BUNDABERG
REGIONAL COUNCIL

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Trail Development Plan

Bundaberg Gin Gin Rail Trail

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Prepared by

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Executive summary

This Trail Development Plan sets out a detailed set of activities for the progressive construction of a trail on the disused railway corridor between Bundaberg and Gin Gin. Section 4.0 contains four tables where a comprehensive works list for each of the proposed stages of the rail trail development is set out, and an estimate of probable costs for each task.

The estimated detailed cost of the project is $13,105,530.

The Bundaberg Gin Gin Rail Trail Feasibility Study (prepared earlier in 2019) provided an estimate of the likely costs involved in establishing the rail trail between Bundaberg and Gin Gin. The project was estimated to cost $9,169,860.

Although the detailed cost estimates provided in this Trail Development Plan are higher than originally estimated, the end result will be a higher quality and longer lasting trail (and associated infrastructure) – and consequently less ongoing maintenance.

For the Feasibility Study, the assessment of the condition of the corridor was done by observations from a distance and inspections where possible at road crossings – the usual level of inspection undertaken during the preparation of a rail trail feasibility study. In preparing the detailed Trail Development Plan, the entire corridor was traversed by foot and as a result much more is known about the requirements to convert the former railway corridor to a rail trail.

The primary costs differences between the estimates in the Feasibility Study and the cost estimates in the Trail Development Plan are:

- Surfacing costs increase was a major cost difference. The Feasibility Study recommended an unsealed surface for the entire trail length and costed it at $2,538,000. The Trail Development Plan recommends the trail be sealed from Bundaberg North Trailhead to Sharon, and from McIlwraith Rd to Gin Gin (to enable greater use by a greater range of potential user groups, including use by small wheeled vehicles such as people with prams, people in wheelchairs, kids using scooters, etc). This brought the trail construction costs to $3,996,450 – a difference of $1,458,450.
- There is a significantly increased cost for bridgework, both for Splitters Creek Bridge and more notably for the installation of new bridges.
- The Feasibility Study allowed $10,000/lineal metre for refurbishment of Splitters Creek bridge (a total of $2.85 million). While the engineering report prepared as part of this Trail Development Plan does include a low-cost option ($1.85 million) and a mid-range option of ($2.75 million), this Trail Development Plan recommends the most comprehensive refurbishment (and therefore most expensive) option which will give the bridge the longest design life of 75-100 years. This brings the bridge cost to $3.25 million – a difference from the original estimate of $400,000.
- The Feasibility Study allowed for the replacement of 240 metres of (missing) bridges. It was known that all the original bridges (with the exception of the Splitters Creek Bridge) no longer existed and would need to be replaced by pre-fabricated bridges. Detailed field inspections (plus extensive research which resulted in acquisition of copies of the original railway plans) enabled more accurate cost estimates to be prepared. The original railway drawings show the locations (and lengths) of all the original bridges (referred to as 'flood openings') and revealed a much larger number (and total length) of bridges than had been allowed for in the Feasibility Study. A total of 476 metres of new pre-fabricated bridges will need to be installed – almost double the original estimate. At $4,000/lineal metre, this difference is $944,000.
- Clearing was originally costed at $228,340. Once the corridor was traversed in detail, significantly more heavy clearing was required than originally envisaged, lifting the clearing costs to $366,430, a difference of $138,090.
- Landholder requests have added to the original estimate though not significantly. The estimate in the Feasibility Study included fencing and machinery crossings and was costed at $503,950. The Trail Development Plan has costed requests at $569,280, a difference of $65,330.

It should be noted that this increase does not affect overall feasibility. Benefits of almost $3 million/year on a cost of $13.1 million (as opposed to $9.1 million) mean that the project's "pay-back" time is slightly longer.

There are unknowns when dealing with the construction of rail trails such as this. The extent of approvals needed prior to development of the trail and the requirement for permits and additional studies is not known but an allowance has been made.

Recommendation

It is recommended that the Bundaberg Regional Council use this Trail Development Plan, and other documentation in future funding applications to the Queensland Government.

Section 1 – Background

The proposed Bundaberg Gin Gin Rail Trail would be developed on the disused railway corridor between Bundaberg and Gin Gin – a distance of some 46 kilometres.

In 2017, the Queensland Government released its Queensland Cycling Action Plan in 2017 which committed to the investment of $14 million over four years to develop and implement a program to deliver rail trails in partnership with local governments on state-owned disused rail corridors. This funding provided an impetus to examine a range of railway corridors which may have the opportunity to be converted to rail trails.

In mid 2018, Bundaberg Regional Council sought funding under the Queensland Cycling Action Plan to commission a Feasibility Study on the Bundaberg to Gin Gin Rail Trail.

A Feasibility Study examining the merit of developing a 'rail trail' on the disused railway line was undertaken. (A rail trail is the conversion of a disused railway into a multi-use recreation path, typically for walking, cycling and sometimes horse riding. The characteristics of abandoned railways - flat, long, and frequently running through historical areas - are appealing to numerous potential user groups).

The Feasibility Study set out a number of matters for consideration and included the history of the corridor and recent State Government commitments to developing rail trails on publicly owned railway corridors. It was also informed by a series of Open Houses (or 'drop in' sessions) held along the railway corridor in November 2018.

The Feasibility Study found that a trail from Bundaberg to Gin Gin (on the railway corridor) was feasible from a technical and economic viewpoint. It was submitted to Bundaberg Regional Council in January 2019.

In February 2019, Bundaberg Regional Council accepted the report's findings and determined to proceed to the next stage of work – a detailed Trail Development Plan.

This Trail Development Plan provides the Council with a construction blueprint, enabling it to proceed with the establishment of the rail trail (should it determine this to be the appropriate course of action) once funds become available.

Section 2 – Scope of works

This Trail Development Plan provides sufficient detail for a funding application to be prepared and to guide the actual construction once funding has been obtained. The Trail Development Plan is a construction blueprint. The primary focus is on the works necessary to convert the corridor to a rail trail and the ongoing maintenance and funding. The Plan provides examples of already constructed rail trails elsewhere in Australia and overseas. The Trail Development Plan builds on the work undertaken for the Feasibility Study and focusses on detailed design and costings.

- This Trail Development Plan provides detailed works lists and detailed cost estimates (item by item, location by location) covering all elements needed to convert the rail corridor to a rail trail - informed by a traverse of the corridor by foot and detailed meetings with adjoining landowners. Construction plans with a list of necessary (and optional) construction items, quantity estimates, materials required, and construction schedules have been prepared.
- The main elements of this Trail Development Plan are as follows:
- Fieldwork, which involved a traverse of the corridor (by foot);
- Identification of alternative routes where necessary;
- Preparation of detailed works lists and calculation of quantities for construction;
- Preparation of detailed cost estimates for construction;
- Basic design and construction guidelines;
- Preparation of drawings and cross-sections;
- Mapping of corridor (illustrating construction activity); and
- Management and maintenance planning. A list of maintenance tasks that need to be attended to have been provided and innovative ways of addressing these tasks have been suggested.

Section 3 – Trail design and development considerations

3.1 General considerations

This section of the Trail Development Plan addresses a series of matters relating to trail design and development of the Bundaberg Gin Gin Rail Trail – to achieve a rail trail that is constructed with minimal disturbance to the natural environment, is sustainable, has minimal impact on adjoining landowners (particularly those with intensive agricultural activities) and that requires minimal maintenance.

During construction of the original Bundaberg to Mt Perry Railway (of which this section is a part), effective drainage was important, as it is with all public infrastructure. Locating a trail on the formation of the former railway is important, and reinstatement of bridges (all of which – apart from the Splitters Creek Bridge - have been removed) is vital for the success of the rail trail.

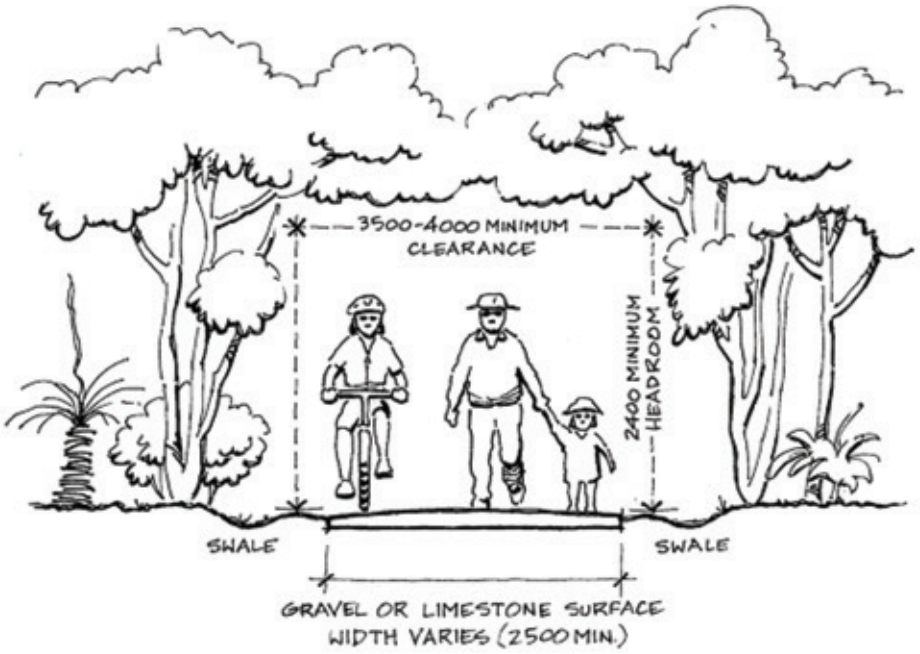
In addition to Splitters Creek Bridge, there are 40 'flood openings' (as they were called on the original railway plans) between Bundaberg and Gin Gin. All have been removed (although some were replaced with concrete culverts over the years and these have not been removed). In all instances where the bridges have been removed, replacement with pre-fabricated bridges is recommended.

Construction of the railway involved the cutting and filling of the landscape to create a surface that was relatively flat to enable the passage of steam trains. The result was a series of cuttings and embankments along the entire length of the rail corridor although there are far fewer on this corridor than on most others. Effective drainage will be required, especially within cuttings, to ensure stormwater is quickly and effectively removed from the sides of the trail (as it was when the trains were running).

Culverts and other drainage controls should be used to direct run-off away from the trail. Stormwater must drain freely, and where possible, pass beneath the trail without impact on either the base formation or the surface itself. Rail trails, by their very nature, tend to deal with these problems relatively well. Numerous culverts inspected during fieldwork were completely or partially block (or impenetrable due to vegetation regrowth), thereby inhibiting the free flow of stormwater under and away from the railway embankment. The works lists provide an allowance for the cleaning of these culverts. Ongoing, regular cleaning of blocked culverts is essential to avoid serious soil and water degradation problems.

During construction of the rail trail particular care must be given to reinstating the side (cess) drains through cuttings.

At some point in the past, contractors were engaged to remove the steel railway track and sleepers – probably at the same time the bridges were dismantled. The formation now is overgrown with vegetation regrowth and clearing will be required along much of the corridor to permit the development of the trail.



SHARED USE TRAIL – GENERAL CHARACTERISTICS

3.2 Trail width and height

To function effectively as a shared use facility (for cyclists and walkers), the Bundaberg Gin Gin Rail Trail should have a width of 2.5 metres. Anything wider than that and the trail starts resembling a road, which is not what rail trail users want. The width of the existing embankment/formation of the original railway will ultimately determine the width that the proposed rail trail can be constructed in some locations.

Some sections of the former railway corridor are currently used for farming purposes (grazing, banana farming, sugar cane, etc.), as access to farming properties, or as access between paddocks. Access can be retained without seriously diminishing trail user experiences (subject to trail manager approval).

The railway has been disused since 1993. During this time some sections of the corridor have become overgrown and will require clearing for the passage of trail users. Where vegetation has regrown, overhead clearance should be maintained to approximately 2.4 metres from the rail trail surface. All overhanging vegetation – and that which intrudes from the sides into this 'corridor' should be cut back on a regular basis. Care should be taken that sharp and dangerous 'points' are not left in this pruning process.

There are instances where side vegetation can be retained, as the trees are attractive and provide shade. They also provide an attractive vista along the cutting or embankment.

3.3 Trail surfacing

A smooth compacted surface is most appropriate for a shared use rail trail. The surface should be firm enough to provide cyclists (the predominant user group of rail trails) with a relatively smooth ride.

Most rail trails developed in Australia use a locally available earth surface (gravel, decomposed granite, crushed limestone, etc.) to produce a firm surface easily capable of accommodating walkers and cyclists.

Some sections of this rail trail can function as an urban commuter path as well as a more traditional rail trail. Sealing the 'in-town' sections of the trail is appropriate, and the works lists makes provision for sealed surfaces at both the Bundaberg end and the Gin Gin end. It is recommended that the trail be sealed westwards from the Bundaberg trailhead as far as Sharon Road, where it will connect with the existing sealed section of rail trail. At the Gin Gin end it is recommended that the rail trail be sealed as far east as the McIlwraith Rd crossing.

Grading will be required prior to a surface material being applied. Care should be taken not to create berms of ballast on the side of the trail which have the effect of trapping the water in the trail formation i.e. creating a dam effect. Care should also be taken to ensure in cuttings that the graded material is not simply pushed in to the existing drains on the side of the trail as this will have the effect of preventing the drains from performing as they should. Grading should be followed by the installation of the new surfacing material.

In the costs estimates that are included within this Trail Development Plan, an allowance has been made for clearing of the trail corridor (vegetation and top soil and whatever ballast remains), further grading and shaping of the formation to create as smooth a surface as possible, and additional fill material.

3.4 Consideration of intensive agricultural issues/practices

This disused railway corridor passes by, and on occasions passes through, various intensive agricultural activities such as sugar cane plantations, nut farms and banana plantations. Consultation with adjoining landowners has highlighted the need to put in place measures to ensure the safety of trail uses and measures to ensure that the biosecurity of these farms is maintained.

Of particular concern to adjoining landowners are the following issues:

- **The possibility of billets from cane harvesters during harvesting hitting trail users.** The need for physical barriers such as chain mesh fencing (or golf course netting) to contain the billets to the property (and not being sprayed onto the public land) has been considered. Signage at gates (see below) warning trail users not to enter the trail corridor while a harvester is running close to the corridor is recommended. (Warnings/advice should also occur on all trail "literature" – brochures, trailhead signage, etc - to reflect this situation).

- **The movement of heavy machinery** (such as cane haul-out trucks, harvesters and other farm machinery) across the railway corridor and the need to maintain access across the corridor. Crossing points and gating systems need to be open 24/7 and located as appropriate/needed in discussion with landholder. The provision of a 10m wide crossing would satisfy machinery movement needs as most machines are 4 - 5 metres wide. Concreting (i.e. hardening) of crossing points will be required in some locations. Signage is to be installed at gates warning trail users not to enter the trail corridor while machinery is crossing the corridor. (Warnings/advice should also occur on all trail "literature" – brochures, trailhead signage, etc - to reflect this situation). Temporary signs would need to be erected at certain times (by the farmer) – especially when machinery is being used close to the trail.

- **The need to ensure the safety of trail users** when heavy machinery is in use, especially when nut trees are being trimmed. The trimming process involves high powered machinery operating on the outside of tree rows; in some circumstances this will be close to the corridor. Provision has been included in the works tables to address safety issues. Signage should be erected at gates warning trail users not to enter the trail corridor while machinery is crossing the corridor, or when harvesters are close by. (Warnings/advice should also occur on all trail "literature" – brochures, trailhead signage, etc - to reflect this situation).

- **The possible dangers involved when crops are being sprayed** and the potential for spray drift across the trail. (Warnings/advice should also occur on all trail "literature" – brochures, trailhead signage, etc - to reflect this situation). Temporary signs would need to be erected at certain times (by the farmer) – especially when spraying insecticides and fertilisers. CSIRO has prepared a report Spray Drift Management - Principles, Strategies and Supporting Information to educate farmers on best practices.

- **The possible dangers to trail users from water/ irrigation drift**, especially the large volume from large sprinklers (not being contained to the farmland). Some farmers mentioned that irrigation sprinklers do emit high volumes of

Above left: harvesting cane (source: www.canegrowers.com.au/) and above right: trimming nut trees (source: mpcmacs.com.au/about-macadamias/farming/). Both present safety issues for the development of the proposed rail trail.

water at high speed and shifting wind patterns during irrigation can cause "water drift" potentially creating a hazard to human safety given the volume and speed of water. Promotion should occur on all trail "literature" to advise of this activity. Signs on gates should make users aware of this activity. Trail users should also be warned via trail literature to stop when they see this type of activity impacting on the trail corridor.

- **The need for farmers to undertake shooting of feral animals,** including wild dogs. Shooting is carried out in response to an attack i.e. it is spontaneous and ad hoc. Some farmers use professional shooters to control pest animals and they set themselves up on the edge of the corridor as it is a high point and shoot across the farmed property (not across the railway corridor). This activity may cause shock and/or frighten trail users if they are not aware of it. Night time shooting (when trail is not used) is one solution that may partially address the issue. The temporary closure of the segment of trail may be necessary (to be arranged by farmer in conjunction with trail manager).
- **The potential impact on the biosecurity status of farms** from people passing close to crops and carrying with them various diseases. Panama virus is one such disease, especially for banana plantations. The Panama disease (Tropical Race 4) has devastated crops elsewhere in Australia. It is a soil-borne disease which can be very difficult to get rid of once it is established and has devastating effects on crops. One farmer is very concerned that trail users will bring this virus in on boots or on horses. Wash-down facilities at critical locations are recommended as one solution (for both boot and bike tyres). These have been used with success in WA to prevent the spread of dieback (Phytophthora cinnamomi) – another soil-borne disease. The need for washdowns is considered as a potential solution as is the banning of horses from the trail.
- **Interaction with dogs.** Some landowners were concerned about their dogs' interactions with trail users and other dogs. Dogs should be allowed within the in-town sections of the trail on leads only but should not be permitted on the rural sections of the trail. This will limit

Above: Boot and tyre cleaning brushes on Denmark Nornalup Rail Trail in WA. Above right: boot scrubbers at campsite on Bibbulmun Track. Right: boot scrubbers are located at sensitive locations along Bibbulmun Track.

interactions. Fencing may be appropriate in some locations to ensure the dogs of adjoining landowners stay separated from trail users (it is noted that the behaviour of any dog on public property is the responsibility of the dog owner). However, in this instance, the installation of 2.4m chain mesh barrier fencing along some property frontages addresses a number of concerns.

- **Dust can be an issue during dry weather, especially when large machines are moving close to the trail corridor.** Landowners indicated that agricultural activities, particularly at harvesting, creates a lot of dust and limits visibility. The dust may lead to users not seeing machinery. (Warnings / advice should also occur on all trail "literature" – brochures, trailhead signage, etc - to reflect this situation). Temporary signs would need to be erected at certain times (by the farmer).
- **Security of farm sheds and other property** (houses, fertiliser storage, machinery, etc). The works tables provide for 2.4m high chain mesh fence where this has been requested (to deal with both safety and security).
- **Maintenance of access across the corridor.** Some farmers have created driveways across the corridor (for safe access to residences or for access for farm machinery) or may require them in the future should subdivision or development proposals proceed. Each request for a crossing of the rail trail corridor should be considered by the trail manager. This trail development plan has made an allowance for the continuance of the existing crossings (and for some proposed future crossings), where requests have been made.
- **Use of excess width of corridor.** The former railway corridor is 20 - 30m wide. Only 5-7m is required for the trail. Some landholders have expressed a desire to use the excess corridor width to turn machinery and they would in return maintain the corridor. Any future new fencing should take this into consideration.
- **Emergency access along the trail and access for utility companies along the trail.** Vehicles from Ergon Energy currently use sections of the corridor or have a need to travel along or across the corridor. Ergon vehicles, maintenance vehicles, firefighting and other emergency vehicles will continue to have access to the corridor via keyed-alike padlocks or via combination locks to be used on the gates at all road crossings and other locations. This will enhance access to the corridor particularly as they cannot currently access the corridor.
- **Camping along trail. Some landowners were concerned about camping at various locations along the trail** (such as at Splitters Creek Bridge). The trail manager should declare camping along rail trail corridor to be illegal and erect signs to indicate that it is illegal, and punishable by a fine (according to applicable local government by-laws). Fencing will help prevent access off the rail trail, particularly at the bridge.
- **Timetabling of construction.** There is an issue of rotation of cattle through different paddocks on some properties and the limited time cattle can spend on paddocks other than those that adjoin the corridor. Some farmers are worried that during the construction phase some fences may be down at a time when they need to put cattle on paddocks adjoining the corridor. The trail manager will need to negotiate and advise of construction timetables once the project commences. The manager also needs to be aware of these issues in advance and should contact all adjoining landholders with as firm a timetable as possible at the start of the project and needs to continue this dialogue throughout construction.
- **Signage as a key solution.** Even though some adjoining landholders are sceptical of the value of signage on the rail trail, arguing that it would not deter some users, it is important to recognise that signage is one element of trail management and it does give enforcement powers to the trail manager. Some of the potential signs that could be deployed at critical locations (such as at each end of each cane, banana or nut plantation) and at each crossing point are:
  - No Trespassing
  - Farm Biosecurity
  - Warning: Harvesting in Progress
  - Close the Gate
  - Warning: Heavy Machinery Crossing
  - Caution: Spray Drift
  - Caution: Water Spray Drift
  - Use Cleaning Station on Boots and Bike Tyres
  - No Horses
  - No Dogs

There are already innumerable and appropriate signs that could be used along the rail trail to alert trail users to the possibility of encountering some potentially dangerous conditions. Signs can also be used to deter certain uses, including illegal activity. Some of these signs are already used by farmers and form a component of good farming practices and protocols.

3.5 Safety considerations

One of the most significant safety issues is that of potential conflict between users of the proposed rail trail and road users (cars and trucks)– especially at road crossings. This is more fully dealt with in 'Road Crossings' (see Section 3.6).

Possible conflicts between different types of trail users is a potential safety issue. Users in conflict can be both legal and illegal – for example, between trail users (walkers and cyclists) and trail bikes or 4WD's that have illegally accessed the rail trail. Effective signage and vehicle exclusion barriers (management access gates and chicanes) will greatly limit this potential problem.

Dogs can be a potential safety consideration. Given the predominant rural nature of the trail, dogs should be not permitted on the trail except at either end within the town limits. The trail manager will be responsible for making this decision and enforcing it in accordance with relevant local laws.

As noted earlier, safety for trail users when passing agricultural activities (harvesting etc) is of particular concern to farmers. With good design, and adequate signage and adherence to good farming protocols, conflict and safety issues can be avoided.

3.6 Road crossings

Road / trail crossings always present a special hazard which must be addressed carefully. A crossing should have enough space cleared and levelled on both sides of the road to allow cyclists travelling together to gather in a group and cross en masse. One-at-a-time crossing greatly increases the overall time in the roadway and therefore increases the likelihood of encountering a vehicle. The crossing should ideally be at a straight, level area allowing both trail user and vehicle driver good visibility and the driver ample stopping distance (if possible). All trail crossings should be perpendicular to the road.

The 15 road crossing concept drawings that form part of this Trail Development Plan (see Appendix 1) illustrate the signage that is required at each road crossing and the positioning of gates (for management access vehicles and for trail users). Trail users will cross Bundaberg Gin Gin Rd four times. No allowance has been made in the cost estimates for any sort of grade separation. All road crossings will be 'at-grade', as is common with the overwhelming majority of road crossings on rail trails in Australia (as well as many other trails). Crossing points of the major roads have been located to maximise sight distances and visibility of trail users.

Signs required to create safe road crossing are outlined in Section 3.7. The rail trail should be clearly marked on each side of the road for easy recognition and the crossing be designed to move the trail user away from the road reserve as quickly as possible.

Details pertaining to shared path crossings of roads can be found in Austroads Guide to Road Design Part 4: Intersections and Crossings – General (Australia).

Generally, the road crossing treatment required includes:

- Installation of signage on the rail trail (both sides of the road crossing) advising (or warning) of the upcoming crossing of the road. The recommended treatment is the installation of (either or both) "Give Way" (or "Stop" signs or pavement markings if it is a major road) and "Road Ahead" signs on both sides of the crossing;
- "Trail Crossing Warning Signage" on the road (both sides of the trail crossing) alerting road users of the upcoming trail crossing;
- Management access gates and chicanes (permitting access by legitimate trail users and authorised vehicles, such as emergency services vehicles and management vehicles) in certain locations. A technical drawing setting out the specifications for chicane gates can be found in Appendix 2, as well as a photo of such a gate on the Lilydale Warburton Rail Trail in Victoria;
- Installation of pipe culverts (where required);
- Installation of an asphalt 'apron' each side of road crossing – basically, a flat, durable sealed surface providing a non-slip and smooth transition from the gravelled trail surface to the asphalt road; and
- Miscellaneous signage (including Rail Trail name and logo; distance signs; Emergency Marker signs; road name signs; "Unauthorised Vehicles Prohibited" signs; "Trail Bikes Prohibited" signs, etc.).

3.7 Signage

Several kinds of signage are required on the Bundaberg Gin Gin Rail Trail, including distance, directional, warning, promotional, etiquette and interpretive signs. Each should be standardised along the rail trail and, where appropriate, compliant with relevant local or Australian 'standards' or practices. The chosen colours of all signs should be uniform throughout the trail.

Themes and styles already established for other rail trails in Australia, and in keeping with the uniformity in signage sought by Railtrails Australia, may dictate what style of signs and marker posts are used along this rail trail. Trail markers and signage on other rail trails are sometimes affixed to old (recycled) railway sleepers or recycled plastic posts.

3.7.1 Distance signage

Recognising that users will join a rail trail at any number of points, installing distance and direction signs at road crossings will not only benefit those joining the rail trail at that location, but provide additional information for users already on the rail trail. The plate should indicate the distance to the upcoming road crossings along the rail trail.

Trail distance signage will need to be placed at regular intervals along the route. The obvious location is at each road crossing (and at the trailhead) where trail users are likely to join the trail. It is recommended that distance marker posts (together with Emergency Management GPS markers – see 3.7.2) be installed every 1 km.

The recommended distance sign plates (as with all other signs) should be affixed with at least 4 stainless security screws to prevent them being removed. In addition, the distance signs (as well as the various other sign panels used on the posts) should be affixed with silastic or 'liquid nail' products.

Distance marker near road crossing on Railway Reserves Heritage Trail in Mundaring, Western Australia.

A distance marker is installed every mile along the Row River Rail Trail in Oregon, USA, together with a plaque indicating the responsible Adopt-a-Trail volunteer.

3.7.2 Emergency management signage

Distance signage provides good reference points for emergency services. It gives anyone who needs emergency assistance an easy reference point. On other projects, consultation with ambulance officers in particular highlighted this need. When people panic (as they often do in an emergency situation), normal cognitive processes do not work. On-trail signage should be as helpful as possible and minimise likely stress. Consequently, distance signs should be installed at regular intervals, with distances to the next trailhead or major town or road crossing (on either side of the post). This enables people to quickly identify where they are by travelling a very short distance from the emergency situation. All road crossings should also have a GPS reference/identifier on the chicane (or on a separate post) for use in emergencies, again as a location aid for those in stress. There is also a need to include the emergency telephone number at all trailheads (on the trailhead map panel) and clearly identify that one number will contact all three emergency services (police, ambulance, fire). While the emergency number from a landline is 000, the emergency number that works best from a mobile phone is 112. Information on what to do in an emergency, the location of public phones (there may be none on the trail itself), and the capacity for a flip-down sign indicating trail closure (due primarily to fire, flooding or maintenance work) should also be included at each trailhead.

It is strongly recommended that "Emergency Markers" be installed along the Bundaberg Gin Gin Rail Trail. The works tables (Section 4) have included these markers within the trail distance signage as has been done on the Kilkivan Kingaroy Rail Trail in Queensland and the Lilydale Warburton Rail Trail in Victoria.

In summary, the emergency signage that should be erected on a trail consists of:

- Distance signs at regular intervals showing distances to next trailhead or town or road crossing (double-sided). It is recommended that these include emergency marker signs (with a series of unique codes or identifiers);
- GPS identifiers at all road crossings (attached to the sign posts or gating systems); and
- Trailhead signage specifying what to do in an emergency, the numbers to call, the location of public phones, and the capacity for a flip-down sign indicating trail closure (due primarily to fire, flooding or maintenance work).

An Emergency Marker sign on the Lilydale Warburton Rail Trail in Victoria

An Emergency Marker on the Kilkivan Kingaroy Rail Trail in Queensland. Post also has distance plates.

3.7.3 Warning signage

There are a number of locations along the proposed Bundaberg Gin Gin Rail Trail that demand warning signage, primarily at the many road crossings facing trail users. In the case of road crossings, (either or both) a "Road Ahead" yellow diamond warning sign (W6-8A) some 50-70 metres before a crossing is recommended (on a stand-alone post), with a triangular "Give Way" sign (R1-2) on the verge at the road crossing (on a stand-alone post) – or a "Stop" sign where appropriate (R1-1 – 300 x 300).

Bicycle/pedestrian (i.e. Trail Crossing) warning signs (W6-9) with arrow (W8-23) (or W6-V105) are recommended for installation on roads, either side of a trail crossing, or use of "Crossing Ahead" signs as indicated below.

The proposed rail trail has 15 road crossings along the route, and some of these provide both challenges and opportunities for trail development. The challenges come in ensuring that these crossings are safe for future trail users, while the opportunities surround the passing road users who can be alerted to the trail's presence. Such 'opportunistic' promotion can only be good for the future of the rail trail in raising awareness and increasing user numbers.

Signage for the Tiger Rail Trail in Victoria warns of the upcoming road crossing as well as promoting its existence to road users.

Different signs may need to be used, depending on trail user groups being permitted on the proposed trail.

3.7.4 Promotional signage

Promotional signage has been used to great effect on other rail trails throughout Australia, increasing general awareness of the trail among the broader community. For the proposed Bundaberg Gin Gin Rail Trail, the recommended 'promotional' sign should be incorporated into the on-road 'Crossing Ahead' warning signs (such as has occurred on the Forrest Birregurra Tiger Rail Trail). They are an excellent means of communicating the message to road users that they need to be alert for the presence of cyclists and pedestrians.

Though the railway corridor may be quite likely familiar to many local residents, it is recommended that a number of "Trailhead" signs also be erected to give prominence to the trail when constructed. The installation of these signs will enable local people and visitors become more aware of the trail (a good example is the High Country Rail Trail).

3.7.5 Permitted user signage

Signs (in the form of pictograms) indicating user groups that are permitted (or not permitted) on the various sections of the Bundaberg Gin Gin Rail Trail should be installed at every road crossing and entry point. These small signs can easily be installed on the totem posts near to the proposed trail user access gates (chicanes) or even on the gates/ chicanes themselves. Pictogram signage could include "No Motor Vehicles", "No Motor Bikes", "No Smoking", "No Alcohol" and "Dogs on Lead" (or "No Dogs"). The installation of "No Motor Vehicles" and "No Motor Bikes" are recommended at the outset, and the trail manager will ultimately determine what other signage may be required.

Pictogram signs, as used extensively on other trails, can have a major impact by discouraging illegal users and activity.

Signs pointing in to the "Trailhead", as used on the High Country Rail Trail in Victoria, are an excellent means of directing trail users to a Trailhead and serve to promote the existence of the rail trail to passing motorists, tourists and local people.

3.7.6 Interpretive signage

On-trail interpretation is becoming more and more of a feature of trails built in recent times. When well done, it can add significantly to the depth of the user's experience. It can also generate a sizeable cost and can be subject to ongoing vandalism in urban and rural areas.

All rail corridors are inevitably rich with history, not just European settlement history but also indigenous and natural history. The Bundaberg Gin Gin Rail Trail corridor is no different. People will move along this trail at a leisurely pace. This slower rate of travel, a more relaxed frame of mind and openness to new experiences provide ideal circumstances to educate trail users on all aspects of the country through which they pass. There are many stories that can be told along rail trails. The provision of interpretive material will greatly enrich the experience of visitors to the rail trail.

Effective interpretive material gives a specific "flavour" of the events, landforms, wildlife, vegetation and agricultural activities relevant to a specific site. The intention is for the traveller to develop a deeper understanding of the multitude of stories contained in a region. Conversely, the themes can be designed to spark interest, encouraging people to explore any story that interests them. It may also encourage them to extend their stay in the region to further pursue an interesting story or theme.

Interpretive signage does not need to be in place from the trail opening (though this would be a commendable outcome) but at least some information should be embodied in the trail

brochure. Interpretation should be an integral part of any trail's development process.

The works tables make allowance for the placement of a number of panels along the rail trail.

3.8 Erosion control

Proper drainage is of considerable importance in constructing a lasting, maintenance-free trail. Water should be removed from trail surfaces as fast as possible, wherever possible. Given the flat terrain or gentle slopes involved on much of the proposed rail trail, erosion control should be relatively easy. As the railway has not operated for many years, maintenance of the formation and its drainage structures has been non-existent. Consequently, many of the culverts under the formation and drains along the formation have become overgrown with weeds, grasses and other vegetation. Most require cleaning out.

Those sections of the railway formation which do have blocked culverts or dysfunctional drains should be attended to in the trail construction process, as allowing water to stand on the proposed trail surface or run down even a gentle slope is to invite surface damage followed by costly repairs.

It may be necessary to clear existing drains on a regular basis, or to install additional culverts under the trail in some locations to remove standing water effectively – if this is done, care must be taken to ensure the surface is soundly patched afterwards.

While the cuttings appear to be in good condition, it may be necessary to build up the trail within the cuttings to ensure the cess (or side) drains operate effectively. It may be more effective to "build up" the trail formation to 300mm (rather than 150mm) rather than excavating the cess drains in cuttings – this can be determined at the time of construction. Sealing the trail (rather than providing a compacted earth surface) may present its own solutions to this particular issue.

3.9 Bridges

Bridges are one of the most obvious reminders of the heritage value of disused railways. They are also one of the most significant attractions of trails along disused railways and one of the costliest items in the development of trails on former railways.

There is only one substantial bridge on the corridor across Splitters Creek. At around 285 metres long (and 10-15m above the ground and creek) it is a spectacular sight and will in itself attract hundreds, perhaps thousands, of visitors each year over and above the number that will come to ride and walk the rail trail. The refurbishment and re-use of Splitters Creek Bridge is highly recommended as the bridge would become a significant tourist attraction in its own right. It can be re-purposed as a rail trail bridge, needing only to be suitable to carry pedestrians and bike riders. It would not need to carry vehicles (often rail trail bridges provide a much easier way for emergency and management access vehicles to traverse a rail trail and access surrounding properties). Given the proximity of suitable roads, such a need does not emerge for the Bundaberg Gin Gin Rail Trail – the Splitters Creek Bridge is not "isolated" - emergency vehicles can get onto the trail very easily either side of the bridge.

This bridge near Bingera Siding was typical of the 40 "flood openings" on the railway between Bundaberg and Gin Gin. Replacement of these missing structures will be a major cost component of the development of the proposed rail trail.

