufficient time to take action to pass safely by moving to the unsealed shoulder. It also relies upon the unsealed shoulder construction material to bind well enough and remain hard enough in all conditions to avoid excessive wear and create unsafe conditions where one or both vehicles must use the shoulder while passing each other. The solution is not recommended for any of Bark Hut Road, McBrides Road, Gap Road, Ropers Road or Mount Taylor Road.

Looking at roads in the next category, with traffic volumes of AADT 150 – 500 vpd, the PBS Guidelines recommend two 2.8m lanes with 1.0m shoulders (total formation width of 7.6m). A recommended approach for the above roads, which exceeds minimum PBS Guidelines but takes into account shoulder maintenance issues, would therefore be to apply a 6.0m seal width (comprising two 2.8m lanes and nominal 0.2m extra per lane to limit damage to the seal edges). Better still, adopting a 6.2m seal would allow room for an edge line to be applied, better defining the road edge. Since the total formation width required for AADT of less than 150 vpd is 7.2m, this would result in 0.5m wide unsealed shoulders protecting the 6.2m wide sealed carriageway. Overall, the residual risk for this carriageway standard would be P3 approaching P4.

For North Coast Road, which fits within the AADT 150 – 500 vpd category, and carries a high level of tourist traffic in addition to local commuters, adopting a 6.6m seal width (comprising two 2.8m lanes and 0.5m sealed shoulder) plus further 0.5m unsealed shoulder either side (for a total formation width of 7.6m) complies with the PBS Guidellines. The residual risk for this carriageway standard would be P3. As an added risk management measure, if capital works funds allowed, increasing the seal width to 7.2m and formation width to a minimum 8.4m would result in a residual risk of P4 – potentially relevant for such an important tourist route.

Assuming that all existing unsealed roads will need to be upgraded to a minimum sealed standard at some stage in the future, the capital works cost estimates presented in the next section define:

(1) the immediate capital works cost to meet a PBS Level 2B standard, based upon a low volume of heavy vehicles introduced that allow unsealed roads to be maintained as unsealed; and

(2) the more likely scenario of additional cost to reconstruct and seal an appropriate width of existing unsealed road to handle the proposed high volume of heavy vehicles.

A decision by Council on which of the above two scenarios is to be adopted (indeed it may be a staged approach from (1) to (2)) will be dependent upon suitable refinement of pavement design requirements and anticipated construction costs, which is well beyond the scope of the current brief.

19.0 CAPITAL WORKS COST ESTIMATES

There are a number of issues associated with the potential gazettal of either main route option for PBS Level 2B vehicles. Categorised by assessed risk level, the main issues are identified in the two maps below. A recommended approach (subject to DPTI and Council deciding upon their tolerance for risk) is for P1 and/or P2 risks to be reduced to P3 or lower. While it is recommended that all P1 risks be addressed, the removal of P2 risks using capital works improvements is recommended if the route is to be gazetted for general use, but P2 risks could potentially be managed via operational controls should a permit be issued for use of the route only by KIPT heavy vehicles. This is addressed in the following Sections 19.1 and 19.2 of the report, using item references as depicted below for the two options.

19.1 Cost Summary – Gazetted Main Route

It is recommended that, for a gazetted route, all risks are reduced to a P3 residual risk or lower. State and Council road managers will have to manage this residual risk. The tables below provide a summary of the capital costs for this scenario.

Option 2 – Cost Summary

Item	Issue and Risk Rating	Cost ($)	Residual Risk
1	Junction P2	300,000	P3
2	Carriageway P2	25,000	P4
3	Guardfence P1	200,000	P3
4	Alignment P2	250,000	P3
7	Batters P2	100,000	P4
9	Crossing P2	150,000	None
10	Junction P1	200,000	P3
12	Culvert P2	50,000	P3
19	Junction P1	200,000	P3
20	Carriageway P1	420,000	P4
21	Alignment P2	10,000	P4
27	Junction P1	200,000	P3
28	Carriageway P2	500,000	P4
33	Alignment P2	15,000	P4
35	Alignment P2	10,000	P4
43	Guardfence P2	30,000	P3
44	Alignment P2	15,000	P3
	Total Cost	**2,675,000**	

Option 5 – Cost Summary

Item	Issue and Risk Rating	Cost ($)	Residual Risk
51	Clear Zone P2	20,000	P3
54	Junction P1	200,000	P3
55	Carriageway P2	350,000	P4
56	Clear Zone P2	20,000	P3
59	Culvert P2	30,000	P3
61	Culvert P2	20,000	P3
63	Culvert P2	20,000	P3
64	Culvert P2	50,000	P3
66	Junction P2	50,000	P3
67	Carriageway P2	440,000	P4
69	Bridge P1	350,000	P3
70	Curve P2	20,000	P4
72	Clear Zone P2	20,000	P3
74	Junction P2	300,000	P3
75	Carriageway P2	250,000	P4
76	Clear Zone P2	5,000	P3
77	Culvert P2	30,000	P3
78	Steep hill P2	280,000	P3
83	Culvert P2	40,000	P3
86	Carriageway P2	135,000	P4
	Total Cost	**2,630,000**	

In addition to the above specifically identified items, four locations (Items 22, 41, 58 and 62) displayed alignment deficiencies rated as a P2 risk. However, the capital cost to reduce these risks to a residual risk of P3 are already built into the estimated costs for carriageway widening shown under Items 20, 28 and two under 55, so the items have not been shown separately.

19.2 Cost Summary – Permitted Main Route

It is recommended that, for a permitted route, all risks are reduced to a P2 residual risk or lower. State and Council road managers will have to manage this residual risk, but this may include operational controls such as speed restrictions, fleet restrictions and communication between drivers. The tables below provide a summary of the costs for a permitted route.

Option 2 – Cost Summary

Item	Issue and Risk Rating	Cost ($)	Residual Risk
3	Guardfence P1	200,000	P3
10	Junction P1	200,000	P3
19	Junction P1	200,000	P3
20	Carriageway P1	420,000	P4
27	Junction P1	200,000	P3
	Total Cost	**1,220,000**	

Option 5 – Cost Summary

Item	Issue and Risk Rating	Cost ($)	Residual Risk
54	Junction P1	200,000	P3
69	Bridge P1	350,000	P3
74	Junction P2 (interim throat widening)	50,000	P2
	Total Cost	**600,000**	

19.3 Cost Summary – Additional Routes

Playford Highway Extension

The Playford Highway Extension is already a sealed road and has been assessed as generally in good to very good condition. The summary below shows that there is a minimal cost impact to upgrade this section of road to PBS Level 2B gazettal standard.

Playford Highway Extension – Cost Summary

Item	Issue and Risk Rating	Cost ($)	Residual Risk
90	Carriageway P2	250,000	P3
91	Clear zone P2	5,000	P3
92	Pedestrians P2	10,000	P3
95	Culvert P2	20,000	P3
96	Culvert P2	15,000	P3
98	Batters P2	100,000	P3
	Total Cost	**400,000**	

Mount Taylor Road

Mount Taylor Road is a narrow unsealed road with poor alignment at multiple locations. It has been assessed as generally in average to poor condition. The summary below shows that there are significant capital costs to upgrade this section of road to PBS Level 2B gazettal standard.

Mount Taylor Road – Cost Summary

Item	Issue and Risk Rating	Cost ($)	Residual Risk
100	Junction P1	200,000	P3
101	Carriageway P1	130,000	P3
101	Carriageway P2	750,000	P3
104	Pavement P2	15,000	P4
106	Culvert P2	20,000	P4
108	Clear zone P2	5,000	P4
112	Curve P2	10,000	P3
113	Curve P2	10,000	P3
117	Curve P2	10,000	P3
	Total Cost	**1,150,000**	

In addition to the above specifically identified items, one location (Item 109) displayed alignment deficiencies rated as a P2 risk. However, the capital cost to reduce this risk to a residual risk of P3 is already built into the estimated cost for carriageway widening shown under Item 102, so the item has not been shown separately.

Overall, the first 5.8km of Mount Taylor Road has significantly fewer upgrades required. While the road width still needs to be increased, there are minimal horizontal curve issues and clear zone issues. It may be possible for KIPT to utilise internal roads south of this section, with the northern section of Mount Taylor Road utilised to access the Playford Highway. This would reduce the above capital costs to about $ 560,000.

19.4 Cost Summary – Pavement Reconstruction and Sealing

The discussion in Section 18 highlighted the fact that, due to predicted heavy vehicle volumes, all unsealed roads forming part of the adopted heavy vehicle route are likely, in the medium term, to require full reconstruction and sealing. It is therefore relevant to estimate the capital cost of sealing all unsealed roads along the route, as part of the route selection process. Pavement and seal widths adopted for this cost estimate are as detailed in Section 18 and lengths are as detailed in Section 3.

