

REPORT OF THE ROAD SAFETY AUDIT OF ROADS ON TARAWA ISLAND, REPUBLIC OF KIRIBATI



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ROAD SAFETY AUDITOR

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AUSTROADS (2009) defines road safety audit as “a formal examination of an existing or future road or traffic project in which an independent, qualified team reports on the project’s crash potential and safety performance.” The main objective of road safety audit is to ensure a high level of safety for all new or existing road schemes. A road safety audit is a good way to ensure that safety is given thorough consideration throughout each phase of the project. Road crashes have a very wide range of contributing factors, and therefore an audit cannot guarantee that every possible potential safety concern has been identified. However, careful consideration and adoption of road safety audit recommendations will reduce the risk to road users.

CONTENTS

1. INTRODUCTION
2. THE ROAD SAFETY AUDIT PROCESS
3. SCOPE OF WORKS
4. ROAD SAFETY AUDIT OF ROADS ON TARAWA ISLAND, KIRIBATI
 - 4.1 Background to the project
 - 4.2 The road safety auditor
 - 4.3 This road safety audit
 - 4.4 Recommendations from previous audits
 - 4.5 Description of the existing roads
 - 4.6 Expected road safety concerns when the road is reconstructed/
rehabilitated
 - 4.7 Summary of the necessary road safety engineering for the new road
5. CONCLUDING STATEMENT
6. DOCUMENTS USED DURING THE ROAD SAFETY AUDIT
7. TABLE OF ROAD SAFETY AUDIT FINDINGS AND RECOMMENDATIONS
8. OTHER BACKGROUND INFORMATION
 - 8.1 General Kiribati road safety information
 - 8.2 Findings of investigations of six blackspots in South Tarawa

1 INTRODUCTION

This report details the results of a road safety audit of the existing road conditions along the main island road on Tarawa Island, in the Republic of Kiribati.

The road safety audit has been conducted in accordance with Austroads Road Safety Audit Guidelines (2009) and has included several day time and night time site inspections of the road. Also included in the report are the results of an audit of approximately 8km of sealed roads in the township of Betio – at the western end of Tarawa Island, and the Betio Causeway (approximately 3km) joining Betio to Bairiki.

The safety concerns found in these road safety audits are reported in Section 7 of this report. The audit has been undertaken to assist the World Bank in its planning and design for the reconstruction/rehabilitation of the main island road, and repairs to parts of the Betio township road network and the Causeway.

2 THE ROAD SAFETY AUDIT PROCESS

AUSTROADS (2009) defines road safety audit as “a formal examination of an existing or future road or traffic project in which an independent, qualified team reports on the project's crash potential and safety performance.”

The main objective of road safety audit is to ensure a high level of safety for all new or existing road schemes. A road safety audit such as this one of the main road on Tarawa Island (Kiribati) is a good way to ensure that potential road safety concerns are identified and given thorough consideration before they manifest themselves as blackspots or the site of serious crashes. Road crashes have a wide range of contributing factors, and an audit cannot guarantee that every possible potential safety concern has been identified. However, the consideration and adoption of road safety audit recommendations will reduce risk for road users.

3 SCOPE OF WORKS

The World Bank is preparing the Kiribati Road Rehabilitation Project (KRRP) which will rehabilitate the main road on Tarawa from St Anne's (at the western end) to the international airport (at the north eastern end), as well as to Temaiku. As part of that project, the Bank has requested that a road safety audit of the South Tarawa paved roads (including Betio town) be undertaken to identify engineering deficiencies and other issues which can be addressed through the civil works activities on the Bank's project.

The Bank has also requested the development of Terms of Reference for Road Safety Technical Assistance Activities which are non-engineering works, such as helping to address education, enforcement, training, emergency response, etc. The Terms of Reference will be the subject of a separate report.



4 ROAD SAFETY AUDIT, TARAWA ISLAND, REPUBLIC OF KIRIBATI

4.1 Background to the project

Kiribati is a small, remote country comprised of a number of dispersed islands. The capital and 43% of the country's population (some 45,000 people) is located on the island of South Tarawa. The communities on this island are linked to each other, and the international airport, by a single main sealed road and three causeways which run east to west. This road has urban development along much of its length, particularly in the far west in the main urban centre of Betio.

Recent prolonged periods of heavy rain, coupled with the high traffic levels (over 6,000 vpd in some locations), and use by large, heavy equipment for delivery of containers has severely damaged the road. The magnitude of the damage has overwhelmed the Government's capacity for repair to the extent that substantial sections have reverted to unpaved status. Many sections of the road are now in need of reconstruction, with the balance in need of urgent rehabilitation to prevent further deterioration.

The damage to the road has affected travel in South Tarawa - the average travel speed is reduced to 20 km/h, with vehicles forced to navigate large, deep depressions and numerous "pot holes". During the rainy season these are completely filled with water. During the dry season, the dust from the unpaved sections is reported to be contributing to upper respiratory problems among local residents.

The World Bank and Asian Development Bank have provisionally agreed to finance the reconstruction of the road. There is awareness that the present poor condition of the road restricts vehicle speeds, and hence reduces the crash risk. Because the road passes almost continuously through populated areas (with houses, shops, schools and businesses very close to the edge of the road), there are concerns for safety as speeds will increase due to the improved road surface. Provided these speeds are not excessive, this will be a desirable project outcome. However, road safety is a new topic in Kiribati and speed enforcement cannot be guaranteed. At present speeds are constrained by a series of road humps. It has been determined that the new road design must incorporate road safety measures, including properly marked speed humps at appropriate locations.

To this end, the World Bank has engaged a Consultant to undertake a detailed road safety audit of the South Tarawa paved road network. The safety audit is to clearly identify all issues along the paved road network with specific recommendations as to the engineering improvements which need to be made at each location. This report shall be used by the design consultant during the design stage.

4.2 The road safety auditor

This road safety audit was undertaken by Phillip Jordan - a consultant in road safety engineering and a registered Senior Road Safety Auditor in the Victorian (Australia) register of road safety auditors administered by VicRoads. He has not previously been involved in any aspects of this project and is independent as required.

4.3 This road safety audit

This report details the findings of the road safety audit of the existing conditions along the main road in South Tarawa (between St. Anne's Pre-School in Bairiki to Tanaea, including Tekawai ae Boou and Temaiku Road – a distance of approximately 27.5km). It also includes an audit of the sealed road network within Betio Township (a length of some 8km of roads) and an audit of the Causeway near Betio (approximately 3km).