Appendix 5 contains the report commissioned during this study to assess the structural integrity of the bridge and the work required, and cost, to bring the bridge into a suitable condition for use as a cycling and walking bridge.

3.9.1 Summary and conclusions from wood research and development report.

Wood Research and Development (WRD) was commissioned to complete a detailed visual inspection and refurbishment options report based on the current condition of Splitters Creek Railway Bridge. The main objective of the investigation was to establish the general condition of the primary structural elements, and to assess what techniques could be utilized to safely repurpose the structure into a rail trail bridge for pedestrian and cyclist use.

WRD determined that the substructure elements (timber frame and pile bents) in Splitters Creek Railway Bridge are in overall poor condition. The timber superstructure (girders and corbels) was also deemed to be in poor condition while the deck of the structure appears to be in fair-poor condition. However, to repurpose as a rail trail bridge the deck will require refurbishment works to ensure safety for the pedestrians and cyclists. The structure has been given an overall condition state rating of 3.

This rating was based from a small sample size of field data collected and it is highly recommended to conduct a detailed inspection of the entire bridge. This will gain a higher level of accuracy for the recommended repair options listed and costed in the report.

Based on the information compiled from both the visual inspection and testing, the bridge will require several repairs/replacement to repurpose the railway bridge as a rail trail bridge for pedestrian and cycle use. Three (3) options have been developed to refurbish the structure into a rail trail bridge. Option 1 utilises the entire existing structure in its 'current' condition with a new deck and handrail system installed on top of the existing rail ties (transoms). Depending on the results of the full inspection this option cannot be guaranteed a 5kPa load rating unless high strength fibres are used to restore the existing elements and can only be rated for a service life of 10 - 15 years (condition state rating of 3) based on the existing condition of the elements and the connection details used. Option 2 involves removing the existing railway line and transoms, repairing/replacing substructure and superstructure elements where required with kind for kind elements and adding in addition hardwood log girders where required. A hardwood deck system with a code compliant handrail and cycle rail system will be fitted on top of the girders utilising a horizontal connection system that achieves a 25 - 50 year design life (condition state rating of 2) for this option along with a 5kPa load rating. Option 3 will result in the longest design life (75 - 100 years) as this option involves installing a new glulam superstructure and deck/handrail system on top of the restored existing substructure.

All options include the remaining hardwood elements to be diffused with Borate salt rods to increase the life of the structure by preventing decay as described in the report. Also included for options 2 and 3 is the restoration and repair works required to use the existing steel plated girders that span over the creek and is the main reason the structure is listed under the Queensland Heritage Act. Finally, it is highly recommended that all exposed bright wood be treated with Copper Naphthenate and seal end-grain with a paraffin wax sealant.

Option 3, which is the most expensive but gives the longest lifespan, is our recommended option for refurbishment of the bridge.

3.9.2 Existing flood openings

Fieldwork for this Trail Development Plan focussed on the 40 locations where small bridges (i.e. "flood openings") are (or were) in place - most have been removed. The bridges (when they existed) were evidently timber structures spanning each watercourse, with solid concrete abutments at each end, and perhaps timber piles supporting each span. A simple option at these locations is to install pre-fabricated bridges (ranging in size from 7m to 40m). Landmark is one company that specialises in supplying such bridges but there are other suppliers. The Council may be able to negotiate a reasonable rate on these bridges given the number needed and the relatively simple process of installation (none of the locations are particularly difficult working environments). These locations all have some remnants of the old crossings – notably concrete abutments and these are in varying condition. These may need to be cleared away and the bridges installed on-site.

Handrails will be required where the fall from the bridge decking to the ground is greater than 1 metre (this applies to all sites where pre-fabricated bridges have been recommended). This is a Standards Australia requirement. Handrails will help ensure the safety of users of the bridges, preventing people from falling over the sides and giving a sense of safety, uniformity and consistency along the trail.

There are designated standards for handrails for pedestrians and cyclists (1.0 – 1.1m high for walkers and 1.3m for cyclists with a number of detailed specifications regarding design).

Some of these pre-fabricated bridges may need to carry vehicles (particularly, small fire-fighting

vehicles and perhaps emergency vehicles). At most of the locations, there is sufficient "go-round" space to allow vehicles access along the trail elsewhere within the former railway corridor (alternatively road crossings are close by). The trail construction process will need to work out which of the locations will require the pre-fabricated bridges to be able to carry vehicles (this will affect the costs; costings have been developed based on pre-fabricated bridges not needing to carry vehicles).

3.10 Trail furniture

There are a number of scenic locations along the corridor well suited to the placement of seats that would benefit all trail users. An allowance has been made for the eventual installation of seats – at sites selected by the trail manager. Sites should have views over the adjoining countryside and the various bushland sites and agricultural crops. Care should be taken in the selection of styles of seating and tables. Many styles commonly used on trails are more suited to backyard gardens, or city parks. Few look 'right' in the natural environment.

Placement of simply constructed seats at intervals along the trail will benefit all trail users.

3.11 Trailheads and parking

A trailhead is usually defined by the existence of a car parking area, often with picnic facilities, interpretive signage, a map panel of the trail showing sites of interest and distances to features along the trail and a Code of Conduct. It is a location where a (short or long) trail walk or ride can begin or end.

The most logical trailhead locations have been chosen for the major trailheads (or trail termini) - being Rotary Park in North Bundaberg and at the Gin Gin Railway Museum at Gin Gin). North Bundaberg Railway Station Museum was not chosen as the Bundaberg trailhead given its very limited parking spaces, its limited opening hours and the difficulty in accessing it from the trail route. Rotary Park is a much better option and is close to many existing facilities and amenities. The recommended (additional) directional signage will guide trail users from the rail trail route to the museum if desired.

Other (minor) trailheads have been recommended, to enable potential users to undertake shorter trail experiences. These other trailheads are located at Sharon, Bullyard and Koolboo siding. Basic facilities such as parking, and a picnic table or seats in the shade, interpretive information (on a map panel) showing distances to features along the rail trail is important and will prove useful to all rail trail users.

A concept plan for each trailhead is included in Appendix 3 of this Trail Development Plan.

A typical trailhead interpretive shelter. Usually these shelters may contain two information panels (front and back, incorporating general information, a map with the trail route and key features and important safety information for trail users.

3.12 Fencing

Fencing along a rail trail is required for several reasons:

- To prevent unauthorised access onto the rail trail;
- To prevent authorised trail users (cyclists, walkers) from attaining access onto adjoining properties, and to prevent unauthorised trail users (trail bikes, etc.) from illegally trespassing onto private property;
- To minimise disturbance of stock by trail users;
- To prevent encroachments by adjoining landowners;
- To delineate freehold (private property) from Crown land and to minimise encroachments and trespassing, unintended or otherwise;
- To ensure the safety of trail users during harvesting in particular;
- To prevent stock from straying (recognising that it is the land owner's responsibility to ensure stock does not stray); and
- To keep stock off the rail trail and away from trail users.

Given that much of the corridor between Bundaberg and Gin Gin has a road as one "neighbour", the existing boundary fencing along the corridor remains in good condition. It is critical that the rail trail corridor be

fenced on both sides of the trail where it passes through farms – for public liability insurance and risk reasons. The rail trail corridor cannot remain unfenced. The existing boundary fencing in many situations is sufficient to address these concerns.

One of the options to maintain the corridor (as opposed to maintaining the actual rail trail) is to allow adjoining or adjacent landholders to use the excess corridor either for agricultural purposes or grazing. This should be permitted on those parts of the corridor not required for a trail (a 6 metre envelope incorporating the trail on the railway formation). As the original railway corridor is mostly 20 – 30 metres wide, the excess corridor can be leased to adjoining landowners. This approach will minimise the reduction in land that they currently farm and enable either the farmer or stock to 'maintain' the corridor outside of the fenced trail corridor (noting that some landholders already farm the corridor).

There are some locations where the need for fencing was obvious, primarily as there is no existing boundary fencing – fencing in these locations has been included in the works items. The works tables also contain a general allowance for further fencing to be negotiated with adjoining landholders should the trail proceed.

The recommended fencing alignment will generally follow the original corridor reserve boundary (but does not need to if there is a request from adjoining landowners for it to be located elsewhere). The adjoining landowner may wish to continue to utilise the 'spare' parts of the former railway corridor (i.e. that which is not required for the actual rail trail) and would need to enter into negotiations with the trail manager.

The installation of the fencing should be undertaken in close consultation with the adjoining landowner.

3.13 Machinery and stock crossings

Primarily due to the nature of the corridor between Bundaberg and Gin Gin, there are numerous 'private' level crossings– these crossings allow adjoining landowners to move their machinery or stock from one side of the rail trail corridor to the other.

Any such crossings should be retained, and the development of any trail will need to make allowance for their retention. These facilities are generally required where landholders' own parcels on both sides of the corridor. They may also be needed where an adjoining landholder can only safely access their property via a minor road (and not from the Bundaberg Gin Gin Rd).

Such crossings can be either 'open' meaning that machinery/stock are able to cross the rail trail to the other side of the corridor at all times, unhindered by gates – with trail users having to open gates to get across the crossing, or they can be gated either side of the corridor meaning that the adjoining landowners would be responsible for opening the gates when needed. In one instance, gates on all four sides of the trail are proposed.

By having 'open' crossings, machinery - especially at busy times such as cane harvesting - can have unrestricted access. In this scenario, trail users will need to open self-closing gates at each side of the crossing and pass across from one side to the other. The gates need to be 1200mm spring-loaded gates opening into the crossing in order to prevent stock pushing them open. Gate design needs to ensure that the gate closes against the adjoining fence post (i.e. the opening for the gate is to be less than 1200mm). While not favoured by rail trail users as this is somewhat inconvenient (especially when there are many gates to open/close) it is regarded as one of the best compromise designs. By allowing machinery and/or stock from adjoining farms to cross from one side of the corridor to the other at all times, the interruption to current farming practices is minimised and adjoining landowners are much more favourably disposed to the prospect of the rail trail.

Individual discussions with landholders at the time of construction would work out the most appropriate system, although consultation for this plan has arrived at a number of solutions. (See photos for typical examples of a grid and crossings points on a rail trail).

As noted earlier, a concreted crossing point of the rail trail surface at each 'machinery crossing' is strongly recommended to ensure the regular passage of machinery and stock across the rail trail does minimal damage to the trail surface and is long-lasting.

Above and below: two styles of crossings on the Otago Central Rail Trail in New Zealand.

A farmer alongside Port Fairy Warrnambool Rail Trail (in Victoria) has complete control over gates and opens them when he needs to move stock and machinery across the corridor.

There are several options for moving stock and machinery across a rail trail. Above: crossings that are gated either side of the corridor allow the controlled passage of stock and/or machinery at certain times.

Crossings where gates are across the rail trail, where trail users need to open/close the gate.

3.14 Encroachments in the trail corridor

Between the closure of the railway in 1993 and the present, several encroachments on to the former railway corridor have been made. Greenhouses have been constructed that protrude into the corridor in one location (near Nicholsons Rd at Sharon). In several locations, industrial and household rubbish has been dumped within the corridor. A section of the corridor has previously been used for a banana plantation (now fallow). Hay appears to have been stored on the corridor at Bingera Siding (as seen in aerial photography, but not at time of inspection). At Koolboo there are numerous (old) earthmoving machines stored on the corridor.

The practical difficulties associated with developing a trail where there are longstanding encroachments are appreciated, given that these uses of the corridor are probably longstanding. It is typical of most abandoned railway corridors that neighbouring landowners take advantage of the available (public) land when there seems no other use.

However, it is not desirable to pursue a course that takes the trail off the railway corridor to avoid these encroachments (a trail can be developed/ located within the railway corridor but not on the old formation).

Re-routing the trail around encroachments is only proposed in a limited number of circumstances.

3.15 Other users and trail etiquette

Managing interaction between user groups is a primary prerequisite on all trails, and standard signage and protocols already exist. Providing adequate signage is installed and users are well aware of the likelihood of meeting other user groups, such interactions should generally be non-threatening and relatively safe.

Every attempt must be made to ensure the rail trail is not used by either four-wheel drives or trail bikes, though this is likely to be difficult to manage and hard to police. The proposed management access gates and chicanes at every road crossing will go part way to addressing this issue.

Education through signage and use of gates or other vehicle exclusion barriers will help, as will encouraging bona-fide users – and local residents – to report registration numbers of illegal users.

3.16 Codes of conduct

A Code of Conduct for each user group provides all trail users with guidelines to minimise their impact on the environment, and on other trail users.

Codes of Conduct help to:

- Prevent trespass;
- Prevent soil erosion;
- Minimise trampling;
- Prevent the introduction and spread of noxious and exotic plants;
- Protect waterways;
- Reduce the risk of fire;
- Protect significant and environmentally sensitive sites;
- Minimise potential conflict with other users of the trail; and

Trailhead signage is the best place to provide Code of Conduct signage.

The Murray to the Mountains Rail Trail has a Code of Conduct sign board at regular intervals along the trail ensuring that all trail users are aware of their rights and responsibilities.

3.17 Heritage issues

Splitters Creek Bridge is the most obvious structure along the trail corridor with historic or heritage value. Most other structures have been removed.

It is strongly recommended that the trail manager seek to ensure all artefacts and relics of the railway remain in place during the construction of the trail. The existing Gin Gin and North Bundaberg station buildings and other buildings in the station grounds are outstanding examples of preserved railway heritage. It is hoped that station/siding name boards can be returned (or replicated) to each siding location as part of the interpretation of that site.

3.18 Environmental issues

A number of key environmental issues have been identified. These include:

- Clearing of regrowth vegetation along the corridor, and the need for clearing permits and the possible future need for offset re-vegetation.
- The potential for the spread of weeds (and pathogens) during the construction phase and, potentially, through usage of the trail.

- Contamination of soils as a result of the operations of the railway and the manner in which former bridges were constructed and maintained.
- The potential for sedimentation of watercourses as a result of trail construction and bridge works.

In addition, care will need to be taken in the ongoing maintenance of the proposed rail trail to ensure weeds and pathogens are not unwittingly spread by maintenance machinery. Ongoing clearing at the sides of the rail trail will be required to keep the trail corridor at acceptable widths.

As stated elsewhere in this Trail Development Plan, the installation of 'wash-down' stations (for the cleaning of boots and bicycle tyres) is strongly recommended.

3.19 Clearing for the rail trail

In the years since the railway last operated, vegetation (in various forms) has regrown along parts of the corridor that formerly was kept clear of vegetation. The amount of regrowth vegetation varies markedly along the corridor. In numerous places adjoining landowners may have kept the former railway reserve totally cleared of regrowth vegetation. At the other extreme, there are several sections of the former railway reserve that have considerable regrowth vegetation.

Three types of clearing have been identified along the length of the corridor. These are:

- Minor clearing of vegetation required (only top soil needs removal and/or slashing prior to earthworks).
- Moderate clearing of vegetation (some regrowth in trail corridor).
- Heavy clearing of vegetation (substantial regrowth in trail corridor and/or thick undergrowth).

The estimates of probable costs reflect these various types of clearing of vegetation.

Generally speaking, a cleared 'trail corridor' of 3.5 - 4.0 metres will be required to enable a trail of 2.5 metres to be developed in the centre of the cleared corridor. Either side of this trail will be further clearing of vegetation up to 1.0m for drainage.

Ongoing maintenance will be required, on an 'as and when required' basis, to prune the vegetation alongside the trail to keep the trail corridor clear of overhanging vegetation. The regularity of the clearing of side growth vegetation will depend on numerous factors, particularly the type of vegetation growing alongside the trail over its length.

3.20 Toilets

The proposed trailheads at Rotary Park in Bundaberg and Gin Gin Railway Station Museum have existing toilets.

There are also toilets at Sharon and Bullyard. Consideration has been given to the installation of additional toilets along the rail trail but it is felt unnecessary given the relatively short distances between the existing facilities and the high cost of new toilets. There is no standard accepted distance between toilets on a trail.

3.21 Cane railway crossings

There are several locations where the proposed rail trail will need to cross cane railways.

The trail should cross these railways perpendicular to the cane railway – not at an angle – to ensure that bicycle wheels do not get caught in the groove of the railway track. The works lists have included a cost for the placement of a rubberised crossing treatment, similar to what would be found in cities where bicycle lanes or shared paths cross light rail, tram or railway tracks.

Warning signage would also be appropriate at these crossings. Given the low speeds of the cane trains, the excellent sight lines and the relative infrequency of the trains, pedestrian 'mazes' (as would be found in an urban area where fast trains might be encountered far more frequently) are not recommended.

One example of a product developed specifically for use on shared paths, enabling safe crossing of the railway tracks by cyclists.

Section 4 – Works lists and probable costs

4.1 Introduction

Investigations undertaken during the fieldwork associated with this project enable a reasonably accurate picture of the work required to bring about the development of a rail trail within the disused railway corridor between Bundaberg and Gin Gin.

4.2 Landholder consultation

A number of landholders took the opportunity to meet with the consultants during fieldwork to discuss issues and possible solutions. Several issues were raised (Section 3.4 covers these in more detail). Issues raised covered:

- Illegal access from the corridor to adjoining farmland and properties;
- Safety of users in terms of farm machinery – issues around harvesting, moving machinery across the trail corridor, trimming of nut trees;
- Safety issues associated with spray drift;
- Safety issues associated with Irrigation spraying;
- Safety issues around dust and consequent reduced visibility for trail users in terms of seeing machinery;
- Retaining existing access across the corridor for machinery in particular (where a landholder uses both sides of the corridor) but also for driveways (existing or proposed);
- Shooting – farmers are using shooting to control pest animals;
- Biosecurity particularly for banana crops;
- Illegal camping on the corridor or on other areas accessed by the corridor;
- Trail relocations within the corridor to facilitate activities by adjoining landholders;
- Use of the "excess" corridor for agricultural practices (turning machinery in particular);
- Approved vehicle access to/across the corridor (notably Ergon); and
- Fencing.

Whilst many landholders met were opposed to the project, most were also cooperative in identifying issues and agreeable solutions should the trail proceed. Landholder requests are identified in the works tables. It should be noted that particularly in respect of driveways and machinery crossing points, landholders identified some specific locations where they would like to see such solutions and also asked that other locations ben negotiated during construction. Where possible, the number of additional crossing points has been noted in the tables and a cost provided (though not the specific location).

There is an additional allowance in each section for additional landholder requests.

It should be noted that the works items recommended reflect the farming practices in place at the time of report preparation. It may be that the farming practice and the crops being farmed will change between the report finalisation and trail construction (should it proceed). The consultants have been told that cane growing has being replaced over time by nut tree farming. This practice may continue and may require different solutions on individual parcels of land at the time the trail proceeds.

4.3 Additional notes

The following notes are relevant when reading Tables 1 to 4:

Map references shown in the tables refer to works items shown on Plans in Appendix 6.

- Plan 1 covers the section from Bundaberg to Sharon.
- Plan 2 covers the section from Sharon to Koolboo Road Trailhead.
- Plan 3 covers the section from Koolboo Road Trailhead to Bullyard.
- Plan 4 covers the section from Bullyard to Gin Gin.

Works items shown on maps are generally in the precise location (though measurements may vary slightly on the ground).

4.4 Works tables

Table 1: Bundaberg to Sharon Trailhead (9,180 metres) (refer Plan 1 in Appendix 6)

Works Item No.	GPS Reference	Works item	$
1	S 24° 51.683'	Bundaberg North Trailhead (See Trailhead plan – Appendix 3). ● Install double-sided trailhead sign (brown chevron) on s-w corner of Perry St and Queen St ($1,600). ● Install single-sided trailhead sign ($1,000) ● Install Trail Directional Marker ($600). ● South face - Town centre (right turn arrow), Gin Gin (left turn arrow). ● West face - Town centre (straight ahead arrow). ● East face - Gin Gin (straight ahead arrow). ● Install Trailhead map panel ($5,500). ● Pave semi-circular area around map panel (5m^2) to delineate it from road and footpath ($2,000). ● Install sculptures (allow $5,000).	15,700
2		Trail to use existing concrete footpath to Hanbury Street.	0
3	S 24° 51.679' E 152° 20.658'	Install Trail Directional Markers either side of Queens Rd ● TDM on eastern side of road (20 m east of road edge). East face - Gin Gin (Straight ahead arrow); West face -Town centre (Straight ahead arrow). ● TDM on western side of road (20 m west of road edge). East face - Gin Gin (Straight ahead arrow); West face -Town centre (Straight ahead arrow).	1,200
4	S 24° 51.671' E 152° 20.576'	Existing path (to be used) crosses gravel road and goes under active railway bridge. Install interpretative panel about railway history	3,000
5		Trail to use existing concrete footpath along Hanbury Street. BRC may wish to widen sections of this path to allow shared use as some of existing path is quite narrow – not costed.	0
6	S 24° 51.630' E 152° 20.380'	Install Trail Directional Marker either side of Hanbury Rd to inform and direct users to Bundaberg North Railway Museum (crossing drawing not provided). ● TDM on southern side of road South face - Gin Gin (Left turn arrow); Museum (Straight ahead arrow); West face - Town centre (Straight ahead arrow); Museum (left turn arrow); North face Gin Gin (Right turn arrow); Town Centre (Right turn arrow) ● TDM on northern side of road South Face: Museum (Straight ahead arrow); North face: Gin Gin, Town Centre (Straight Ahead arrow). Install Trail Directional Marker at corner of Station St and Hinkler Ave (service road) to confirm directions to museum. ● South face - Museum (Left turn arrow); West face - Town centre (Right turn arrow).	

Works Item No.	GPS Reference	Works item	$
6	S 24° 51.630' E 152° 20.380'	Install Trail Directional Marker either side of Hanbury Rd to inform and direct users to Bundaberg North Railway Museum (crossing drawing not provided). • TDM on southern side of road South face - Gin Gin (Left turn arrow); Museum (Straight ahead arrow); West face - Town centre (Straight ahead arrow); Museum (left turn arrow); North face Gin Gin (Right turn arrow); Town Centre (Right turn arrow) • TDM on northern side of road South Face: Museum (Straight ahead arrow); North face: Gin Gin, Town Centre (Straight Ahead arrow). Install Trail Directional Marker at corner of Station St and Hinkler Ave (service road) to confirm directions to museum. • South face - Museum (Left turn arrow); West face - Town centre (Right turn arrow).	1,800
7	S 24° 51.586' E 152° 19.789'	Road crossing – Hanbury Street. (See road crossing drawing - Appendix 1). • Apply "Give Way" signs on path on both sides of road ($200). • Install "trail crossing" signs on both sides of trail ($1,200). • Install trail directional markers (both sides of road) ($1,200).	2,600
8	S 24° 51.586' E 152° 19.789'	• Construct trail between Hanbury St and Splitters Creek bridge (east). • Construction of sealed pathway 2.5m wide, compacted to 150mm thickness (includes stripping of topsoil, boxing out, clearing side drains, compacting subgrade, filling, levelling, shaping and sealing). (4,600m).	1,035,000
9	S 24° 51.586' E 152° 19.795'	Turning triangle. Moderate clearing (30m).	210
10	S 24° 51.530' 152° 19.795'	Slashing/side clearing: Northern end of turning triangle to One Mile Rd (930m).	1,395
11	S 24° 51.543' E 152° 19.789'	New 2.4m colourbond boundary fence for privacy - eastern side of corridor (65m). No Trespassing sign on fence.	7,250
12	S 24° 51.497' E 152° 19.758'	Pipe and fill under trail 3m (l) x 3m (w) X 2m (h). 120m x 3m screen planting on southern side from this point to eastern side of units (landholder request). Install pipe (parallel to corridor) from packing shed onto road crossing to deal with flooding on southern side of corridor (400 m) (landholder request). No Trespassing sign on fences (3) (landholder request).	14,520

Works Item No.	GPS Reference	Works item	$
13	S 24º 51.495' E 152º 19.745''	• Pipe and fill under trail 3m (l) x 3m (w) X 1.5m (h).	1,500
14	S 24º 51.504' E 152º 19.540'	• Material stored on corridor – tyres, sand etc. Remove/ negotiate use of excess corridor.	0
15	S 24º 51.508' E 152º 19.397'	• Develop trail 5m south of centreline of formation (200 metres). This allows golf club to use northern side of formation for vehicle parking (landholder request). Install bollards for 200 m (at 1.4 m intervals) on north side of trail. 200m x 3m screen plantings on south side against boundary fence. (more detail provided in road crossing drawing for One Mile Rd – Appendix 1).	19,700 Trail construction covered in WI 8
16	S 24º 51.512' E 152º 19.277'	End of screen plantings, trail diversion and bollards. Road crossing – One Mile Road. (See road crossing drawing - Appendix 1). • Install "Give Way" signs on both sides of road ($400). • Install "trail crossing" signs on both sides of trail ($1,200). • Install Trail Directional Marker (east side of One Mile Rd) ($600). • Install trail user chicane and management gate system (west side of road only). Set gating system in asphalt "apron" ($3,540). • Install "Shared Use Zone" sign at edge of carpark ($200).	5,940
17	S 24º 51.512' E 152º 19.277'	Moderate clearing: One Mile Rd to entrance to Oakwood Golf Course (725m).	5,075
18	S 24º 51.520' E 152º 19.173'	Install pre-fabricated bridge – allow 14m.	56,000
19	S 24º 51.531' E 152º 18.847'	Gravel road constructed on formation. Reports from adjoining landowner that gazetted road is built on old railway formation. Construct trail on north side of corridor (at adjoining (southern) landholder's request (length of "diversion" - 1,550m). (Final determination of which side of corridor to use to be made at the time of construction n consultation with both adjoining landholders) Allowance for two access points across corridor for vehicles and machinery. Access points open 24/7; gating system to have management access gate, self-closing pedestrian and bike access gate, and 5 m fencing either side (landholder request – precise location to be determined at time of construction).	5,000 Trail construction covered in WI 8

Works Item No.	GPS Reference	Works item	$
20	S 24° 51.540′ E 152° 18.700′	• Pipe and fill under trail 3m (l) x 3m (w) X 1.5m (h).	1,500
21	S 24° 51.544′ E 152° 18.452′	• Material stored on corridor – tyres, sand etc. Remove/ negotiate use of excess corridor.	0
22	S 24° 51.557′ E 152° 17.963′	• Develop trail 5m south of centreline of formation (200 metres). This allows golf club to use northern side of formation for vehicle parking (landholder request). Install bollards for 200m (at 1.4m intervals) on north side of trail. 200m x 3m screen plantings on south side against boundary fence. (more detail provided in road crossing drawing for One Mile Rd – Appendix 1).	19,700 Trail construction covered in WI 8
23	S 24° 51.558′ E 152° 17.921′	End of screen plantings, trail diversion and bollards. Road crossing – One Mile Road. (See road crossing drawing - Appendix 1). • Install "Give Way" signs on both sides of road ($400). • Install "trail crossing" signs on both sides of trail ($1,200). • Install Trail Directional Marker (east side of One Mile Rd) ($600). • Install trail user chicane and management gate system (west side of road only). Set gating system in asphalt "apron" ($3,540). • Install "Shared Use Zone" sign at edge of carpark ($200).	5,940
24	S 24° 51.556′ E 152° 17.860′	Moderate clearing: One Mile Rd to entrance to Oakwood Golf Course (725m).	5,075
25	S 24° 51.575′ E 152° 17.668′	Oakwood Road crossing. Install gating systems and signage to manage trail user interaction and to prevent access off trail. • Install "No access to rail trail/Splitters Creek Bridge" signs on Oakwood Road near intersection with Bundaberg Gin Gin Rd. • Install gating system on trail. Gating system across trail to have management access gate, self-closing pedestrian and bike access gate, and 10 m fencing either side (both sides of access point). • Install management access gates perpendicular to trail on both sides of trail connecting to fencing across trail. Gates to be locked with access available only to landholder who may wish to leave them open 24/7 at harvest time or other times. (Note emergency and maintenance vehicles have easy access from One Mile Road –there is no need for them to have access to these gates).	56,000

Works Item No.	GPS Reference	Works item	$
25 cont.		• Machinery access point to be 10 m wide (trail will be sealed at this point so no need for reinforcing). • Install appropriate warning signs about agricultural activity on both sides of trail gating system. • Install "No Trespassing" signs on management access gates and alongside Oakwood Road near "bin loading areas". Consultant-designed solution in response to landholder request.	
26	S 24° 51.575' E 152° 17.668'	Allowance for surveying – Oakwood Rd to Splitters Creek Bridge (870m) to precisely locate corridor and adjoining property boundaries.	4,350
27	S 24° 51.575' E 152° 17.610'	Heavy clearing Oakwood Rd to Splitters Creek Bridge (eastern side) (850m).	11,900
28	S 24° 51.578' E 152° 17.602''	Install gating systems and signage to manage trail user interaction and to prevent access off trail. • Install gating system on trail. Gating system across trail to have management access gate, self-closing pedestrian and bike access gate, and 10 m fencing either side (both sides of access point). • Install management access gates perpendicular to trail on both sides of trail connecting to fencing across trail. Gates to be locked with access available only to landholder who may wish to leave them open 24/7 at harvest time or other times. (Note emergency and maintenance vehicles have easy access from One Mile Rd –there is no need for them to have access to these gates). • Machinery access point to be 10 m wide (trail will be sealed at this point so no need for reinforcing). • Install appropriate warning signs about agricultural activity on both sides of trail gating system. Install 2.4m high chain mesh barrier fencing both sides of corridor (220 metres). Install golf course netting or similar on top of the chain mesh fencing to limit accident risk.	63,800
29	S 24° 51.583' E 152° 17.540'	Rail corridor and trail go into a deep cutting. No fencing needed here (160 metres). Clean out/reinstate side drainage in cutting.	4,000
30	S 24° 51.609' E 152° 17.456'	Install 2.4m high chain mesh barrier fencing both sides of corridor to Splitters Creek Bridge (430 metres). Install golf course netting or similar on top of the chain mesh fencing to limit accident risk.	103,200

Works Item No.	GPS Reference	Works item	$
31		Allowance for two additional access points with signage across corridor to allow neighbouring cane farmer to move machinery as needed. Gating systems to be discussed at time of construction. Landholder request – precise location of crossing points to be negotiated at time of construction.	18,000
32	S 24º 51.750' E 152º 17.255'	Splitters Creek Bridge (eastern side). See Appendix 5 for detailed report on design and costings.	3,255,750
33	S 24º 51.785' E 152º 17.090'	Splitters Creek Bridge (western side).	0
34	S 24º 51.785' E 152º 17.090'	Construct trail between Splitters Creek bridge (west) and Sharon Road (2,310m). Construction of sealed pathway 2.5m wide, compacted to 150mm thickness (includes stripping of topsoil, boxing out, clearing side drains, compacting subgrade, filling, levelling, shaping and sealing).	519,750
35	S 24º 51.785' E 152º 17.090'	Slashing/side clearing: Splitters Creek Bridge (western side) to eastern end of Nicholsons Rd (620m).	930
36	S 24º 51.860' E 152º 16.940'	Develop trail 5m north of centreline of formation (230 metres). This allows landholder to use southern side of formation to construct road access to property to the east (landholder request).	Trail construction covered under WI 34
37	S 24o 51.890' E 152o 16.900'	Install screen plantings on both sides of corridor (150m x 3m)	2,700
38	S 24º 51.950' 152º 16.840'	Western end of trail diversion and screen planting. Driveway access to house on northern side of corridor has been built along formation at this location – 100 metres to property gate/boundary. Trail manager to determine whether this can be a shared route (i.e. driveway and trail on same section or owner needs to provide new driveway access). Sign as appropriate.	500 (sign allowance). If separate trail needs to be constructed . it is covered under WI 34
39	S 24º 51.990 ' E 152º 16.815'	Install spring-loaded pedestrian and management access gate in existing boundary fence (final configuration may depend on solution to shared access driveway (WI 38). Install warning signage regarding agricultural activity.	2,300
40	S 24º 51.990 ' E 152º 16.815'	Moderate clearing: Eastern end of Nicholsons Rd to Sharon Rd (1,690m).	11,830
41	S 24º 51.990 ' E 152º 16.815'	Install 2.4m high chain mesh barrier fencing and appropriate signage to eastern edge of land under sugar cane cultivation (900m).	72,000

Works Item No.	GPS Reference	Works item	$
42	S 24º 52.190 ' E 152º 16.560'	Install pre-fabricated bridge – allow 35 m.	140,000
43	S 24º 52.244' E 152º 16.478'	Install pre-fabricated bridge – allow 14 m. The alternative is to construct a pipe and culvert set-up similar to what is present on the northern side of the formation at this point (3 RCPs in a concrete box). FO#10.	56,000
44	S 24º 52.330' E 152º 16.370'	End of chain mesh barrier fencing (WI 41).	0
45	S 24º 52.330' E 152º 16.370'	Construct trail between southern side of cutting and Nicholsons Rd on what appears to be road reserve. Start construction where cutting appears and end it at Sharon Rd. (710 metres). Greenhouses and other buildings have been constructed illegally on the corridor at this location. Construction would be easier on the road reserve given the need to construct a bridge on the existing formation if trail follows original alignment (and sheds would need to be removed). Heavy clearing (100 m). Slashing/side clearing (610 m).	2,315 Trail construction covered under WI 34
46	S 24º 52.415' E 152º 16.209'	Retain existing crossing point across trail for sheds. Install Give way signs on trail at current access point.	400
47	S 24º 52.497' E 152º 16.050'	Install culvert/pipes under trail to match the pipe under Nicholsons Rd on the same drain line.	7,500
48	S 24º 52.513' E 152º 15.989'	Road crossing – Sharon Road. (See road crossing drawing - Appendix 1). ● Install "trail crossing" signs on both sides of trail ($1,200). ● Apply "Give Way" signs on trail on both sides of road ($200). Install Trail Directional Marker (3) to direct users to trail and to Sharon Trailhead ($1,800). ● South eastern TDM. South East face -Gin Gin, Sharon (right turn arrow); North west face – Bundaberg (Left turn arrow). ● North eastern TDM. South East face -Gin Gin ((left turn arrow); Sharon (Straight ahead arrow); South Western face – Bundaberg (Right turn arrow); Sharon (Left turn arrow); North western face – Bundaberg (Straight ahead arrow); Gin Gin (Right turn arrow) ● TDM on south western side of Sharon Rd. South western face – Bundaberg; Sharon (Straight ahead arrow); North eastern face – Gin Gin (Straight ahead arrow)	3,200