Option 2 Cost Estimate

Bark Hut Road – 6.0 km at $ 120,000/km = $ 720,000 (pavement overlay & 6.2m seal).
McBrides Road – 7.1 km at $ 150,000/km = $ 1,065,000 (full construction & 6.2m seal).
North Coast Road – 18.0 km at $ 150,000/km = $ 2,700,000 (pavement widening, overlay and 7.2m seal).

Total Cost – $ 4,485,000

Option 5 Cost Estimate

Ropers Road – 4.4 km at $ 200,000/km = $ 880,000 (full construction with extra sub-base due to low lying conditions & 6.2m seal).
Gap Road – 7.1 km at $ 150,000/km = $1,065,000 (full construction & 6.2m seal).
North Coast Road – 5.9 km at $ 150,000/km = $ 885,000 (pavement widening, overlay and 7.2m seal).

Total Cost – $ 2,830,000

Mount Taylor Road Cost Estimate

Mount Taylor Road – 17.8 km at $ 150,000/km = $ 2,670,000 (full construction & 6.2m seal).
Mount Taylor Road (Northern Section Only) – 5.8 km at $ 150,000/km = $ 870,000 (full construction & 6.2m seal).

20.0 RECOMMENDATOINS

Based upon the risk analysis and recommended improvements resulting from the heavy vehicle route assessment (covered in Sections 14 to 17), along with associated capital works cost estimates in Sections 19.1 to 19.3, initial conclusions can be drawn about a preferred route and likely capital works cost for the proposed KIPT heavy vehicle haulage route. However, the initial conclusions must then be tested against whole-of-life considerations, due to the proposed high volume of heavy vehicle movements and the likely need, in the medium term, to seal currently unsealed routes. Such considerations, while not normally part of a heavy vehicle route assessment, have been (at least subjectively) addressed in Section 18, along with associated capital works cost estimates in Section 19.4. The proviso is that a geotechnical field assessment of the selected route should be undertaken, with pavement design depths and capital works cost estimate updated accordingly, before the overall capital works budget for the heavy vehicle route is finalised.

Also to note is that this report does not address environmental issues associated with road widening. By using PBS Guidelines and a risk based approach, proposed pavement widths on low volume roads has been kept to a minimum (indeed less than traditional Austroads standards recommend), thereby limiting the impact on adjacent vegetation. However, some widening along the proposed carriageways (mostly up to 2m) is inevitable, along with junction widening and vegetation clearing to improve sight distance. Appropriate consideration of native vegetation clearance requirements and overall environmental impact along the selected route will be required, but it is unlikely to alter the recommendations listed below.

The recommended course of action is therefore:

<u>Stage 1</u>

1. Adopt Option 5 (Playford Highway / Ropers Road / Gap Road / North Coast Road) as the preferred heavy haulage main route option.

2. Reduce two P1 very high risks along the Option 5 route to a residual risk of P3 by widening the North Coast Road / Gap Road junction (Item 54 in this report) and widening or reconstructing the Ropers Road Bridge (Item 69) at a total estimated capital cost of $ 550,000.

3. Construct interim widening of the throat of the Playford Highway / Ropers Road junction (Item 74) so that left turn movements can be fully completed on unsealed road pavement at an estimated capital cost of $ 50,000.

4. Prioritise heavy vehicle flow along Ropers Road and Gap Road by improving sight distance and changing junction 'give way' arrangements at Ropers Road / Gum Creek Road / Duck Lagoon Road / Gap Road intersection (Item 66) and at Gap Road / Springs Road intersection (Item 60) at an estimated capital cost of $ 50,000.

5. Reduce two P1 very high risks along the Mount Taylor Road extension to a residual risk of P3 by widening the Playford Highway / Mount Taylor Road junction (Item 100) and widening any existing sections of Mount Taylor Road which are under 6.0m width (Item 101a) at a total estimated capital cost of $ 330,000.

6. Manage remaining P2 high risks using operational restrictions on KIPT heavy vehicles under permit conditions, including:

    a. Impose a maximum heavy vehicle speed on all unsealed roads along the route of 80 kph.

    b. If Ropers Road Bridge reconstruction is not complete, impose a 60 kph heavy vehicle approach speed immediately either side of the bridge and instruct unladen (south bound) KIPT vehicles to give way to laden (north bound) vehicles – on the ground signage could be employed so that all vehicles apply this rule.

    c. Until the Playford Highway / Ropers Road junction is upgraded (which will be subject to additional Council and/or DPTI funding and DPTI approval), instruct all unladen (south bound) KIPT vehicles to hold back from the junction and give way to laden (turning) vehicles at the junction using radio communications to confirm the presence of any vehicle coming in the opposite direction.

7. Issue a permit to KIPT for restricted operation of its vehicles on the Option 5 main route, plus Playford Highway Extension and Mount Taylor Road Extension, covering a period of up to three years.

The estimated total capital works cost of Stage 1 is **$ 980,000**. In addition, extra maintenance of the unsealed roads will be required to ensure they remain in a suitable state that does not increase the safety risk beyond the overall P3 level with a moderate number of P2 risks. This will need to be funded appropriately.

Note that, fundamental to Stage 1, only permitted KIPT B-Doubles or 30m A-Double short road trains, with authorised drivers who are familiar with the route risks and actions to be taken, should be allowed on the route.

By way of comparison, selection of Option 2 as the preferred heavy haulage main route option would result in a comparable total spend under Stage 1 of $ 1,550,000.

Stage 2

As funds become available, potentially over a two to three year period:

1. Reconstruct and seal Ropers Road (including its junction with Playford Highway), followed by Gap Road and then the relevant section of North Coast Road, in order to simultaneously reduce critical identified P2 risks to P3 or lower, as well as limit on-going deterioration of all unsealed roads which form a part of the route. The cost estimate for these capital works comprises the Playford Highway / Ropers Road junction full upgrade cost of $ 300,000 (Item 74 in the report), four major culvert extensions along Gap Road (Items 59, 61, 63 and 64) costing $ 120,000, together with all full carriageway upgrade costs detailed in Section 19.4, namely $ 880,000 for Ropers Road, $ 1,065,000 for Gap Road and $ 885,000 for North Coast Road.

2. Upon progressive completion of Stage 2, the speed restrictions placed upon KIPT heavy vehicles operating under permit along the route should be lifted for the respective upgraded road length.

The estimated total capital works cost of Stage 2 is **$ 3,250,000.** When combined with the Stage 1 estimated capital works cost of $ 980,000, it will bring total spend to a little over $ 4.2 million.

By way of comparison, selection of Option 2 as the preferred heavy haulage main route option would result in a comparable total spend under Stage 2 of $ 4,115,000. The total spend across Stages 1 and 2 under Option 2 would be in the order of $ 5.7 million.

At the end of Stage 2, maintenance of the route will have been substantially reduced since all roads except Mount Taylor Road will be sealed. However, the route will still have a number of residual P2 high risk sites, particularly works along Playford Highway and some outstanding works along the other roads that may not have been picked up during full reconstruction. For this reason, the route should remain a permit based route at the end of Stage 2, rather than be gazetted for general use.

Stage 3

If further funds become available, potentially in Years 4 and 5 of the overall project, all remaining P2 risks along the entire route should be reduced to P3 or P4 residual risks. Using the tables from Section 19.1 and 19.3 as a reference, all remaining works are shown below.

1. Playford Highway.

Item	Issue and Risk Rating	Cost ($)	Residual Risk
75	Carriageway P2	250,000	P4
76	Clear Zone P2	5,000	P3
77	Culvert P2	30,000	P3
78	Steep Hill P2	280,000	P3
83	Culvert P2	40,000	P3
86	Carriageway P2	135,000	P4
	Total Cost	**$ 740,000**	

2. Playford Highway Extension.

Item	Issue and Risk Rating	Cost ($)	Residual Risk
90	Carriageway P2	250,000	P3
91	Clear Zone P2	5,000	P3
92	Pedestrians P2	10,000	P3
95	Culvert P2	20,000	P3
96	Culvert P2	15,000	P3
98	Batters P2	100,000	P3
	Total Cost	**$ 400,000**	

3. Mount Taylor Road Extension (recommended to remain unsealed).

Item	Issue and Risk Rating	Cost ($)	Residual Risk
101	Carriageway P2	750,000 (max)	P3
104	Pavement P2	15,000	P4
106	Culvert P2	20,000	P4
108	Clear zone P2	5,000	P4

112	Curve P2	10,000	P3
113	Curve P2	10,000	P3
117	Curve P2	10,000	P3
	Total Cost	**$ 820,000 (max)**	

The estimated total capital works cost of Stage 3 is **$ 1,960,000.** When combined with the Stage 1 and 2 estimated capital works costs, it will bring total spend to a little under $ 6.2 million.