The Environmental Management Plan for the project (dated 18th August 2010) states that the new road will have a 7m sealed pavement with 1.5m wide easements either side for telephone, electricity and other services. The Plan also refers to enhancements such as indented bus stops, road humps, signage, footpaths, suitable sight distance, and safety during the roadworks. It is also understood that a decision has been taken to re-construct and rehabilitate this road within its existing Right of Way and on its present alignment.

The audit has recognised that there are many competing issues involved in this road project - safety, environmental, financial and more. Therefore, while this report is focussed on safety only, it also recognises that there will be difficulties if sensitive works (such as a widening of the road, or the removal of many trees) are proposed in the interests of safety. Hence – although the auditor may support a widening and straightening of some sections of the road, or the removal of trees in other sections for safety reasons, these are not stated in this report as they will likely encounter difficulties. The management of vehicle speeds is, and will continue to be, a critical road safety issue for this road. This report stresses the need to manage speeds to the present levels. This report also stresses the need for the road design to assist the largest road user group on Tarawa – the pedestrians.

The road safety audit included numerous site inspections (morning, afternoon and night) during the week 14th -21st September 2010. The weather during the inspections was (typically) warm and dry. There was rain only on one occasion.

The safety deficiencies identified in this audit have been given a risk rating by the auditor, based on the risk assessment method in the AUSTROADS Road Safety Audit guide 2009. The auditor has estimated the likelihood of a crash occurring due to the deficiency, together with the potential consequences of that crash. These risk ratings are listed in the box below:

- INTOLERABLE RISK – major safety issues with a high probability that traffic crashes will occur and/or that those crashes will result in multiple deaths;
- HIGH RISK – major safety issues with a high probability that traffic crashes will occur and/or that those crashes will result in serious injury or death;
- MEDIUM RISK– safety issues with a lesser risk that crashes will occur and/or that those crashes will result in less serious/minor injuries only;
- LOW RISK – safety issues that can be reasonably expected to result in few crashes and/or those crashes will result in minor injuries or property damage only.

4.4 Recommendations from previous audits

The auditor is not aware of any earlier road safety audits of this road or this project.

4.5 Description of the existing roads

The **main road** serving the island is:

- A two-lane, two-way road some 30km. in length. It has abutting residential and commercial development over more than 90% of this length.
- A flat road (Tarawa is a low lying island with no hills).
- The pavement at present is between 6-7m wide. The edge is badly broken in parts, with large drop offs. Small sand drifts have built up in some parts, making it difficult to ascertain the present width.
- The road does not have sealed shoulders – there are substantial drop-offs (up to 120mm) from some parts of the road to the unsealed, damaged shoulders.
- There are some footpaths in Betio and Bairiki (sometimes too narrow and unfinished), but none in the other towns or villages.
- There is no line marking, no edge lines, no centre lines, no guide posts and no delineation of any kind. There is a centre line of old studs on the Betio Causeway.
- There are few signs – some are hump warning signs and some are speed restriction signs. There are no direction signs. The warning and regulatory signs are not used consistently.
- The road is characterised by numerous short straights followed by short curves. The geometry is acceptable for the existing speed limits (40km/h everywhere except on causeways where the limit is 60km/h).
- The road is in very poor condition. There are numerous pot holes, and when wet the skid resistance of the pavement is poor.
- There are street lights on one side of the road through the more significant towns. These are barely adequate to illuminate the road in those areas. Outside the towns, the road is illuminated only in parts by lights from adjacent houses, schools and stores.
- There are just two intersections of any consequence along the road (other than in Betio township) – the intersection of the main road with the Airport Road (a T-junction) and the intersection at the eastern end of the Betio causeway near Mary's Motel (a cross road junction in Bairiki). Both have some basic safety issues that should be addressed during the project.

It has been reported that the road is used (in one section) by some 6000vpd. Of this number, an estimated 40-50% is buses, 25% cars, 20-25% trucks and utilities, and 5-10% motorcycles. These are estimates only but are given to highlight the important role that buses and trucks play in moving people on this island. However, the largest and most vulnerable road user group are pedestrians. The road is used by people to walk – to bus stops, to school, to church, to shops. If the road is to provide maximum safety benefits for the community it must address the safety needs of the pedestrians.

Vehicle speeds at present are (overall) quite low due to the potholes and the frequently stopping buses. However, some vehicles were noted travelling at higher speeds (above 60km/h) – typically on the causeways (where there is no abutting development) and in other parts where drivers can see a distance ahead free of potholes and traffic. Bus drivers in particular have a reputation for inappropriate speeding.

Summary of the basic road safety and traffic management deficiencies of the existing main road:

- Pedestrian assistance – there are no footpaths, no sealed shoulders and no pedestrian crossing facilities.
- Line marking – there are no centre lines, no edge lines.
- Delineation – there is no delineation of the few significant curves.
- Signs – there are no direction signs and very few warning signs.
- Signs – there are some speed restriction signs but not enough to continually remind drivers of the speed limit.
- Signs - there are no location signs or markings for any road hump. Some drivers are caught by surprise by some of the humps.
- Crash protection – there is no crash barrier other than lengths of non-standard concrete barrier (or sandbags) along the causeways.
- There are few street lights – there are large lengths where the road is very dark.

A clear zone of 3m (from VicRoads Road Design Guide) is an internationally accepted width to be kept clear of fixed road side hazards (for the traffic volumes and speeds on this road). At present, most parts of this road have numerous roadside hazards within a 3m distance from the edge line. These hazards include trees, shipping containers, undrivable side slopes, bridge parapets, ends of concrete barriers, and numerous houses/shops/fences. It is recommended that a 3m clear zone be used to guide the designers in the provision of a safer roadside for the new road.

However, it is considered that (on balance) it is neither realistic nor helpful at this stage to remove or shield every fixed roadside hazard along this road – especially when a great many of these are coconut palm trees. Instead, only those fixed hazards that are considered by the auditor to be particularly serious, or which can be readily addressed without serious environmental or financial impacts, have been identified and recommendations made.