Works Item No.	GPS Reference	Works item	$
49	S 24° 52.413' E 152° 15.760'	Sharon Trailhead (See Trailhead plan – Appendix 3). (using existing parking capacity in the vicinity of Sharon School) ● Install single sided trailhead sign (brown chevron) on southern side of Sharon Rd ($1,000). ● Install double-sided trailhead sign ($1,600). ● Install Trail Directional Markers (2) ($1,200). ● Install Trailhead map panel ($5,500).	9,300
		Allowance for additional landowner requests (e.g. fencing and vegetation screening).	10,000
		Allowance for installation of additional interpretive signage (at locations to be determined by trail manager and local historians) (2 signs).	6,000
		Allowance for Trail Directional Markers (incorporating emergency markers) to be placed along trail every 1km.	5,400
		Allowance for installation of trailside furniture (e.g. seats) at locations to be determined by trail manager (3 units).	6,000
		Allowance for marking trees to be cleared, pruned or left untouched.	2,400
		Allowance for marking centreline of trail with flagging tape prior to clearing and construction.	3,600
		Allowance for purchase and installation of: ● Regulatory signage (Shared Path; "No Trail Bikes"; "Authorised Users Only"); ● Road name signs; ● Trail name signs; ● "No Trespassing" signs; ● Local attractions sign; ● Miscellaneous signs (Keep Out etc.).	1,200
		Allowance for traffic management (3 road crossings).	6,000
		Allowance for cable locators at road crossings (3 road crossings).	3,000
		Sub-total	**5,552,865**
		Approvals, permits, applications, designs, specifications, assessments (2.5% of estimated expenditure).	138,820
		Contingency amount (15% of estimated expenditure).	832,930
		Project management (5% of estimated expenditure).	277,640
		Total (not including gst)	**6,802,255**

Table 2: Sharon Trailhead to Koolboo Rd Trailhead 13,830 (metres) (refer Plan 2 in Appendix 6)

Ref No.	GPS Reference	Works item	$
		Sharon Trailhead (see Table 1). Sharon Road crossing (see Table 1). Trail to continue on existing Sharon Rail Trail.	0
1	S 24° 52.897' E 152° 15.146'	Western end of Sharon Rail trail (constructed). Install Trail Directional Marker to direct users on trail (entering from Davis Road). ● Southern face - Bundaberg (Right turn arrow); Gin Gin (Left turn arrow); Eastern face - Gin Gin (Straight ahead arrow); Western face- Bundaberg (Straight ahead arrow)	600
2	S 24° 52.897' E 152° 15.146'	Complete existing Sharon Rail Trail to Bundaberg Gin Gin Road (sealed surface). Construct trail between end of existing trail and Sharon Road (180 m). Construction of sealed pathway 2.5m wide, compacted to 150mm thickness (includes stripping of topsoil, boxing out, clearing side drains, compacting subgrade, filling, levelling, shaping and sealing).	40,500
3	S 24° 52.925' E 152° 15.038'	Road crossing – Gin Gin Road (1). (See road crossing drawing - Appendix 1). ● Install "road ahead" sign on east side of road ($200). ● Install "stop" sign on both sides of road ($400). ● Install "trail crossing" signs on both sides of trail ($1,200). ● Install trail user chicane (west side of road). Set in concrete/asphalt for ease of maintenance ($3,540). ● Create a 5 m (l) x 2.5m (w) asphalt "apron" connecting road shoulder with trail on west side of road (note: apron not shown on drawing) ($500).	5,840
4	S 24° 52.925' E 152° 15.038'	Construct trail between Bundaberg Gin Gin Road crossing, Sharon and Koolboo (13,650m). Construction includes stripping of top soil, boxing out, cleaning side drains, compacting subgrade (to 150mm), filling with road base, levelling, trimming, shaping and compacting	819,000
5	S 24° 52.925' E 152°o 15.038'	Clearing between Bundaberg Gin Gin Road crossing, Sharon and Koolboo. Allow heavy clearing along creek lines and other heavily overgrown areas (4,780m) Allow moderate clearing along remainder (8,870m)	129,010
6	S 24° 52.925' E 152° 14.990'	New post and wire fencing and screen planting for privacy (100m x 3m) (landholder request)	3,300

Ref No.	GPS Reference	Works item	$
7	S 24° 52.931′ E 152° 14.909′	Maintain existing driveway crossing. Install Give Way signs on both sides of driveway (landholder request). Pipe and fill under trail 3m (l) x 3m (w) X 1.5m (h).	1,900
8	S 24° 52.993′ E 152° 14.298′	Install pre-fabricated bridge – allow 28 m.	112,000
9	S 24° 53.084′ E 152° 13.931′	Maintain existing driveway crossing. Signpost accordingly – Give Way on both sides of driveway (landholder request)	400
		Additional new driveway crossing east of this one. Precise location of crossing points to be negotiated at time of construction (landholder request)	Allow 800 signage and preparation for second access point
10	S 24° 53.102′ E 152° 13.849′	Install interpretive signage – Manoo siding. (location is approximate).	3,000
11	S 24° 53.159′ E 152° 13.698′	Install pre-fabricated bridge – allow 14 m. New abutments also needed. 56,000	56,000
12	S 24° 53.342′ E 152° 13.371′	Cane line and driveway crossing across corridor. Build rubber-based ramp up to go over cane line. Install pipe under ramp (on outer edge). Install give way signage (both sides of cane line). Install bollards for 100 metres (at 1.4m intervals) on eastern side of cane line at southern edge of gravelled parking area (delineate trail from parking area).	10,565
13	S 24° 53.466′ E 152° 13.196′	Install pre-fabricated bridge – allow 14 m (was originally a pipe culvert).	56,000
14	S 24° 53.657′ E 152° 12.934′	Existing 20 m box culvert with 3 openings. Clean and maintain	400
15	S 24° 53.801′ E 152° 12.727′	On southern boundary, forest/bushland is replaced by nut farming. Install trail user self-closing gate with fencing (3m either side of trail at right angles to direction of travel) and appropriate signage.	1,000
16	S 24° 53.956′ E 152° 12.504′	End boundary fencing. Install trail user self-closing gate with fencing (3m either side of trail at right angles to direction of travel) and appropriate signage. Adjoining land use is bushland.	1,000
17	S 24° 54.069′ E 152° 12.359′	On southern boundary, forest/bushland is replaced by nut farming. Install trail user self-closing gate with fencing (3m either side of trail at right angles to direction of travel) and appropriate signage.	1,000

Ref No.	GPS Reference	Works item	$
18	S 24° 54.241' E 152° 12.100'	End boundary fencing. Install trail user self-closing gate with fencing (3m either side of trail at right angles to direction of travel) and appropriate signage. Adjoining land use is bushland.	1,000
19	S 24° 54.241' E 152° 12.087'	Road crossing – Bingera Siding Road. (See road crossing drawing - Appendix 1). ● Install "Give Way" signs on both sides of road ($400). ● Install "trail crossing on side road" signs on both sides of Raines Rd. Install "trail crossing" sign on Bingera Siding Rd ($1,200). ● Install trail user chicane and management gate system (both sides of road). Set in concrete/asphalt apron for ease of maintenance ($7,080). ● Create a 5m (l) x 2.5m (w) asphalt "apron" connecting road shoulder with trail on both sides of road. (note: apron not shown on drawing). ($1,000). ● Install pipe culvert under trail on western side of Bingera Siding Rd ($3,000).	12,680
20	S 24° 54.281' E 152° 11.986'	Bingera siding. Construct trail on southern edge of corridor to avoid travelling close to house (this also provides users with a good view of Bingera siding buildings). Plant 100m x 3m screen planting (60 m on southern side of house and 40m on western side of house) for privacy. Material stored on corridor – machinery, stockpiles. Remove/negotiate use of excess corridor.	1,800 Trail construction covered under WI 4
21	S 24° 54.372' E 152° 11.699'	Install pre-fabricated bridge – allow 28 m. New abutments also needed.	112,000
22	S 24° 54.398' E 152° 11.648'	On southern boundary, forest/bushland is replaced by nut farming. Install trail user self-closing gate with fencing (3m either side of trail at right angles to direction of travel) and appropriate signage.	1,000
23	S 24° 54.442' E 152° 11.512'	Entry to Bundaberg Sugar Tree Farm. Gates to entry have been built on corridor or road reserve. Access way needed. Tree farm extends either side of entry. Install Give Way signs on trail.	400
24	S 24° 54.489' E 152° 11.376'	End boundary fencing. Install trail user self-closing gate with fencing (3m either side of trail at right angles to direction of travel) and appropriate signage. Adjoining land use is bushland.	1,000

Ref No.	GPS Reference	Works item	$
25	S 24º 54.785' E 152º 10.590'	Construct trail on southern edge of corridor at this location to maximise distance from existing house (Road crossing drawing of Birthamba Rd shows the relocation – Appendix 1) (length of diversion is 200 metres). Screen planting for privacy on northern boundary (60 metres x 3m).	1,080 Trail construction covered under WI 4
26	S 24º 54.809' E 152º 10.481'	Road crossing – Birthamba Road. (See road crossing drawing - Appendix 1). ● Install "Give Way" signs on both sides of road ($400). ● Install "trail crossing on side road" signs on Birthamba Rd ($1,200). ● Install trail user chicane and management gate system ((both sides of road). Set in concrete/asphalt apron for ease of maintenance ($7,080). ● Create a 5m (l) x 2.5m (w) asphalt "apron" connecting road shoulder with trail on both sides of road (note: apron not shown on drawing) ($1,000). ● Install pipe culverts under trail on both sides of Birthamba Rd (3 in total) ($6,000).	15,680
27	S 24º 54.965' E 152º 10.040'	Install pre-fabricated bridge – allow 35m. Abutments remain.	140,000
28	S 24º 55.047' E 152º 09.752'	Install pre-fabricated bridge – allow 14m. Abutments remain as well as one centre concrete footing.	56,000
29	S 24º 55.180' E 152º 09.413'	Install pre-fabricated bridge – allow 21m. Abutments remain.	84,000
30	S 24º 55.410' E 152º 08.830'	Koolboo Trailhead (See Trailhead plan – Appendix 3). ● Install double-sided trailhead sign ($1,600). ● Install Trail Directional Markers (2) ($1,200). ● Install Trailhead map panel ($5,500). ● Construct 15 m connecting trail – carpark to rail trail ($900). ● Grade and gravel trailhead parking area (350m2) ($28,000). ● Construct additional access track ($4000)	41,200
		Allowance for additional landowner requests (e.g. fencing and vegetation screening).	10,000
		Allowance for installation of interpretive signage (at locations to be determined by trail manager and local historians) (4 signs).	12,000
		Allowance for Trail Directional Markers (incorporating emergency markers) to be placed along trail every 1 km.	8,400

Ref No.	GPS Reference	Works item	$
30 cont.		Allowance for installation of trailside furniture (e.g. seats) at locations to be determined by trail manager (3 units).	6,000
		Allowance for marking trees to be cleared, pruned or left untouched.	2,800
		Allowance for marking centreline of trail with flagging tape prior to clearing and construction.	4,000
		Allowance for purchase and installation of: ● Regulatory signage (Shared Path; "No Trail Bikes"; "Authorised Users Only"); ● Road name signs; ● Trail name signs; ● "No Trespassing" signs; ● Local attractions sign; ● Miscellaneous signs (Keep Out etc.).	1,600
		Allowance for traffic management (3 road crossings).	6,000
		Allowance for cable locators at road crossings (3 road crossings).	3,000
		Sub-total	**1,778,435**
		Approvals, permits, applications, designs, specifications, assessments (2.5% of estimated expenditure).	44,460
		Contingency amount (15% of estimated expenditure).	266,765
		Project management (5% of estimated expenditure).	88,920
		Total (not including gst)	**2,178,580**

Table 3: Koolboo Trailhead to Bullyard Trailhead (10,470 metres) (refer Plan 3 in Appendix 6)

Ref No.	GPS Reference	Works item	$
		Koolboo Rd Trailhead (see Table 2).	0
1	S 24° 55.393' E 152° 08.807'	Road crossing – Koolboo Road (1). (See road crossing drawing - Appendix 1). ● Install "Give Way" sign on both sides of road ($400). ● Install "trail crossing" signs on both sides of trail ($1,200). ● Install trail user chicane and management gate system (both sides of road). Set in concrete/asphalt apron for ease of maintenance ($7,080). ● Create a 5m (l) x 2.5m (w) asphalt "apron" connecting road shoulder with trail on both sides of road. (note: apron not shown on drawing) ($1,000). ● Install pipe culvert under trail (eastern side of road) ($2,000).	600
2	S 24° 55.393' E 152° 08.807'	Construct trail between Koolboo trailhead and Bullyard trailhead (10,470m). Construction includes stripping of top soil, boxing out, cleaning side drains, compacting subgrade (to 150mm), filling with road base, levelling, trimming, shaping and compacting.	628,200
3		Clearing between Koolboo and Bullyard. Allow heavy clearing along creek lines and other heavily overgrown areas (3,700m) Allow moderate clearing along remainder (6,770 m).	99,190
4	S 24° 55.407' E 152° 08.750'	On western side of Koolboo Rd, major encroachment on corridor. Landholder has parked a large number of old vehicles on the corridor (GPS is mid-point).	0
5	S 24° 55.452' E 152° 08.627'	Install pre-fabricated bridge – allow 21m. Abutments remain.	84,000
6	S 24° 55.515' E 152° 08.483'	Box drain. Clean and maintain.	400
7	S 24° 55.591 E 152° 08.245'	Install pre-fabricated bridge – allow 21m. Abutments remain.	84,000
8	S 24° 55.723' E 152° 07.874'	Install pre-fabricated bridge – allow 7m. Abutments remain.	28,000
9	S 24° 55.909' E 152° 07.333'	Install pre-fabricated bridge – allow 21m. Abutments remain.	84,000
10	S 24° 56.003' E 152° 07.072'	Existing cane line. Build ramp up to go over cane line. Install pipe under ramp (on outer edge). Install give way signage (2).	3,000

Ref No.	GPS Reference	Works item	$
11	S 24º 56.047' E 152º 06.926'	Double cross fence in place. Suggests access point for adjoining landholder. Allow for gating and fencing system for machinery crossing. Trail open 24/7 style of gating system (no landholder request received – observation only).	2,500
12	S 24º 56.101' E 152º 06.761'	Install trail user chicane and management gate system. Set in concrete/asphalt apron for ease of maintenance. Turn trail off formation and head south east in road corridor (detailed in road crossing drawing for Gin Gin Road (2). Install barrier to redirect users.	4,540
13	S 24º 56.168' E 152º 06.863'	Road crossing – Gin Gin Road (2). (See road crossing drawing - Appendix 1). (note trail relocation WI12). ● Install "road ahead" sign on both sides of road ($400). ● Install "stop" signs on both sides of road ($400). ● Install "trail crossing" signs on both sides of trail) ($1,200).	7,000
14	S 24º 56.176' E 152º 06.849'	West of road crossing. New trail to head north west in road corridor alongside existing cane line (for 300m)	Trail construction covered in WI 2
15	S 24º 56.151' E 152º 06.725'	Cane rail access track goes on to what appears to be an old road (bitumen remains and guide posts).	0
16	S 24º 56.142' E 152º 06.685'	Open box culvert on railway corridor 20m east of old road. Clean and maintain. Use old road to access rail formation at this point.	400
17	S 24º 56.137' E 152º 06.651'	Install trail user chicane and management gate system and barrier (barrier to the east of this location). Set in concrete/asphalt apron for ease of maintenance. Install barrier to redirect users. (See Gin Gin Rd (2) crossing drawing in Appendix 1).	4,540
18	S 24º 56.506' E 152º 06.431'	Install pre-fabricated bridge – allow 7m. Abutments remain.	28,000
19	S 24º 56.591' E 152º 06.320'	Pipe culvert in square section. Clean and maintain.	400
20	S 24v 56.648' E 152º 06.199'	200m (x 3m deep) screen planting between corridor and house. Consultant's ecommendation not landholder request.	3,600
21	S 24º 56.698' E 152º 06.129'	Entry gate to siding from Black Creek Rd. Install interpretive panel. Install trail user chicane and management gate system. Set in concrete/asphalt apron for ease of maintenance.	6,540

Ref No.	GPS Reference	Works item	$
22	S 24º 56.738' E 152º 05.998''	Road crossing – Gin Gin Road (3). (See road crossing drawing - Appendix 1). ● Install "road ahead" sign on both sides of road ($400). ● Install "stop" signs on both sides of road ($400). ● Install "trail crossing" signs on both sides of trail ($1,200). ● Create a 5m (l) x 2.5m (w) asphalt "apron" connecting road shoulder with trail on both sides of road. (note: apron not shown on drawing) ($1,000). ● Install 5m bridge/boardwalk on western side of crossing over deep drainage line ($20,000). ● Install pipe culvert under trail (east side of road) ($2,000).	2,500
23	S 24º 56.751' E 152º 05.956'	Install trail user chicane and management gate system. Set in concrete/asphalt apron for ease of maintenance.	3,540
24	S 24º 56.754' E 152º 05.937'	Install pre-fabricated bridge – allow 7m. No remaining material.	28,000
25	S 24º 56.876' E 152º 05.699'	Install culvert to replace old open concrete drainage structure.	4,000
26	S 24º 56.929' E 152º 05.561'	Install pre-fabricated bridge – allow 14m. Abutments remain.	56,000
27	S 24º 56.952' E 152º 05.497'	(Approximate location). Install 850m new fence on southern boundary to match existing fences. (Landholder request).	12,750
28	S 24º 56.996' E 152º 05.192'	Install pre-fabricated bridge – allow 21m. Abutments and two concrete piers remain	84,000
29	S 24º 57.120' E 152º 04.465'	Install interpretive signage at Hilo siding (approximate location only). No evidence on corridor – location taken from QR network plans.	3,000
30	S 24º 57.201' E 152º 03.886'	Install trail user chicane and management gate system. Set in concrete/asphalt apron for ease of maintenance. (see Gin Gin Rd (4) road crossing drawing in Appendix 1). Clean out cess drain in cutting (100m).	4,540
31	S 24º 57.211' E 152º 03.783'	Start of trail diversion to Bullyard Trailhead (see Gin Gin Rd (4) road crossing drawing in Appendix 1). Install barrier to redirect users. Construct trail in north-westerly direction (at western end of cutting).	1,000
32	S 24º 57.191' E 152º 03.676'	Install Trail direction marker for trailhead (diversion). Southern face – Bullyard (left turn arrow); Gin Gin (Left turn arrow); Western face - Bundaberg (Right turn arrow)	600

Ref No.	GPS Reference	Works item	$
33	S 24° 57.198' E 152° 03.623'	Construct connecting trail – north to Bullyard Showground (trailhead); south to Gin Gin Rd (400 m). (see notes on Gin Gin Rd crossing (4) in next table for signage and drainage at this location.	24,000
34	S 24° 57.030' E 152° 03.701'	Bullyard Trailhead (See Trailhead plan – Appendix 3). (using the Bullyard showground) ● Install double-sided trailhead sign ($1,600). ● Install culvert under trail ($2,000). ● Install Trail Directional Marker ($600). ● Install Trailhead map panel ($5,500).	9,700
		Allowance for additional landowner requests (e.g. fencing and vegetation screening).	10,000
		Allowance for installation of interpretive signage (at locations to be determined by trail manager and local historians) (2 signs).	6,000
		Allowance for Trail Directional Markers (incorporating emergency markers) to be placed along trail every 1 km.	6,600
		Allowance for installation of trailside furniture (e.g. seats) at locations to be determined by trail manager (3 units).	6,000
		Allowance for marking trees to be cleared, pruned or left untouched.	2,400
		Allowance for marking centreline of trail with flagging tape prior to clearing and construction.	3,600
		Allowance for purchase and installation of: ● Regulatory signage (Shared Path; "No Trail Bikes"; "Authorised Users Only"); ● Road name signs; ● Trail name signs; ● "No Trespassing" signs; ● Local attractions sign; ● Miscellaneous signs (Keep Out etc.).	1,200
		Allowance for traffic management (3 road crossings).	6,000
		Allowance for cable locators at road crossings (3 road crossings).	3,000
		Sub-total	**1,380,920**
		Approvals, permits, applications, designs, specifications, assessments (2.5% of estimated expenditure).	34,525
		Contingency amount (15% of estimated expenditure).	207,140
		Project management (5% of estimated expenditure).	69,050
		Total (not including gst)	**1,691,635**

Table 4: Bullyard Trailhead to Gin Gin Trailhead (11,500 metres) (refer Plan 3 in Appendix 6)

Ref No.	GPS Reference	Works item	$
		Bullyard Trailhead (see Table 3)	
1	S 24° 57.226' E 152° 03.634'	Road crossing – Gin Gin Road (4). (See road crossing drawing - Appendix 1). ● Install trail directional markers (2) ($1,200). ● Install "stop" signs on both sides of road ($400). ● Install "trail crossing" signs on both sides of trail ($1,200). ● Create a 5m (l) x 2.5m (w) asphalt "apron" connecting road shoulder with trail on both sides of road (note: apron not shown on drawing). ($1,000). ● Install barrier to redirect users ($1,000). ● Install pipe culverts under trail (both sides of road) (3) ($6,000).	10,800
2	S 24° 57.239 E 152° 08.807'	Construct trail between Bullyard and McIlwraith Rd crossing (9,900 m). Construction includes stripping of top soil, boxing out, cleaning side drains, compacting subgrade (to 150mm), filling with road base, levelling, trimming, shaping and compacting.	594,000
3		Clearing between Bullyard and Gin Gin Allow heavy clearing along creek lines and other heavily overgrown areas (4,025m) Allow moderate clearing along remainder (6,770m).	103,740
4	S 24° 57.270' E 152° 03.603'	Install trail user chicane and management gate system. Set in concrete/asphalt apron for ease of maintenance. (see Gin Gin Rd (4) road crossing drawing in Appendix 1).	3,540
5	S 24° 57.343' E 152° 03.460'	Road crossing – Bungadoo Road. (See road crossing drawing - Appendix 1). ● Install "Give Way" signs on both sides of road ($400). ● Install "trail crossing" signs on both sides of trail ($1,200). ● Install trail user chicane and management gate system (both sides of road). Set in concrete/asphalt apron for ease of maintenance ($7,080). ● Create a 5m (l) x 2.5m (w) asphalt "apron" connecting road shoulder with trail on both sides of road (note: apron not shown on drawing). ($1,000).	9,680
6	S 24° 57.755' E 152° 03.080'	Road crossing – Delan Road. (See road crossing drawing - Appendix 1). ● Install "give way" signs on both sides of road ($400). ● Install "trail crossing" signs on both sides of trail ($1,200).	9,680

Ref No.	GPS Reference	Works item	$
6 cont.		• Install trail user chicane and management gate system (both sides of road). Set in concrete/asphalt apron for ease of maintenance ($7,080). • Create a 5m (l) x 2.5m (w) asphalt "apron" connecting road shoulder with trail on both sides of road (note: apron not shown on drawing) ($1,000).	
7	S 24° 57.716' E 152° 03.024'	Large culvert under high embankment. Clean and maintain.	600
8	S 24° 57.689' E 152° 02.946'	Small pipe culvert in concrete wall. Clean and maintain.	400
9	S 24° 57.605' E 152° 02.875'	Small pipe culvert in concrete wall. Clean and maintain. Formation has collapsed though pipe remains intact. Construct new trail away from landslip Allowance for repair of land slips below corridor – rockfill (3m^3) ($15,000)	16,000 Trail construction covered in WI 2
10	S 24° 57.600' E 152° 02.870'	Install interpretive signage at Tagon siding (approximate location only). No evidence on corridor – location taken from QR network plans.	3,000
11	S 24° 57.566' E 152° 02.856'	Formation merges with old road.	0
12	S 24° 57.552' E 152° 02.802'	Constructed road heads away from corridor (property access). Old railway/road formation hard to find. Allowance for survey from Decca Rd to (opposite) Simpson Rd to re-establish formation location (1.6km) ($8,000). Construct trail on formation (except as at WI 9).	8,000
13	S 24° 57.296' E 152° 02.250'	Install wash down station (landholder request).	5,000
14	S 24° 57.313' E 152° 02.250'	Install 2.4m high chain mesh barrier fencing between corridor and banana plantation (1,345m) (landholder request).	107,600
15	S 24° 57.765' E 152° 01.665'	Install wash down station (landholder request).	5,000
16	S 24° 57.741 E 152° 01.635'	Road crossing – Fingers Road. (See road crossing drawing - Appendix 1). • Install "give way" signs on both sides of road ($400). • Install "trail crossing" signs on both sides of trail ($1,200).	1,600
17	S 24° 57.816 E 152° 01.300'	Clean out cess drain in cutting (allow 500 m).	5,000

Ref No.	GPS Reference	Works item	$
18	S 24° 58.085 E 152° 00.891'	School carpark built on corridor. Install "Caution: children" sign on trail on either side of carpark.	400
19	S 24° 58.222' E 152° 00.742'	Road crossing – Melvilles Road. (See road crossing drawing - Appendix 1). ● Install "give way" signs on both sides of road ($400). ● Install "trail crossing" signs on both sides of trail ($1,200). ● Create a 5m (l) x 2.5m (w) asphalt "apron" connecting road shoulder with trail on both sides of road (note: apron not shown on drawing) ($1,000).	2,600
20	S 24° 58.975' E 152° 00.257'	Install interpretive signage at Uping siding (approximate location only). No evidence on corridor – location taken from QR network plans	3,000
21	S 24° 59.103' E 152° 00.032'	Install gating systems and signage to manage trail user interaction and to prevent access off trail. ● Install gating system on trail. Gating system across trail to have management access gate, self-closing pedestrian and bike access gate, and 5m fencing either side (both sides of access point). ● Machinery access point to be 10m wide. Trail surface to be sealed (concrete) across the access point. ● Install appropriate warning signs about agricultural activity on both sides of trail gating system. Install 2.4m high chain mesh barrier fencing on northern side of corridor to property's western boundary (820 metres) (to WI 25). Install 5m pipe and fill over under trail (both sides of crossing). Landholder request.	81,200
22	S 24° 59.132 E 151° 59.965'	Install gating systems and signage to manage trail user interaction and to prevent access off trail. ● Install gating system on trail. Gating system across trail to have management access gate, self-closing pedestrian and bike access gate, and 5 m fencing either side (both sides of access point). ● Machinery access point to be 10 m wide. Trail surface to be sealed (concrete) across the access point. ● Install appropriate warning signs about agricultural activity on both sides of trail gating system. (landholder request – check precise location when constructing).	9,000

Ref No.	GPS Reference	Works item	$
23	S 24° 59.179 E 151° 59.838'	Machinery crossing point at loading dock access way. Install gating systems and signage to manage trail user interaction and to prevent access off trail. ● Install gating system on trail. Gating system across trail to have management access gate, self-closing pedestrian and bike access gate, and 5 m fencing either side (both sides of access point). ● Machinery access point to be 10 m wide. Trail surface to be sealed (concrete) across the access point. ● Install appropriate warning signs about agricultural activity on both sides of trail gating system. (landholder request – check precise location when constructing).	9,000
24	S 24° 59.338' E 151° 59.717'	Install interpretive signage at McIlwraith Siding (location unknown). No evidence on corridor – location taken from QR network plans – indicative only on these plans	3,000
25	S 24° 59.373 E 151° 59.683'	Machinery crossing point. Install gating systems and signage to manage trail user interaction and to prevent access off trail. ● Install gating system on trail. Gating system across trail to have management access gate, self-closing pedestrian and bike access gate, and 5m fencing either side (both sides of access point) ● Machinery access point to be 10m wide. Trail surface to be sealed ● (concrete) across the access point. ● Install appropriate warning signs about agricultural activity on both sides of trail gating system. (Landholder request – check precise location when constructing). (Landholder may also want one more machinery crossing point – extra allowance included).	18,000
26	S 24° 59.361' E 151° 59.701'	Install pre-fabricated bridge – allow 21m. Abutments remain.	84,000
27	S 24° 59.471 151° 59.561	Install pre-fabricated bridge – allow 14m. No remains of bridge structure.	56,000
28	S 24° 59.546 E 151° 59.464	Install pre-fabricated bridge – allow 35m. Western Abutment remains. Middle concrete pier in place. Eastern end overgrown – unclear if abutment remains	140,000

Ref No.	GPS Reference	Works item	$
29	S 24° 59.693 E 151° 58.696	Install pre-fabricated bridge – allow 14m. Southern Abutment remains.	56,000
30	S 24° 59.542 E 151° 58.430'	Road crossing – McIlwraith Road. (See road crossing drawing - Appendix 1). ● Install "Road Ahead" signs on both sides of road ($400). ● Install "give way" signs on both sides of road ($400). ● Install "trail crossing" signs on McIlwraith Rd (1) ($600). ● Install "trail crossing on side road" signs on Bundaberg Gin Gin Rd (2) ($1,200). ● Create a 5m (l) x 2.5m (w) asphalt "apron" connecting road shoulder with trail on east side of road (note: apron not shown on drawing) ($500).	3,100
31	S 24° 51.586' E 152° 19.789'	Construct trail between McIlwraith Rd and Gin Gin Gin trailhead. Construction of sealed pathway 2.5m wide, compacted to 150mm thickness (includes stripping of topsoil, boxing out, clearing side drains, compacting subgrade, filling, levelling, shaping and sealing) (1,600 m).	360,000
32	S 24° 59.562 E 151° 58.281'	Install pre-fabricated bridge – allow 14m. Western Abutment remains.	56,000
33	S 24° 59.778 E 151° 57.924	Install pre-fabricated bridge – allow 14m. Solid concrete abutments remain on both sides.	56,000
34	S 24° 59.809 E 151° 57.783	Install pre-fabricated bridge – allow 21m. Abutments and two concrete footings remain. Creek looks like it has significant flows.	84,000
35	S 24° 59.636' E 151° 57.654'	Gin Gin Trailhead (See Trailhead plan – Appendix 3). (using the Gin Gin Museum parking spaces). ● Construct connecting trail from carparking spaces to rail trail (30 m)($6,750). ● Install double-sided trailhead sign ($1,600). ● Install Trail Directional Markers (2)($1,200). ● Install Trailhead map panel ($5,500).	15,050
		Allowance for additional landowner requests e.g. fencing and vegetation screening).	10,000

Ref No.	GPS Reference	Works item	$
35 cont.		Allowance for installation of interpretive signage (at locations to be determined by trail manager and local historians) (6 signs).	18,000
		Allowance for Trail Directional Markers incorporating emergency markers) to be placed along trail every 1 km.	7,200
		Allowance for installation of trailside furniture (e.g. seats) at locations to be determined by trail manager (3 units).	6,000
		Allowance for marking trees to be cleared, pruned or left untouched.	2,400
		Allowance for marking centreline of trail with flagging tape prior to clearing and construction.	3,600
		Allowance for purchase and installation of: ● Regulatory signage (Shared Path; "No Trail Bikes"; "Authorised Users Only"); ● Road name signs; ● Trail name signs; ● "No Trespassing" signs; ● Local attractions sign; ● Miscellaneous signs (Keep Out etc.).	1,200
		Allowance for traffic management (6 road crossings).	12,000
		Allowance for cable locators at road crossings (6 road crossings).	6,000
		Sub-total	**1,986,390**
		Approvals, permits, applications, designs, specifications, assessments (2.5% of estimated expenditure).	49,660
		Contingency amount (15% of estimated expenditure).	297,960
		Project management (5% of estimated expenditure).	99,320
		Total (not including gst)	**2,433,060**

Table 5: Total Costs: Bundaberg Gin Gin Rail Trail

Section	$
Section 1: Bundaberg to Sharon	$6,802,255
Section 2: Sharon to Koolboo Road trailhead	$2,178,580
Section 3: Koolboo Road trailhead to Bullyard	$1,691,635
Section 4: Bullyard to Gin Gin	$2,433,060
Total (not including gst)	**$13,105,530**

Section 5 - Construction management

Should the trail proceed, prior to the construction of the rail trail between Bundaberg and Gin Gin, the project manager should prepare a Construction Management Plan (CMP).

The purpose of a Construction Management Plan is to provide a framework reference document detailing how the Council and any contractors will manage and control aspects of the trail construction. The CMP will be used as a working document to ensure that obligations and commitments provided in the relevant licences, permits and approvals are made known to all site personnel and implemented effectively as an integral part of trail construction.

It also aims to detail processes to minimise impacts associated with the construction of the rail trail on adjacent areas. Given sufficient thought and consideration prior to construction, risks can be mitigated and impacts can be minimised.

Concerns of adjoining landholders during construction often include:

- Adjoining landowners are to be advised well in advance of construction activity taking place.
- Construction machinery and contractors' vehicles are not to use private property or private roads to access the former railway corridor (except where permission has been granted). Access should either be along the corridor or adjacent gazetted roads.
- Fencing needs to be maintained at all times during construction.
- Contractors and Council employees are not to trespass on private property during construction (unless prior written agreement is obtained from the landowner).
- Spread of weeds along the corridor by construction machinery is to be controlled and minimised. Vehicle and machinery wash down facilities are needed.
- Leaving of rubbish within the corridor during/after construction of the trail should not occur.

- Construction crews should work closely with adjoining landowners over various issues, such as water pipes that cross the corridor, location of machinery and stock crossings, new fencing etc.

The general process for the development of the Bundaberg Gin Gin Rail Trail will involve the following tasks:

- Notification of adjoining landowners well in advance of construction commencing.
- Ongoing consultation with adjoining landowners to clarify/confirm need for, and precise location of, requested items. The works tables identified a number of these items and also identified that the locations of some of these would need to be negotiated as it depended on landholder requirements at the time of construction.
- Negotiation on access to sites. Accessing Splitters Creek Bridge on its western side, for example, is best done by getting off the corridor and crossing adjoining land to park machinery and work under the bridge. Negotiations with the adjoining landholder will be critical in ensuring this access.
- Removal of cross fences where they still exist.
- Installation of new side fencing and gates (where required) and/or relocation of existing fencing.
- Clearing of regrowth vegetation, and removal of weeds.
- Identification and establishment of stockpile locations and machinery wash down facilities.
- Utility identification/relocation (if required).
- Environmental and other surveys (e.g. flora if required, site pegging and on ground delineation).
- Replacement/reinstatement of culverts and bridges.
- Installation of erosion and sediment controls such as silt fences.
- Haulage and stockpiling of material.
- Trail base layers and surfacing.
- Installation of signage (including warning, advisory, trailhead, distance / directional, emergency and interpretive signage).
- Installation of management access gates, and chicanes and associated fencing.
- Landscaping and revegetation.
- Site clean-up.

Consideration will need to be given to the following matters in the preparation of the CMP:

Landholder communication plan

The Council should prepare a Landholder Communication Plan before work commences to ensure that all adjacent landowners are aware of the construction program well in advance and are individually consulted regarding exact placement of recommended works items. This includes the early removal of cross fences (across the railway corridor), the installation of new (or repairs to old) side fences and the installation of machinery crossing points.

Safe work statement method (SWMS)

A Safe Work Method Statement (SWMS) documents a process for identifying and controlling health and safety hazards and risks. Under Occupational Health and Safety Regulations, a SWMS must be prepared before high risk construction work begins, if anyone's health and safety is at risk because of the work, but SWMS can be used for any other work activities. A SWMS is designed to help contractors and their employees think through the hazards and risks involved in the work, and to choose effective control measures. As a matter of course, a SWMS will be required, and the CMP must address all risks and address how they will be controlled. Matters to be addressed include construction activity at road crossings.

Preparation of other works method statements

The appropriate environmental authorities (prior to work commencing) may require several other 'Works Method Statements' such as Clearing Work Method Statement, Minor Earth Works Method Statement and Drainage Works Method Statement. These statements will address a range of potential concerns such as the spread of weeds during vegetation clearing (on and offsite), water pollution or sedimentation due to working near to watercourses, and the discovery or impact to any new sites of Aboriginal or non-Aboriginal heritage or archaeological sites.