1. Upon completion of Stage 3 Priority Item 1, the main heavy vehicle haulage route from Playford Highway / Stokes Bay Road junction to Smith Bay Entrance should be gazetted for PBS Level 2B, allowing multiple operators to use the route. The KIPT permit would then only apply to Playford Highway Extension and to Mount Taylor Road Extension.

2. Upon completion of Stage 3 Priority Item 2 the Playford Highway Extension should be gazetted for PBS Level 2B.

3. Mount Taylor Road should continue to operate as an unsealed heavy vehicle haulage route under permit, unless medium term unsealed pavement deterioration issues dictate reconstruction and sealing.

21.0 ROUTE ASSESSMENT CONCLUDING STATEMENT

A heavy vehicle route assessment has been undertaken of two main route options, plus two proposed extensions, for the KIPT heavy haulage route. This has been completed for the purpose of determining which of the main route options is the more cost effective for issue of a permit, then subsequent gazettal, as a PBS Level 2B heavy vehicle route.

It should be noted that only road capacity, road geometry (with some preliminary intersection geometry) and road safety issues have been considered in this assessment, leading to a potential GML classification. While no detailed geotechnical analysis has been undertaken, unsealed pavement durability and whole-of-life costs to maintain the unsealed road versus capital works cost to reconstruct and seal has also been considered.

Gazettal of the proposed route, in its existing state, to a PBS Level 2B classification, is not recommended.

Conditional upon the level of risk considered acceptable to Kangaroo Island Council and DPTI (for parts of Playford Highway), the recommended main route, being Option 5, and extensions could be operated under permit for PBS Level 2B vehicles, provided a high level of residual risk (P2) is acknowledged and managed accordingly.

Following further upgrade treatment at moderate risk sites, the proposed route could be gazetted as suitable for PBS Level 2B vehicles, provided a moderate level of residual risk (P3) is acknowledged and managed accordingly.

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Appendix A

Photos Showing Very High Risk (P1) and Selected High Risk (P2) Sites

Photo No. 1 – Item 1, junction of Playford Highway and Stokes Bay Road.

Photo No. 2 – Item 2, typical cross-section of Stokes Bay Road.

Photo No. 3 – Item 3, guardfence protecting culverts on Stokes Bay Road.

Photo No. 4 – Item 4, steep down grade on Stokes Bay Road.

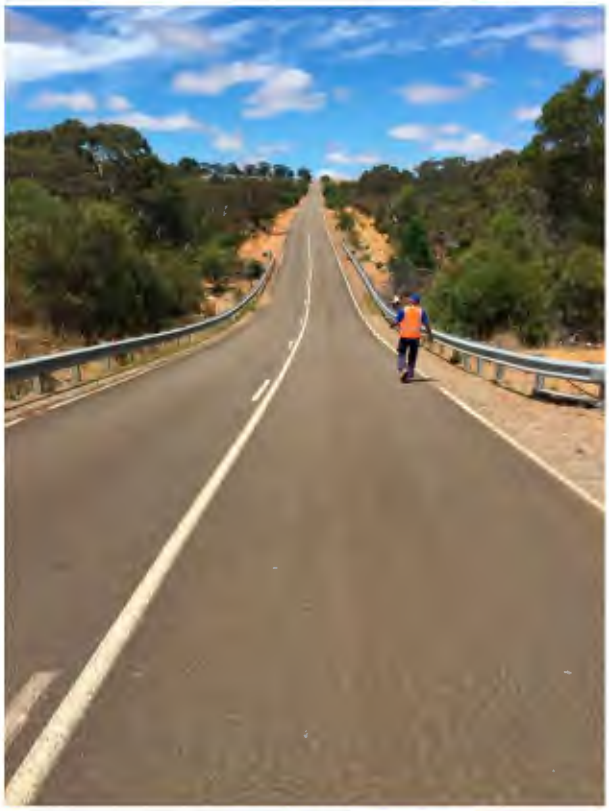

Photo No. 5 – Item 4, guardfence protecting the culvert, the dip is very tight.

Photo No. 6 – Item 10, junction of Stokes Bay Road and Bark Hut Road.

Photo No. 7 – Item 12, guardfence protecting a deep culvert close to the carriageway.

Photo No. 8 – Item 19, junction of Bark Hut Road and McBrides Road.

Photo No. 9 – Item 20, typical cross-section of McBrides Road.

Photo No. 10 – Item 22, vertical alignment on McBrides Road.

Photo No. 11 – Item 27, junction of McBrides Road and North Coast Road.

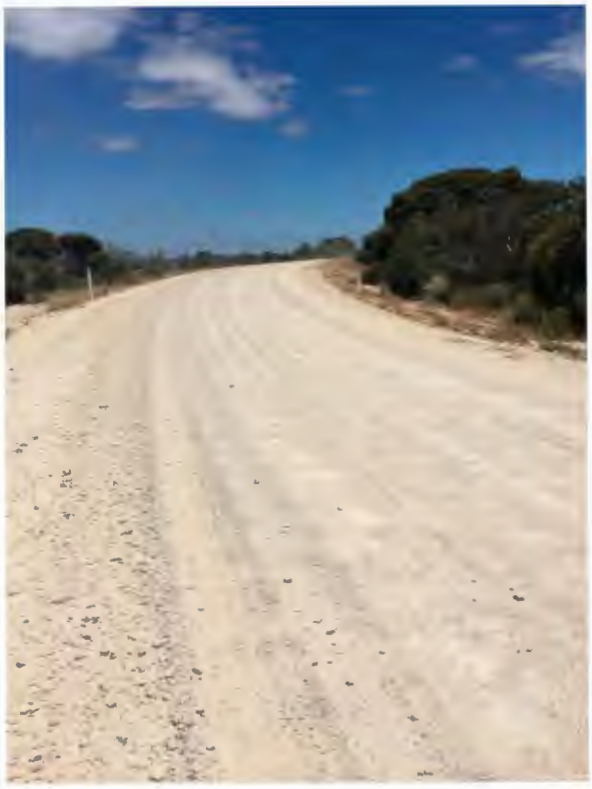

Photo No. 12 – Item 28, typical cross-section of North Coast Road.

Photo No. 13 – Item 43, guardfence protecting a culvert, batter slope not covered.

Photo No. 14 – Item 44, tight horizontal curve on North Coast Road.

Photo No. 15 – Item 51, large tree located on the edge of North Coast Road.

Photo No. 16 – Item 54, Junction North Coast Road and Gap Road.

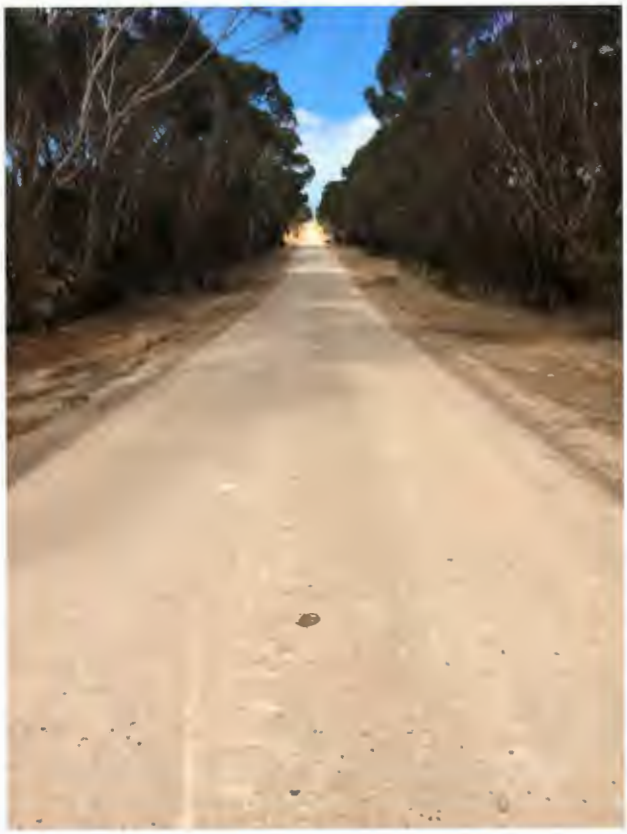

Photo No. 17 – Item 55, insufficient road with on Gap Road.

Photo No. 18 – Item 59, culvert on Gap Road.

Photo No. 19 – Item 61, large culvert on Gap Road.