The **roads in Betio** are in generally better condition. Some have kerbing to define the edge of the road, and in most cases the pavement is good quality. Street lighting exists, and there are bus lay-bys at some of the bus stops. However, the footpaths are inadequate for the numbers of pedestrians. There are some footpaths but many of these are now overgrown with vegetation, and some were too narrow to begin with. In Betio most of the roads have a generous width for motor vehicles, but the footpaths are narrow or non-existent.

There are also a few site specific safety issues that will be detailed later in this report. One is a cross road intersection that warrants better signing and line marking to confirm the priority. The other is the roundabout at the western end of the town that does not have the correct regulatory signing. It also needs a hatched splitter island to confine drivers to their lanes – especially on the western approach.

The **road over the Betio causeway** is straight. It encourages high speeds. The bridge presents a roadside hazard as it is narrower than the road cross section and it has raised footpaths and railings in the path of vehicles. There is a non-standard crash barrier (approximately 650mm high) along both sides of the causeway – if speeds are kept to 60km/h it is considered that this barrier will suffice to contain errant motor cars. However, it is doubtful that this barrier (being quite low and with unknown re-enforcement and with uncertain quality of construction) will contain a truck or other heavy vehicle. In view of this uncertainty and with the numbers of loaded buses and trucks that cross this causeway, it is recommended that the barrier be replaced during this project.

4.6 Expected road safety concerns when the road is reconstructed/rehabilitated

The project to rehabilitate and reconstruct this main road will bring economic benefits to the island. However, it will also increase vehicle speeds, and possibly encourage more vehicles to use the road. With vehicles travelling considerably faster, there will be a definite increase in crash risk along this road. Action – in the form of engineering improvements, enforcement, public awareness and public education - will be needed to mitigate such risk.

In particular, crashes involving speed will increase. These include pedestrian crashes, overtaking crashes, and run-off-road crashes.

Pedestrian crashes in particular will be a concern because the majority of Kiribati people do not own cars. They walk or use buses to get around. School children walk to and from school, people walk to the maneaba, to stores or to sports. The road at present provides poorly for the largest group of its users – the pedestrian. Care must be taken to ensure that the new road does provide for them. Speed management (via speed restrictions that are enforced by Police, and via road humps) plus sealed shoulders for use by pedestrians and footpaths in town centres are recommended.

To further assist pedestrians, lay-bys are recommended for buses to stop in. Shelters and street lights at each lay-by are recommended. Bus drivers should be encouraged to only stop at agreed locations (rather than anywhere as at present). The recommended 1.5m wide sealed shoulders will give some lateral clearance for buses that do stop away from lay-bys.

Overtaking crashes will increase as speeds increase. Centre line marking (including some lengths of No Overtaking line) can help to minimise this crash type. However, as alcohol and speed/impatience are often involved, implementation of a national road safety action plan to address these issues will be essential as part of this project.

Run-off-road crashes can be reduced through good delineation of bends and by good line marking (centre lines and edge lines). As alcohol and speed are over involved in such crashes, again there will be a need for a national approach to road safety awareness and enforcement, as well as better delineation. Selected use of correct standard crash barrier will play a part in minimising the consequences of the run-off road crashes.

4.7 Summary of the necessary road safety engineering for the new road

Based on the findings of this audit and observations of the road users of Tarawa, it is recommended that the design of new road include the following safety features:

- Ensure 60km/h speed zones on the causeways and 40km/h speed zones elsewhere.
- Manage these speeds by the installation of Watts profile road humps at schools, hospitals, churches and maneaba. Install humps as uniformly as possible, with one hump on each approach to each village, with a WELCOME sign for that village – creating a “gateway” treatment.
- Ensure each hump has an advanced warning sign, a location sign, and has line marking in accordance with Australian Standards.
- Ensure the road hump extends to the outside of the sealed shoulder so that drivers cannot drive around the hump. If necessary install kerbing to further restrict this.
- Provide a sealed shoulder at least 1.5m wide (and wider if space permits up to 2.5m wide).
- Provide sealed bus lay-bys in each village at locations agreed by local leaders and bus operators. Place a bus stop sign, construct a bus shelter and install a street light at each stop.

- In those few locations where space exists, seal the wider area and mark it as a Slow Vehicle Turnout (3.5m wide by minimum 50m long) – to permit slower vehicles to pull over to allow a queue to pass.
- Provide uniform and consistent signage – basic direction signs from the airport to Betio, warning signs for each hump, speed restriction signs at each change of speed zone (ie causeways) and at 1km spacing's thereafter. Use signs at humps to create gateway treatments for each village (see above).
- Use white thermoplastic line marking for edge lines and centre line (paint will deteriorate too quickly in this environment).

5. CONCLUDING STATEMENT

This road safety audit has been carried out in accordance with the process detailed in AUSTROADS (2009) for the purpose of identifying any features of the main road and other roads involved in this audit) that could be altered, redesigned or removed to improve safety. The auditor has inspected the roads and their environs. The identified safety concerns are noted in this report.

Phillip Jordan

PHILLIP JORDAN (Senior Road Safety Auditor)
Principal Consultant
21st September 2010

6. DOCUMENTS USED DURING THE ROAD SAFETY AUDIT





- AUSTROADS 'Road Safety Audit' guidelines, 2009

7. ROAD SAFETY AUDIT FINDINGS AND RECOMMENDATIONS



The following Table contains the findings of this road safety audit. The locations of the safety concerns have been identified as accurately as possible, but as there are no distance markers along this road and the road safety auditor has had to make estimates based on odometer readings and proximity to key nearby features. In particular, it is recommended that special attention be given to the safety needs of pedestrians during the design of this road.