Environmental and other surveys (e.g. Flora if required, site pegging and on ground delineation)

Prior to selection of stockpile sites and construction activity, it may be necessary to carry out a variety of environmental and other surveys. The CMP will need to schedule the activity to occur at appropriate times of the year, and prior to construction.

Geotechnical/engineering investigations for drainage crossings

Various investigations may be required at and around watercourses prior to reinstatement of the bridges and culverts. The CMP will need to schedule in this activity prior to construction occurring at these sensitive locations.

Utility identification/relocation (if required)

Fieldwork revealed the existence of utilities (telecom cabling etc) within the corridor. The CMP should allow for a cable locator to establish the precise locations of utilities and services prior to construction activity occurring.

Installation of new gates and fences and stock crossings

In order to ensure stock are kept out of the rail trail corridor, fencing will need to be repaired or relocated or new fencing erected along parts of the corridor. This activity should be undertaken early in the construction process. Cooperation and consultation with adjoining landowners will be required to ensure any new fencing is installed in the appropriate location and that stock crossings (if any) are located in the optimum locations.

Fencing and stock control during construction

Construction of the rail trail will mean numerous (existing) fences erected across the corridor (particularly at property boundaries and road crossings) will need to be removed. One of the first steps in construction will be to erect new fences and gates (where appropriate) to ensure stock are contained to their paddocks and to ensure construction machinery have unlimited access along the corridor. The CMP will need to program this activity, including the necessary consultation with adjoining landowners and contractors.

Selection of material stockpile sites

Construction of the rail trail will involve the removal of material from the corridor (old fencing material, miscellaneous waste/rubbish material) and the delivery of materials to be used in the construction of the trail (gravel, fencing materials, bridge components, etc). Numerous stockpile sites will be required along the alignment to enable the management of surfacing material, culvert materials, fill and potentially topsoil and vegetation. Care will need to be taken to ensure the selected sites are safely located, secure, and minimise the invasion of the privacy of neighbours of the proposed rail trail. The stockpile sites should also be located on already cleared sites (minimising the vegetation clearing requirements) and with little or no impact on watercourses or other environmentally sensitive sites. It is imperative that access to the corridor be via public land, unless agreement has been obtained from neighbouring landowners. Preparation of the CMP should address these issues.

Remediation of contaminants along formation

Although no contamination investigations are known to have been undertaken, it is possible that there are contaminants in the soil from years of maintenance of the railway track, railway corridor and associated infrastructure. One parcel of land adjacent to the corridor (near Birthamba Rd) is on the contaminated land register. The CMP should specify how potential contamination is to be dealt with.

De-contamination of construction equipment

As good practice, it is imperative that any construction equipment be kept clean. The CMP should specify the process by which construction equipment will be kept clean of potential diseases, weeds and contaminants.

Management of fire risk (including spark control)

There is a risk of accidental fires being caused by sparks from machinery. The CMP will need to address ways of ensuring fires are not inadvertently caused by the construction activity, and consideration given to the time of the year that different construction activities are undertaken. The CMP will identify the general requirements regarding fire prevention and management during construction, especially at times of total fire ban.

Weed management – control and eradication

There is a legal obligation to control noxious weeds. The control/eradication of weeds within the former railway corridor is of particular importance and the CMP will need to ensure that construction of the rail trail does not cause weeds to spread.

Marking trees for retention or removal

In many areas vegetation has re-grown within the former railway corridor. In places

(particularly along creek and drain lines), this regrowth is quite thick. Clearing of (some of) the regrowth vegetation will be required. However, some of the regrowth should be retained to provide

shade for trail users, as it is sufficiently clear of the proposed trail corridor so as to not be of concern. In some cases, it also forms a natural barrier between the corridor and adjoining landholders providing visual barriers. Prior to construction commencing trees that are to be retained (for their shade and aesthetic values) should be marked with flagging tape. The CMP should specify the process for marking trees for retention.

Clearing, mulching and disposal of waste vegetative material

Some regrowth vegetation will need to be removed from the rail trail corridor. The CMP will address the process for clearing, and the manner in which vegetative material will be removed from the corridor (such as by mulching and spreading in the immediate area or by other methods).

Erosion control and drainage along corridor

The railway (when operating) had functional erosion control techniques in place. The construction of the rail trail must ensure that no damage is done to existing drainage channels and erosion control devices and that erosion is mitigated rather than exacerbated. This is particularly important when working in and around the numerous watercourses, along embankments and through cuttings. The CMP will need to address how erosion will be controlled, both during the construction of the rail trail and afterwards.

Pollution control at watercourses/ bridges

There will be considerable construction activity in the vicinity of watercourses at the time when bridges and culverts are being replaced and/or refurbished. The CMP will need to specify the installation of erosion and sediment controls, such as silt fences, to be deployed at sensitive locations such as bridges and other watercourses. Utmost care needs to be taken to avoid damage to banks of creeks.

Access considerations

The CMP will need to determine the most efficient means of access to all parts of the corridor (and to stockpile sites), with minimal noise, dust and inconvenience to nearby residents. Given the large number of road crossings, access should not be an issue but disturbance to nearby residents during construction may be an issue.

Traffic control

There are 15 road crossings along the proposed rail trail. Each road crossing will require various improvements, such as the construction of the trail, the installation of gates and fencing, and the installation of signage. The CMP will need to address the issue of traffic management and control to ensure the safety of contractors involved in construction activity in the vicinity of each road crossing – particularly at the four crossings of Bundaberg Gin Gin Rd.

Section 6 – An Implementation Program

6.1 Trail construction stages

Development of trails can often be staged so that parts of trails are developed in line with available funding sources. It is often not possible to open the full length of a trail simultaneously as significant physical, financial, community and institutional work needs to be undertaken. This is the case in many rail trails (and indeed many recreational trails) around Australia. Opening a new trail in stages also allows those who are opposed or undecided about a project to see a clear demonstration of its use and lack of issues (almost inevitably, problems identified by concerned people do not arise).

A staged approach to planning and development is often the best approach as it better suits the capacity of the entity charged with delivering the project.

The Feasibility Study suggested an order of construction. However, construction stages can change and Council will need to take into account a number of factors. This may include adjoining landholder concerns and opposition, and stage costs and approval processes. Table 6 sets out the four logical sections and their costs. Bundaberg Regional Council can determine which stages should be constructed in what order to suit its circumstances at the time the trail proceeds.

Table 6: Construction Stages

Section	Length	$
Bundaberg to Sharon	9.18 km	$6,802,255
Sharon to Koolboo Road trailhead	13.83 km	$2,178,580
Koolboo Road trailhead to Bullyard	10.47 km	$1,691,635
Bullyard to Gin Gin	11.5 km	$2,433,060

6.2 Environmental issues

A number of key environmental issues have been identified. These include:

- Clearing of regrowth vegetation along the corridor, and the need for clearing permits and the possible future need for offset re-vegetation. One landholder raised the issue of the changed vegetation management laws (May 2018). New legislation rregulates clearing of all regrowth along waterways in all 6 Great Barrier Reef catchments. This may mean that clearing to reinstate bridges in particular will require a permit under relevant vegetation management legislation.
- The potential for the spread of weeds (and pathogens) during the construction phase and, potentially, through usage of the trail.
- Contamination of soils as a result of the operations of the railway and the manner in which former bridges were constructed and maintained.
- The potential for sedimentation of watercourses as a result of trail construction and bridge works.

In addition, care will need to be taken in the ongoing maintenance of the proposed rail trail to ensure weeds and pathogens are not unwittingly spread by maintenance machinery. Ongoing clearing at the sides of the rail trails will be required to keep the trail corridor at acceptable widths.

6.3 Management structure

Once a decision is taken to proceed with the development of the proposed rail trail between Bundaberg and Gin Gin, decisions will need to be made about the management regime that will be put in place to manage and maintain the trail. A serious commitment to long term management by the trail's proponents will be required, particularly as there is likely to be a significant investment of Government funds.

Management structures and roles were discussed extensively in the Feasibility Report. As noted in the Feasibility Report, the Queensland Government has not given any indication as to how any new rail trails will be managed. What exists on rail trails presently is a combination of State and Local Government and community groups.

If the trail proceeds, Bundaberg Regional Council in cooperation with the State Government will need to determine the best management structure. It would be the best outcome if the structure can be determined and put in place at an early stage of the project. It should be put in place before construction begins.

Section 7 – Corridor management and operations plan

7.1 A corridor management plan

As the trail development planning moves towards completion and the various landowner and development issues are resolved, a number of decisions need to be made about the ongoing management, operation and maintenance of the rail trail.

The best approach to deal with these issues is through a Corridor Management Plan, which forms the basis for ongoing trail management, operation and maintenance. A well-prepared and comprehensive corridor management plan (undertaken in close consultation with the community and neighbouring landowners) serves to ensure the rail trail functions and operates as a high-quality experience.

The following information is provided for information so that Bundaberg Regional Council (and any Committee of Management set up to progress the project) can consider a range of factors in managing the trail.

7.1.1 What is in a corridor management plan?

There are four major components to a Corridor Management Plan:

- **A 'Trail Policy'** or a set of Guiding Principles which incorporates a set of decisions made about how the rail trail will operate;
- **A Trail Management Plan;**
- **An Emergency Response Plan** (incorporating a Fire Management Plan); and
- **A Trail Maintenance Plan.**

Bringing all four elements together in one framework (a Corridor Management Plan) makes ongoing trail development and management an efficient process and ensures ongoing seamless transitions as personnel involved with the trail change over time.

7.1.2 Guiding principles

The preparation of a set of overarching principles is a useful exercise. Adherence to these principles will serve as a guide to the use, upgrading, maintenance, promotion and management of the Bundaberg Gin Gin Rail Trail. The following principles provide guidance for the Council (and have been adopted from several other rail trail projects). The scope of principles indicates the scope of issues considered in the development of the Rail Trail.

- **Access for all** - where practical and appropriate, the Bundaberg Gin Gin Rail Trail will be developed/ upgraded to enable access by as wide a range of potential users as possible including people in wheelchairs, people with disabilities, family groups and the elderly.
- **Providing enhanced outdoor recreational opportunities** - the Bundaberg Gin Gin Rail Trail will be promoted as an additional component to the range of low cost outdoor recreational opportunities within the Bundaberg region.
- **Minimal conflict between trail users** – the Bundaberg Gin Gin Rail Trail will cater for walkers and cyclists with minimal conflict.
- **Providing access to, and an enhanced understanding of, the natural attributes of the Bundaberg Region** - the Bundaberg region has a diverse and outstanding range of physical attributes, and the Bundaberg Gin Gin Rail Trail will contribute to the provision of greater opportunities to access these natural features.
- **Providing access to and an enhanced understanding of the history of the Bundaberg Region** - the many physical reminders of past land uses and activities can be a major component of interpretive information available on the Bundaberg Gin Gin Rail Trail, and a greater inducement for visitors to use the trail.
- **Quality promotion** - the trail manager will give significant emphasis to promoting the Bundaberg Gin Gin Rail Trail as part of a broader visitor experience of the region.
- **Effective and ongoing maintenance** - the Bundaberg Gin Gin Rail Trail will be the subject of a regular maintenance regime, and a detailed audit every 2–3 years, ensuring that all defects along the trail receive quick attention, thereby keeping the trail up to the requisite standard and quality.
- **Quality construction** – the Bundaberg Gin Gin Rail Trail will be built to appropriate standards, and to a high quality, thereby minimising the need for maintenance, and giving users a quality experience.
- **Quality information, including brochures and mapping** - the Bundaberg Gin Gin Rail Trail will have quality on-trail information, as well as a professionally produced and widely available trail brochure and map. All means of distribution of trail information need to be utilised, including a web site and social media.
- **Outstanding interpretive material** - the Bundaberg Gin Gin Rail Trail will have on-trail interpretive material and will be included within other trail and publicity brochures, providing trail users with a greater appreciation of the more interesting features to be found along the trail.
- **Consistency and uniformity of signage** - signage is recognised as an essential element of a quality trail, and all signage erected at trailheads, along nearby and adjoining roads and along the Bundaberg Gin Gin Rail Trail will conform to accepted standards and will maintain a consistent theme along the entire trail.
- **Adherence to recognised standards** - trail construction, signage and trail markers, and trail classification will comply with recognised Australian Standards, thereby ensuring a high quality and safe experience for all trail users.
- **Community involvement** – the management and maintenance of Bundaberg Gin Gin Rail Trail will consistently seek to involve adjoining landowners and the local communities along the corridor on an on-going basis and in the formulation of critical decisions. This on-going involvement with adjoining landowners and the community will ensure that the use of the rail trail does not impinge on private operations and that disputes are resolved wherever possible to the satisfaction of both the trail manager and the landowner. The on-going involvement with other sectors of the community will ensure that the trail is meeting their expectations.
- **Trail user survey** – trail users will be surveyed on a bi-annual basis to ensure the trail is meeting their needs and expectations, and a survey of adjoining landowners and businesses will be undertaken to ensure the trail is meeting their expectations.

Due to the nature of a rail trail (a corridor surrounded by a range of activities), it can be vulnerable to the negative impacts of surrounding development. The Rails-to-Trails Conservancy (USA) suggests that trail planning include the development of a trail protection policy to prevent damage to the trail corridor. The policy sets out primary uses of the corridor – recreation, transportation, and historic preservation. Any use deemed incompatible with this primary use will be denied; those uses compatible with the primary use will be considered and carefully regulated.

A comprehensive **trail protection policy** provides the trail manager with the authority to do the following:

- Regulate all secondary uses of the trail corridor in a fair and consistent manner;
- Minimise inconvenience to trail users, and assure protection of wildlife habitat and natural and historic resources within the trail corridor;
- Minimise damage to the trail corridor at all times;
- Establish uniform standards for construction and restoration of the trail corridor if it is damaged by a secondary use;
- Ensure that the managing agency recovers all its administrative costs and receives appropriate compensation for use of, and damage to, the trail corridor by secondary uses;
- Inform all public and private interests of the expectations and intentions of the trail managing agency with respect to secondary uses;
- Issue permits and licences for secondary uses; and
- Prohibit the transfer of ownership rights through the use of easements or other mechanisms.

7.1.3 The initial decisions

Some basic initial questions need to be answered, and some crucial decisions made. These inform the management decisions about the ongoing management of the rail trail. The following discussion covers the range of issues generally addressed in trail management. Questions are posed and some possible answers are included. These answers will need to be considered and more fully answered by the Council. Trailhead Code of Conduct signage should reflect the Council's position on the following matters.

Enforcement procedures

What enforcement procedures will be in place? The Council will have existing local laws covering a range of matters such as riding motorbikes in parks (a common issue). These local laws should form the basis for enforcement – the enforcement infrastructure is the key issue.

Dogs on the trail

Will dogs be allowed?

If they are allowed, in what sections should they be allowed? Will they be permitted to be off-leash, or will they be required to be on-leash? The proximity of dogs to other dogs on rural properties and to livestock on adjoining lands can cause an unacceptable conflict or public safety problem.

It is recommended that dogs be allowed within the town areas (Bundaberg, Gin Gin and Sharon), where they could be permitted on leash and managed in accordance with relevant local laws.

Horses on the trail

A number of adjoining landholders expressed concerns over biosecurity which can be exacerbated by horse use of the trail. There does not appear to be significant demand for horse riding along the trail. Consequently, the trail development plan and works items were prepared on the basis that horses will not be permitted on the trail. Any change to this decision by the trail manager will necessitate slashing of a bridle trail along the entire corridor (separate from the constructed trail), consideration of biosecurity issues and a ban on horses east of Sharon (due to Splitters Creek bridge being unsuitable).

Weed eradication and control

What will be the weed eradication and/or long-term control program? The options are grazing, slashing or using poisons. The Council will have an obligation to deal with weeds.

Open fires and barbecues

Any lighting of open fires or barbecues at any time of the year should not be permitted along the rail trail.

Trail construction and infrastructure standards

This Trail Development Plan has recommended a range of infrastructure. This includes the level of development of parking at the trailhead, user information, on-trail signposting, facilities etc. Decisions need to be made as to whether a high or low standard of infrastructure will feature on the trail. This may also include timetables for ongoing enhancements or embellishment of infrastructure. A decision on standards to be adopted on a permanent basis has implications for ongoing trail maintenance.

Strategies for the protection of native vegetation

Together with road reserves, railway reserves played an important role as wildlife corridors and habitats for native birds and animals. In many instances they hold important remnants of the indigenous vegetation that has been all but lost. It is important to manage railway reserves in a manner that maintains and enhances their nature conservation values.

In order to improve aesthetic and nature conservation values, the removal of introduced weeds and grasses and revegetation with native species is desirable. Revegetation is also important in some areas for visitor comfort. Any revegetation areas should be fenced off from stock and planted with native trees, shrubs, herbaceous plants and grasses. This has not been specifically costed in the works tables. Where screen planning is recommended (primarily for privacy purposes), appropriate native species should be used.

The assistance of dedicated volunteer groups will help ensure that revegetation programs are quickly implemented and successful.

Once the rail trail is developed, the Council will be responsible for management of revegetation and the control of weeds within the corridor.

Complaints/communications – procedures and responsibilities

It is critically important for the rail trail users, adjoining landholders and the public to have contact with authorities to ensure that the rail trail is managed properly, that maintenance matters are attended to readily, that any regulations are enforced and that general feedback can be given. It is important that this person or agency is easily contactable. Contact details need to be on all trail literature and maps, on trailhead signage, and on relevant websites.

It is important that the public and users know who to contact about the trail and about management issues. Responsibility rests with an accountable person or group. The Council needs to take responsibility for organising maintenance and for any necessary trail closures and for being the first point of contact for most matters.

It is strongly recommended that one person be allocated with in Council to be the primary contact point for trail matters – this was of critical concern to adjoining landholders spoken to during the preparation of this Plan.

On-trail events and group use policy

One form of group usage is the on-trail special event and how these are to be managed. The Council should notify, and seek input from, local police and other emergency service personnel when any sizeable event is planned. It builds good community relationships. Major events not involving alcohol may also require assistance from police; for example, police are often involved with events, providing some traffic control services. It is good practice to involve local service personnel in the early stages of event planning.

On-trail advertising

Will on-trail advertising be allowed?

The Council needs to be aware that advertising can be an advantage to users and commercial operators, it should be controlled, it is a source of funding for ongoing maintenance/upgrades, it should be to a standard, and style guides should be determined including rail trail logo. On-trail advertising is one avenue of revenue generation. The main impacts of such advertising would be visual impacts and safety impacts. Any permitted advertising signs should not impede trail users nor create a safety hazard (for

Commercial establishments, such as accommodation providers, alongside the Otago Central Rail Trail in New Zealand are obliged to comply with advertising design guidelines and pay for the advertising.

example, by obscuring a road crossing warning sign). Visual impacts are much more difficult to judge. Local governments have a range of signage policies that are likely to address visual amenity. Policies that regulate road-side advertising would be the most relevant. Where these are not compatible, the Council should determine the criteria.

On-trail advertising is likely to be directly connected to trail-side businesses (this could be one of the criteria) but the Council would not be endorsing the service nor directing trail users to that facility under any agreement.

Target user groups need to be identified

A promotion and marketing plan will need to be included in the set of initial decisions. Tasks will need to be allocated both in the initial stage and in ongoing trail development and operation.

The opening of the rail should be well advertised via local media (TV, radio, newspapers), throughout the Wide Bay Burnett region and in Brisbane. Opening events should be arranged to make potential users well aware of the existence of the new trail.

Use of the trail corridor by utilities

A linear corridor such as a rail trail does lend itself to a range of potential future uses – many of which are not excluded by the possibility of the corridor being converted into a recreation trail. This former railway corridor, like so many others around the world, is also ideally suited for the placement of utilities, such as wires, cables and pipes. Data, telephony and energy can and are all carried in pipes alongside or underneath rail trails. These uses can be complementary to the corridor's use as a recreation trail.

Provided the intended co-use does not disturb the natural, scenic and historical qualities of the trail, it can be permitted in accordance with the Trail Protection Policy (discussed in Section 7.1.2). In other jurisdictions, utilities are charged an annual fee for corridor use.

Consideration and amelioration of impacts on adjoining landholders

This covers issues such as fencing, privacy issues, trespassing, the rights to use the corridor for agricultural purposes (notably the turning of machinery), who will pay for construction works that allow farmers to continue activities etc. The Corridor Management Plan needs to set a basis for how these are dealt with on an on-going basis. One of the guiding principles for the Bundaberg Gin Gin Rail Trail should be that the management and maintenance of the trail will consistently seek to involve the local community on an on-going basis and in the formulation of critical decisions. This on-going involvement with adjoining landowners and the community will ensure that the use of the rail trail does not impinge on private operations and that disputes are resolved wherever possible to the satisfaction of both the trail manager and the landowner.

A spirit of cooperation with adjoining landholders needs to be continued throughout the life of the rail trail. Building community support is critical – adjoining landholders can provide a significant boost for wider community support. There are no rules for on-going engagement with adjoining landholders – a willingness to sit down and listen and discuss openly is required. Having a single contact point for the trail would be a significant advantage to ensure ongoing good relationships with landholders. Inviting landowners to 'adopt-the-trail-section' adjacent to their property may be warranted.

Using the "remnant" corridor

Using the "remnant" corridor not required for the trail for agricultural purposes has the benefit of reducing maintenance costs for the Council. At least two landholders have expressed an interest in using the corridor (or part of the corridor) to turn machinery during the course of agricultural purposes. Sugar cane has been planted to the boundary and harvesting machinery in particular has used the corridor to turn. This practice should be allowed to continue by agreement. Other landholders with stock may be interested in grazing the remnant corridor where appropriate.

Management structures and management planning

Decisions about management structures, timetables for change and the reasons for decisions should also be included in the Corridor Management Plan. Ongoing community involvement which will be driven through the management structures needs to be also included in the Corridor Management Plan – the why, the how and the who need to be clearly articulated in an accessible document.

7.2 A trail management plan

A Trail Management Plan is essential to setting both the long-term and day-to-day management objectives for the trail and provides a framework against which a range of decisions can be made.

Such a document - as with all management plans - should be both flexible and responsive to change yet set a clear management framework for future directions and priorities. Trails that do not have a Management Plan suffer from decisions taken on the run, out of context or as knee-jerk responses to critical situations.

The trail manager (Shire of Mundaring) for the Railway Reserves Heritage Trail (RRHT) in Western Australia prepared a Trail Management Plan several years ago. It is a useful model to consider the issues that need to be dealt with by a Trail Management Plan. The issues covered were:

- Philosophical background to RRHT development;
- A statement of guiding principles;
- Review of how RRHT is, and can be further linked to other trails, especially the Munda Biddi Trail, the Bibbulmun Track, the Kep Track, the Farming Heritage Trail and those in the eastern portion of the City of Swan.
- Clarification of management roles and responsibilities for the various trail sections;
- Risk management policy;
- Group and commercial usage policy and guidelines;
- Provision of essential services for trail users, such as water points, toilets, rubbish bin, lighting and other desirable trail furniture;
- Identification of any outstanding access /egress works for the RRHT, including disability works;
- Fire management and emergency evacuation procedures;
- Preparation of a promotional and interpretation management sub-plans, including specifications for signage and suggestions for interpretation along the trail between the townsites;
- Mapping and brochures – guiding principles;
- Formation of a Friends of the RRH Trail Group; and
- Timetable for reviewing and updating the Management Plan

Some of the initial decisions mentioned above flow into a trail management plan and should be included.

A timetable for reviewing and updating this Plan should be set, with annual reviews and three (or five) year updates recommended. The Plan must outline a professional program of management, designed to ensure that there is no lapse into a belief that trails, once built, will manage themselves.

Further, this plan must clearly define who is responsible for what – it is crucial that everyone knows what their role and responsibility is. Without this, it is all too easy for everyone to sit back expecting someone else to do the work. Trail management plans need to be specific about roles in management and maintenance.

7.3 General risk management

A risk is the chance of something happening as a result of a hazard or threat that will impact on an activity or planned event. Risk arises out of uncertainty. It is measured in terms of the likelihood of it happening and the consequences if it does happen. Risk therefore, even on trails, needs to be managed.

Ignoring the risks that apply to a recreation trail or events planned along a trail could impact on:

- The health and safety of trail users, staff, volunteers and event participants;
- The reputation, credibility and status of the trail and its manager (or trail association);
- Public and customer confidence in the trail manager;
- The trail manager's financial position; and
- Plant, equipment and the environment.

A systematic approach to managing risk is now regarded as good management practice. Risk management is a process consisting of well-defined steps which, when taken in sequence, support better decision making by contributing to a greater insight into risks and their impacts. It is as much about identifying opportunities as it is about avoiding losses. By adopting effective risk management techniques, the trail manager can help to improve the safety of trail users, the quality of experience for trail users and business performance of the trail organisation. Sound risk management can prevent injuries from occurring and help to reduce insurance claims and costs. Risk management is of particular importance to nature based and adventure tourism operations and requires careful consideration in how it is planned for and dealt with. The courts expect that a business (including local governments) will exercise due diligence in carrying out hazard assessment, risk management planning and emergency response planning. There are many benefits in implementing risk management procedures. Some of these include:

- More effective strategic planning; Better cost control;
- Increased knowledge and understanding of exposure to risk;
- A systematic, well-informed and thorough method of decision making;
- Increased preparedness for outside review;
- Minimised disruptions;
- Better utilisation of resources;
- Strengthening culture for continued improvement; and
- Creating a best practice and quality organisation.

Though the rail trail would be located on a reasonably flat grade, and is wide enough to accommodate several user groups, there will be risks associated with use of the trail.

Some of the risks involved are:

- Encountering motor vehicles at road crossings;
- Conflict between user groups;
- Encountering illegal trail users such as cars/4WD and trail bikes;
- Falling from unprotected bridge crossings (though handrails on all bridges over 1 metre high would be required);
- Falling from high embankments, where there are no barriers;
- Being caught in a grass fire;
- Being caught in a flood; and
- Being bitten by a snake.

Good design and construction address some of these risk elements. Many trail projects have in place a maintenance plan which sets out clearly the items which require regular inspection, the frequency of that inspection and assessment, the actions to take in response to degraded surface conditions or infrastructure, and remedial action to rectify a problem or fault.

The threat of fires is always present. Though snakes are rarely encountered, it may be prudent for trail promotional material to carry a warning about possible encounters and to provide information about dealing with a snakebite.

7.4 An emergency response plan

Major fire events throughout Australia in recent years have put the need for emergency planning and management into sharp focus. Trail managers need to be very conscious of the need to prepare emergency response plans and work out how to deal with emergencies on trails. This is not limited to fires. Flooding can be just as serious an issue.

The key elements of an emergency response plan for a rail trail such as this are:

- General risk management;
- Fire risk and fire management;
- Flood risk and evacuation procedures;
- The provision of appropriate signage;
- Trail access for emergency service vehicles;
- Emergency responses – how and who;
- The provision of adequate information and mapping to the services' communications centres;
- The need for special agreements between emergency service providers and the trail manager; and
- The provision of on-trail communication systems.

7.4.1 Fire risk and management

The trail manager will be responsible for implementing fire protection and management along the rail trail corridor to protect life, property, public assets and natural and cultural values from fire, reduce the incidence of fire, reduce the severity and restrict the spread of fire. The aim of fire management is to ensure trail users and adjoining landholders are protected from fire commencing on or travelling along the rail trail corridor. To reduce the incidence of fire starting from the rail trail all open or solid fuel fires should be prohibited. At visitor facilities, such as trailheads, picnic shelters and rest areas, slashing should be used to reduce fuel loads. Where the corridor has tree cover or where revegetation is to occur, there will be a need to provide a buffer zone along the boundary or alternatively seasonal grazing of the vegetated area to reduce fuel loads will be permitted. Relevant signage at trailheads needs to include fire warnings.

Fire management issues include:

- Fire risk factors in the area – risk profile is influenced by a number of factors including slope of the land (hilly terrain and north and west facing slopes increase risk), response time for emergency vehicles (the closer to a town a trail location, the less time for emergency vehicles to get there), proximity of roads and how heavily trafficked they are (highways and major arterials increase risk due to higher numbers of passing motorists), and closeness of refuges including fire-proof buildings and roads.
- Fire management responses for the trail. These included closure on days of total fire ban (and consequent policing). This is now done regularly in National Parks throughout Australia and on recreational trails. Mapping technology may be available that provides good indicators as to fire paths which would allow parts of the trail to be ranked in terms of fire risk (recognising that nothing can be absolutely precise). Possible management responses in zones of highest fire risk may include appropriate warnings, and possible longer closures on these sections (rather than just on days of total fire bans). Sections of trail in zones of lower fire risk could have a lower level of fire management response.
- The banning of smoking on the rail trail under legislation governing smoking in outdoor areas. It is acknowledged that this is difficult to enforce except by having a constant presence; it is however a possible 'tool in the toolbox' for managing fire risk.

It is of major importance to develop a Bush Fire Risk Management Plan early in the planning process in consultation with the Qld Fire and Emergency Services. This is an issue with many rail trails (and in fact with any activity that takes people out into the bush in significant numbers). It has been successfully tackled elsewhere. For example, the Lilydale to Warburton Rail Trail (in Victoria) has developed a Wildfire Risk Management Plan. The Plan includes a number of objectives and relevant actions. The objectives are:

- Providing a safe recreation trail for walkers, cyclists and horse riding;
- Providing a safe access onto and along the trail for all emergency vehicles;
- Minimising the risks of fires spreading from or onto the rail trail; and
- Developing annual maintenance works and maintenance programs (with an accent on fire hazard reduction).

7.4.2 Flood risk

Flood issues include:

- Need for safe crossing of all waterways.
- Closing the trail, or sections of the trail, at times of flooding (or immediately after heavy rains when the trail surface may be impacted by trail users).
- Evacuation procedures when trail users are inadvertently caught on the trail during a sudden flood event.

7.4.3 Appropriate signage

Trailhead signage should specify what to do in an emergency, the numbers to call, the location of public phones, and the capacity for a flip-down sign indicating trail closure (due primarily to fire, flooding or maintenance work).

Many trails, including rail trails, are now using Emergency Marker signage placed at regular intervals along the trail and at road crossings.

The Emergency Marker system generally uses a unique alpha-numeric code for each location. The trail would have a series of consecutively numbered sign posts. The signs contain not just the unique alpha-numeric identifier, but also the Emergency telephone number to call for help. Emergency Service operators are aware of the location of each uniquely identified sign and can send help to that specific location in an emergency.

7.4.4 Trail access for emergency services

The main design element is that emergency vehicles will need to have access to the rail trail. The simplest option is to ensure that all locked management gates along the trail (such as recommended for all road crossings) and alongside adjoining roads have the same locking system, either key or combination locks. The preferred option is a combination lock. A single combination for an entire trail is recommended; this can be registered with the communications centres of each of the emergency services, which dispatch vehicles to emergencies.

7.4.5 Emergency responses – who and how

In an emergency situation, one of the key issues that arise is how an emergency is communicated. The emergency number from a landline is 000, while the emergency number that works best from a mobile phone is 112. Once a call is made by a trail user, the communications centre for the appropriate service dispatches the required personnel and vehicles. The trail manager would only likely to be involved after the emergency situation is resolved, to review and record the incident, and to review the response.

It is a different situation when the emergency is a slowly emerging situation, such as a period of total fire ban (or very high fire risk) or the likelihood of flooding. The trail manager needs the vested authority to close the trail under such circumstances (under relevant state government legislation). Once the trail manager advises police that the trail (or part of the trail) is closed, police have the powers to ensure that people do not go onto the trail or can be removed from the trail if they are on it (an administrative trespass) though most people accept the advice of police. In an emergency such as a fire or flood (as opposed to trail closure because of a fire risk for example), emergency services have 'command and control' powers that allow them to remove people from a situation considered to be dangerous. In such circumstances, emergency service personnel are 'out and about' and see people and move them to an appropriate place.

At times when the trail needs to be closed (such as a very high fire risk or when flooding of watercourses is present), police would be able to travel to trailheads in their area and 'flip down' the Trail Closed sign.

7.4.6 Provision of adequate information for communications centres

As the trail develops, mapping data should be provided to the communications centres for each of the emergency services. The data that should be entered into their system covers maps with the location of Emergency Markers, trail distance markers (and their reference points), and road crossings (and their GPS coordinates) marked on the maps. One set of data should be developed and given to all the communications centres.

7.4.7 Special agreements

There is usually no need for special formal arrangements between the trail manager and the emergency services for a trail. It is a resource and an activity that the emergency services need to deal with as part of their everyday activities. Any major events on the trail should trigger early involvement by police and ambulance in particular – this is good practice and ensures good relationships.

7.4.8 On-trail communications systems

The placement of emergency phones on the trail as a way of ensuring that emergencies could be managed could be considered. However, this is a significant cost item to install, replace and maintain. In addition, most trail users would have some form of mobile phone. In addition, placing phones on the trail possibly increases the trail manager's liability – if a phone does not work (for instance it is broken), an aggrieved person may look for recompense from the trail manager. Public phones are often quite accessible from trailheads and their locations should be shown on all trail mapping (brochures, trailheads, Web sites etc.).

7.5 A trail maintenance plan

(This material was partially covered in the Feasibility Report but is covered in more detail below)

7.5.1 Introduction

Ongoing trail maintenance is a crucial component of an effective management program – yet it is often neglected until too late. Countless quality trails have literally disappeared because no one planned a maintenance program and no one wanted to fund even essential ongoing repairs. It is therefore essential that funds be set aside in yearly budgets for maintenance of this trail - to ensure user safety and enjoyment, and to minimise liability risks for land managers.

7.5.2 The maintenance task

Ongoing maintenance can be minimised by building a trail well in the first place. A well-constructed trail surface will last considerably longer than a poorly built trail. Signs, gates, and posts installed in substantial footings stand less risk of being stolen or damaged. Well designed, well-built and well installed management access gates and trail user gates (as proposed) will keep motor vehicles and motorised trail bikes off the trail with a consequent lessened need for surface repairs. Trail furniture (such as bench seats, trail directional marker posts and interpretation) should be installed in substantial footings sufficient to withstand high winds and theft. These should require minimal ongoing maintenance. Vehicles moving along a sealed pathway (as proposed for Bundaberg to Sharon, and from McIlwraith Rd to Gin Gin) have the capacity to crack the surface if tyres sit on the trail edge. Care needs to be taken by maintenance vehicles.

The presence of trees along some of the trail means that time will be spent removing damaged and fallen trees and branches in the aftermath of a storm.

The most frequent maintenance task will be attending to fallen branches and limbs, repairing trail surfaces, replacing stolen or damaged signs (including road signs), clearing culverts and under bridges and ensuring gates and fences are functioning as intended.

As noted above, building good trails in the first place is the very best way of minimising future problems and costs. As a second line of defence, a clear and concise Management Plan with a regular maintenance program written into it will aid significantly in managing ongoing resource demands.