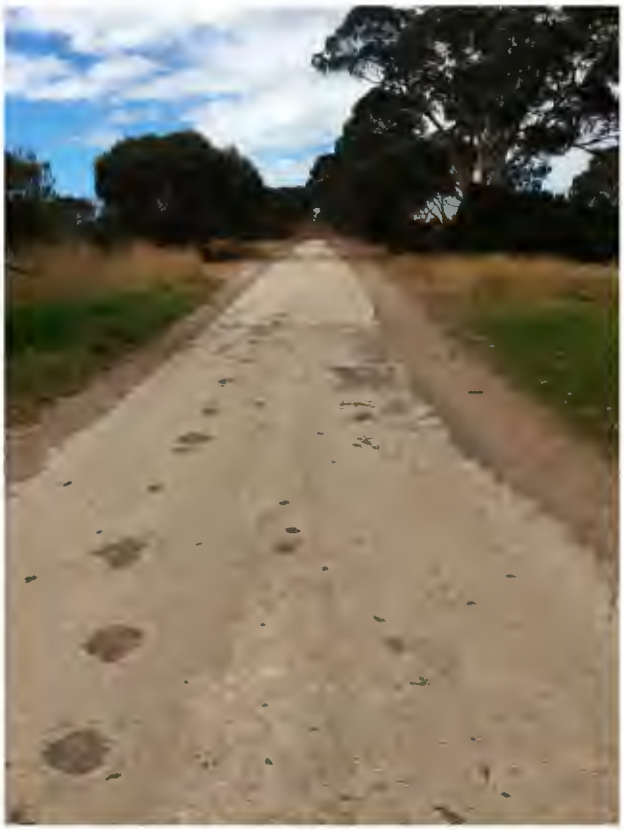

Photo No. 20 – Item 68, insufficient road width on Ropers Road.

Photo No. 21 – Item 69, single lane bridge on Ropers Road.

Photo No. 22 – Item 70 and 72, tight curve and close trees on Ropers Road.

Photo No. 23 – Item 74, junction of Playford Highway and Ropers Road.

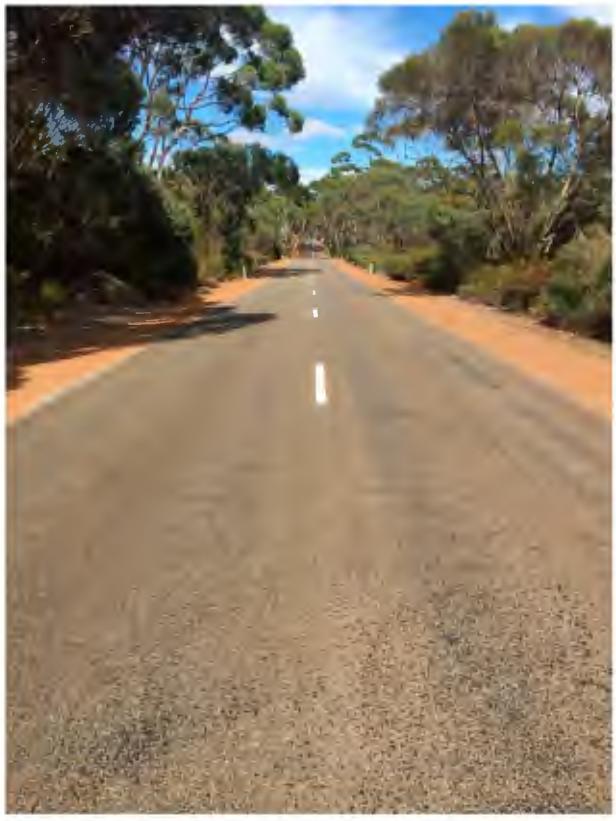

Photo No. 24 – Item 75, Playford Highway typical cross-section.

Photo No. 25 – Item 77, large culvert at the bottom of the downgrade on Playford Highway.

Photo No. 26 – Item 78, steep downgrade on Playford Highway.

Photo No. 27 – Item 78, the junction and horizontal curve on the downgrade.

Photo No. 28 – Item 86, typical cross-section of Playford Highway.

Photo No. 29 – Item 90, typical cross-section on Playford Highway.

Photo No. 30 – Item 100, junction of Playford Highway and Mount Taylor Road.

Photo No. 31 – Item 101, typical cross-section on Mount Taylor Road.

Photo No. 32 – Item 104, corrugations and tight horizontal curve.

Photo No. 32 – Item 107, tree on the edge of the carriageway.

Appendix B

Vehicle Turning Movements

DRAFT

Letter	REVISIONS	Date

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Client
KANGAROO ISLAND COUNCIL

Project
KIPT FREIGHT ACCESS ROUTE OPTIONS
PLAYFORD HIGHWAY AND ROPERS ROAD JUNCTION
VEHICLE TURNING MOVEMENT
30m A-DOUBLE

John C Olaon FIEAust Chartered Professional Engineer Member No. 108394	Approved (Manager)
	Date
Drawn: PC	Checked:
Scales: As shown	Sheets in Set: -

Drawing Number:
KI210-SK01
January 2018

Letter	REVISIONS	Date

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Project
KIPT FREIGHT ACCESS ROUTE OPTIONS
GAP ROAD AND NORTH COAST ROAD INTERSECTION
VEHICLE TURNING MOVEMENT
30m A-DOUBLE

John C Olson
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Drawn:	PC	Checked:
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Project: KIPT FREIGHT ACCESS ROUTE OPTIONS
PLAYFORD HIGHWAY AND STOKES BAY ROAD JUNCTION
VEHICLE TURNING MOVEMENT
30m A-DOUBLE

John C Olson
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Chartered Professional Engineer
Member No. 999594

Approved (Manager) _____ Date _____

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January 2018

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Project
KIPT FREIGHT ACCESS ROUTE OPTIONS
STOKES BAY ROAD AND BARK HUT ROAD JUNCTION
VEHICLE TURNING MOVEMENT
30m A-DOUBLE

John C Olson
FIEAust
Chartered Professional Engineer
Member No. 926394

Approved (Manager)
Date

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KI210-SK04

January 2018

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Project:
KIPT FREIGHT ACCESS ROUTE OPTIONS
BARK HUT ROAD AND MCBRIDES ROAD JUNCTION
VEHICLE TURNING MOVEMENT
30m A-DOUBLE

	John C Olson FIEAust Chartered Professional Engineer Member No. 800304	Approved (Manager) Date
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Drawing Number: **KI210-SK05**

January 2018

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Letter	REVISIONS	Date

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Project
KIPT FREIGHT ACCESS ROUTE OPTIONS
MCBRIDES ROAD AND NORTH COAST ROAD JUNCTION
VEHICLE TURNING MOVEMENT
30m A-DOUBLE

John C Olson
FIEAust
Chartered Professional Engineer
Member No. 806384

Approved (Manager) _____
Date _____

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Drawing Number:
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January 2018

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Project
KIPT FREIGHT ACCESS ROUTE OPTIONS
PLAYFORD HIGHWAY AND MT TAYLOR ROAD JUNCTION
VEHICLE TURNING MOVEMENT
30m A-DOUBLE

John C Olson
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Member No. 500384