No.	SAFETY CONCERN	RISK	RECOMMENDATION	CLIENT RESPONSE
A. GENERAL ROAD SAFETY CONCERNS ALONG THE MAIN ROAD THROUGH SOUTH TARAWA, THE BETIO SEALED ROADS AND THE BETIO CAUSEWAY				
1 PEDESTRIANS	Pedestrians are the largest and most vulnerable group of road users on the Island. They walk along this road day time and night time. The new road should be designed to provide better facilities for pedestrians; the increased vehicle speeds on the new road will place the pedestrians at greater risk.	HIGH	<ul style="list-style-type: none"> The design of the new road must recognise that the road serves a large community, and that most of the road users are not car owners. The road can and should be designed to improve pedestrian safety and convenience. 	
1.1	<p>The existing road makes no provisions for pedestrians to walk along the road or to cross the road. Walking is the main form of short distance transport in Tarawa and facilities need to be provided to assist pedestrians.</p> <p>To assist pedestrians walking along the road, sealed shoulders and, in one or two busy locations (such as near larger markets and larger schools), footpaths should be provided. Ensure the footpath is paved and made “all weather”.</p> <p>To encourage more use of the footpaths in Betio, Bairiki and Bikenibeu) – pave them and make them attractive for “all weather” use.</p> <p>To assist pedestrians at each causeway, a separate “all weather” footway should be formalised through the grass/trees on one side of the causeway.</p>	HIGH	<ul style="list-style-type: none"> Ensure that the cross section of the new road provides for sealed shoulders on both sides of the road at least 1.5m wide (and wider where space is available). In the 3 main town centres (Betio, Bairiki and Bikenibeu) pave the footpaths to encourage their use. Maintain speed control by the prudent use of speed restrictions signs (See 4.1) and road humps (See 4.2) Enhance the street lighting within the towns by installing new high pressure sodium lighting on both sides of the road wherever there is a footpath. On balance, pedestrian facilities such as zebra crossings are not recommended at this time (provided speeds are managed and sealed shoulders/footpaths are constructed). 	
1.2	Pedestrians do not appear to have many difficulties crossing the road at present. Traffic volumes and speeds are low enough that there are many long gaps for pedestrians to (generally) amble across. However, there is a risk involved in rushing to catch a bus, and some younger pedestrians do not look when darting across. It is considered important to maintain speeds to 40km/h or less.	MED	<ul style="list-style-type: none"> At locations agreed within the local community – and with the number of humps dependent on the length of the road in each village – install a Watts profile road hump to control speeds. Each hump should conform to the given profile – 3700mm long by 100mm high, a segment of a circle. Each hump should be line marked (Australian Standard) and have a sign at the hump as well as another in advance. In villages, place a hump and a WELCOME sign on each approach to form a gateway treatment. The space the humps at 100m centres – one either side of schools and maneaba - as key starting locations. 	



No.	SAFETY CONCERN	RISK	RECOMMENDATION	CLIENT RESPONSE
				
	<i>Many pedestrians walk along the road – at all times of day and night. Where the shoulder is wide (such as here) they can walk clear of traffic. However, there are other locations where they must walk on the road, and this exposes them to risk of being struck by a motor vehicle.</i>		<i>There are many locations – especially in the town centres – where pedestrians walk close to traffic. This is potentially a high risk activity and the risk will increase if speeds increase. Footpaths are needed through the town centres, and sealed shoulders are needed elsewhere.</i>	
				
	<i>One of the busiest times of day is the mid afternoon when the schools finish for the day. Many students walk along the road, relying on sound (engines or horns) to decide when to move onto the shoulder.</i>		<i>Near schools there are often large numbers of school students crossing the road. It is unlikely that a crossing will be used or observed correctly by the pedestrians or the drivers. Managing vehicle speeds is thus important to assist safety in these circumstances.</i>	



No.	SAFETY CONCERN	RISK	RECOMMENDATION	CLIENT RESPONSE
				
	<i>There are four causeways. At each one, pedestrians walk along a narrow track such as this one, or along the causeway wall, or along the side of the road across the causeway.</i>		<i>A number of pedestrians were observed walking along the retaining wall of the causeways. This is a sign that they do not have a more convenient and safe footway along which to cross the causeway.</i>	
				
	<i>In Betio, where the road network was formalised several years ago, pedestrians often find no suitable footpaths to walk on. Consequently they walk on the road, and are exposed to risk of collisions. It is recommended that the reconstruction work in Betio also include improved and widened footpaths where possible. At least, the existing footpaths should be paved with concrete – to be “all weather”.</i>		<i>These covered drains in a part of Bairiki show that consideration has been given to assisting pedestrians in some areas. While this is a good example of assisting pedestrians, it is a little too narrow to encourage groups of pedestrians to use. People in Kiribati like to walk in groups.</i>	

No.	SAFETY CONCERN	RISK	RECOMMENDATION	CLIENT RESPONSE
2 CROSS SECTION	It is understood that the new road will not permanently acquire any land, and that it will follow the alignment of the existing road. This being the case it is important to make use of every bit of cross section available. It is difficult to know just how much this is, as the road reservation is not easy to determine at present.	MED	<ul style="list-style-type: none"> Ensure consistent lane widths are provided, together with sealed shoulders. The width of the sealed shoulders can vary – ideally efforts should be made to construct 1.5m wide sealed shoulders but this may not be possible due to numerous trees etc. Go for the best available without serious tree removal. 	
2.1	<p>Lane widths of 3.5m will be acceptable. It is important to ensure that the shoulders are sealed, so that pedestrians are given an all weather path on which to walk. The sealed shoulder will also provide a better and safer place for the buses to stop – assuming that they will continue their practice of stopping anywhere, anytime. A minimum width of sealed shoulder of 1.5m should be designed, more if land permits.</p> <p>Sealed shoulders also provide a recovery area for errant vehicles. The six blackspots that have been investigated along the main road have a run-off-road pattern to them. The sealed shoulder and edge line should greatly assist in reducing these.</p>	MED	<ul style="list-style-type: none"> Seal the shoulders on both sides of the road for at least 1.5m width. If space permits, seal wider. Be prepared to settle for less sealed shoulder width if the road reservation does not permit for any reason – particularly at pinch points. Consider colouring the seal (See photo below). Buses will use the sealed shoulder for stopping – consideration should be given to the use of full depth pavement for the shoulder at critical bus stop locations, and at places where buses or trucks will turn into abutting properties. Use white thermoplastic edge lines (100mm wide) to demarcate the edge of the through lane. 	
				
<p>A sealed shoulder (similar to that shown in this sketch) – minimum 1.5m wide is recommended along the full length of this road. Where space permits, widen this further, up to a max 2.5m. Ensure that a strong edge line is installed in white thermoplastic – to delineate at night and to reinforce the nature of the shoulder.</p>		<p>A sealed shoulder (such as this one in Australia) provides a safe smooth surface for pedestrians, bicyclists and motorcyclists. The red scoria in the sealed shoulder highlights it – a possible thought for the Tarawa road project</p>		



No.	SAFETY CONCERN	RISK	RECOMMENDATION	CLIENT RESPONSE
2.2	There are a number of locations where small side roads intersect with the main road. To preserve the shoulder and to minimise sand and gravel being drawn onto the main road (where it will present a sliding hazard for motorcyclists) the side road should be sealed for a short distance.	LOW	<ul style="list-style-type: none"> Seal all side roads for a distance of approximately 10m back from the main road. 	
				