The goals of a Trail Maintenance Plan are to:

- Ensure that trail users continue to experience safe and enjoyable conditions;
- Guard against the deterioration of trail infrastructure, thereby maintaining the investment made on behalf of the community;
- Minimise the trail manager's exposure to potential public liability claims arising from incidents which may occur along the trail; and
- Set in place a management process to cover most foreseeable risks.

Erosion (caused by weather and unauthorised users), regrowth of vegetation (including grass and weeds on the trail corridor but not on the trail surface), fallen trees and branches, and damage to signage and fences are likely to be the greatest maintenance

activities on the trail. Providing these effects are attended to early, they are largely labour intensive rather than capital expensive. Calamitous events such as fire or major flood will naturally generate significant rebuilding activity and consequent costs. These events are generally unmanageable and should simply be accepted as part of the longer-term reality of trail management.

7.5.3 Public liability and risk management

It is important that Bundaberg Regional Council is aware that – whether or not visitors are actively encouraged to come to the trail – they carry a significant duty of care towards those visitors accessing the trail. The maintenance of a quality trail is therefore critical from this perspective. Liability generally rests with the land managers and hence, every attempt should be made to minimise the risk of accident or injury to trail users (and therefore the risk of legal action).

While public liability is certainly an issue for all land managers, it is not a reason to turn away from providing safe, sustainable and enjoyable resources. It is simply a mechanism by which to recognise the responsibilities inherent in managing natural and built resources. Dealing with a perceived liability threat is not about totally removing that threat – it is about doing all that is manifestly possible to provide safe access opportunities for visitors, thereby minimising the risk of liability claims.

A formal Hazard Inspection process is crucial in the ongoing maintenance plan. Not only will this define maintenance required and/or management decisions to be addressed, it is vital in ensuring safe conditions and therefore in dealing with any liability claim which may arise in the future. Courts are strongly swayed by evidence of a clear and functional program, and a regular series of reports, with follow-up actions, will go a long way to mitigating responsibility for injuries. Further, clearly defined 'User Responsibility' statements in brochures, maps, policy documents, plans and public places will assist this process.

7.5.4 Trail maintenance

The following information is provided as general maintenance guidance. An inventory of works and locations needs to be prepared for maintenance purposes – this cannot be prepared until construction is completed. An example of a checklist for a trail is included in Appendix 4. The Council will need to create a specific checklist based on this example once the trail is completed.

Maintenance on the trail should be divided between regular inspections and simple repairs, a one (or two) person job, and quarterly programs undertaking larger jobs such as significant signage repairs or weed / vegetation control. A range of basic machinery, tools and equipment will be required for this work.

At the core of any trail maintenance program is an inspection program. The relevant Australian Standards sets out the basis for frequency of trail inspections. It only covers walking tracks and provides for inspections every 30 days (or less) for Class 1 trails, every 90 days for Class 2 trails, and annually for Class 3-6 trails. This sets the minimum standard for inspections and is a guide only. What the Australian Standards do not include but should include is an inspection of any trail after significant weather events such as storms, fire, floods, and high winds in addition to the regular inspection program. The proposed inspection regime recommends inspections every 90 days.

Clear records of each activity/inspection will be kept by the body with responsibility for maintenance. Pro-formas serve to maximise user safety and minimise liability risks. It will also provide a valuable record of works undertaken and make for efficient use of maintenance resources over time.

In general, Maintenance Plans are based around regular inspections, at which time simple maintenance activities should take place concurrently. More time-consuming maintenance activities should take place every six months, while detailed Hazard Inspections should occur annually. Further, the capacity to respond immediately to random incoming reports of hazards or major infrastructure failures should be built into the Plans. Table 7 gives a suggested schedule for general maintenance activities to achieve acceptable maintenance levels and provides explanatory notes pertaining to each Activity.

Table 7: General Maintenance Activities

Activity	Activity Description	Site	Frequency
Undertake full inspection of the trail	**At trailheads** The trailhead should be carefully checked to ensure that all signage is present, and that all signs are clearly visible and legible. An inventory needs to be prepared to assist in regular maintenance. Surface of access tracks and parking areas need to be checked and potholes eliminated. Inspect and check trailhead facilities and infrastructure: ● Parking areas and access tracks (check surfaces) ● Bollards ● Trailhead (map) panel ● Interpretive panel ● Seating/shelter/picnic tables ● Trailhead signage (on road) ● Trail directional marker posts	Entire trail	Every third month
	At Road crossings Particular attention needs to be given to signs at road crossings or junctions. Each crossing should be carefully checked to ensure that all signage is present, and that all signs are clearly visible. Particular attention must be given to ensuring that "Trail Crossing ahead" signs (on roadside at approach to trail crossing) are not obscured by overhanging vegetation. Replace damaged and/or missing signs. Check management access gates and trail user chicanes for structural stability and function. **Fencing** Check and make repairs to side fencing. To be done by arrangement with adjoining landowners.		
Check signage and clean, replace or repair as required esp. road crossing signage and directional markers. All signage should be checked for vandalism and cleaned if necessary. If damage is too great, replacement is essential. An inventory of locations of all signs needs to be prepared to assist in regular maintenance.	Check, repair or replace all trail signage, including interpretive signage, trail distance and directional markers (logo/arrow plates). Replace missing and/or damaged signs.	All locations	Every third month - at each trail inspection

Activity	Activity Description	Site	Frequency
Slashing of trail environs		Various locations	Timing dependent on seasonal growth patterns
Check trail surface and arrange repair as required		Entire trail	Every third month. Arrange repairs immediately if acute, or schedule maintenance for six monthly work sessions if not.
Maintenance of trail surface	Check condition of trail surface for damage and arrange repairs if necessary; trim off regrowth vegetation.	Entire trail	Every six months
Sweep or rake debris from trail surfaces, especially at road crossing points		Various locations	Every six months
Maintenance of culverts and other drainage measures	Check and clear drains and culverts. Drains need to be checked and cleared once or twice/year and after heavy rainfall events. Regular maintenance especially after heavy rainfall is essential. Most maintenance will involve clearing of material from silted up or blocked drains. Drain blockages should be cleared as urgent priority. Silt traps at culvert discharges or entry points should be cleared regularly. Cess drains in cuttings should be checked to ensure they function effectively.	Entire trail	Every six months
Cut back regrowth, intruding and overhanging vegetation.	Check overhanging or intruding vegetation. Cut back where required. Clear fallen trees and branches. Undergrowth vegetation grows quickly, and over time will continue to intrude into the trail 'corridor'. Such intruding vegetation needs to be cut back to provide clear and safe passage for trail users. "Blow-downs" - trees or limbs that have fallen across the trail – need to be cleared as/when required. Sight lines must be kept clear either side of road crossings, to ensure that users can clearly see a safe distance either way at road crossings.	Entire trail	Every six months, unless obviously requiring attention at regular inspections.

Activity	Activity Description	Site	Frequency
Check structural stability of interpretive signage, and interpretive shelters. Check structural stability of seating, distance posts. Inspect and replace when needed.	Interpretive panels should be checked for vandalism and cleaned if necessary. If damage is too great, replacement is essential. An inventory of locations needs to be prepared to assist in regular maintenance. Furniture alongside trails, if installed, needs to be checked regularly for damage to ensure safety and comfort of trail users.	Entire trail	Every six months
Undertake Hazard Inspection and prepare Hazard Inspection Report	This should be done annually. Inclusion of a formal Hazard Inspection process, crucial in addressing risk, is necessary in the ongoing maintenance plan. Not only will this define maintenance required and/or management decisions to be addressed, it is vital in ensuring safe conditions and therefore in dealing with any liability claim which may arise in the future. Courts are strongly swayed by evidence of a clear and functional program, and a regular series of reports, with follow-up actions, will go a long way to mitigating responsibility for injuries. Further, clearly defined 'User Responsibility' statements in brochures, maps, policy documents, plans and public places will assist this process.	Entire trail	Annually
Check structural integrity of bridges. Inspect and maintain bridges. Check for obstructions and clearing under bridges.	Visual inspection is appropriate though detailed inspection should follow storm and flood events. After floods, bridge should be inspected and damaged components replaced as soon as possible. Handrails and surface decking on bridge should be inspected for damage at regular intervals.		Annually
Major repairs and replacements		Entire trail	Every 5 years
Major repairs and replacements		Entire trail	Every 10 years

It should be noted that this schedule does not allow for repair works above and beyond 'normal' minor activities. For example, if a section is subject to heavy rain, and erosion control fails, additional repair works will need to be undertaken.

7.5.5 Maintenance costs

(General costings were discussed in detail in the Feasibility Report. The information below is more specific to this trail).

Resourcing a maintenance program is crucial, and funds will be required on an ongoing basis to enable this essential maintenance. It would be short sighted to go ahead and build the trail and then baulk at the demands of managing and maintaining it.

The biggest maintenance costs involved are obviously maintenance of the items that initially cost the most to install – surfacing and bridges (though use of a sealed surface reduces the maintenance load, as will the use of pre-fabricated bridges).

It is difficult estimating the costs involved in maintaining a trail until every last bridge and other infrastructure items have been installed.

The use of volunteers to undertake many of the routine repairs and cleaning tasks can substantially reduce the costs.

Table 8 makes an attempt at estimating an amount that may be required on an annual basis for maintaining the proposed Bundaberg Gin Gin Rail Trail.

Table 8: Estimate of Maintenance Costs (Bundaberg Gin Gin Rail Trail – 45 km)

Task	Frequency/note	Possible costs
Inspect and check trailhead facilities and infrastructure: • parking areas (check surfaces) • bollards • interpretive panel • picnic tables • trailhead signage (on road) • trailhead (map) panel • trail directional marker posts	Average repairs of $1,000 per site (5 trailheads).	$5,000
Trail surface - allowance for incidental repairs to, and upgrading of, trail surface.	Allowance of 2% of replacement cost (i.e. 2% of $3,996,450).	$80,000
Check side vegetation growth and overhead vegetation and cut back where required. Clearing of fallen trees and branches.	Allowance of 8 person days per year (@ $500/day).	$4,000
Inspection and routine maintenance of bridges (all timber components, decking, handrails, etc.). Check for obstructions and clearing under bridges.	Allowance of $11,000 per year for large timber bridge (1), $1,000 per year for new installations (allow for 27 bridges).	$38,000
Check and clear culverts.	Allowance of 40 hours for checking and cleaning.	$4,000

Task	Frequency/note	Possible costs
Check road crossings. Replace damaged and/or missing signs and undertake other tasks: • Give Way signs • Road Ahead signs • Trail Crossing warning signs Road name signs • Regulatory signs • Check sight distances and clear vegetation if necessary	15 crossings at average repairs of $300 per crossing.	$4,500
Inspection of and allowance for replacement of trail directional marker logo/arrow plates and trail kilometre posts.	3 replacements per year.	$1,200
Allowance for repairs to trailside furniture and occasional replacements (when required).	Inspection and minor repairs every 6 months. 2 replacements per year.	$3,000
Check regulatory signs along trail (e.g. road ahead, give way, trail name, distance signs, "No trespassing", bridge load signs, etc).	Allowance for 10 replacements per year.	$3,000
Check management access gates, chicanes and fences at road crossings. Make repairs where necessary.	Allowance of $10,000 per year for repairs.	$10,000
Check interpretation along trail for damage and structural stability.	Allowance for replacement of 3 panel per year.	$9,000
Check miscellaneous items (such as bollards, sculptures, side fencing, screen planting, concrete crossings,)	Allowance for repairs and/or replacement.	$10,000
Check miscellaneous (advisory / warning) signs along trail (e.g. Agric Vehicles Operating, No Trespassing, pictograms at crossings etc).	Allowance for 10 replacements per year.	$2,000
Inspection of rail trail (3 times/year).	Allowance for 5 inspection trips per year.	$7,500
Preparation of annual Hazard Inspection Report.	3 person days @ $1000/day.	$3,000
		$184,200 excl GST (per annum)

Notes on Maintenance Program:

Reporting of routine maintenance requirements by trail users will remove the need for many scheduled inspections.

Appointment of a Trail Manager, with responsibility for regular inspections of the entire trail, will substantially reduce the need for unscheduled and expensive maintenance.

Little maintenance will be required on newly built trail surfaces, bridge structures and other elements of the rail trail for several years after construction. Good asset management practice suggests money be put aside every year for maintenance, even though much of it will not be spent in the first 5-10 years as there will be limited need for maintenance.

Almost 50% of the maintenance budget is surface repair. The maintenance budget includes an annual allocation, but it should be noted that there will be very limited need for surface repairs in the first 5 years.

An allowance is also included for bridge maintenance – bridges are even less likely to need repair for the first 5 years (or even 10 years) of a trail's life. Re-constructed and refurbished bridges will require little or no maintenance for many years. However, after perhaps a decade of use they will require more and more maintenance of decking timbers (if used) and more scrutiny of fixings (depending on what materials are used for decking). Pre-fabricated bridges (suggested for watercourse crossings) require less maintenance over time.

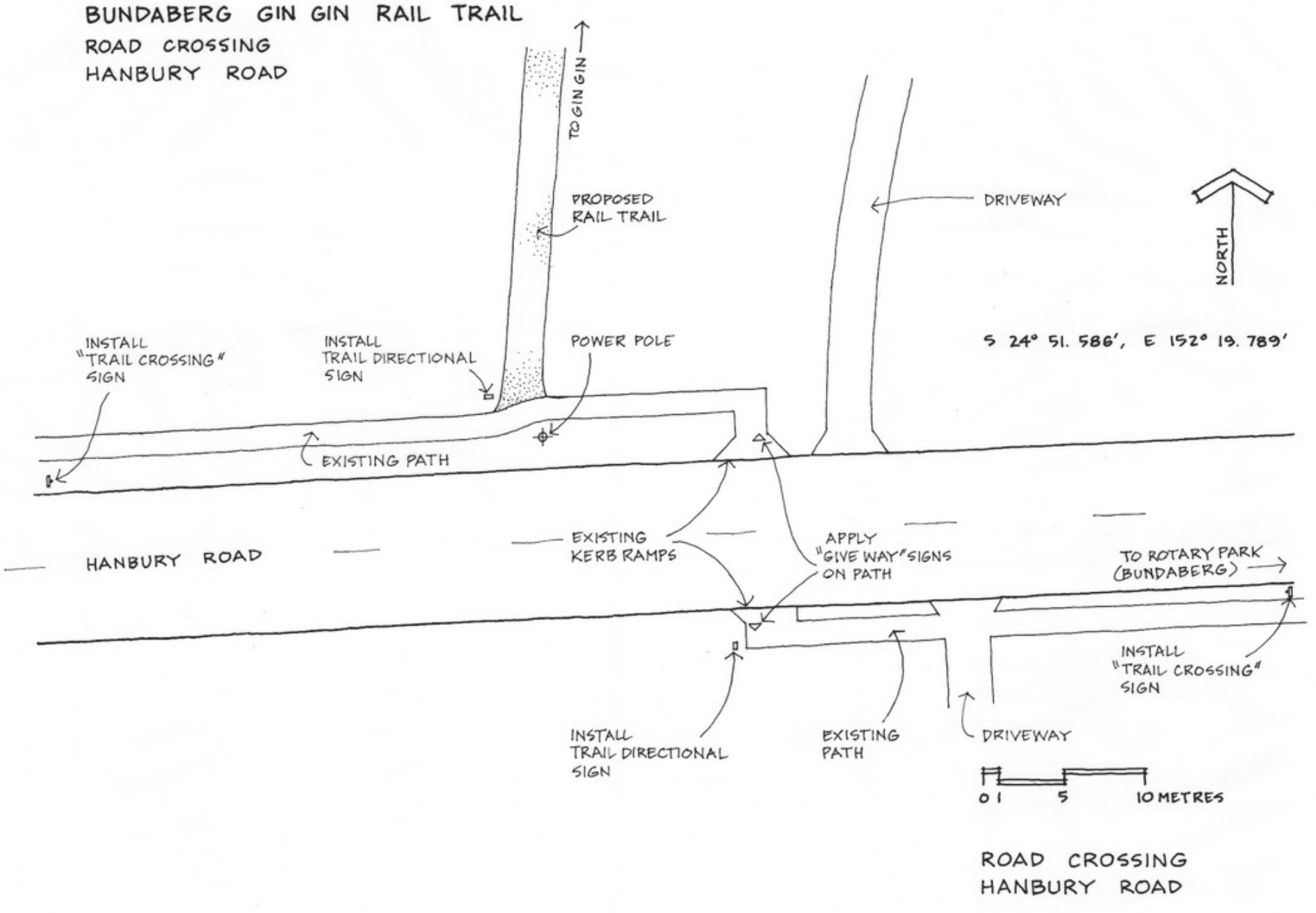
Maintenance on the two critical elements (surface and bridges) is even less likely to be needed in the first 5-10 years if the trail is built well in the first place. The key message is spend more on construction and spend less on maintenance.

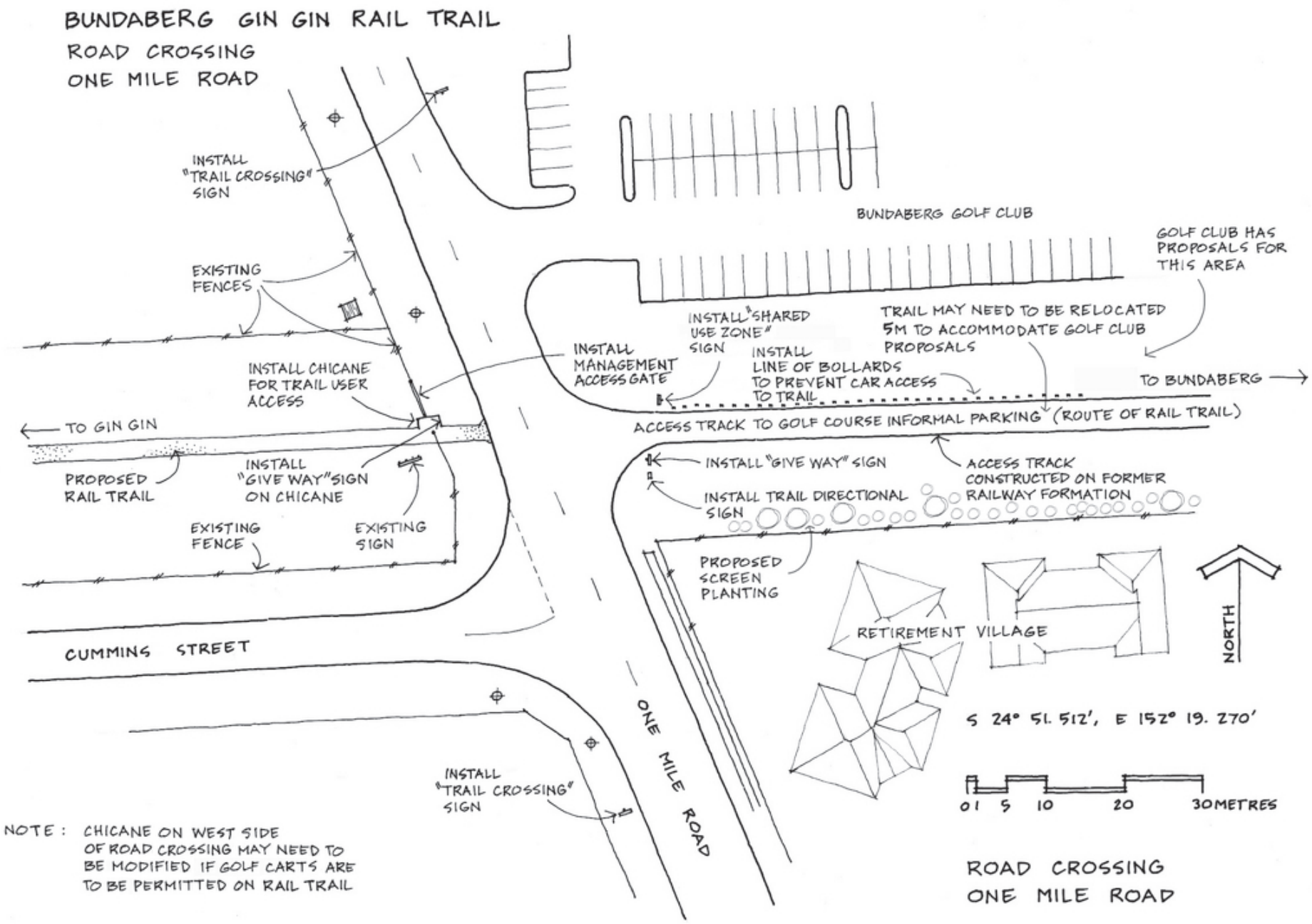
The likely maintenance costs in the first few years of a trail's life will focus on sign damage and inspections.

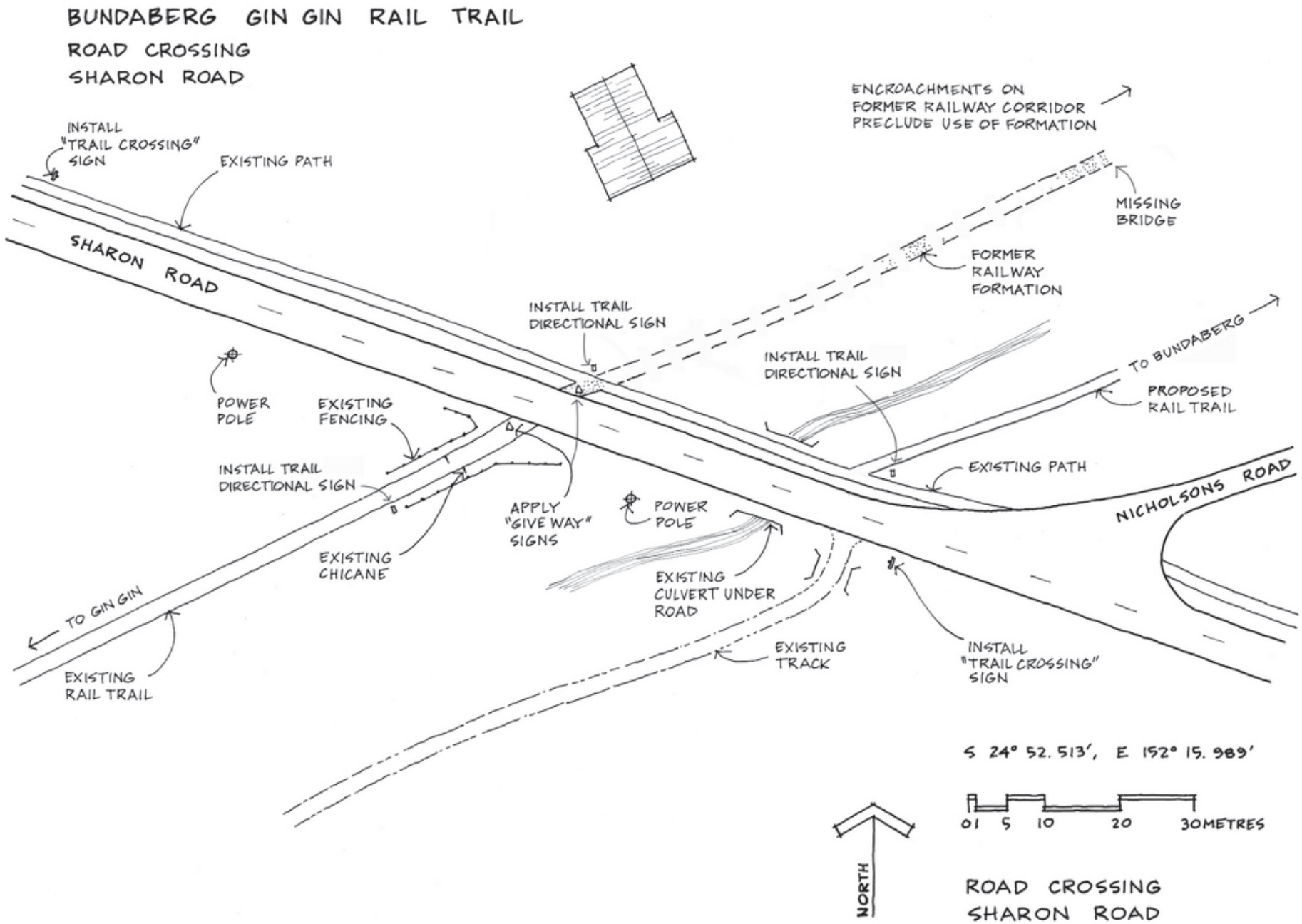
Costings are at full commercial rates (but of course this would be far less if volunteers are involved). US evidence suggests significant savings using volunteer maintenance (trails maintained by volunteers costs one-third of those maintained by Government entities).

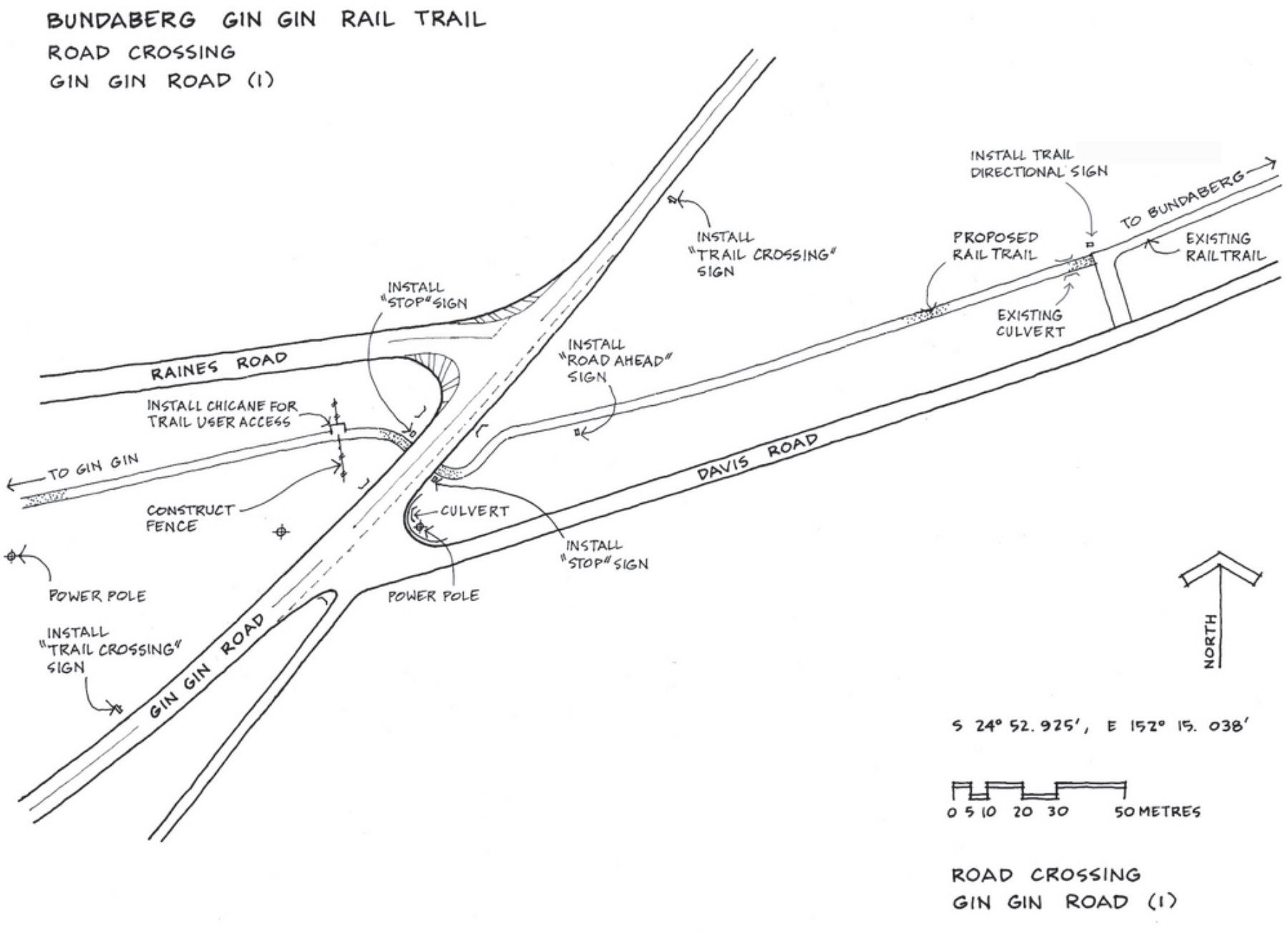
Appendix 1

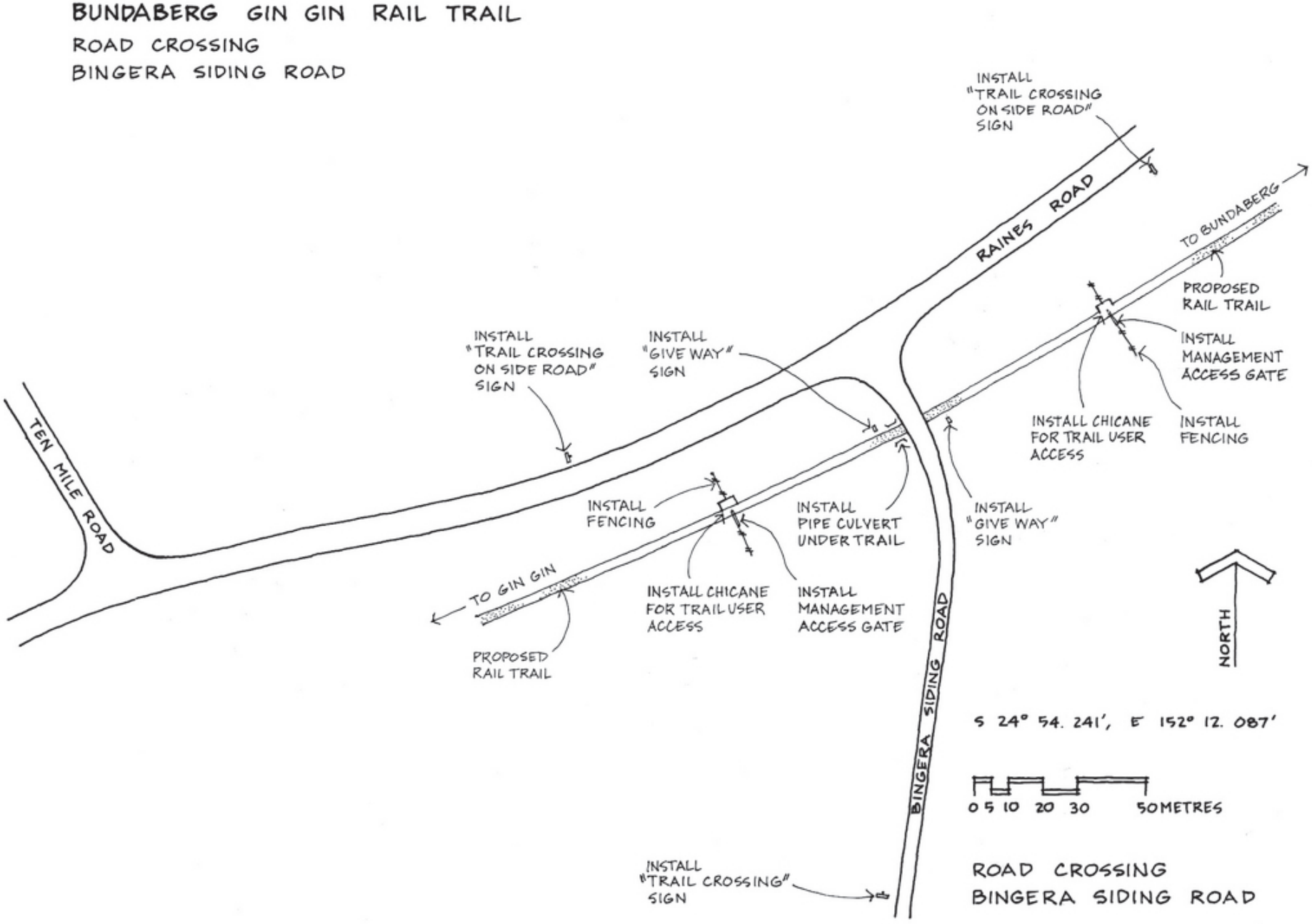
Road crossing drawings

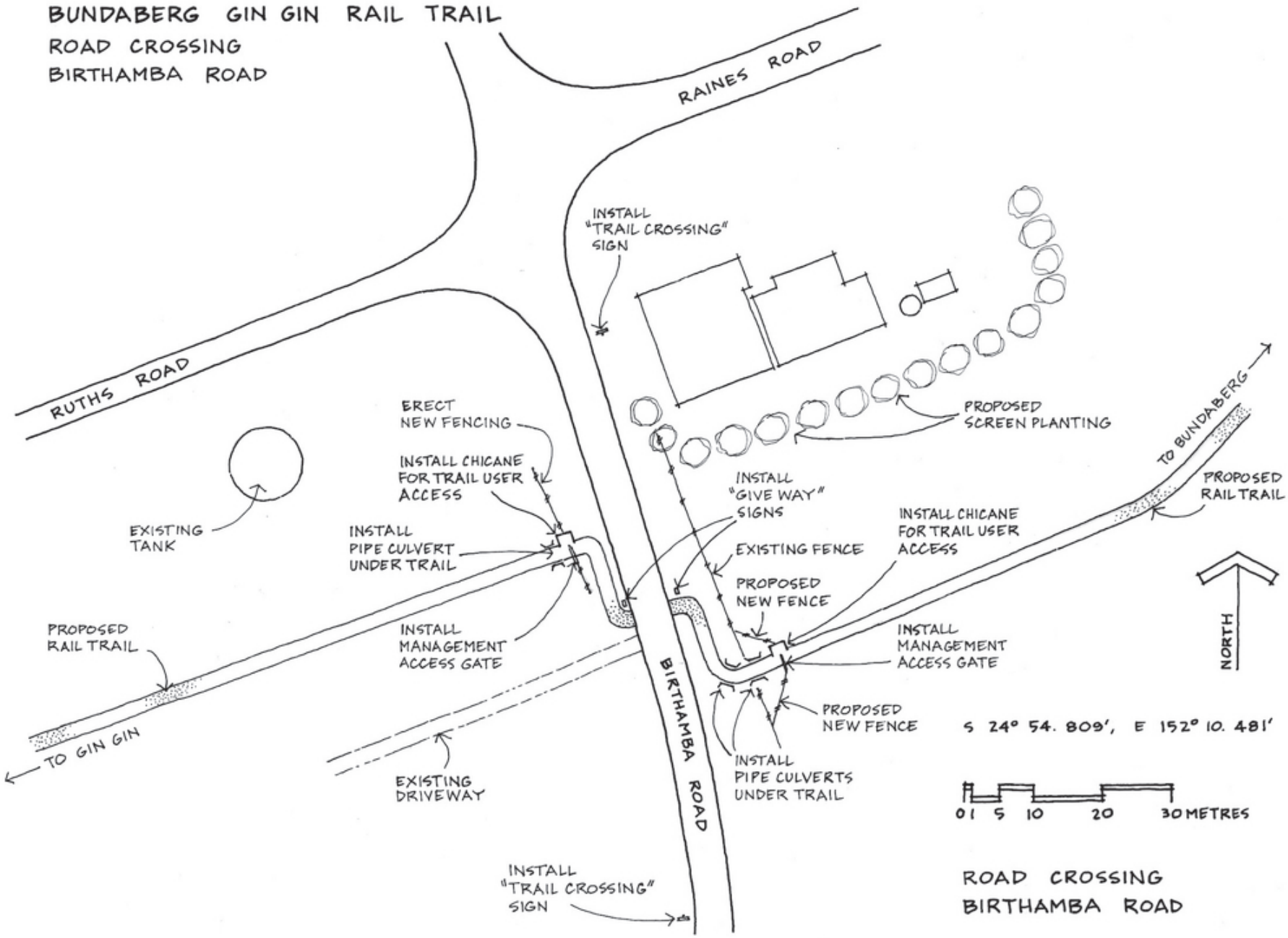

BUNDABERG GIN GIN RAIL TRAIL
ROAD CROSSING
HANBURY ROAD
TO GIN GIN
PROPOSED RAIL TRAIL
DRIVEWAY
NORTH
INSTALL "TRAIL CROSSING" SIGN
INSTALL TRAIL DIRECTIONAL SIGN
POWER POLE
S 24° 51. 586', E 152° 19. 789'
EXISTING PATH
HANBURY ROAD
EXISTING KERB RAMPS
APPLY "GIVE WAY" SIGNS ON PATH
TO ROTARY PARK (BUNDABERG)
INSTALL "TRAIL CROSSING" SIGN
INSTALL TRAIL DIRECTIONAL SIGN
EXISTING PATH
DRIVEWAY
0 1 5 10 METRES
ROAD CROSSING
HANBURY ROAD