Approved (Manager)
Date

Drawn:	PC	Checked:
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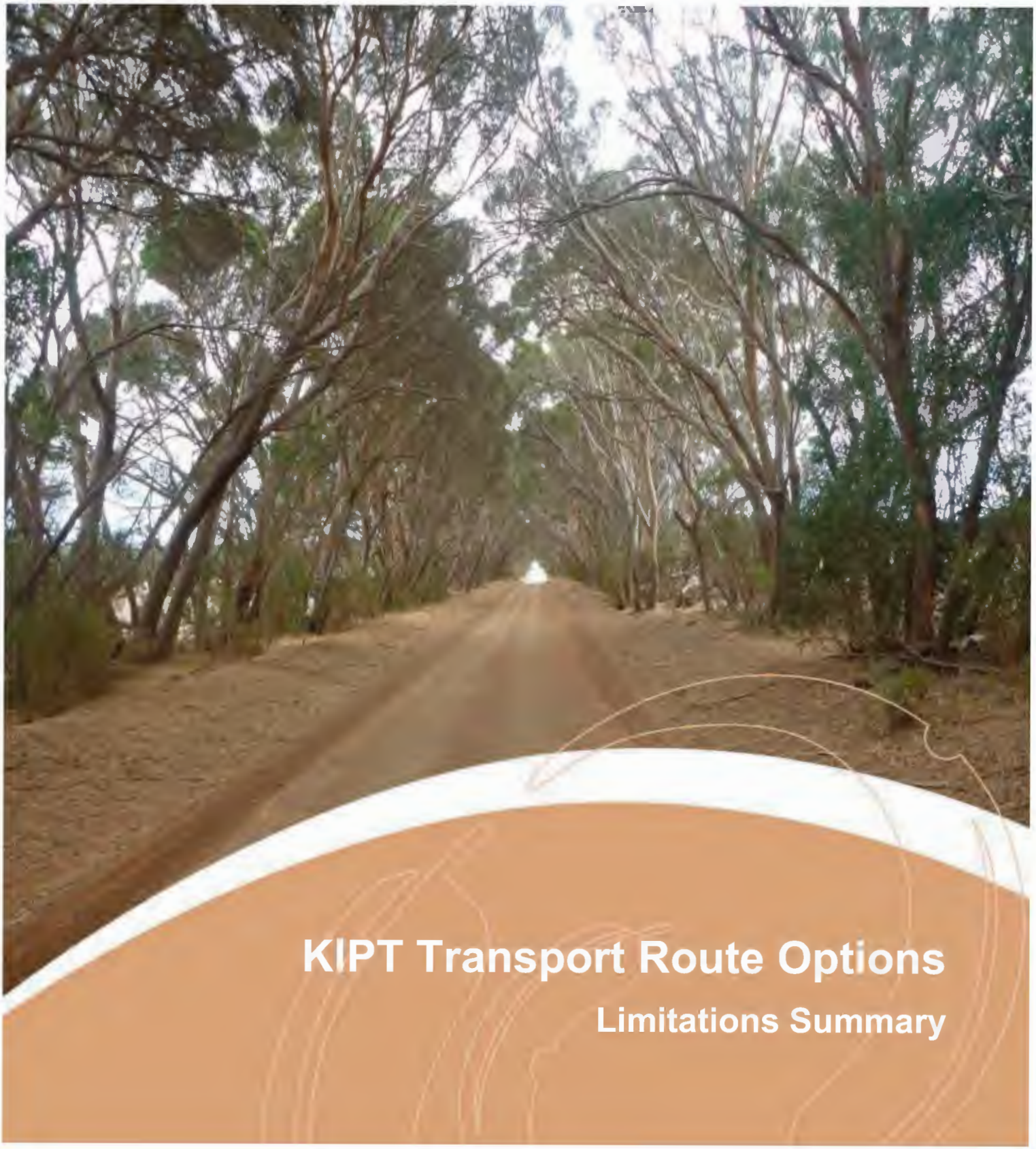
Drawing Number:
KI210-SK07
January 2018

Appendix P5 – KIPT Transport Route Options – Limitations Summary – EBS Ecology

ebs ecology



KIPT Transport Route Options

Limitations Summary

KIPT Transport Route Options Limitations Summary

17 April 2018

Version 2

Prepared by EBS Ecology for Environmental Projects

EBS Ecology Project Number: E10818

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CITATION: EBS Ecology (2018) KIPT Transport Route Options Limitations Summary. Report to Environmental Projects. EBS Ecology, Adelaide.

Cover photograph: *Eucalyptus cneorifolia* on Ropers Road reserve.

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1 INTRODUCTION

Following the initial vegetation assessment and ecological sensitivity report, EBS Ecology has been engaged by Environmental Projects to summarise the limitations specific to Transport Route Option 2 (Figure 1), which was found to have a number of areas rated as having an extreme sensitivity under the initial assessment. This was largely due to vegetation associated with Ropers and Gap Roads where the clearance envelope requirement to enable two way heavy vehicle access ensured an almost certain likelihood of impact.

1.1 Objectives

The objective of this summary is to highlight the relevant limitations associated with this route option and what the legislative requirements may be in terms of gaining approval for this option.

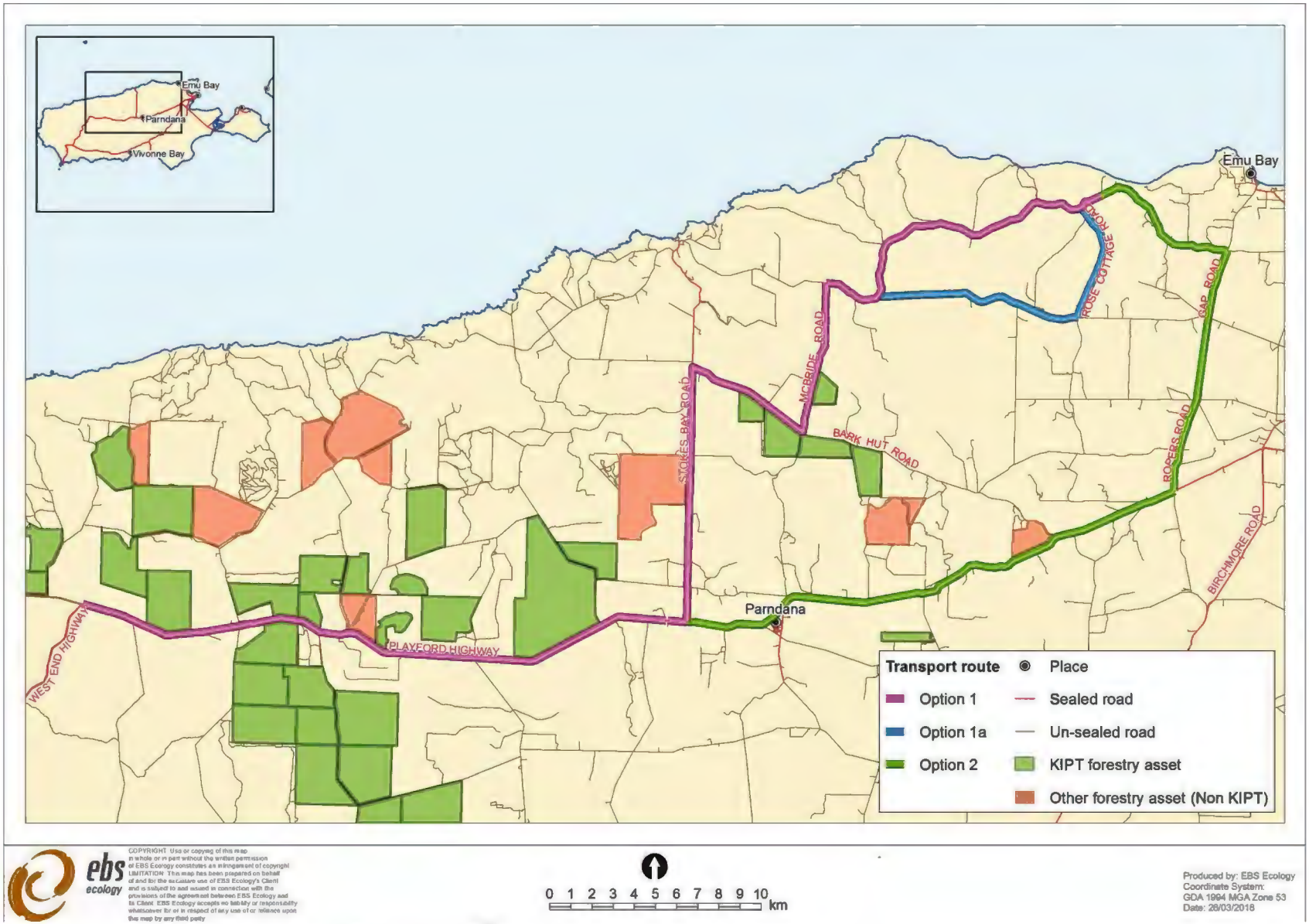


Figure 1. Transport route options with Option 2 displayed in green.

2 BACKGROUND INFORMATION

2.1 Method to gauge sensitivity

The route options were initially assessed as a desktop study of background information and literature review. Following this, an on ground assessment was conducted along the three routes as displayed in Figure 1. The on ground assessment consisted of mapping the individual vegetation associations and undertaking Bushland Condition Assessments within relevant associations and condition gradients.

Following the desktop and field assessments the following method was used to highlight the sensitivity for the initial route options;

An ecological sensitivity map of the individual route options was produced by integrating the information collected which includes assigning habitat units based on their ecological properties, potential presence of sensitive species and the Bushland Assessment Scoresheet biodiversity unit score (BUS).

The consequence and likelihood of each individual risk was analysed using the risk assessment matrix. Table 1 and Table 2 present the ratings for consequence and likelihood respectively. These tables were guided by AS/NZS ISO 31000:2009.

Table 1. Rating for the sensitivity assessment or consequence.