	<i>The existing road has many lengths with deep drop offs from the pavement. Sealed shoulders will help to overcome this problem, and will help to preserve the road pavement.</i>		<i>There are many roadside hazards (especially trees) along this road. Rather than cut them down, or shield them with barrier, it is recommended that the sealed shoulder and the strong edge line be used to help to keep drivers and vehicles on the road. Some chevron alignment markers are recommended at sharp curves as well.</i>	
3 ROADSIDE HAZARDS	Road safety engineering guidelines (eg VicRoads) indicate that the clear zone for this road (speeds in the 60km/h range, and some 3000vpd each way) should be 3m.	MED	<ul style="list-style-type: none"> Decisions about roadside hazards have been based on this clear zone. The clear zone is measured from the edge line. Every reasonable opportunity should be taken to eliminate any hazards (any fixed object with a diameter greater than 100mm) within this clear zone. 	
3.1	The road at present lacks sealed shoulders. The sandy shoulders are – in many locations – up to 120mm below the existing pavement. This drop-off is a hazard for motorcyclists and smaller vehicles. Sealed shoulders provide a recovery area for errant vehicles and also assist with the preservation of the road pavement.	HIGH	<ul style="list-style-type: none"> Construct sealed shoulders. Aim for a min 1.5m wide sealed shoulder but go for a greater width in those locations where it is possible. Consider using a coloured scoria to highlight the shoulder as a “no drive” area. Install an edge line along both sides of the new road, over its full length. 	



No.	SAFETY CONCERN	RISK	RECOMMENDATION	CLIENT RESPONSE
3.2	There are numerous trees and houses shops, and other fixed objects within the clear zone along this road. There are too many to individually highlight, and it is expected that removal of the trees will not be a favoured option. The installation of crash barriers is not recommended – such barriers will not fit in some parts because of inadequate widths for offsets and deflection. They will also cause “innocent hits” when buses/cars pull too close.	HIGH	<ul style="list-style-type: none"> Design the road with suitable line marking and associated delineation to minimise the risk of a vehicle leaving the road. Take into account especially the locations at each end of the causeways (where speeds will be highest) and ensure that delineation of the curves is excellent. At selected locations install 2-3 chevron alignment markers (CAM's) to delineate a sharp curve. Consider developing a program of tree removal to remove only those trees few that are closest to the road in the high risk locations (blackspots) at the end of the causeways. 	
				
<p>The bridge on the Betio causeway is narrower than the road cross section. The footpath and the bridge railing are road side hazards that present a risk to any vehicle that is a metre or two off path.</p>		<p>The Betio port road runs beside the sea – it requires crash barrier to prevent a vehicle from dropping 4m into the sea.</p>		



No.	SAFETY CONCERN	RISK	RECOMMENDATION	CLIENT RESPONSE
				
	<i>This barrier is believed to be a retaining wall against the sea. As a crash barrier it has questionable structural capacity to resist an impact from an errant vehicle. While it is suspected that it can withstand an errant car travelling within the speed limit, it is doubtful that it could withstand an impact from a large truck, or even a small fully loaded bus travelling at 60-80km/h.</i>		<i>The barrier is lower than the normally acceptable height of 780mm. It is beyond the 3m clear zone width defined in this report and it could be retained as it is. However, the consequences of a large vehicle hitting this barrier at speed will be serious. It should be structurally reviewed, and most likely replaced with full height New Jersey barrier.</i>	
4 SPEED MANAGEMENT	There will be an increased need to manage speeds after the road is improved. The present road humps are helping to maintain lower speeds, but these are also causing noise, inconvenience and discomfort (as well as likely vehicle damage). Unfortunately, for safety road, humps will continue to be the treatment of best effect.		<ul style="list-style-type: none"> • Install road humps at the entry to each village, together with a WELCOME sign. • Install them also at locations near schools, churches, markets and maneaba where they are needed. • In addition, install road humps through all 40km/h speed zones at centres of no more than 1000m. 	
4.1	The most impressive safety feature of the existing road is the 40km/h and 60km/h speed restrictions. While these are not well signed, and some drivers do ignore them, they are a positive safety feature that can be built upon with the new road. It is vitally important – especially for the safety of pedestrians – that speeds be maintained at or below today's legal levels.	HIGH	<ul style="list-style-type: none"> • Design the new road with a design speed no greater than 60km/h for the causeways and no greater than 40km/h elsewhere. • Ensure that <u>pairs</u> of speed restriction signs are installed to match the present speed restrictions. • Ensure repeater speed restriction signs are placed at 1km spacing's along the road (but not too close to other traffic control devices such as intersections or humps). 	



No.	SAFETY CONCERN	RISK	RECOMMENDATION	CLIENT RESPONSE
4.2	Road humps appear to be accepted by the community. At present they seem to come in three differing profiles – the smaller one is particularly hazardous. They are not well signed and they have no line marking. Humps are recommended for the new road, but only on the basis that they are signed correctly and line marked.		<ul style="list-style-type: none"> All humps should conform to the same profile. The concrete humps in use at present appear to be a slightly modified Watts profile hump (a segment of a circle 3700mm long by 100mm high). Small, short humps must not be used. Each hump should be signed in advance <u>and</u> at the hump. Each hump should have stripped markings (in accordance with the Australian Standard). Wherever possible, the humps should be located below a street light. 	
				
<p>Road humps are an accepted part of the Tarawa road. They are neither consistent nor conspicuous at present. There are varying profiles; there are no markings; the advance warning signs vary; there are no location signs.</p>		<p>This road hump (in Betio) appears to be a newer hump. It appears to almost conform to the Watts profile (it is about 50% higher than the standard Watts profile) – but is otherwise an acceptable profile. It is recommended that this type of hump be the only hump used in Tarawa. Each hump requires standard line marking and a sign at each, as well as a sign in advance.</p>		
4.3	The placement of the humps will be as important for safety as the profile of the hump. At present the humps appear to be (loosely) located near schools and churches. This is good practice but a series of humps, carefully spaced through a village will have greater effect than one single hump.	MED	<ul style="list-style-type: none"> Each village should be reviewed in terms of the number of humps needed. A “gateway” hump with a WELCOME sign should be located first. After that, humps in advance of the schools, maneaba and churches should be located. Humps should be at reasonably uniform spacing's of 100m if possible, with variations as necessary because of the vastly varying abutting development. 	