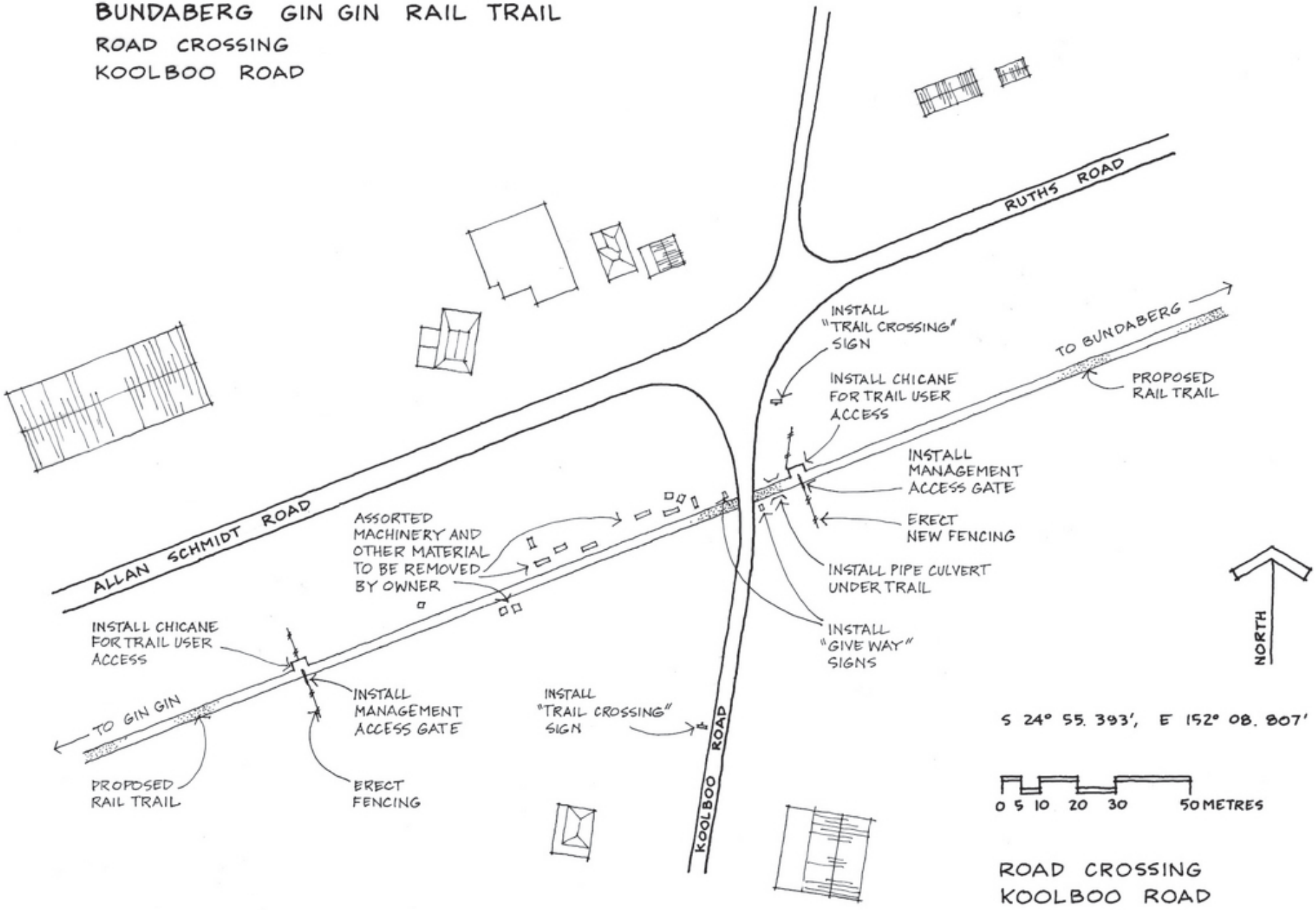

BUNDABERG GIN GIN RAIL TRAIL
ROAD CROSSING
ONE MILE ROAD
INSTALL "TRAIL CROSSING" SIGN
EXISTING FENCES
INSTALL CHICANE FOR TRAIL USER ACCESS
TO GIN GIN
PROPOSED RAIL TRAIL
INSTALL "GIVE WAY" SIGN ON CHICANE
EXISTING FENCE
EXISTING SIGN
CUMMING STREET
INSTALL "TRAIL CROSSING" SIGN
ONE MILE ROAD
NOTE : CHICANE ON WEST SIDE OF ROAD CROSSING MAY NEED TO BE MODIFIED IF GOLF CARTS ARE TO BE PERMITTED ON RAIL TRAIL
BUNDABERG GOLF CLUB
GOLF CLUB HAS PROPOSALS FOR THIS AREA
INSTALL "SHARED USE ZONE" SIGN
INSTALL MANAGEMENT ACCESS GATE
INSTALL LINE OF BOLLARDS TO PREVENT CAR ACCESS TO TRAIL
TRAIL MAY NEED TO BE RELOCATED 5M TO ACCOMMODATE GOLF CLUB PROPOSALS
TO BUNDABERG
ACCESS TRACK TO GOLF COURSE INFORMAL PARKING (ROUTE OF RAIL TRAIL)
INSTALL "GIVE WAY" SIGN
INSTALL TRAIL DIRECTIONAL SIGN
ACCESS TRACK CONSTRUCTED ON FORMER RAILWAY FORMATION
PROPOSED SCREEN PLANTING
RETIREMENT VILLAGE
NORTH
S 24° 51. 512', E 152° 19. 270'
0 1 5 10 20 30 METRES
ROAD CROSSING
ONE MILE ROAD

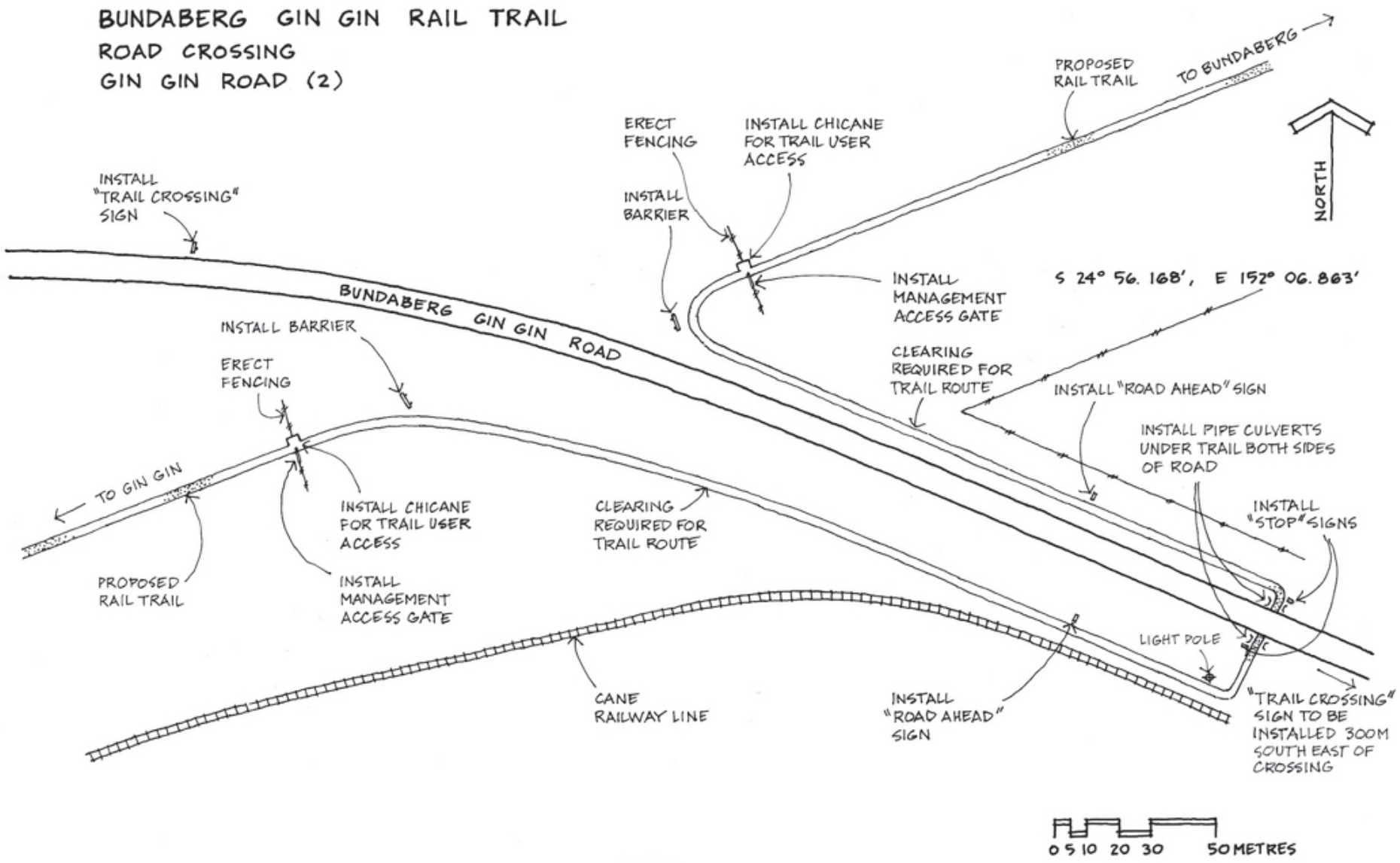

BUNDABERG GIN GIN RAIL TRAIL
ROAD CROSSING
SHARON ROAD
INSTALL "TRAIL CROSSING" SIGN
EXISTING PATH
SHARON ROAD
ENCROACHMENTS ON FORMER RAILWAY CORRIDOR PRECLUDE USE OF FORMATION
MISSING BRIDGE
FORMER RAILWAY FORMATION
INSTALL TRAIL DIRECTIONAL SIGN
INSTALL TRAIL DIRECTIONAL SIGN
TO BUNDABERG
PROPOSED RAIL TRAIL
POWER POLE
EXISTING FENCING
INSTALL TRAIL DIRECTIONAL SIGN
EXISTING PATH
NICHOLSONS ROAD
APPLY "GIVE WAY" SIGNS
POWER POLE
EXISTING CHICANE
EXISTING CULVERT UNDER ROAD
TO GIN GIN
EXISTING RAIL TRAIL
EXISTING TRACK
INSTALL "TRAIL CROSSING" SIGN
S 24° 52. 513', E 152° 15. 989'
01 5 10 20 30METRES
NORTH
ROAD CROSSING
SHARON ROAD

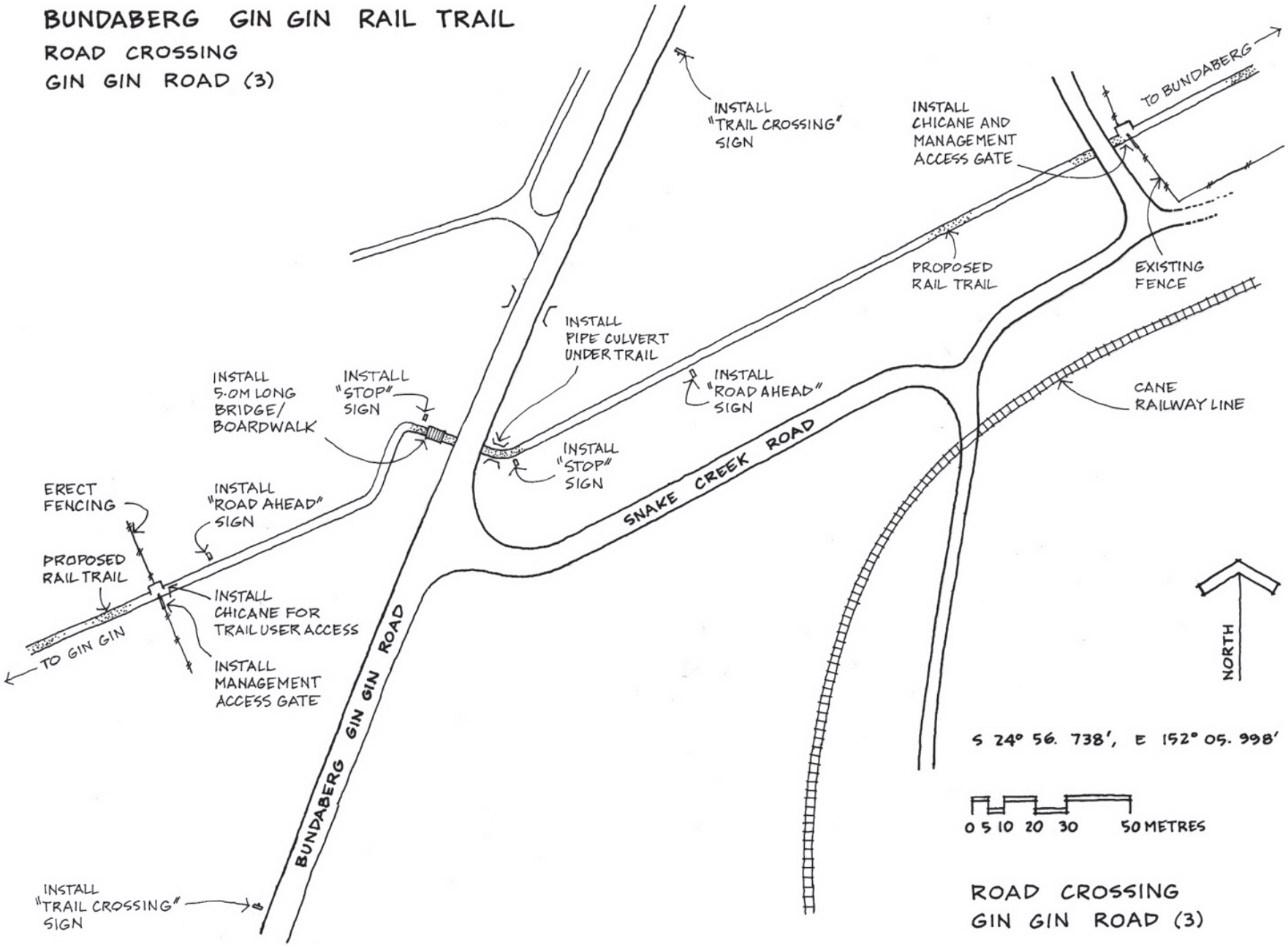

BUNDABERG GIN GIN RAIL TRAIL
ROAD CROSSING
GIN GIN ROAD (1)
INSTALL TRAIL DIRECTIONAL SIGN
TO BUNDABERG
INSTALL "TRAIL CROSSING" SIGN
PROPOSED RAIL TRAIL
EXISTING RAIL TRAIL
INSTALL "STOP" SIGN
EXISTING CULVERT
INSTALL "ROAD AHEAD" SIGN
RAINES ROAD
INSTALL CHICANE FOR TRAIL USER ACCESS
TO GIN GIN
DAVIS ROAD
CONSTRUCT FENCE
CULVERT
INSTALL "STOP" SIGN
POWER POLE
POWER POLE
INSTALL "TRAIL CROSSING" SIGN
GIN GIN ROAD
NORTH
S 24° 52. 925', E 152° 15. 038'
0 5 10 20 30 50 METRES
ROAD CROSSING
GIN GIN ROAD (1)

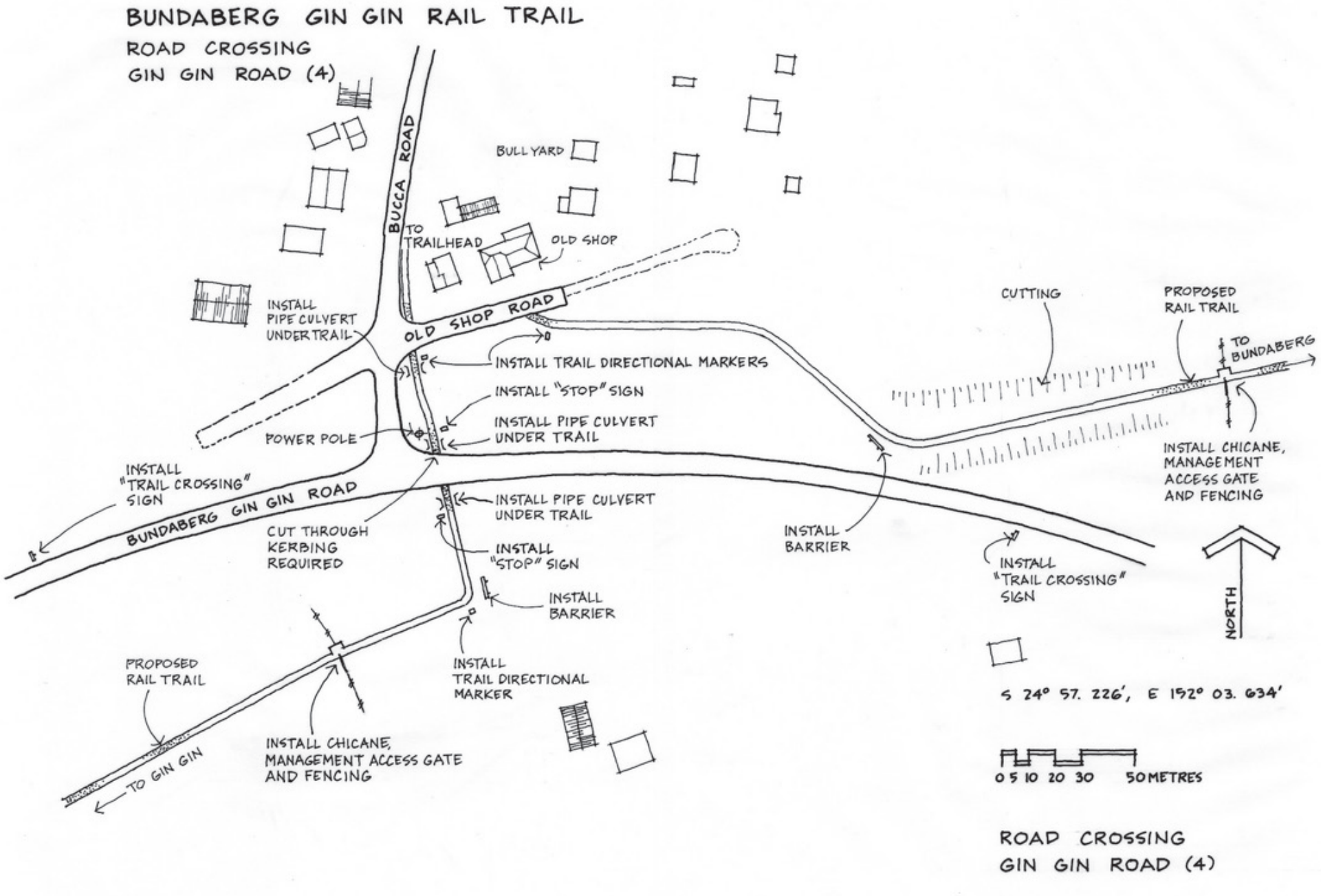

BUNDABERG GIN GIN RAIL TRAIL
ROAD CROSSING
BINGERA SIDING ROAD
INSTALL "TRAIL CROSSING ON SIDE ROAD" SIGN
RAINES ROAD
TO BUNDABERG
PROPOSED RAIL TRAIL
INSTALL MANAGEMENT ACCESS GATE
INSTALL CHICANE FOR TRAIL USER ACCESS
INSTALL FENCING
INSTALL "TRAIL CROSSING ON SIDE ROAD" SIGN
INSTALL "GIVE WAY" SIGN
TEN MILE ROAD
INSTALL FENCING
INSTALL PIPE CULVERT UNDER TRAIL
INSTALL "GIVE WAY" SIGN
TO GIN GIN
INSTALL CHICANE FOR TRAIL USER ACCESS
INSTALL MANAGEMENT ACCESS GATE
PROPOSED RAIL TRAIL
BINGERA SIDING ROAD
NORTH
S 24° 54. 241', E 152° 12. 087'
0 5 10 20 30 50METRES
INSTALL "TRAIL CROSSING" SIGN
ROAD CROSSING
BINGERA SIDING ROAD

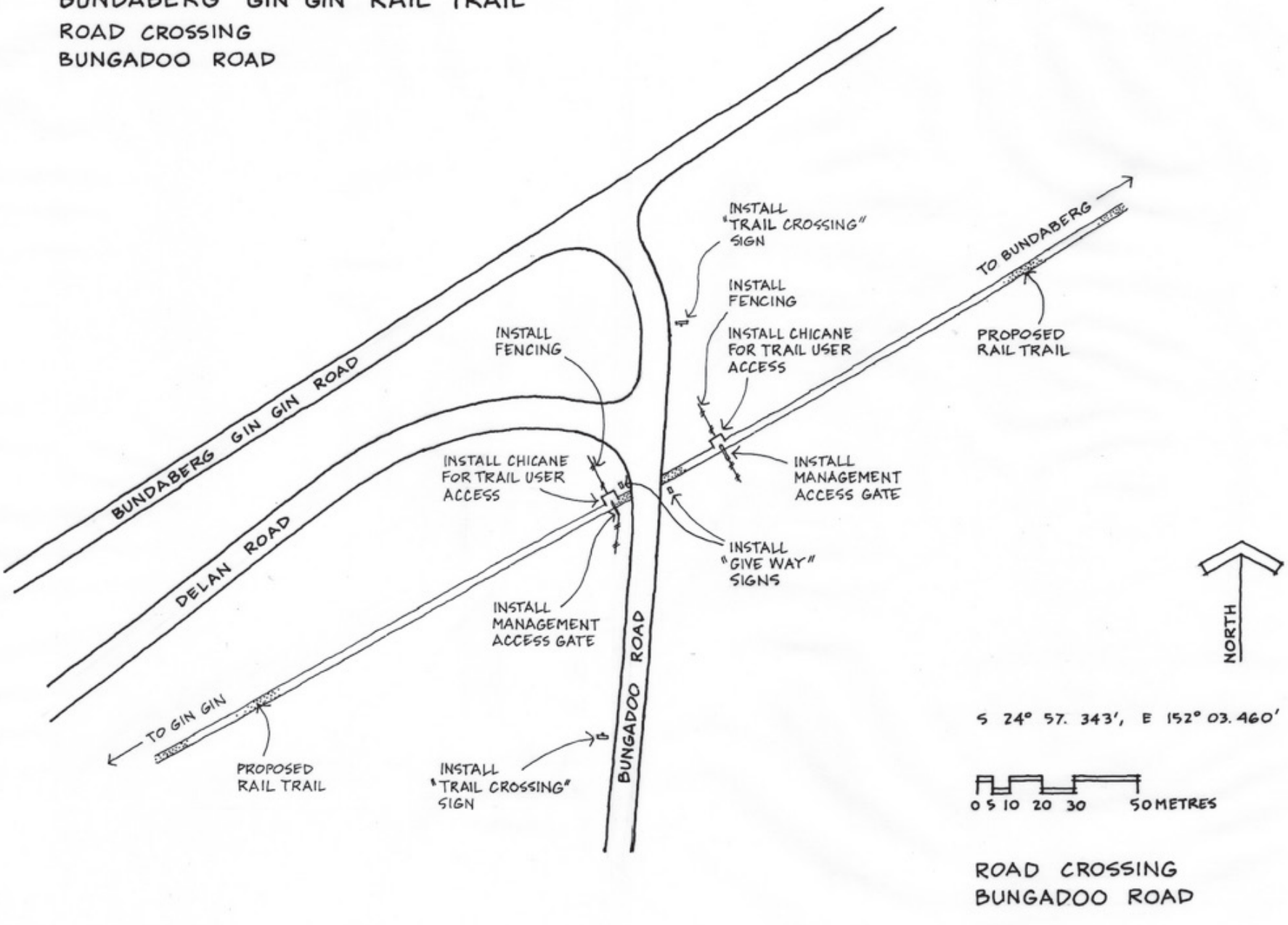

BUNDABERG GIN GIN RAIL TRAIL
ROAD CROSSING
BIRTHAMBA ROAD
RAINES ROAD
RUTHS ROAD
INSTALL "TRAIL CROSSING" SIGN
PROPOSED SCREEN PLANTING
TO BUNDABERG
PROPOSED RAIL TRAIL
ERECT NEW FENCING
INSTALL CHICANE FOR TRAIL USER ACCESS
INSTALL "GIVE WAY" SIGNS
EXISTING TANK
INSTALL PIPE CULVERT UNDER TRAIL
EXISTING FENCE
INSTALL CHICANE FOR TRAIL USER ACCESS
PROPOSED NEW FENCE
PROPOSED RAIL TRAIL
INSTALL MANAGEMENT ACCESS GATE
INSTALL MANAGEMENT ACCESS GATE
NORTH
BIRTHAMBA ROAD
PROPOSED NEW FENCE
S 24° 54. 809', E 152° 10. 481'
TO GIN GIN
EXISTING DRIVEWAY
INSTALL PIPE CULVERTS UNDER TRAIL
0 1 5 10 20 30 METRES
INSTALL "TRAIL CROSSING" SIGN
ROAD CROSSING
BIRTHAMBA ROAD

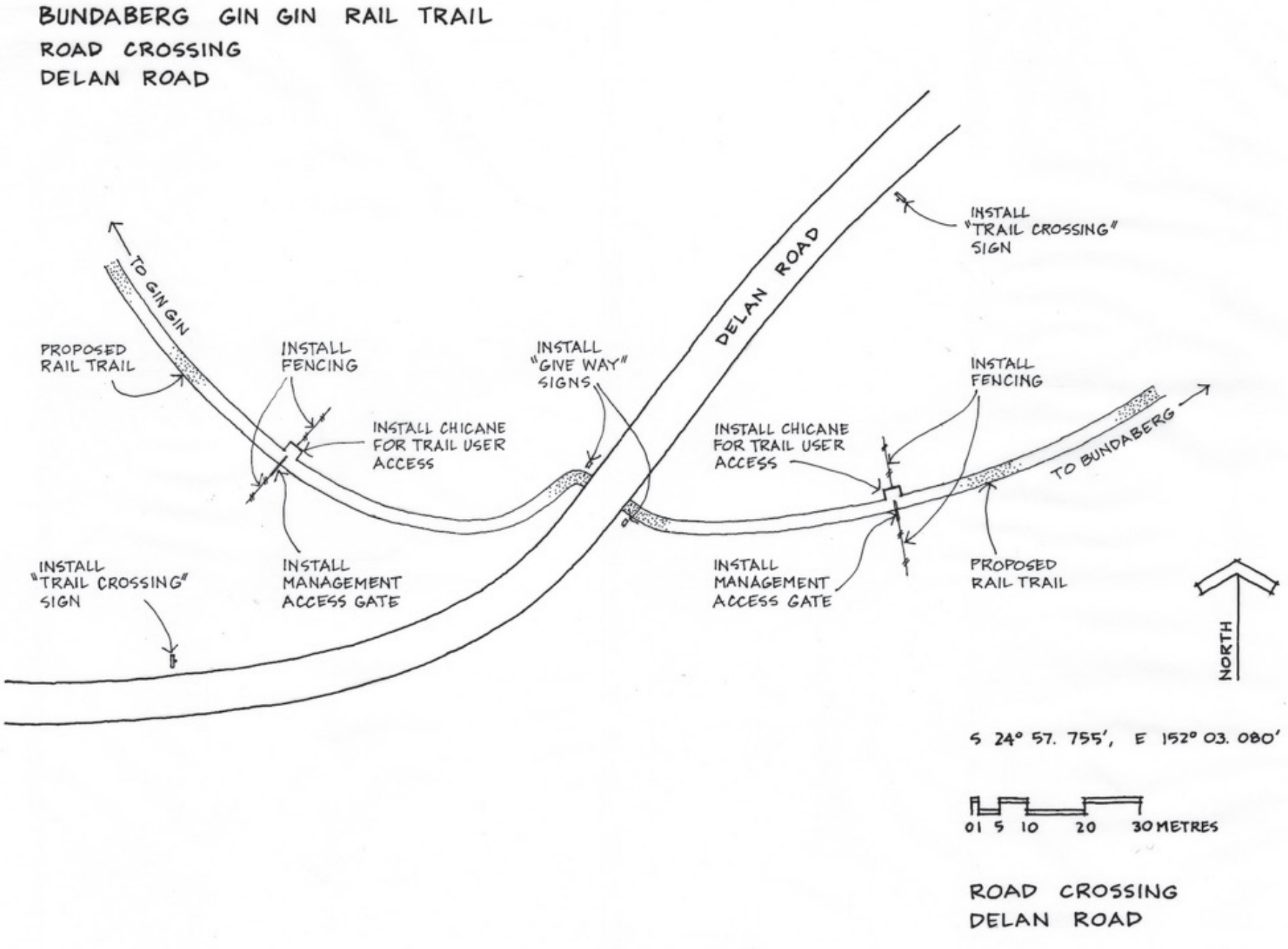

BUNDABERG GIN GIN RAIL TRAIL
ROAD CROSSING
KOOLBOO ROAD
RUTHS ROAD
ALLAN SCHMIDT ROAD
KOOLBOO ROAD
INSTALL "TRAIL CROSSING" SIGN
INSTALL CHICANE FOR TRAIL USER ACCESS
TO BUNDABERG
PROPOSED RAIL TRAIL
INSTALL MANAGEMENT ACCESS GATE
ERECT NEW FENCING
INSTALL PIPE CULVERT UNDER TRAIL
INSTALL "GIVE WAY" SIGNS
ASSORTED MACHINERY AND OTHER MATERIAL TO BE REMOVED BY OWNER
INSTALL CHICANE FOR TRAIL USER ACCESS
TO GIN GIN
INSTALL MANAGEMENT ACCESS GATE
INSTALL "TRAIL CROSSING" SIGN
PROPOSED RAIL TRAIL
ERECT FENCING
NORTH
S 24° 55. 393', E 152° 08. 807'
0 5 10 20 30 50 METRES
ROAD CROSSING
KOOLBOO ROAD

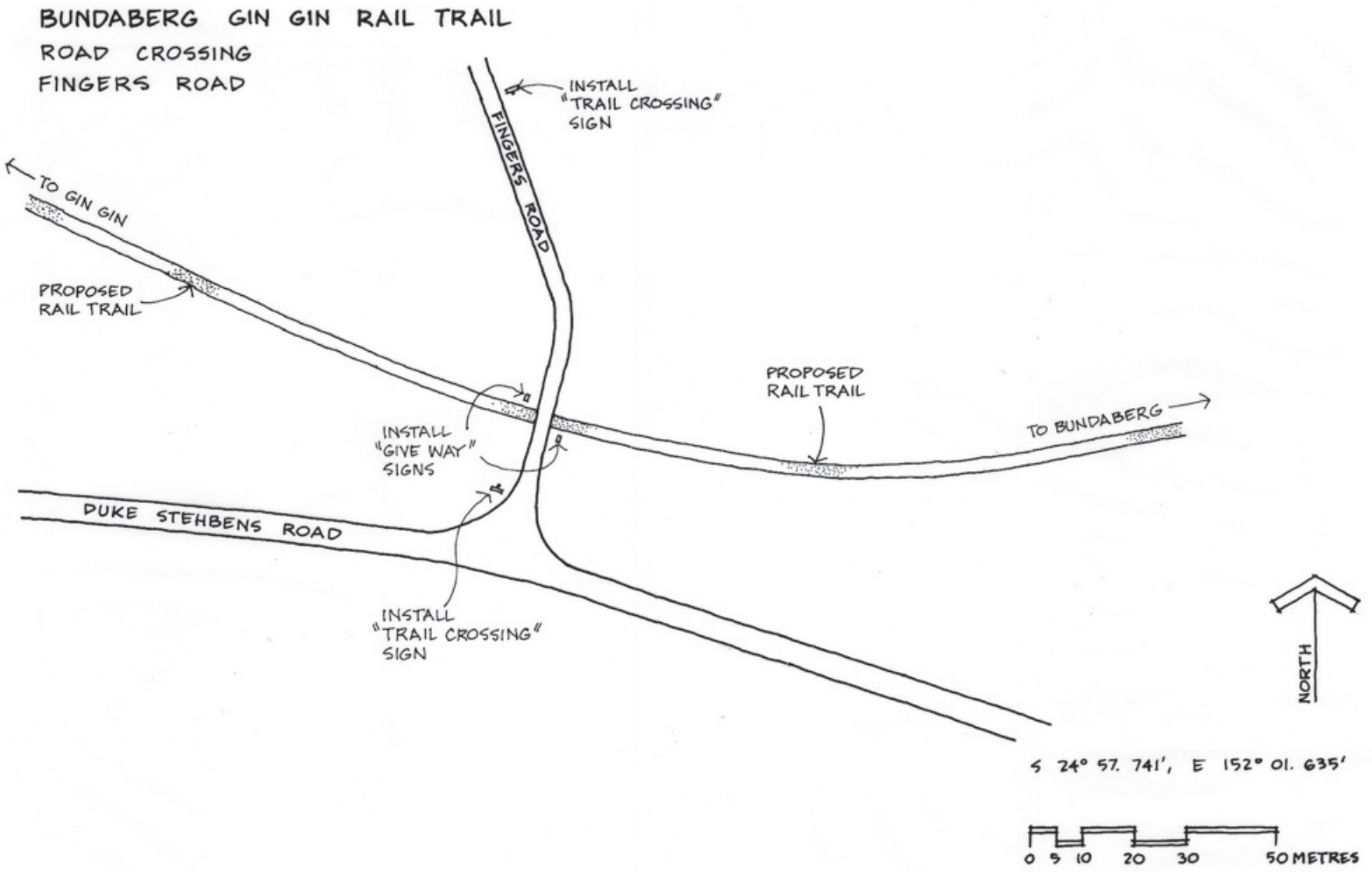

BUNDABERG GIN GIN RAIL TRAIL
ROAD CROSSING
GIN GIN ROAD (2)
PROPOSED RAIL TRAIL
TO BUNDABERG
NORTH
ERECT FENCING
INSTALL CHICANE FOR TRAIL USER ACCESS
INSTALL BARRIER
INSTALL "TRAIL CROSSING" SIGN
INSTALL MANAGEMENT ACCESS GATE
S 24° 56. 168', E 152° 06. 863'
BUNDABERG GIN GIN ROAD
CLEARING REQUIRED FOR TRAIL ROUTE
INSTALL "ROAD AHEAD" SIGN
INSTALL PIPE CULVERTS UNDER TRAIL BOTH SIDES OF ROAD
INSTALL BARRIER
ERECT FENCING
TO GIN GIN
INSTALL CHICANE FOR TRAIL USER ACCESS
CLEARING REQUIRED FOR TRAIL ROUTE
INSTALL "STOP" SIGNS
PROPOSED RAIL TRAIL
INSTALL MANAGEMENT ACCESS GATE
LIGHT POLE
CANE RAILWAY LINE
INSTALL "ROAD AHEAD" SIGN
"TRAIL CROSSING" SIGN TO BE INSTALLED 300M SOUTH EAST OF CROSSING
0 5 10 20 30 50 METRES
NOTE:
ROAD CROSSING LOCATION CHOSEN TO MAXIMISE SIGHT LINES IN BOTH DIRECTIONS. TRAIL ROUTE UTILISES ROAD RESERVE ON BOTH SIDES OF BUNDABERG GIN GIN ROAD.
ROAD CROSSING
GIN GIN ROAD (2)