Consequence level	Communities	Species
1	No expected impact to high value ecological communities. Clearance of low value communities with biodiversity unit score (BUS) of <20. Low level trimming and isolated tree removals of degraded communities with BUS of <40	Low or no impact to terrestrial species
2	Minor impacts such as dust deposition, disturbance to habitats through vehicle noise. Clearance of ecological communities with BUS of >20 / <40. Impact Restricted to local area only.	Low impact to fauna species such as loss of nesting or other habitat requirements. Increased road kill.
3	Impact likely to have knock on effects to the wider area such as pathogen spread (Phytophthora) and increase of weeds and pests. Clearance of ecological communities with BUS of >40	Impacts to potential nesting and/or feeding habitat for conservation significant species. Disturbance to nesting / roosting habitat. Significant increase in roadkill.
4	Loss of road reserve width and fragmentation of high value communities with BUS of >60. Likely to have direct impact.	Impacts critical nesting and/or feeding habitat and nationally listed conservation significant species. Very high roadkill numbers

Table 2. Ratings for the assessment of likelihood.

Likelihood	Environment
Almost certain	Is expected to occur
Likely	Occurs frequently in similar projects
Possible	Could occur under unusual circumstances e.g. extreme weather events etc.
Unlikely	Unlikely to occur within the next 20 years
Rare	Unlikely to occur ever

The overall risk category was determined by the risk matrix provided below in Table 3 which considers both the consequence and probability.

Table 3. Risk assessment matrix.

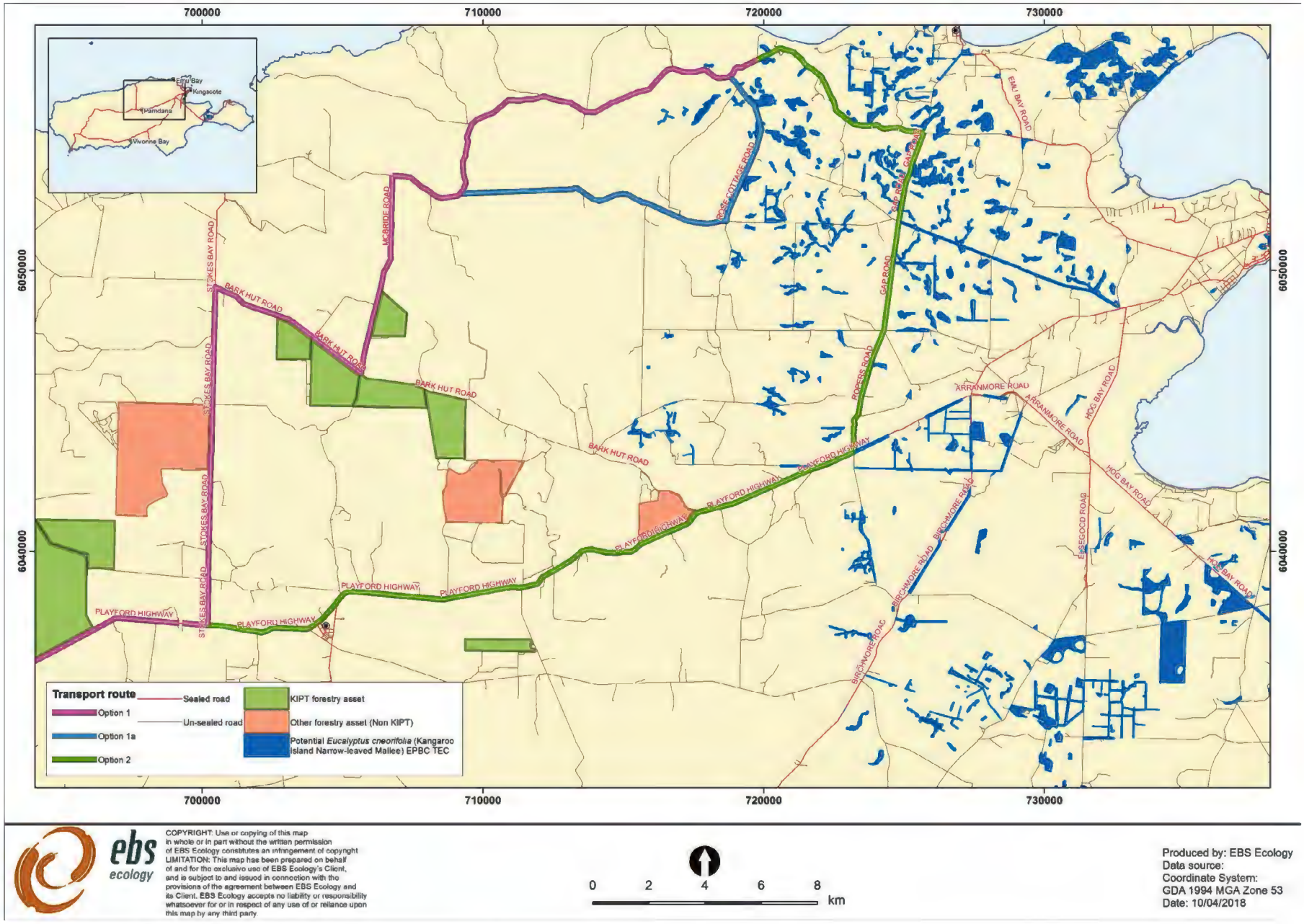
Likelihood	Consequence			
	1	2	3	4
Almost certain	Moderate	High	Extreme	Extreme
Likely	Moderate	Moderate	High	Extreme
Possible	Low	Moderate	Moderate	High
Unlikely	Low	Low	Moderate	Moderate
Rare	Low	Low	Low	Moderate

2.2 Key findings

The results of the sensitivity assessment showed that all route options had areas where there was some sensitivity surrounding the roadside vegetation across all route options either from a specific species perspective or as having conservation significant vegetation communities present. Areas which were adjacent to major carriageways were commonly of lower sensitivity due to already well established clearance envelopes which resulted in no clearance requirement or were deemed to be at low risk of unquantifiable risks such as noise disturbance or dust deposition.

Route Option 2 was highlighted as the least preferred option from an ecological perspective which was largely due to the following key factors;

- The Route Option 2 section which included Ropers and Gap Roads is narrow which resulted in an almost certain likelihood of requiring clearance along most of its length.
- The Ropers Road alignment passes through a significant area known to be critical nesting habitat for the nationally endangered Glossy Black Cockatoo (listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999*) (EPBC Act).
- The Ropers / Gap Road reserve has significant remnant populations of Kangaroo Island Narrow-leaved Mallee which is, in sections, contiguous with patches likely to be a nationally Threatened Ecological Community (TEC) under the EPBC Act (Figure 2).
- Areas of Kangaroo Island Narrow leaved Mallee not protected under the EPBC Act are listed as Endangered under the Provisional list of State Threatened Ecosystems of South Australia (DEH, (in progress) unpublished and provisional list.
- The Playford Highway section of Route Option 2 passes through areas of known critical nesting and feeding habitat for the nationally endangered Glossy Black Cockatoo.
- *Spyridium eriocephalum* var. *glabrisepalum* (McGillivray's Spyridium) is endemic to Kangaroo Island. It occurs in one large and four small sub-populations in eastern Kangaroo Island. It is known from a number of locations adjacent to the Playford Highway in the area east of Bark Hut Road and from a few locations on Gap Road. Any clearance occurring within the Gap Road area would likely have an impact on the viability of this species.



Produced by: EBS Ecology
Data source:
Coordinate System:
GDA 1994 MGA Zone 53
Date: 10/04/2018

Figure 2. Kangaroo Island Narrow leaved Mallee (*Eucalyptus cneorifolia*) Threatened Ecological Community likely distribution.

2.3 Other limitations

All route options had some presence of threatened species and ecosystems. Route Option 2 however had three areas of high ecological significance in terms of habitat. These were:

- Playford Highway adjacent to the Parndana Conservation Park
- Playford Highway where it crosses the upper Cygnet River catchment area of Branch Creek
- the Ropers Road crossing of the Cygnet River.

Eight nationally threatened flora species occur within 5km of Route Option 2 (Figure 3). Most of these are not likely to be impacted as part of the project under the risk assessment.

Forty-four fauna species of state or national significance are known to occur within 5km of Route Option 2 (Figure 4). Many of these species use habitat within the project area for habitat requirements however are not generally specific to this route option.