No.	SAFETY CONCERN	RISK	RECOMMENDATION	CLIENT RESPONSE
5 SIGNS, LINE MARKING AND ROAD HUMPS	There are no lines on the road. Without longitudinal lines, drivers may have difficulty remaining in their correct lane. Without lateral lines, drivers may not know where to stop or give way. There are few signs along the road. Those that do exist are warning signs for the humps, and some speed restriction signs. However, there is no consistency in the use of the type of these signs. There are no direction signs and no delineation.	MED	<ul style="list-style-type: none"> Ensure that lines are provided. Use thermoplastic for durability in the tropical weather. Ensure that correct and conspicuous signs (warning, direction, regulatory) are used on the new road. 	
5.1	A main road needs centre lines to separate the two directions of travel. Busy main roads also benefit from edge lines – to assist drivers to remain on the road at night, and to assist when there is headlight glare. The Tarawa main road has no line marking. The new road must include thermoplastic line marking as an essential part of the traffic management.	MED	<ul style="list-style-type: none"> Ensure that 100mm wide white thermoplastic is used to mark a dashed centre line and solid edge lines along the full length of this road. The lines should conform to AS1742.2 (Manual of Uniform Traffic Control Devices). 	
5.2	There are numerous road humps along the existing road. They seem to be well accepted by the community, but they are in three different shapes, and they are poorly signed. They have no line marking.	HIGH	<ul style="list-style-type: none"> Ensure that all road humps are of one shape (profile) only. The new hump used in Betio is recommended. Ensure each hump is line marked (with Australian Standard markings). Ensure each hump has an advanced warning sign 50m in advance on each approach, plus a hump location sign at the hump. Extend each hump to include the sealed shoulder. Where a hump is placed where vehicles may drive around it, ensure that there is kerbing placed beside the hump to prevent such action. 	
5.3	There are no Stop lines or Give Way lines at the intersections. These are needed to strengthen the necessity for vehicles to stop/give way, and they also assist to reduce the risk of overshooting.	MED	<ul style="list-style-type: none"> Ensure that all sealed intersections along the main road are controlled by Stop or Give Way signs. At each, ensure that there is a matching stop or give way line. 	
5.4	There are no direction signs anywhere along the road. Direction signs are needed to provide guidance to drivers and to highlight key junctions. This is especially important at the airport, and at the intersection of the Airport road and the main road.	LOW	<ul style="list-style-type: none"> Install white on green direction signs at the airport, and at the intersection of the Airport Road/main Road. Install confirmation signs along the main road at key locations to show distances to Betio and Bairiki. 	



No.	SAFETY CONCERN	RISK	RECOMMENDATION	CLIENT RESPONSE
				
	<i>The road lacks lines at present. It is a (generally) east/west road and sun glare is an issue. Edge lines and a centre line are required for the new road.</i>		<i>This highway in Australia benefits from a sealed shoulders, edge lines and a centre line. In this case the centre line prohibits overtaking – something that may need to be considered on Tarawa depending on the radius of the curves.</i>	
6 SAFETY DURING ROADWORKS	During the inspections of the road there were long term works underway on one causeway that caused one lane to be closed. There was also short term patching underway in one of the villages that caused a lane closure. Neither work site was well signed – there was no speed reduction, no advanced warning of the lane closure, no information or traffic control for the one lane operation. This raises serious questions about whether the contractor will use safe procedures for the construction of the road.	MED	<ul style="list-style-type: none"> Ensure that the Specifications for the project clearly require the Contractor to construct this road by complying with Australian Standard AS1742.7 (Code of Practice for Road Works) requirements. Ensure that drivers/riders are given advanced warning of the worksite, a reduced speed limit through the work zone, and clear traffic control (Stop/Slow baton) to assist them through the works when a lane is closed. 	
6.1	It is expected that the road construction will take many months to complete. It will cause severe disruption to traffic on South Tarawa as it is the only road serving the island. Consequently in addition to careful planning of the sequence of construction, it will be vital to manage the traffic through the worksite. It is likely that one side of the road will be constructed while one lane of traffic is permitted through. If so, careful management of the one lane of traffic will be needed.	MED	<ul style="list-style-type: none"> Ensure that the construction sequence for the new road aims to minimise disruption to traffic. Ensure that advanced warning is given (100m in advance) of all work sites. In addition, ensure speeds are reduced in work zones to 20km/h and that Stop/Slow controllers are used to control the one lane of traffic that may well be necessary. Inform the bus operators (in person) in advance of the road works and advise of the need for patience. 	



No.	SAFETY CONCERN	RISK	RECOMMENDATION	CLIENT RESPONSE
6.2	Workers were wearing high visibility vests. This is a good sign. It will be important for all road workers on the new road to wear high visibility vests	LOW	<ul style="list-style-type: none">Write into the Specifications for the work that all road workers are to wear high visibility vest at all times while on the job.Specify that the Contractor must comply with AS1742.7 Code of Practice for Road works	
				
<i>The short term patching was being undertaken with no advanced warning, no speed control and no management of the one lane that was left open to serve both directions of travel.</i>		<i>This work on the seawall along a causeway has been on-going for some time. It also fails to warn drivers in advance, to control speeds, or to control the traffic into a single lane. Such practices should be overcome during the roadworks of the new road project.</i>		
B. <u>LOCATION SPECIFIC SAFETY CONCERNS</u>				
7.1	There are two intersections in Betio that warrant attention during the rehabilitation work. The first is the “roundabout”. It is incorrectly signed and it should have a painted splitter island installed on the western approach	LOW	<ul style="list-style-type: none">Place advanced warning signs 50m in advance of the roundabout.Remove the advanced warning signs from the central island of the roundabout.Place a regulatory roundabout sign on each entry into the roundabout (on the left hand side of the approach).Paint a large “splitter island” on the western approach to this roundabout – roughly over the area that is presently covered with sand. The vehicle swept paths show that this is the correct shape to demarcate the lanes here.	