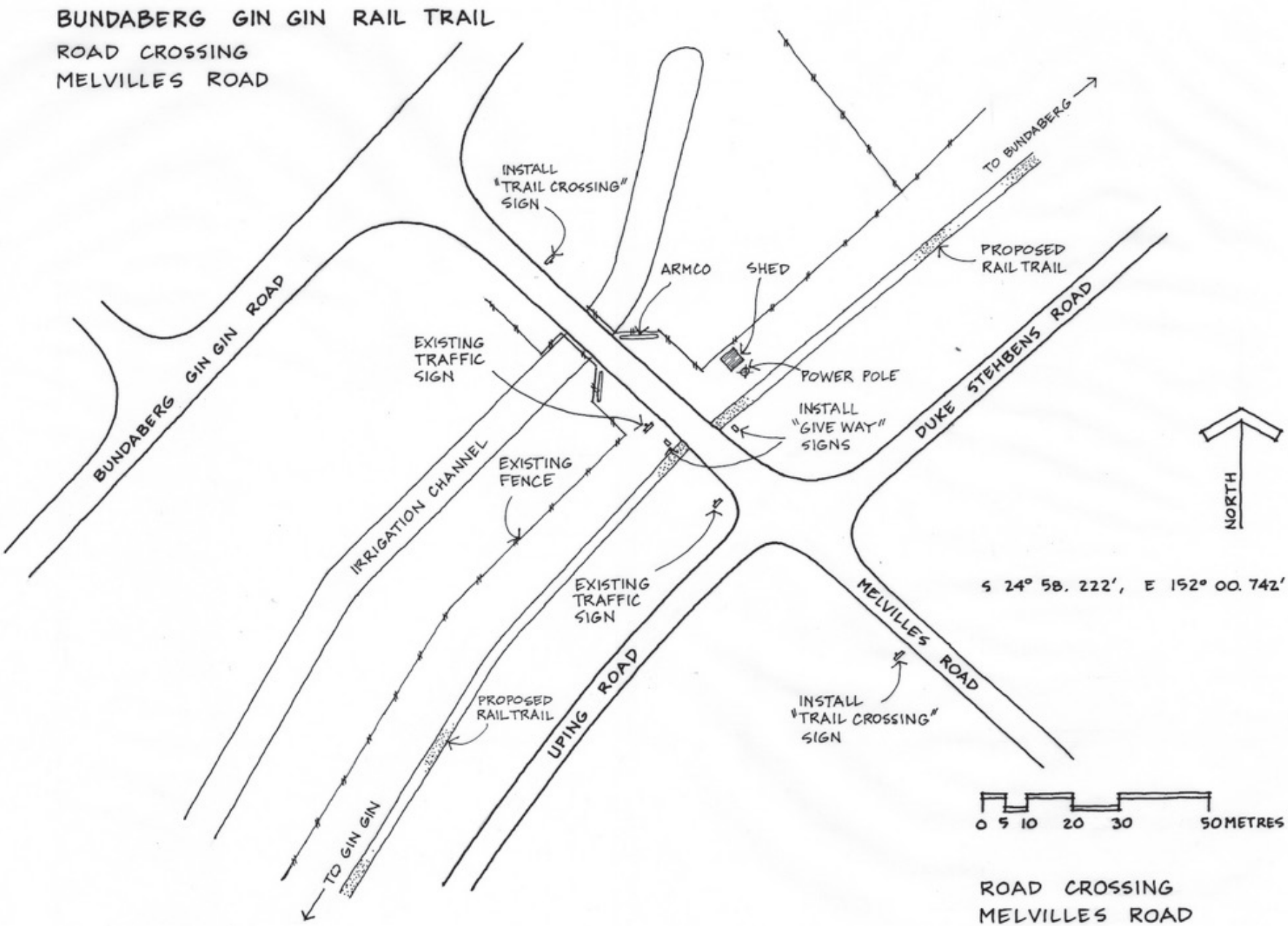

BUNDABERG GIN GIN RAIL TRAIL
ROAD CROSSING
GIN GIN ROAD (3)
INSTALL "TRAIL CROSSING" SIGN
INSTALL CHICANE AND MANAGEMENT ACCESS GATE
TO BUNDABERG
PROPOSED RAIL TRAIL
EXISTING FENCE
INSTALL PIPE CULVERT UNDER TRAIL
INSTALL "ROAD AHEAD" SIGN
CANE RAILWAY LINE
INSTALL 5.0M LONG BRIDGE/ BOARDWALK
INSTALL "STOP" SIGN
INSTALL "STOP" SIGN
SNAKE CREEK ROAD
ERECT FENCING
INSTALL "ROAD AHEAD" SIGN
PROPOSED RAIL TRAIL
INSTALL CHICANE FOR TRAIL USER ACCESS
TO GIN GIN
INSTALL MANAGEMENT ACCESS GATE
BUNDABERG GIN GIN ROAD
INSTALL "TRAIL CROSSING" SIGN
NORTH
S 24° 56. 738', E 152° 05. 998'
0 5 10 20 30 50 METRES
ROAD CROSSING
GIN GIN ROAD (3)

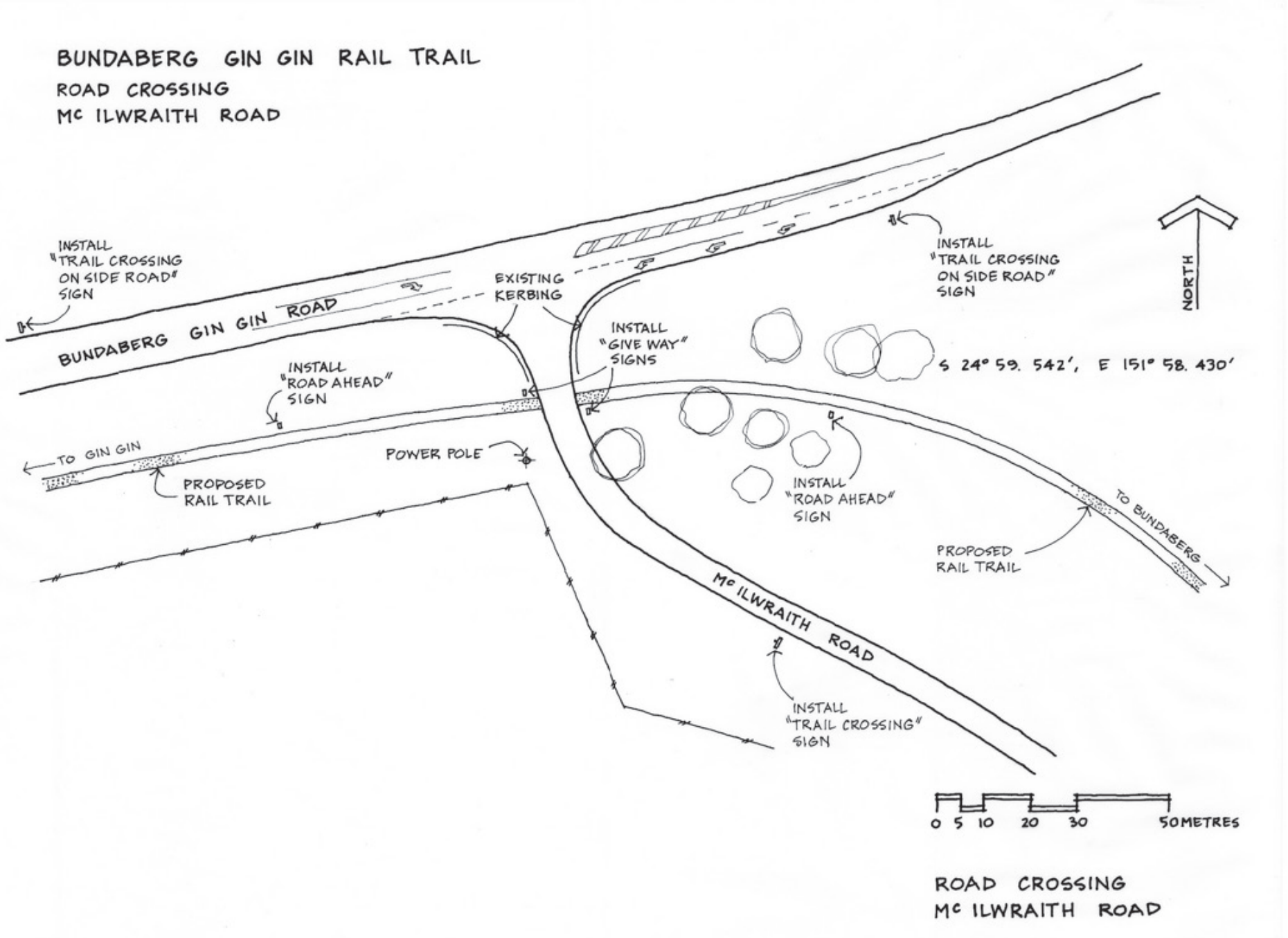

BUNDABERG GIN GIN RAIL TRAIL
ROAD CROSSING
GIN GIN ROAD (4)
BUCCA ROAD
BULL YARD
TO TRAILHEAD
OLD SHOP
OLD SHOP ROAD
INSTALL PIPE CULVERT UNDER TRAIL
INSTALL TRAIL DIRECTIONAL MARKERS
INSTALL "STOP" SIGN
INSTALL PIPE CULVERT UNDER TRAIL
POWER POLE
INSTALL "TRAIL CROSSING" SIGN
BUNDABERG GIN GIN ROAD
CUT THROUGH KERBING REQUIRED
INSTALL PIPE CULVERT UNDER TRAIL
INSTALL "STOP" SIGN
INSTALL BARRIER
INSTALL TRAIL DIRECTIONAL MARKER
PROPOSED RAIL TRAIL
TO GIN GIN
INSTALL CHICANE, MANAGEMENT ACCESS GATE AND FENCING
CUTTING
PROPOSED RAIL TRAIL
TO BUNDABERG
INSTALL CHICANE, MANAGEMENT ACCESS GATE AND FENCING
INSTALL BARRIER
INSTALL "TRAIL CROSSING" SIGN
NORTH
S 24° 57. 226', E 152° 03. 634'
0 5 10 20 30 50 METRES
ROAD CROSSING
GIN GIN ROAD (4)


BUNDABERG GIN GIN RAIL TRAIL
ROAD CROSSING
BUNGADOO ROAD
BUNDABERG GIN GIN ROAD
DELAN ROAD
BUNGADOO ROAD
INSTALL "TRAIL CROSSING" SIGN
INSTALL FENCING
INSTALL CHICANE FOR TRAIL USER ACCESS
TO BUNDABERG
PROPOSED RAIL TRAIL
INSTALL FENCING
INSTALL CHICANE FOR TRAIL USER ACCESS
INSTALL MANAGEMENT ACCESS GATE
INSTALL "GIVE WAY" SIGNS
INSTALL MANAGEMENT ACCESS GATE
TO GIN GIN
PROPOSED RAIL TRAIL
INSTALL "TRAIL CROSSING" SIGN
NORTH
S 24° 57. 343', E 152° 03. 460'
0 5 10 20 30 50 METRES
ROAD CROSSING
BUNGADOO ROAD


BUNDABERG GIN GIN RAIL TRAIL
ROAD CROSSING
DELAN ROAD
TO GIN GIN
PROPOSED RAIL TRAIL
INSTALL FENCING
INSTALL CHICANE FOR TRAIL USER ACCESS
INSTALL "GIVE WAY" SIGNS
DELAN ROAD
INSTALL "TRAIL CROSSING" SIGN
INSTALL FENCING
INSTALL CHICANE FOR TRAIL USER ACCESS
TO BUNDABERG
INSTALL "TRAIL CROSSING" SIGN
INSTALL MANAGEMENT ACCESS GATE
INSTALL MANAGEMENT ACCESS GATE
PROPOSED RAIL TRAIL
NORTH
S 24° 57. 755', E 152° 03. 080'
01 5 10 20 30 METRES
ROAD CROSSING
DELAN ROAD

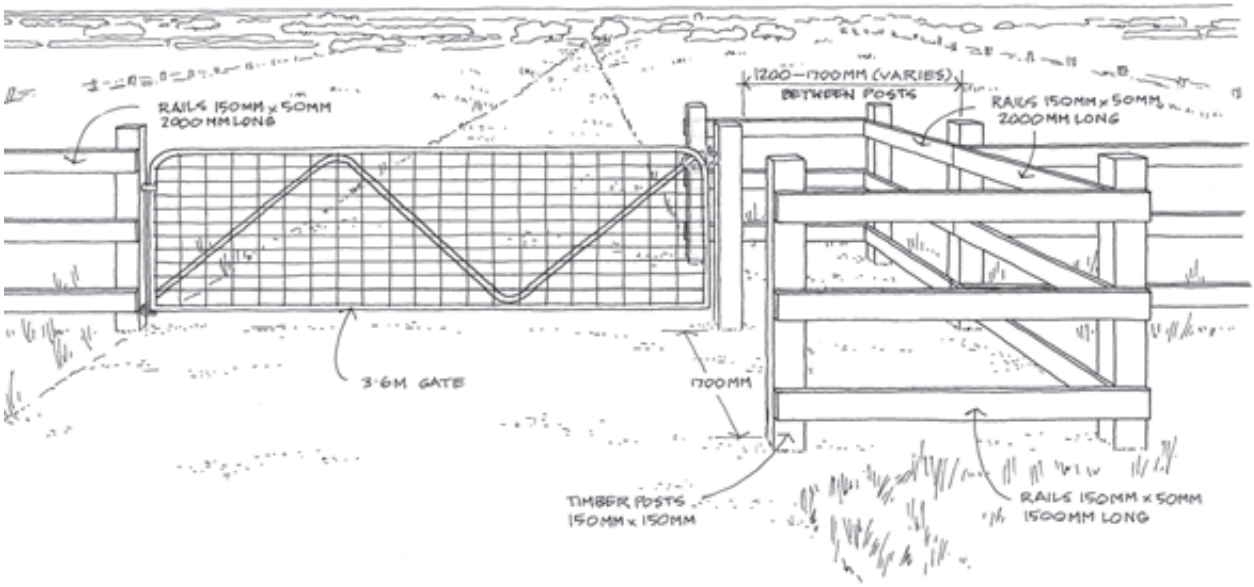

BUNDABERG GIN GIN RAIL TRAIL
ROAD CROSSING
FINGERS ROAD
INSTALL "TRAIL CROSSING" SIGN
FINGERS ROAD
TO GIN GIN
PROPOSED RAIL TRAIL
PROPOSED RAIL TRAIL
TO BUNDABERG
INSTALL "GIVE WAY" SIGNS
DUKE STEHBENS ROAD
INSTALL "TRAIL CROSSING" SIGN
NORTH
S 24° 57. 741', E 152° 01. 635'
0 5 10 20 30 50 METRES
ROAD CROSSING
FINGERS ROAD


BUNDABERG GIN GIN RAIL TRAIL
ROAD CROSSING
MELVILLES ROAD
INSTALL "TRAIL CROSSING" SIGN
ARMCO
SHED
TO BUNDABERG
PROPOSED RAIL TRAIL
BUNDABERG GIN GIN ROAD
EXISTING TRAFFIC SIGN
POWER POLE
INSTALL "GIVE WAY" SIGNS
DUKE STEHBENS ROAD
IRRIGATION CHANNEL
EXISTING FENCE
NORTH
EXISTING TRAFFIC SIGN
S 24° 58. 222', E 152° 00. 742'
MELVILLES ROAD
UPING ROAD
PROPOSED RAIL TRAIL
INSTALL "TRAIL CROSSING" SIGN
TO GIN GIN
0 5 10 20 30 50 METRES
ROAD CROSSING
MELVILLES ROAD

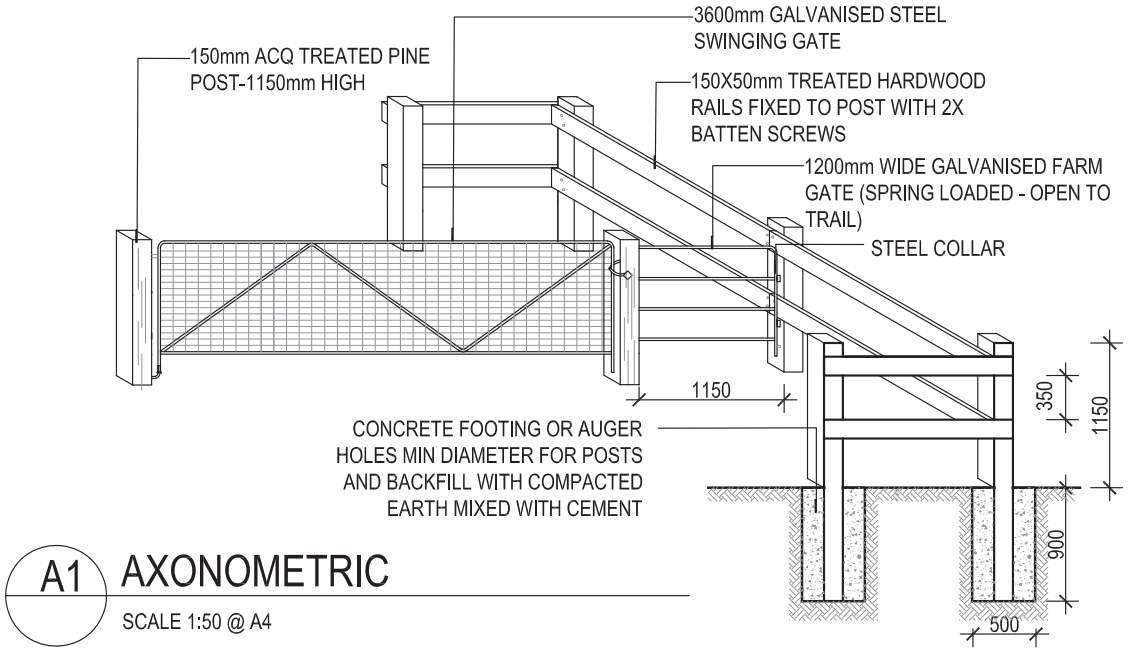

BUNDABERG GIN GIN RAIL TRAIL
ROAD CROSSING
Mc ILWRAITH ROAD
INSTALL "TRAIL CROSSING ON SIDE ROAD" SIGN
BUNDABERG GIN GIN ROAD
EXISTING KERBING
INSTALL "GIVE WAY" SIGNS
INSTALL "TRAIL CROSSING ON SIDE ROAD" SIGN
NORTH
S 24° 59. 542', E 151° 58. 430'
INSTALL "ROAD AHEAD" SIGN
TO GIN GIN
POWER POLE
PROPOSED RAIL TRAIL
INSTALL "ROAD AHEAD" SIGN
TO BUNDABERG
PROPOSED RAIL TRAIL
Mc ILWRAITH ROAD
INSTALL "TRAIL CROSSING" SIGN
0 5 10 20 30 50METRES
ROAD CROSSING
Mc ILWRAITH ROAD

Appendix 2

Chicane gating design

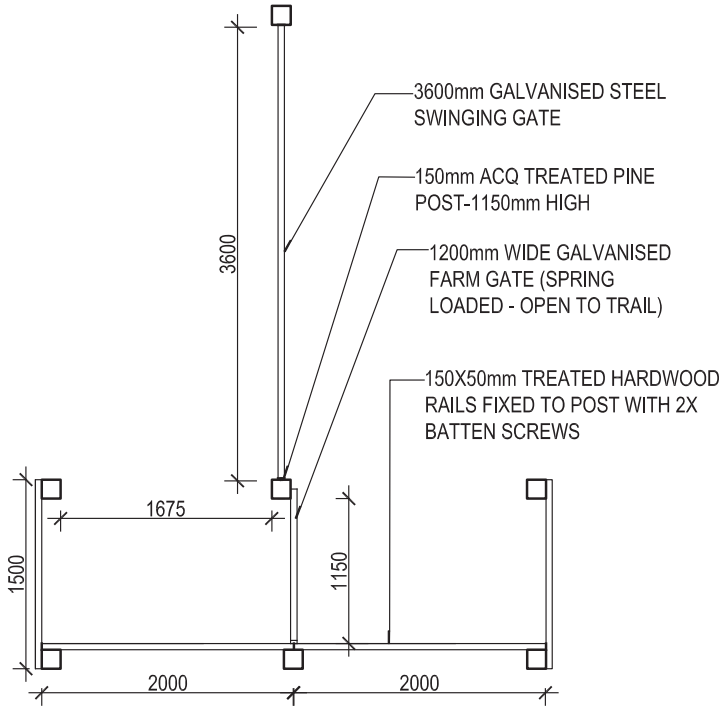


TYPICAL MANAGEMENT ACCESS GATE AND CHICANE



A1 AXONOMETRIC

SCALE 1:50 @ A4



P1 PLAN

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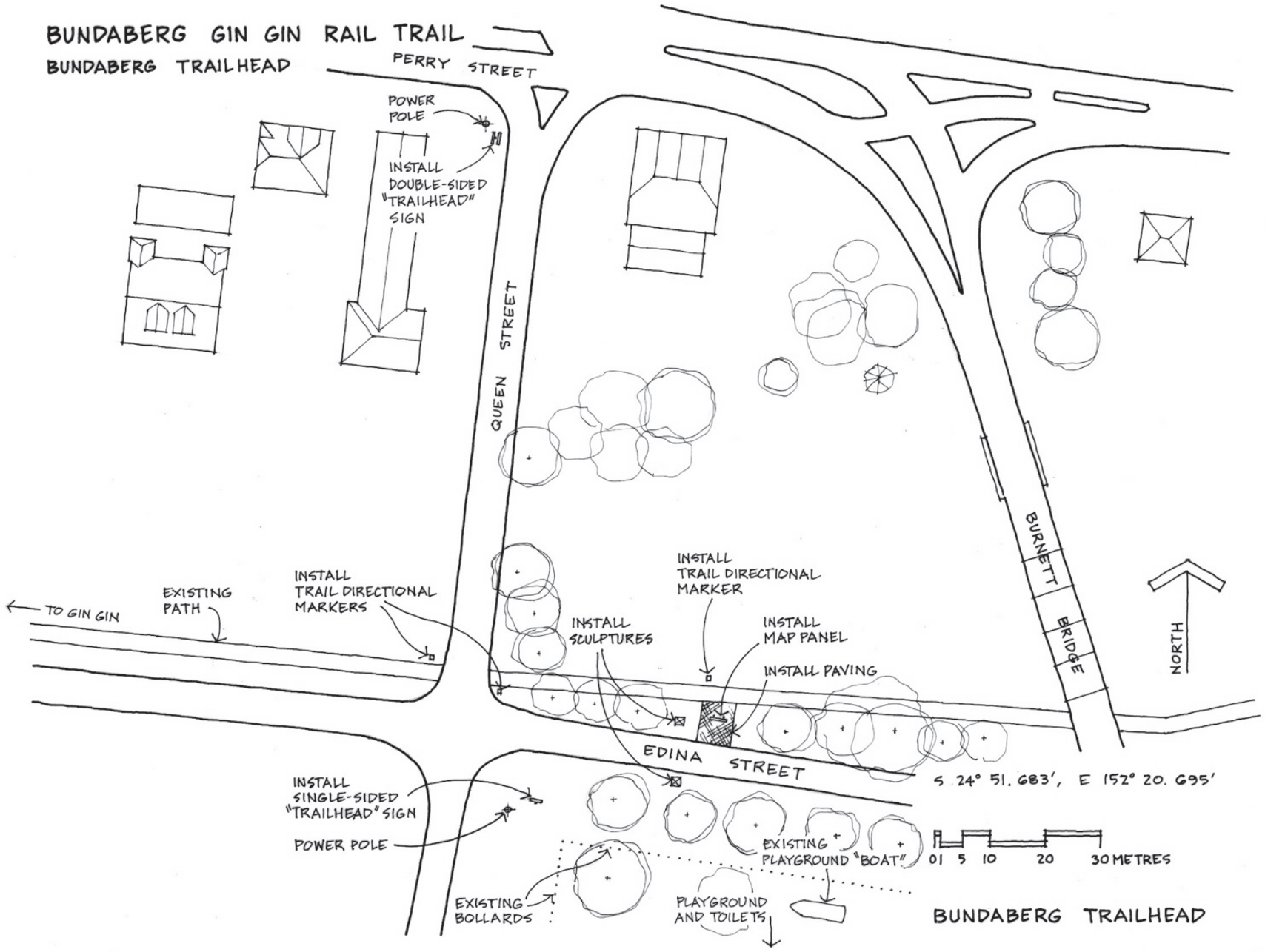
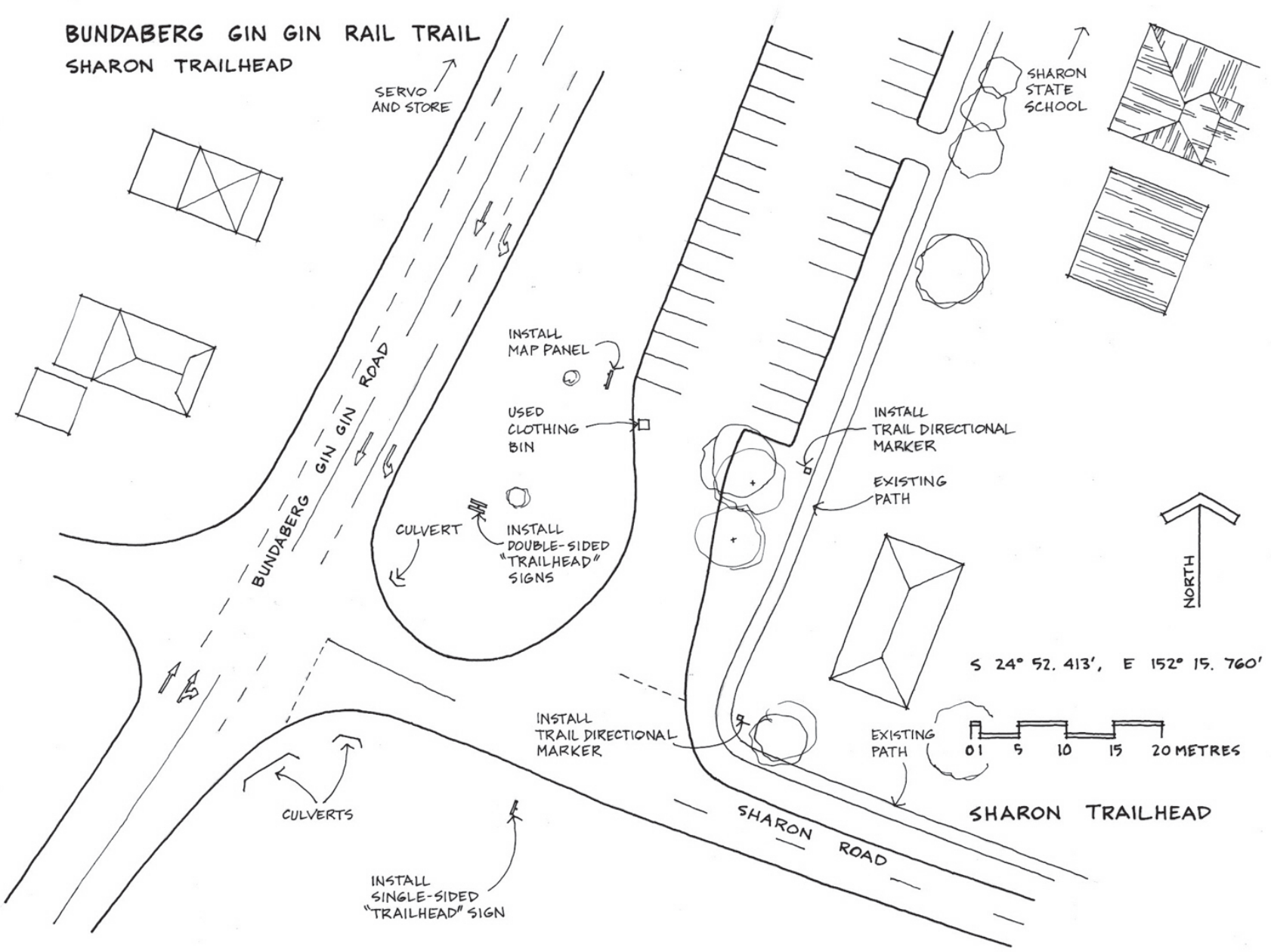
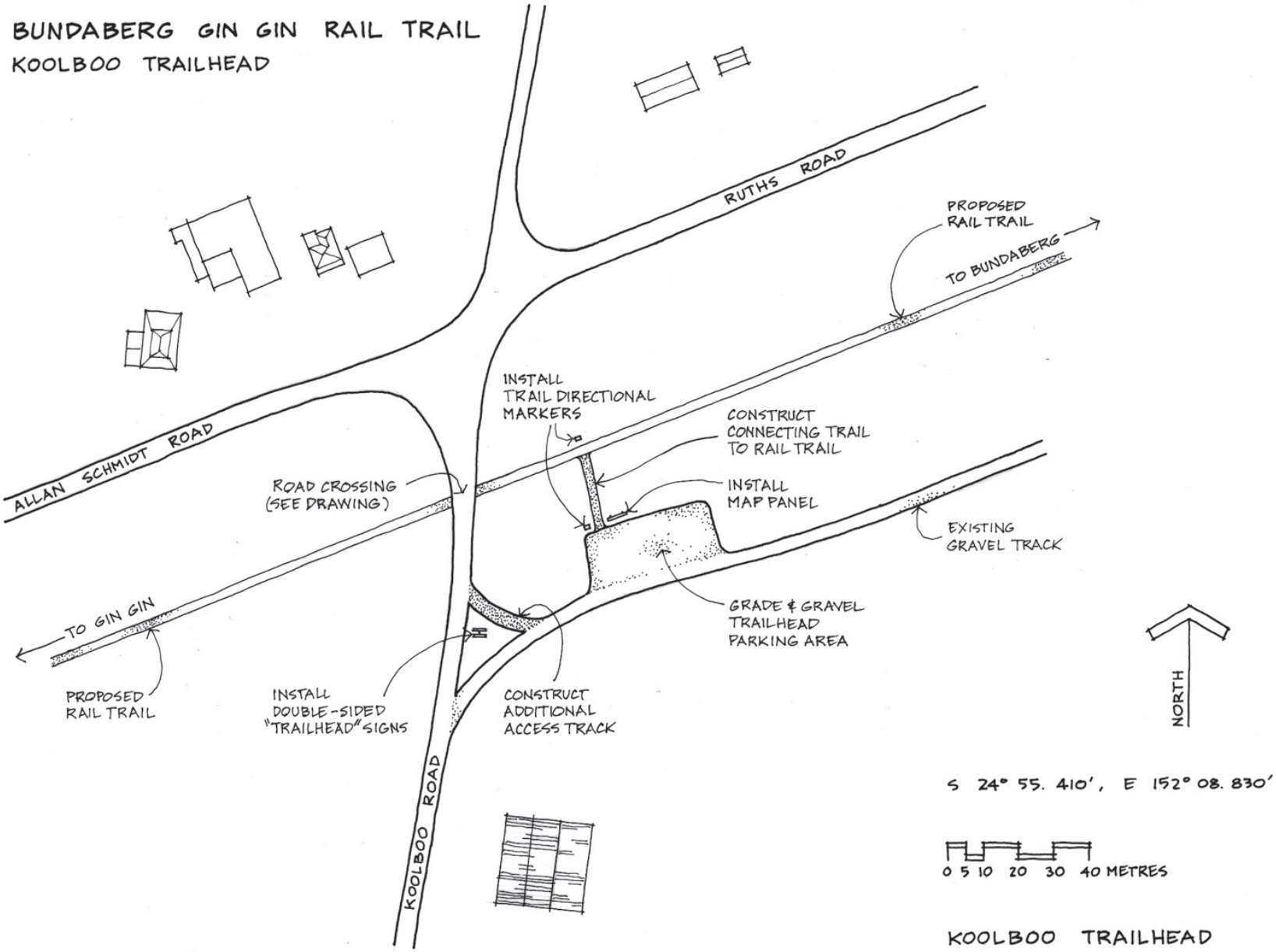
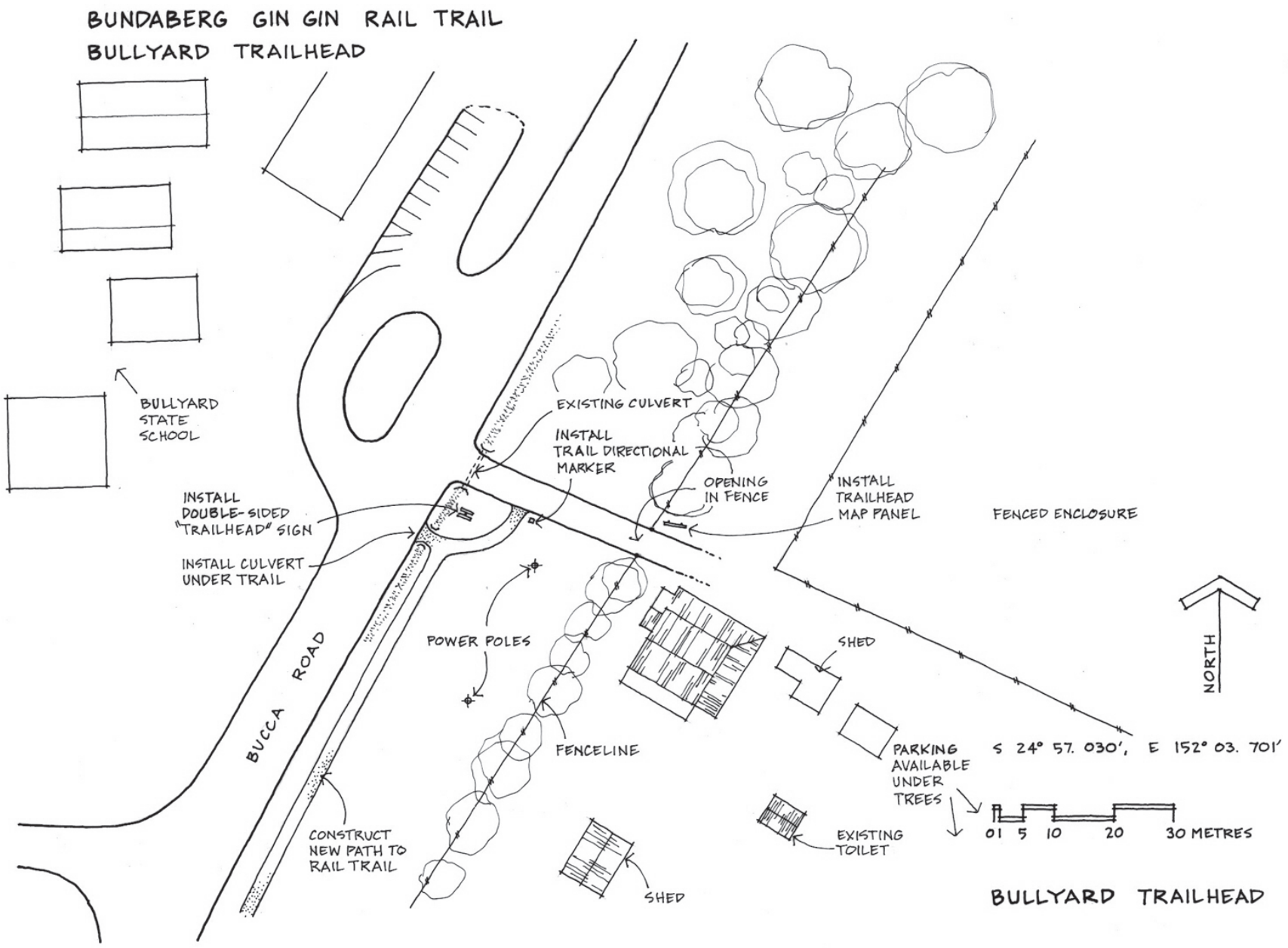
Appendix 3