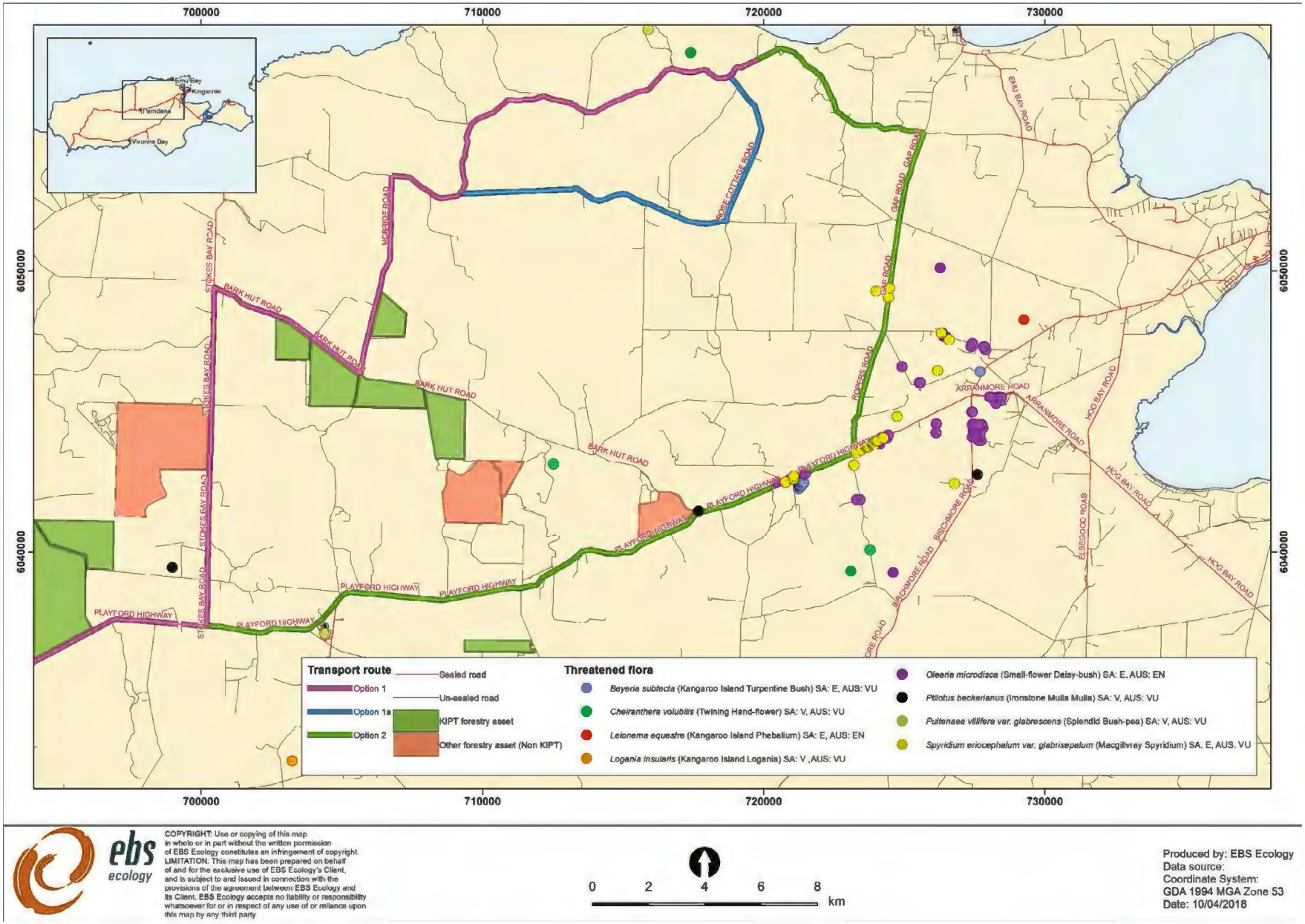


Figure 3. Threatened flora species locations relevant to Route Option 2.

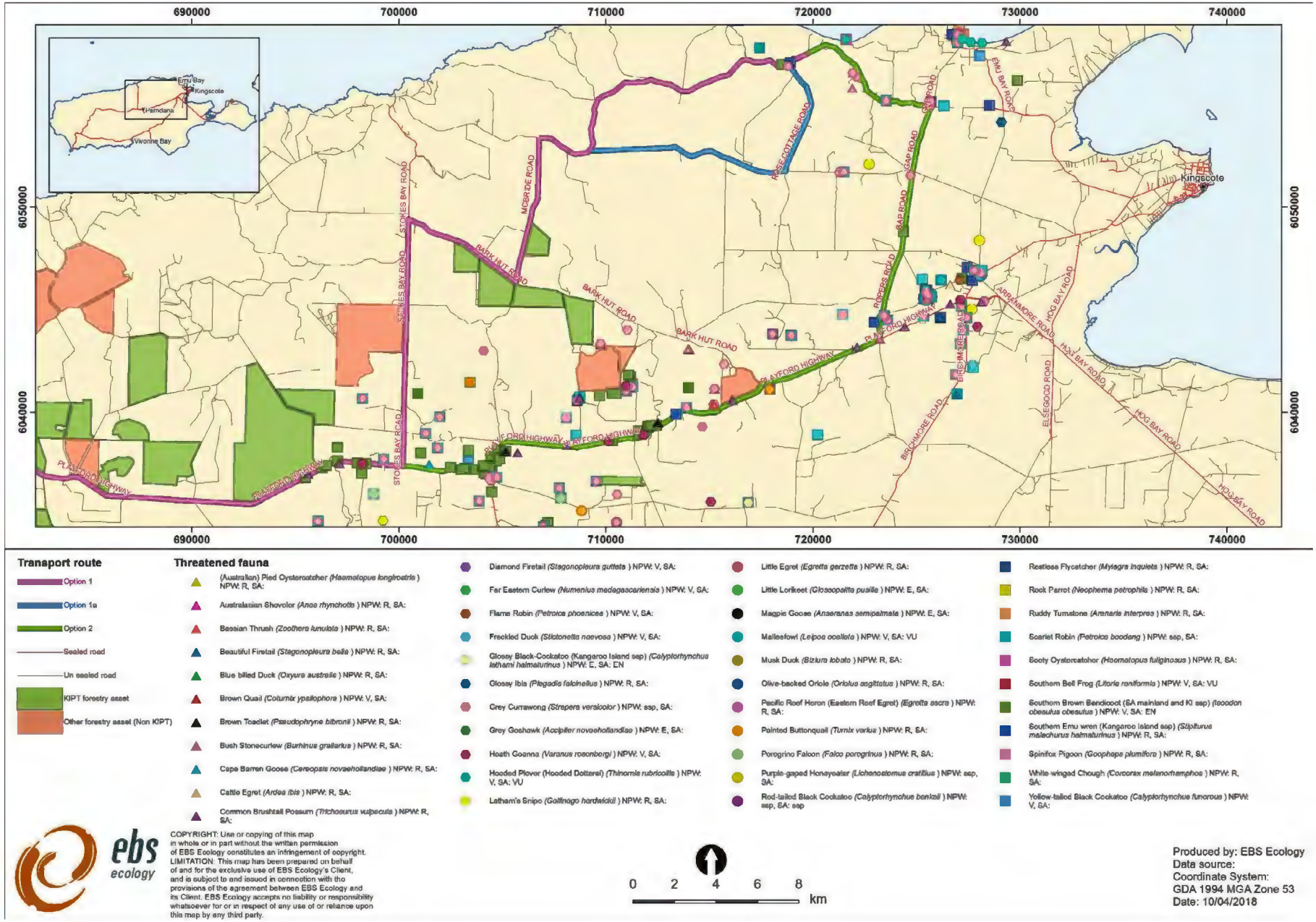


Figure 4. Threatened fauna species relevant to Route Option 2.

3 LEGISLATIVE LIMITATIONS

3.1 EPBC Act

The matters of national environmental significance (under the EPBC Act) are:

- World heritage properties
- National heritage places
- Wetlands of international importance (often called 'Ramsar' wetlands after the international treaty under which such wetlands are listed)
- Nationally threatened species and ecological communities
- Migratory species
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mining)
- A water resource, in relation to coal seam gas development and large coal mining development.

A person who proposes to take an action that will have, or is likely to have, a significant impact on a matter of national environmental significance must refer that action to the minister for a decision on whether assessment and approval is required under the EPBC Act.

The presence of known nesting habitat for the nationally endangered species Glossy Black Cockatoo in the immediate vicinity of the southern section of Ropers Road near the Cygnet River Crossing triggers point 4 of the matters of national significance, i.e. nationally threatened species and ecological communities

The presence of Kangaroo Island Narrow leaf Mallee in areas adjacent to the road and contiguous with areas of the Ropers and Gap Road reserve trigger point 4 of the matters of national significance.

The likely presence of *Spyridium eriocephalum* var. *glabrisepalum* triggers point 4 of the matters of national significance.

3.1.1 Nationally threatened species and ecological communities

In regards to point 4, the following applies in considering whether the project will have, or is likely to have a significant impact on a species listed in any of the following categories:

- extinct in the wild
- critically endangered
- endangered, or
- vulnerable.

An action will also require approval if the action has, will have, or is likely to have a significant impact on an ecological community listed in any of the following categories:

- critically endangered, or
- endangered.