No.	SAFETY CONCERN	RISK	RECOMMENDATION	CLIENT RESPONSE
7.2	The other intersection is 25m west of the Ministry of Public Works. It is a cross road intersection, but it is not conspicuous. When the road surface is rehabilitated there will be an increased risk that drivers will overshoot this intersection without realising it is there.	MED	<ul style="list-style-type: none">When the road is rehabilitated, install new stop signs on the north and south (side road) approaches.Paint Stop lines (in thermoplastic) across the side roads at the stop signs.Mark a centre line along the main road here.Place an advanced warning sign (cross road ahead) 50m in advance of the intersection on the main road on both approaches.	
				
<i>This cross road intersection in Betio (just 25m from the Ministry of Public Works) lacks conspicuity. There is a risk of drivers “overshooting” this intersection. When the pavement is rehabilitated, Stop lines should be installed across the minor roads – and a centre line installed along this main road. Warning signs for the cross road should be installed 50m in advance of the junction on both main road approaches.</i>		<i>This junction has a roundabout warning sign – but it has Give Way signs. The sand on the pavement indicates the travel paths. When rehabilitation takes place, this should be formalised as a roundabout. The advanced warning signs should be moved to 50m in advance of the junction. A splitter island should be marked in thermoplastic on this western approach. Regulatory roundabout signs should replace the GW sign on each approach.</i>		
7.3	The road to/from the port in Betio runs beside the water, with a drop of approx 4m into the sea. There are no barriers to prevent a vehicle (or pedestrian) from dropping into the water. The drop is a roadside hazard and it warrants improvement. A crash barrier is the safest option.	MED	<ul style="list-style-type: none">Install a W beam steel crash barrier along the side of the drop into the water, set back as far as practical from the road.Ensure that edge lines are painted along both sides of this road.	
7.4	There are several footpaths in Betio that are not used by pedestrians because they are too sandy, or overgrown with vegetation. They should be “finished” in	LOW	<ul style="list-style-type: none">Wherever possible. Pave the town footpaths with concrete to make it an attractive all weather path for pedestrians to use.	

No.	SAFETY CONCERN	RISK	RECOMMENDATION	CLIENT RESPONSE
	such a way that pedestrians are attracted to use them, rather than walking on the roads.			
7.5	The bridge on the Betio (Nippon) Causeway is the only bridge in this project. It is narrower than the Causeway cross section and thus the footpath and the bridge railings are roadside hazards within the 3m clear zone.	MED	<ul style="list-style-type: none"> Either widen the bridge so that the bridge railing is in line with the barrier along the causeway retaining wall, or remove the footpath (if possible) and then use W beam steel barrier to shield the railing. Such barrier will need to be carefully and strongly attached to the causeway retaining wall so that it redirects an impacting vehicle, rather than pocketing them. A thermoplastic edge line and reflectors should also be installed to aid night time delineation 	
				
<p><i>Betio has a number of indented bus lay-bys. This concept should be extended to other points along the main road so that buses are encouraged to stop at set points. These points should be decided in consultation with the bus operators. Shelters and a street light should also be installed as a standard fixture at each lay-by.</i></p>		<p><i>This is the only bridge along the main road. It presents a roadside hazard to drivers/riders. The bridge should be widened and W beam crash barrier installed to shield the bridge railings and parapet from being struck. If widening is not possible, W beam barrier should be installed across the bridge, securely fastened to concrete barrier at either side. A thermoplastic edge line and reflectors should also be installed to aid night time delineation.</i></p>		
7.6	The intersection just east of the Nippon Causeway (at Mary's Motel) is too complex for the needs of this area and a little too narrow for the side road movements. The intersection does not need left turn slip lanes (it is difficult to see safely due to the angle). They take space that should be allocated to the side road.	LOW	<ul style="list-style-type: none"> Reconstruct this intersection. Remove all the left turn slip lanes. Convert this to a conventional cross road intersection. Construct narrow splitter islands in the side road to regulate turns in and out from the main road. Use Stop signs and lines to control the traffic. 	

No.	SAFETY CONCERN	RISK	RECOMMENDATION	CLIENT RESPONSE
				
	<i>This cross road intersection at Mary's Motel, immediately east of the Betio Causeway, has been "over designed". It does not need the left turn slip lanes, and these are too acutely angled. The side road is too narrow for turning vehicles to safely enter. When reconstruction takes place, move the islands and create a simple cross road, with splitter islands in the minor road approaches</i>		<i>This curve – at the western end of the second causeway (just east of Ambo) requires 2-3 chevron alignment markers to improve delineation at night. It is a reported blackspot with several run-off-road crashes reported. Some of the lesser trees could be removed.</i>	
7.7	The sweeping curve at the western end of the second causeway (just east of Ambo) is a blackspot. It has a history of run-off-road and head on crashes. The curve needs better delineation from both directions.	MED	<ul style="list-style-type: none"> In addition to the centre line and the edge lines here, install 3 chevron alignment markers on the outside of this curve to face both directions of traffic. Remove some of the lesser trees on this curve (inside and outside). 	
7.8	In Korobu village (opposite the Uniting Church school) there is a length of approx 50m x 6m wide beside the sea retaining wall that will be suitable for a Slow Vehicle Turnout. This area could be sealed and signed to permit overtaking and bus stopping.	LOW	<ul style="list-style-type: none"> Seal this area, and place SLOW VEHICLE TURNOUT signs at the western end – to encourage slow vehicles to use it to permit others to overtake. 	
7.9	There is a blackspot at the reverse curves at the Otintaai Hotel. At these pair of reverse curves, drivers apparently fail to safely negotiate these curves especially after dark. There is a need to enhance night time delineation on these curves.	MED	<ul style="list-style-type: none"> In addition to the centre line and the edge lines here, install 3 chevron alignment markers on the outside of each curve to face traffic. 	

No.	SAFETY CONCERN	RISK	RECOMMENDATION	CLIENT RESPONSE
7.10	The entrance into the hotel is a Y junction on a curve. Such junctions present risks – head on and side swipe collisions can occur if drivers select wrong gaps to enter the hotel. During reconstruction, it is recommended that this entrance be modified in consultation with the hotel owners.	LOW	<ul style="list-style-type: none"> Aim to remove the triangular walled island in the entrance to the hotel. Try to simplify the entrance – maximising sight line for both directions for exiting traffic. 	
				
<p><i>There is a blackspot at the Otintaai Hotel. There is a pair of reverse curves and drivers apparently fail to safely negotiate these curves especially after dark. It appears that the road may once have been straight here – passing immediately in front of the hotel. The road appears to have been re-aligned to allow the hotel to expand. If so, this is unfortunate as the curves are tight enough to restrict safe overtaking.</i></p>		<p><i>The entrance into the hotel is a Y junction on a curve. Such junctions present risks – head on and side swipe collisions can occur if drivers select wrong gaps to enter the hotel. During reconstruction, it is recommended that this entrance be modified in consultation with the hotel owners</i></p>		
7.11	The T junction where the Airport Road intersects with the main road requires attention. It is a known blackspot. It is unclear which road should have “priority” but for now it is best to assume the Airport Road traffic should stop and give way. There is a risk of a vehicle from the airport “overshooting” this intersection. Work needs to be done to reduce this risk.	MED	<ul style="list-style-type: none"> Install a 20m long, 1.8m wide splitter island in the Airport Road on the approach to this intersection. Place a second Give Way sign on the island. Take the centre line marking to the left of the island as an edge line, and hatch the area at both ends of the island. Allow for turning movements at the intersection (ie place the splitter island back a couple of metres). Relocate the 40km/h speed restriction sign around the corner, away from the intersection. Install a direction sign in advance of the intersection, pointing to Bairiki and Betio. Repeat this on the far 	

No.	SAFETY CONCERN	RISK	RECOMMENDATION	CLIENT RESPONSE
			<p>side of the intersection, just above a bi-directional hazard board (black and white).</p> <ul style="list-style-type: none"> Install a street light at this intersection to highlight it. 	
7.12	Approximately 400m north of the intersection (heading towards the airport) is a large culvert that appears to let seawater into the adjoining fish farms. The culvert is a roadside hazard within the clear zone. It is too large and too close to the road to be allowed to remain.	MED	<ul style="list-style-type: none"> Shield this culvert on both sides of the road with correctly installed W beam steel crash barrier. Ensure that the terminals of the barrier are an approved type – preferably an approved terminal that will collapse if struck. DO NOT use a simple blunt (fish tail) end to the barrier. 	
				
<p>The T junction where the Airport Road intersects with the main road requires attention. It is a known blackspot. It is unclear which road should have "priority" but for now it is best to assume the Airport Road traffic should stop and give way.</p>		<p>This 40km/h speed restriction sign is poorly placed. It distracts attention at a time when drivers should be focussing on more important and immediate issues. The Give Way sign should be renewed, a long splitter island installed in the Airport Road and a duplicate GW sign installed on it. A bi-directional hazard marker should be installed on the far side of the junction to reduce the risk of a vehicle overshooting at night. A street light is desirable.</p>		
7.13	The road outside the airport lacks delineation and direction signs. It is a poor entrance to this island. There are few foreign drivers who drive from the airport, but there is still a need to tidy up this section of road and to provide clear direction and traffic control at the exit.	LOW	<ul style="list-style-type: none"> Place a Stop sign at the exit from the airport. Install a direction sign directly opposite the exit – pointing to Bairiki and Betio. 	

No.	SAFETY CONCERN	RISK	RECOMMENDATION	CLIENT RESPONSE
7.14	The two road humps (one either side of the hospital entrance) in Bikenibeu are a good example of hump placement. All schools, churches and maneaba that have a need for humps should have a pair of humps located approximately 50m either side so that vehicles in both directions are slowed down in advance of the location.	TO NOTE	<ul style="list-style-type: none"> The placement of humps is an important safety issue. At present, apart from having humps that are of inappropriate size, and not marked or signed, attempts are made to slow traffic with just a single hump. It will be more effective to slow the traffic from both directions in advance by using pairs of humps – one either side of the school /church etc. 	
7.15	At the eastern end of the road in Temaiku, near the Technical Mission of the Republic of China, there are two curves that are quite short radius – there is scrubby vegetation along here that needs to be cut back to open up sight lines through these curves.	LOW	<ul style="list-style-type: none"> Cut back this vegetation so that sight lines are opened up. 	

8. OTHER BACKGROUND INFORMATION

8.1 General Kiribati road safety information

The most recent official number of annual road traffic deaths in Kiribati is 7 in 2007 (Kiribati Police Service)

The proportion of road traffic fatalities involving:

- Drivers of 4-wheeled vehicles – 38%
- Passengers of 4-wheeled vehicles – 13%
- Drivers/passengers of motorized two-wheelers or motorized three-wheelers – 44%
- Pedestrians – 6%
- 84% of fatalities are males, 16% are females (1999-2006)
- An estimated 30% of annual road traffic fatalities are attributable to alcohol (Kiribati Police Service)

Kiribati is experiencing road fatality rates that are well above those that are acceptable in countries such as Australia or New Zealand. The poor road conditions at present are believed to be helping to keep the road toll down. The new road project will increase speeds and this will increase crash frequency and severity. It is likely that – unless determined action is taken on a national level – Kiribati will see a significant increase in its road fatality rate in the coming years.

8.2 Findings of investigations of six blackspots in South Tarawa

At the invitation of Ms Mweritonga Rubeiariki (Ministry of Health and Medical Services, Kiribati), six known blackspots were inspected on Thursday 16th September. It appears that these blackspots are known to the Road Safety Taskforce. The locations are:

- Western end of the Nippon (Betio) Causeway
- On the causeway east of Bairiki
- At the western end of the Ambo causeway
- Outside the entrance to Tangintebu Theological College
- On the reverse curves outside the Otintaai Hotel
- At the intersection at the southern end of the road leading to the airport

Although no crash data was available for the investigations, Ms Rubeiariki explained the crash patterns as they are known to her. The six sites had surprising similar crash patterns:

- Mainly run-off-road and head on crashes
- Speed and alcohol appear to have been involved

Each location was typically on a curve located at the end of a long straight section of road. The crashes occurred mainly during night time. The brief investigation of these six sites adds weight to the recommendations contained later in this report about speed management, line marking and delineation. It also indicates the need for implementation of a comprehensive road safety action plan that addresses the problem of speeding and drink driving.

The main road is basically an east west road. There is a problem with sun glare in the mornings and the late afternoons. Coupled with the shadows from the nearby trees, and possible dirty windscreens due to the dust, there is a risk of drivers not seeing pedestrians or other road users ahead.