The width of the existing road reserve on Ropers and Gap Road means that it is likely that clearance would be required to allow for the safe passage of heavy vehicles in either direction. In order to determine whether the action is likely to have a significant impact discussion is provided in the following sections for a number of criteria.

3.1.2 Critically endangered and endangered species

Individual species likely to be impacted as part of this action are:

- *Calyptorhynchus lathami halmaturina* (Glossy Black Cockatoo)
- *Spyridium eriocephalum* var. *glabrisepalum* (McGillivray Spyridium).

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of a population

  It is unlikely that clearance of potential nesting trees will lead to a decrease in the population of Glossy Black Cockatoo unless active nest sites are removed (not likely). Clearance on Gap Road may impact the population size of McGillivray Spyridium

- reduce the area of occupancy of the species

  This criteria may be relevant in terms of disturbance to roosting habitat by continuous flow of heavy vehicles. The large *Eucalyptus camaldulensis* potential nesting habitat trees which may be removed in the critical nesting habitat for Glossy Black Cockatoo may form roosting habitat for this species and therefore the action may reduce the occupancy for Glossy Black Cockatoo. The action would potentially reduce the area of occupancy for McGillivray Spyridium

- Fragment an existing population into two or more populations

  Due to the general high density of the trees on the road reserve and surrounding areas, the wider areas would not be significantly fragmented, however an action may lead to a small spatial separation of two areas of intact vegetation. Plantations of trees in the areas specifically undertaken for the enhancement of Glossy Black Cockatoo habitat may become less effective given the possibility of some clearance of large potential roosting habitat trees such as *Eucalyptus cladocalyx* (Sugar Gum) and *Eucalyptus camaldulensis* (River Red Gum).

- Adversely affect habitat critical to the survival of a species

  Any removal of large trees within this area is loss of habitat for Glossy Black Cockatoo. Large trees without suitable nesting hollows at the current point in time may become suitable over time, especially given the trunk size of the trees in question. Any narrowing of areas of road reserve containing McGillivray Spyridium would reduce the quality of the habitat. As a result, the action would definitely adversely impact the habitat critical to the species above.

- Disrupt the breeding cycle of a population

It is possible that disturbance from heavy vehicle traffic, if increased dramatically, would have an impact to the species. Scientific studies are required to quantify impacts.

- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Disturbance may lead to a decline in habitat quality however this is not directly known.

- Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

This criteria is not likely to impact Glossy Black Cockatoo. Any increased fragmentation would be detrimental to the resilience of the intact vegetation and increase the opportunity for exotic flora species to reduce the quality of available habitat.

- Introduce disease that may cause the species to decline, or

It is unlikely that any impacts related to the project would be vectors for pathogens or diseases associated with nationally threatened species.

- Interfere with the recovery of the species.

The action may interfere with the recovery of the species if potential nesting sites are lost as a result of the action. This applies to the entire project site and not just Route Option 2.

3.1.3 Critically endangered and endangered ecological communities

Roadside vegetation is generally excluded from the EPBC listed community in road reserves. In some areas within the road reserve however, large tracts of the road reserve form parts of larger patches in adjoining paddocks, hence making these areas of very high conservation value and worthy of consideration under the EPBC Act.

Significant impact criteria

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- Reduce the extent of an ecological community

Clearance of the road reserve would most definitely reduce the overall extent of the protected communities. Even in the event of retention of narrow strips of vegetation, areas of increased fragmentation are increasingly subject to weed and pathogen invasion, loss of ecological function such as seed movement and physical effects such as breakage from increased wind velocity to individual trees.

- Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines

This criteria would be directly impacted through definitive fragmentation.

- Adversely affect habitat critical to the survival of an ecological community

This community is typically low in species richness and understorey, however loss of function from species such as Ants may be critical to the long term survival and resilience of the community.

- Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns

It is unlikely that any impacts related to the project would impact the flow of surface or groundwater given adequate engineering elements such as culverts etc. that allow the existing natural events to continue unimpeded.

- Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting

It is unlikely that any impacts related to the project would cause changes in fire regimes or any other factors that would lead to a functional change in the natural ecology of the community such as nutrient cycling, infiltration or stability.

- Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

  – assisting invasive species, that are harmful to the listed ecological community, to become established, or

  – causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or

- Interfere with the recovery of an ecological community.

Point one would be a direct vector for the introduction of declared and environmental weed species.

3.2 Native Vegetation Act 1991

In considering the clearance of native vegetation in areas not subject to the EPBC Act, we must then consider the *Native Vegetation Act 1991* and the mitigation hierarchy.

When deciding whether to consent to a proposal to clear under the Native Vegetation Regulations 2017, the Native Vegetation Council (NVC) will look at how the proponent of a project considered the Mitigation Hierarchy.

The Mitigation Hierarchy calls for proponents to plan their activity in the following order of importance:

- Avoid impacts on native vegetation. This must be the first step in your planning. It includes planning to place infrastructure, buildings or other assets in a way that completely avoids impacts to biodiversity. For example, is there a particular location or time of year that you could clear that would avoid damaging native vegetation altogether?

Avoidance is the critical first step and means to find a route that avoids the clearance of vegetation in the first instance is essential. In this case, Ropers and Gap Road fails to satisfy that option with this road likely to require clearance along most of the approximately 12 km length. There is unlikely to be significant clearance required for other sections of the route option.

- Minimise the duration, intensity and/or extent of impacts on native vegetation (including direct, indirect and cumulative impacts), if clearance cannot be avoided.

Minimising the clearance would most likely require that where possible the clearance would occur on one side of the road only to maintain the largest possible intact areas rather than finish with two very narrow strips which will struggle to maintain resilience against weeds and other impacts in comparison to a single large patch in this instance.

- Rehabilitate or restore, the ecosystems that have been degraded at the site of clearance, if adverse impacts cannot be minimised or avoided.

The road reserves are difficult to restore given the already fragmented nature in the event of clearance. Engagement with the local Natural Resources Management (NRM) agency or similar may allow for enhancement of other nearby intact patches.

- Offset to compensate for any significant residual adverse impacts that cannot be otherwise avoided, minimised and/or rehabilitated or restored, so that there is no net loss of biodiversity.

3.3 Provisional list of State threatened ecosystems

The following vegetation communities were identified within Route Option 2 and are listed on the provisional list of state threatened ecosystems (DEH, in progress).

ENDANGERED
ENDEMIC

E. cneorifolia, *E. phenax* ssp. 'Kangaroo Island' Mallee on gilgai soils on plains
In lower Cygnet River catchment and MacGillivray plateau. Only conserved in Beyeria CP and an adjacent HA. Otherwise confined to roadsides where it is threatened by weed invasion and bulldozing.
IBRA Regions: KAN
Trend: declining

This was identified along the entire extent of the Ropers Road area and while it was largely in poor condition, the overstorey was well established. There was no evidence of recruitment within this area due to high levels of annual exotic grass cover which makes these areas a high threat to ongoing degradation and increased weed invasion, particularly from species such as Olive (*Olea europaea*).

ENDANGERED
ENDEMIC

E. cneorifolia, *E. rugosa* Mallee over *Rhagodia candolleana* on glacial sediments on plains
Locally common on roadsides between Kingscote and Emu Bay. Not conserved and largely confined to roadsides, where it is threatened by weed invasion and bulldozing.
IBRA Regions: KAN
Trend: declining
NVIS Subgroup: mallee eucalyptus low open woodlands
Subregion: KAN1

This community was more representative of the communities observed at the northern end of Gap Road and along the North Coast Road west of the Emu Bay Road. This also has a declining trend. This community was prevalent along the eastern section of North Coast Road within the project area.

VULNERABLE

E. fasciculosa +/- *E. leucoxylon* Heathy Woodland on sandy loams of flats and slopes.
Reserved examples mostly small and in poor condition.
IBRA Regions: FLB, KAN, NCP, MDD
Trend: declining
NVIS Subgroup: eucalyptus forests with a heath understorey
Subregion: FLB1, KAN1, KAN2, NCP1, NCP3, NCP4, MDD4

This community was located along Route Option 2 on the Playford Highway however is not expected to be impacted as part of the project.

VULNERABLE

E. ovata +/- *E. viminalis* ssp. *cygnetensis* +/- *E. camaldulensis* var. *camaldulensis* Low Woodland in valleys and drainage lines
Heavily modified and fragmented by clearance for grazing, and no examples in reserves.
IBRA Regions: KAN, NCP
Trend: declining
NVIS Subgroup: eucalyptus woodlands with a shrubby understorey
Subregion: KAN1, KAN2, NCP2, NCP3

This community was not specifically mapped, however small numbers of individuals of *Eucalyptus ovata* were recorded within the project area on the Playford Highway. This community is not expected to be impacted as part of the project.

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