Trailhead drawings


BUNDABERG GIN GIN RAIL TRAIL
BUNDABERG TRAILHEAD
PERRY STREET
POWER POLE
INSTALL DOUBLE-SIDED "TRAILHEAD" SIGN
QUEEN STREET
BURNETT BRIDGE
NORTH
TO GIN GIN
EXISTING PATH
INSTALL TRAIL DIRECTIONAL MARKERS
INSTALL TRAIL DIRECTIONAL MARKER
INSTALL SCULPTURES
INSTALL MAP PANEL
INSTALL PAVING
EDINA STREET
S 24° 51. 683', E 152° 20. 695'
INSTALL SINGLE-SIDED "TRAILHEAD" SIGN
POWER POLE
EXISTING PLAYGROUND "BOAT"
0 1 5 10 20 30 METRES
EXISTING BOLLARDS
PLAYGROUND AND TOILETS
BUNDABERG TRAILHEAD

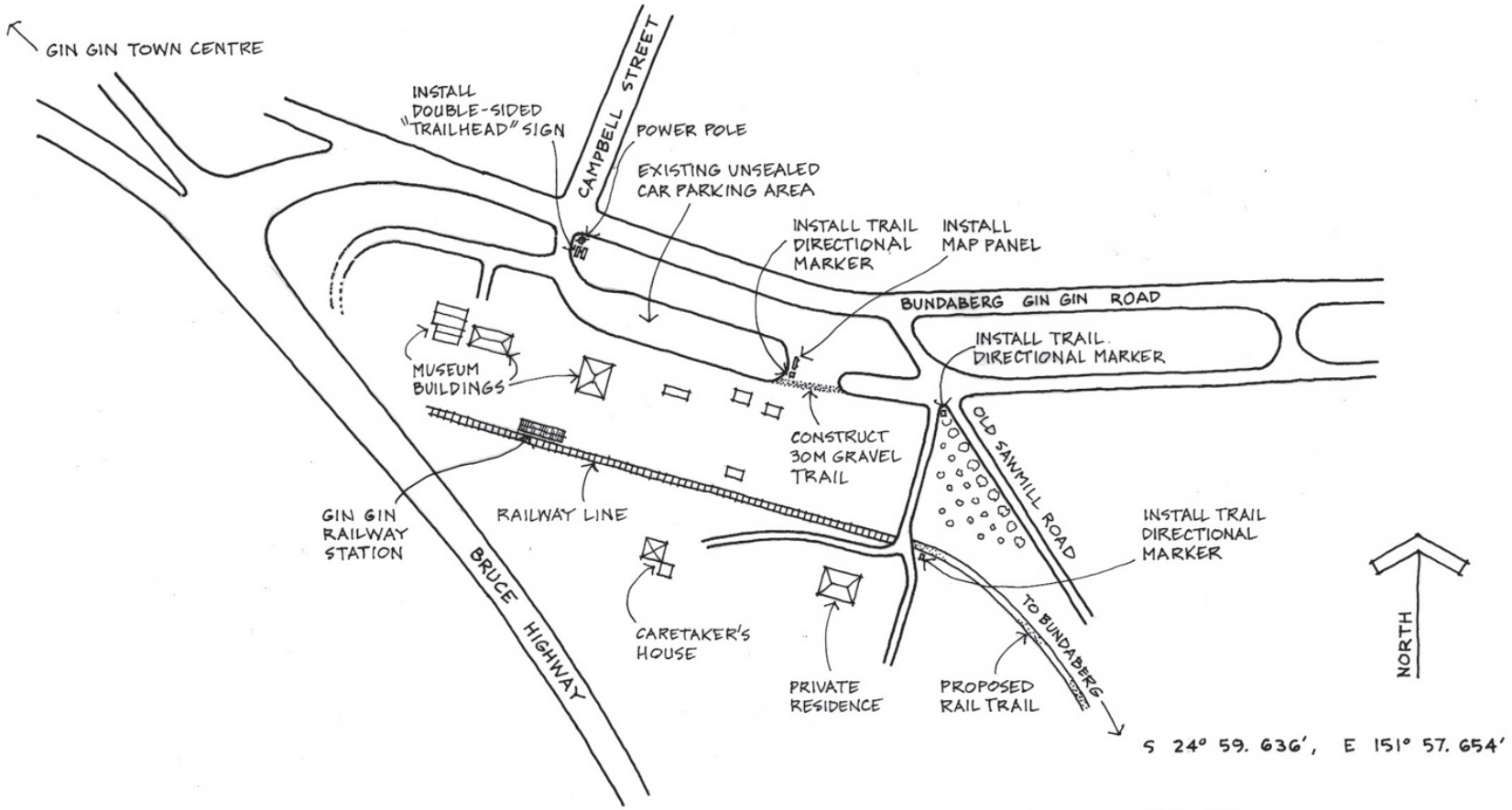

BUNDABERG GIN GIN RAIL TRAIL
SHARON TRAILHEAD
SERVO AND STORE
SHARON STATE SCHOOL
BUNDABERG GIN GIN ROAD
INSTALL MAP PANEL
USED CLOTHING BIN
INSTALL TRAIL DIRECTIONAL MARKER
EXISTING PATH
CULVERT
INSTALL DOUBLE-SIDED "TRAILHEAD" SIGNS
NORTH
S 24° 52. 413', E 152° 15. 760'
INSTALL TRAIL DIRECTIONAL MARKER
EXISTING PATH
0 1 5 10 15 20 METRES
CULVERTS
SHARON ROAD
SHARON TRAILHEAD
INSTALL SINGLE-SIDED "TRAILHEAD" SIGN


BUNDABERG GIN GIN RAIL TRAIL
KOOLBOO TRAILHEAD
RUTHS ROAD
PROPOSED RAIL TRAIL
TO BUNDABERG
ALLAN SCHMIDT ROAD
INSTALL TRAIL DIRECTIONAL MARKERS
CONSTRUCT CONNECTING TRAIL TO RAIL TRAIL
ROAD CROSSING (SEE DRAWING)
INSTALL MAP PANEL
EXISTING GRAVEL TRACK
TO GIN GIN
GRADE & GRAVEL TRAILHEAD PARKING AREA
PROPOSED RAIL TRAIL
INSTALL DOUBLE-SIDED "TRAILHEAD" SIGNS
CONSTRUCT ADDITIONAL ACCESS TRACK
KOOLBOO ROAD
NORTH
S 24° 55. 410', E 152° 08. 830'
0 5 10 20 30 40 METRES
KOOLBOO TRAILHEAD


BUNDABERG GIN GIN RAIL TRAIL
BULLYARD TRAILHEAD
BULLYARD STATE SCHOOL
EXISTING CULVERT
INSTALL TRAIL DIRECTIONAL MARKER
OPENING IN FENCE
INSTALL TRAILHEAD MAP PANEL
FENCED ENCLOSURE
INSTALL DOUBLE-SIDED "TRAILHEAD" SIGN
INSTALL CULVERT UNDER TRAIL
POWER POLES
BUCCA ROAD
SHED
NORTH
FENCELINE
PARKING AVAILABLE UNDER TREES
S 24° 57. 030', E 152° 03. 701'
CONSTRUCT NEW PATH TO RAIL TRAIL
EXISTING TOILET
01 5 10 20 30 METRES
SHED
BULLYARD TRAILHEAD

BUNDABERG GIN GIN RAIL TRAIL

GIN GIN TRAILHEAD



GIN GIN TRAILHEAD

Appendix 4

Trail maintenance checklist: An example

KEP TRACK MAINTENANCE CHECKLIST

The checklist that follows has been designed to be copied before each regular inspection, filled out and filed for future reference. It assumes the inspection will commence at Mt Helena and proceed in an easterly direction towards Wooroloo. This is an essential component of the maintenance program.

KEP TRACK (Mt Helena to Wooroloo) - MAINTENANCE CHECKLIST

Inspection Date (circle a year and tick one box):

☐ Jan 2005/6/7 ☐ Feb 2005/6/7 ☐ Mar. 2005/6/7 ☐ Apr 2005/6/7

☐ May 2005/6/7 ☐ Jun 2005/6/7 ☐ Jul 2005/6/7 ☐ Aug 2004/5/6

☐ Sep 2004/5/6 ☐ Oct 2004/5/6 ☐ Nov. 2004/5/6 ☐ Dec 2004/5/6

Actual Date: _____

Person undertaking inspection: _____ Signature:

LOCATION	ACTION REQUIRED	TICK IF OKAY	ACTION TAKEN (IF ANY)
Sawyers Road Crossing in Mt Helena	• Check gate west side • Check directional markers • Check totems and signage • Check promotional signage		
Johnston Street (Mt Helena)	• Check gate west side • Check directional markers • Check totems and signage		
Lion St crossing	• Check gates both sides • Check interpretive sign (north west corner) • Check directional markers • Check totems and signage • Check promotional signage		
Exit from Eastern Hills High School (crossing)	• Check gate east side • Check directional markers • Check totems and signage • Check interpretive sign (opposite Sime Rd)		
Thomas / Elliot road crossing	• Check gates both sides • Check directional markers • Check totems and signage • Check promotional signage • Check interpretive sign (opposite booster station)		
Chidlow Reserve	• Check interpretive signs (at turnoff to Lake Leschenaultia;opposite standpipe; opposite stone building; at old interpretive shelter) • Check condition of new trail through reserve		

KEP TRACK (Mt Helena to Wooroloo) - MAINTENANCE CHECKLIST

LOCATION	ACTION REQUIRED	TICK IF OKAY	ACTION TAKEN (IF ANY)
Old Northam Rd (Chidlow)	• Check gate east side • Check directional markers • Check totems and signage • Check promotional signage • Check culvert west side • Check ramps • Check interpretive sign (mid point between Old Northam Rd & Ash Rd)		
Ash Rd crossing	• Check gates both sides • Check directional markers • Check totems and signage • Check promotional signage		
Doconing Rd crossing	• Check gates both sides • Check directional markers • Check totems and signage • Check promotional signage • Check interpretive sign (150 metres east of crossing)		
Old Northam Rd crossing	• Check gates both sides • Check directional markers • Check totems and signage • Check promotional signage • Check culverts (both sides) • Check interpretive sign (SW corner)		
Entrance to horse trials paddocks	• Check gates • Check directional markers • Check totems and signage • Check road warning signs		
Government Rd crossing	• Check gates both sides • Check directional markers • Check totems and signage • Check new 40 metre section of trail at road crossing		
Government Road to Green St	• Check interpretive sign (where pipeline crosses trail) • Check interpretive sign (opposite Jason St)		
Green Street	• Check gates both sides • Check directional markers • Check totems and signage		
Any additional work required?			
Hazard Inspection	Whole trail - annually		
Annual budget allocation	Discuss with staff		

Appendix 5

Splitters Creek Bridge report by Wood Research and Development

23rd April, 2019

Visual Condition Report and Recommendations of Repurposing for a Rail Trail Bridge

Splitters Creek Railway Bridge

Client: Mike Halliburton Associates

PREPARED AND PRESENTED BY:

Dan Tingley
PhD | PEng (CA) | MIEAust | CPEng | RPEQ (AU)

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Caboolture, QLD 4510
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WOOD RESEARCH AND DEVELOPMENT

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1.0 INTRODUCTION

The visual condition state inspection of Splitters Creek Railway Bridge was completed by a Wood Research and Development (WRD) Level II Certified Inspection Engineer on the 28th March 2019. The objective of the investigation was to establish the general condition of the primary structural elements, and to assess what techniques could be utilized to safely repurpose the structure into a rail trail bridge for pedestrian and cyclist use. A detailed visual inspection was commissioned and used in this investigation along with a brief, low density/cavity test of several elements using non-destructive tests, including: EPHOD® Stress Wave Technology. Refer to **Appendix A** for more information about this technology.

This inspection report has been prepared by Dan Tingley Ph.D., P.Eng. (Canada), MIEAust, CPEng, RPEQ, senior engineer and wood technologist for WRD and Andrew La Spina, Timber Structures Engineers for WRD.

Splitters Creek Bridge is situated approximately 7km West of Bundaberg along the decommissioned railway line running from Mount Perry to Bundaberg which opened in 1980 and continued in operation until 1993. The 290m long bridge is comprised of two steel through plate girder spans over Splitters Creek with 7 timber approach spans on side 1 of the creek and 18 timber approach spans on side 2. Each timber approach span has 2 hardwood girders which are supported by corbels with the typical length of 6.1m close to the abutment and the remaining 20 spans are 11m long and strengthened with strut and crown bracing along with 2 lengths of steel cabling running full length. The metal girders are continuous over two spans and support cross-girders at lower flange level which support the longitudinal timber stringers on which the rails rest.

The approach span bents (piers) consist of a concrete footing which supports 4 x 9m-10m long timber posts (approximately 25% of the piers have 5 posts) while the 3 bents for the metal girder spans over the creek are constructed from brick & concrete with timber wale caps on top of the footing which supports the 12 x 10.5m-11m timber posts (double configuration). The original design required screw pile foundations, but a deep bed of boulders was encountered and cast iron caissons, later filled with concrete and brickwork, had to be sunk instead. The 6.1m spans at each abutment are supported by 2 or 3 driven piles while the abutments are constructed from concrete with wing walls consisting of concrete panels (sleepers) held in place by a section of the steel railway line. Refer to **Table 1-1** for a summary of the configuration and dimensions for Splitters Creek Bridge.

The structure crosses over the tidal Splitters Creek, where the upstream side of the creek is on the right-hand side (Girder 2 side) of the structure. Approach 1 with the GPS co-ordinates of '-24.86251, 152.287552' is located on the Eastern Side of structure and is closest to the township of Bundaberg. The nomenclature used in this report is consistent with that adopted by the Department of Transport and Main Roads. The abutments and bents are numbered in increasing order as they progress further along the route from the Eastern end of the bridge, and the girders and corbels are numbered increasing from left to right.

Splitters Creek Railway Bridge was listed on the Queensland Heritage Register on 21 October 1992 having satisfied the following criteria below. A late 19th century timber trestle bridge, representative of a type once more widespread in Queensland, with riveted half-through continuous plate girder main spans which are the oldest example of their type in Queensland.

- The place demonstrates rare, uncommon or endangered aspects of Queensland's cultural heritage.
- The place is important in demonstrating the principal characteristics of a particular class of cultural places.

Table 1-1: Summary of Configuration and Dimensions for Splitters Creek Bridge

Type of Span	Number of Spans	Span Length	Girders per Span	Size of Girder	Typical Spacing	Type of Substructure (supports)	Number of Posts/ Piles	Size of Piles	Typical Spacing
Centre Steel (over creek)	2	18.3m	2	Ø 375-450mm	1.7-1.8m	Timber Posts with brick and concrete footing	12	Ø 375-450mm	0.8-1.2m
Timber Approach Span	20	11.0m	2	Ø 375-450mm	1.7-1.8m	Timber Posts with concrete footing	4-5	Ø 375-450mm	1.4-1.8m
Timber Approach Span	5	6.1m	2	Ø 375-450mm	1.7-1.8m	Driven Piles	2-3	Ø 375-450mm	1.4-1.8m

.

2.0 INSPECTION FINDINGS

2.1 Visual Inspection

An essential step in evaluating the condition of a structure is undertaking a visual inspection. The visual aspect of the investigation is used to pick up missing or failed elements, cracks and splits, cavitation, connection details, abutment condition, undermining and debris build-up, among other important information. Gathering this information is essential for completing a comprehensive investigation, and taking into account the surroundings in addition to the main structural elements. See **Figure 2-1** through **Figure 2-13** below for a summary of findings.

Figure 2-1: View of Splitters Creek Bridge from end 1. There is 7 timber approach spans on Side 1 (Eastern Side) of the creek which is spanned by 2 continuous steel through plate girders supported by a centre timber bent (trestle) in the creek. There is a large amount of vegetation growth around the timber bents which keeps the moisture content high in the timber. When the moisture level in the timber is above 22%, decay-causing fungi can start to grow; when the moisture content drops below this level, the fungi become dormant and decay will be arrested until the moisture content rises again.

Figure 2-2: View of Splitters Creek Bridge from end 2. There is 18 timber approach spans on Side 2 (Western Side) of the creek. Unlike side 1, the vegetation is quite low and clear under and around the bridge as cattle continually graze this area. Note Bent 1 consists of driven timber piles (Pile Bent), while the remaining bents of this side are constructed from timber posts bearing directly on a concrete footing (Frame Bent). Note the fence to prevent pedestrian or vehicle traffic.

Figure 2-3: View on top of the bridge from Abutment 2. The transoms (rail ties) remain intact along with the railway line and the existing features such as the emergency bays (absent of hand rails on two sides in each case) off the side of the bridge.

Figure 2-4: Close-up view of the transoms and the condition of the girders from the top. Overall the timbers members appear in a fair condition and it seems a large amount of restoration works were completed just prior to the railway line closing in 1993, 26 years ago. However, with the high density of vertical through bolts suggest that there might be decay within the members or lead to decay in the near future once the 'natural durability' of the hardwood depletes. Vertical fasteners increase the rate of decay in timber as they allow moisture to travel down the fastener into the heartwood of the girders and corbels where evaporation is more difficult, therefore increasing the moisture content in the middle of these elements over longer periods of time. The heartwood of a log element is less capable of breathing and expelling moisture than the sapwood that surrounds it, so vertical connectors funnel the moisture directly into the heartwood accelerating decay. Once the moisture content exceeds 22%, timber consuming fungi are activated and the decay process begins. Refer to Figure 4-2 for a detailed description of how and where the decay occurs due to these vertical bolts.

Figure 2-5: View of both abutments, Abutment 1 on top and Abutment 2 the bottom image. Both abutments are concrete piers with the wingwalls consisting of concrete panels held in place by sections of the steel railway line. This is a typical abutment configuration for this period of railway construction and is a testament to the original construction and should be retained as they are in fair condition.

Figure 2-6: An overall view of the timber approach spans of side 2 from the creek bed. The 11m long girders are supported by struts (knee braces) attached to the frame bents which effectively reduces the span length and helps transfer the load from the superstructure (girders) into the substructure (posts). This allows smaller (more accessible at the time) girders to span a longer length and keep the number of bents down as they would have been a large percentage of the overall cost of the bridge. The girders bear directly on corbels which sit on the headstocks. The headstocks transfer the load into the 4 posts (some posts have 5 posts) and down into the concrete spread footing. The timber sashes (horizontal braces) and cross bracing provides lateral support for the tall bents. The full length shoes for the knee brace attachment to the girders is an interesting design not typical of the period.

Figure 2-7: Several of the bents have log longitudinal bracing that extends from the concrete base of one bent to the top sash of the bent being supported. This bracing is repeated on the other side of the bent. This type of stability repair is seen in two other locations along the bridge.

Figure 2-8: There are three larger timber frame bents that support the two steel plated girder spans over Splitters Creek. These bents consist of 12 timber posts that bear on timber cap wales that help distribute the load into the concrete footings. Overall these bents are visually in fair condition and are very significant to the heritage of the structure. Note the black coal tar coating applied to the bottoms of the columns. This coal tar paint holds the moisture into the bottoms of the columns and the moisture absorbed from the concrete below is not able to evaporate. This is an old method of heavy timber bridge construction that actually shorted the timber component life. Diffusing these areas would be important to preserve and extend the life of the element.

Figure 2-9: View of one of the pile bents on approach 1 side of the creek. This bent consist of three driven piles and overall in fair condition. Most of the corbels in these bents are in fair condition, however there was only one corbel found that had crushed and failed due to the vertical through bolt allowing moisture in which lead to the member decaying.

Figure 2-10: The typical detail of the post hold down connection is two large steel plates (railway line) embedded into the concrete footing that connects to the timber post with 6 horizontal bolts. As shown in Figures 2-11 & 2-12 below, the bottom section of several posts have moderately to severely undergone decay. This is as per expected due to the timber posts bearing directly on the concrete footing which typically has a high moisture content. Over time the timber post undergoes capillary action and draws up the moisture like a 'straw'. Once the moisture content in the timber elements reaches 22%, decay causing fungi are activated and the decay process begins. The heavy solids coating on the column bottoms has further increased the moisture retention problem by preventing the element from breathing and reaching equilibrium moisture contents below the point at with decay begins and proceeds (22%).

Figure 2-11: As described above, the bottom sections of the timber posts were determined to be a 'hotspot' for decay and determined to be an ideal area to test using non-destructive methods, such as EPHOD® Stress Wave Technology. Refer to Appendix A for more information of this type of testing method. The reading of 2236 µs recorded is the time taken for the compression wave to travel across the section of the member tested. This was recorded at the bottom of one of the posts and was found to be similar across 25% of the posts. Deterioration of this magnitude means that the Modulus of Elasticity/Modulus of Rupture in various stress directions (wood is anisotropic with different strength properties in different directions) has deteriorated to an extent that the element can no longer support its own dead weight. Readings between 1000µs and 2200µs indicate that the member cannot carry its own dead weight in these regions. Readings in excess of 2200µs can signify a cavity while a reading above 3300µs indicates the element can no longer support its own dead load and is at risk of failing at any point. It can also be noted that roughly 1m above the concrete footing the post had readings around 600 µs which signifies sound (solid) wood resulting in only the bottom portions requiring require. It is highly recommended to conduct a detailed inspection of the entire substructure utilizing non-destructive technology through the use of the Stress Wave Timer (SWT) machine. Also note that termites were found at this particular location and it's unknown how many other areas of the structure are affected. It is estimated that 25% of the posts will require repair at the bottom 1m section of the post and 10% will require full repair/replacement. Refer to Section 5 for a full list of recommended repair options for refurbishment to a pedestrian/cycle bridge.

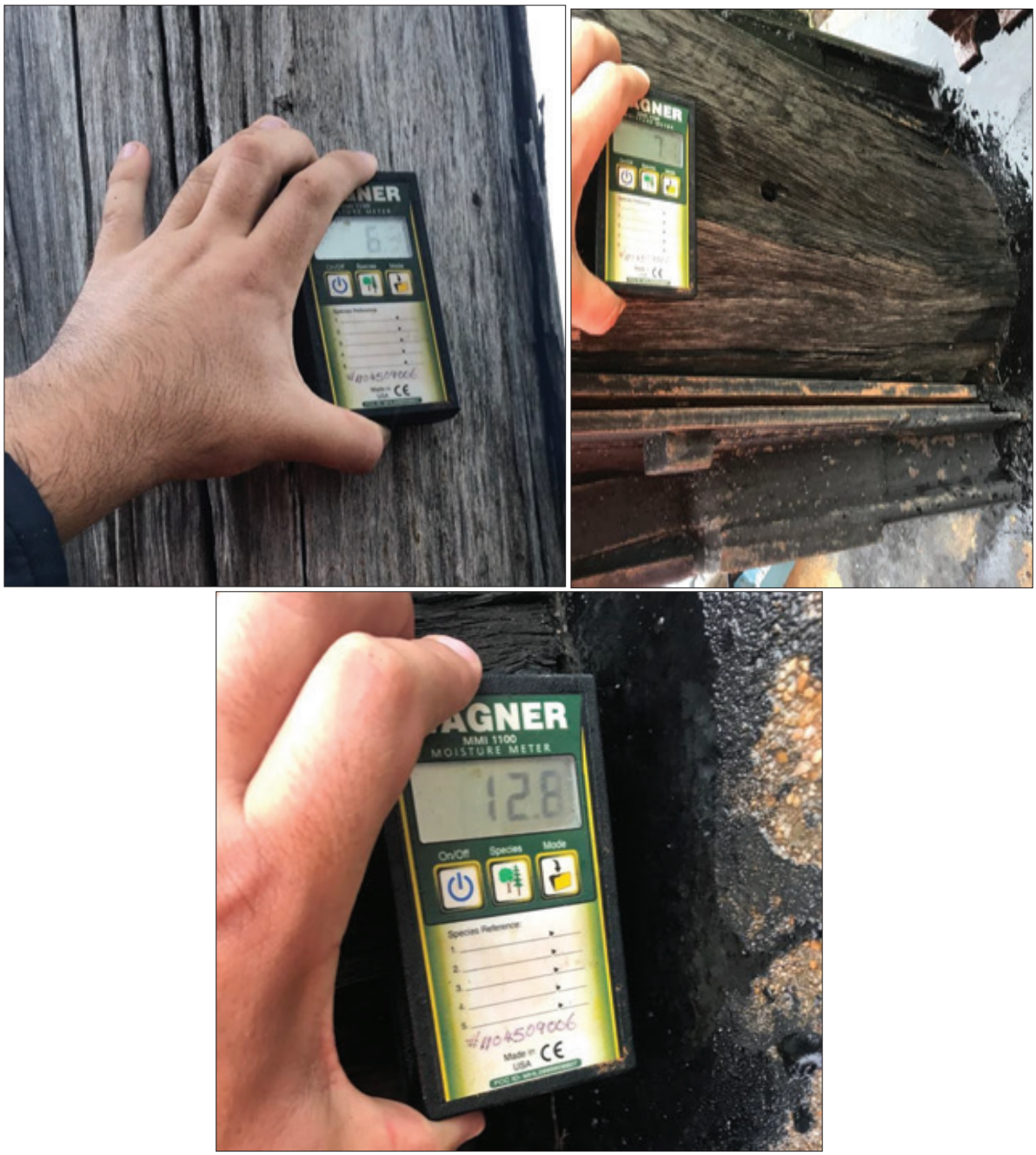

Figure 2-12: As mentioned previously and proved in the three images above, the moisture content (MC) of the timber post is higher in the timber element closer to the 'saturated' concrete footing. The 6.3% MC is measured roughly 1m up from the footing, the 7.1% reading was 0.5m from the bottom and the highest reading of 12.8% MC reading was just above the concrete footing.

Figure 2-13: The girders and corbels of the two lower spans at Abutment 2 end was also briefly tested with the SWT machine. The adjusted values of most of the readings did not exceed 700 microseconds. This suggests that the timber at the locations tested is still in fair condition and will be suitable for use in carrying pedestrian loadings. However this is only a small sample size and it is highly recommended to conduct a detailed inspection of the entire superstructure using of the SWT machine. As mentioned previously the vertical fasteners that connect these members together increase the rate of decay in timber as they allow moisture to travel down the fastener into the heartwood of the girders and corbels, therefore increasing the moisture content in the middle of these elements. The heartwood of a log element is less capable of breathing and expelling moisture than the sapwood that surrounds it, so vertical connectors funnel the moisture directly into the heartwood accelerating decay. Once the moisture content exceeds 22%, timber consuming fungi are activated and the decay process begins. It is estimated that 10% of the corbels and girders will require repair/replacement. Refer to Section 5 for a full list of recommended repair options for refurbishment to a pedestrian/cycle bridge.

2.2 Site Evaluation

To successfully evaluate the strength and durability of a bridge a site evaluation must also be considered. Several key elements of the surroundings must be considered such as stream migration, substructure foundations and stream debris fields. Once these factors are identified, discussed and evaluated the true strength and longevity of the bridge can be determined.

2.2.1 Stream Migration

The migration of a creek has high importance when considering the potential impacts on the durability and serviceability of the foundations of structures adjacent to it. Factors such as water levels, flow rate and volume can directly influence the rate of deterioration of the bridge. When inspected, the creek had minimal water flowing between the two middle spans, which allowed a visual inspection of all of the exposed substructure elements.

High flow rates can put the structure at high risk of being damaged by impact. Large debris can get caught in the current and, moving quickly, can impose a great deal of damage on the structural elements. At the time of inspection, the water present had a slow flow rate and posed no risk to any of the elements in the structure. Large amounts of bracing was evident which suggest the structure does experience high flow rates during a flooding event so this must be considered when designing the refurbished structure.

High lateral loading imposed by the creek on the bridge develops when the volumetric flow rate is high. Put simply, the higher the volume of water passing the bridge, the larger the lateral and uplift forces being applied to the elements. It is important to monitor the bridge for movement following high water events. Further investigation was conducted up and down the creek in order to detect signs of erosion that can lead to future stream migration and potential undermining of the structure. No signs of migration were found, and it appears as though the creek is following a stable route. It is important to monitor conditions, especially following peak flow events, as migration can be initiated at any time. The high lateral loading can be increase further when longitudinal bracing and longitudinal knee bracing extends into the channel flow area. The APR100 flood condition levels must be checked against the position of the longitudinal bracing found in the bridge.

2.2.2 Substructure Foundations

Evaluating the integrity of the substructure foundation to establish the risk of undermining and erosion is just as important as determining the strength of the substructure itself. The risk of failure increases if the surrounding foundation areas of key substructure components such as abutments and piers are weak or poorly supported. Erosion of soil around piers and abutments can lead to undermining, which in turn can result in destabilization of the bridge support system. The substructure appears to be free of erosion, undermining and head cut; however it should be monitored following high water events to ensure stability of the piers and abutments.

2.2.3 Stream Debris Fields

Just as important as the live loads applied when pedestrians pass over the bridge are the loads exerted on the bridge by water and debris flowing down the stream. Although no debris present on the bridge at the time of inspection it is important to keep the bridge free of debris because build-up creates a larger bearing surface for lateral loads than was anticipated during design. Another issue that arises from debris build-up is an increase in moisture content as the debris retains moisture against the structural elements.

3.0 CONDITION STATE ANALYSIS

To meet the objective of the project, an assessment of the structure was undertaken to determine its current condition as well as its suitability for repurposing into a rail trail bridge for pedestrian and cycle use. Note: the analysis was completed based on a visual assessment and a low number of test locations using non-destructive tests, including: EPHOD® Stress Wave Technology. Refer to Appendix A for more information about this technology. It was determined that the substructure elements (timber frame and pile bents) in Splitters Creek Railway Bridge are in overall poor condition. The timber superstructure (girders and corbels) was also deemed to be in poor condition while the deck of the structure appears to be in fair-poor condition. However, to repurpose as a rail trail bridge the deck will require refurbishment works to ensure safety for the pedestrians and cyclists. The structure has been given an overall condition state rating of 3. This rating does not speak to the load rating. A load rating of the structure was not completed for this report.

This rating was based from a small sample size of data collected and it is highly recommended to conduct a detailed inspection of the entire bridge. This will gain a higher level of accuracy for the recommended repair options listed and costed in **Section 5** below. The definitions of the condition ratings relating to the Bridge Inspection are:

Table 3-1: Condition State Rating Descriptions

Condition State	Subjective Rating	Estimated Remaining Life Span		Description
1	Good	100%	80 Years	Like new condition and free of defects.
2	Fair	80%	64 Years	Free of defects affecting structural performance, integrity and durability. Deterioration of a minor nature in the protective coating and/or parent material is evident.
3	Poor	30%	24 Years	Defects affecting the durability/serviceability which may require monitoring and/or remedial action or inspection by a structural engineer. Component or element shows marked and advancing deterioration including loss of protective coating and minor loss of section from the parent material is evident. Intervention is normally required.
4	Very Poor	5%	4 Years	Defects affecting the performance and structural integrity of the structure which require urgent action as determined by a detailed structural engineering inspection. Component or element shows advanced deterioration, loss of section from the parent material, signs of overstressing or evidence that it is acting differently to its intended design mode or function.
5	Unsafe	1%	Less Than 2 Years	Structure should be closed. Structural integrity is severely compromised, and the structure must be taken out of service until a structural engineer has inspected the structure and recommended the required remedial action.

1. Typically a structure may be defined as defective when greater than 25% of principal components are rated as Condition State 4 in a single abutment, pier or span group.

4.0 TYPICAL DECAY AND ITS OCCURRENCE

4.1 Wood Deterioration

Wood deteriorates for numerous reasons, and as deterioration implies this adversely affects woods properties. The two primary causes of deterioration in wood are: biotic (living) agents and physical (nonliving) agents. In many cases the agents that first alter the wood, provide the conditions for other agents to attack (e.g. insects bring woodpeckers). The effectiveness of an inspection of deteriorated wood depends upon the inspector's knowledge of the agents of deterioration. A well-trained inspector is essential for accurately assessing wood deterioration.

4.2 Wood Deterioration Due to Biotic Agents

Biotic, or living, organisms that attack wood include bacteria, fungi, insects, and marine borers. As living organisms, they require certain conditions for survival such as moisture, oxygen, temperature, and food, which is usually the wood. When the basic necessary living conditions are available biotic agents of wood deterioration are free to proliferate, but if any one of them is removed the wood is safe from further biotic attack. Geographical regions tend to have higher moisture content due to average temperature and relative humidity. See **Figure 4-1** below for the decay hazard zones for Australia.

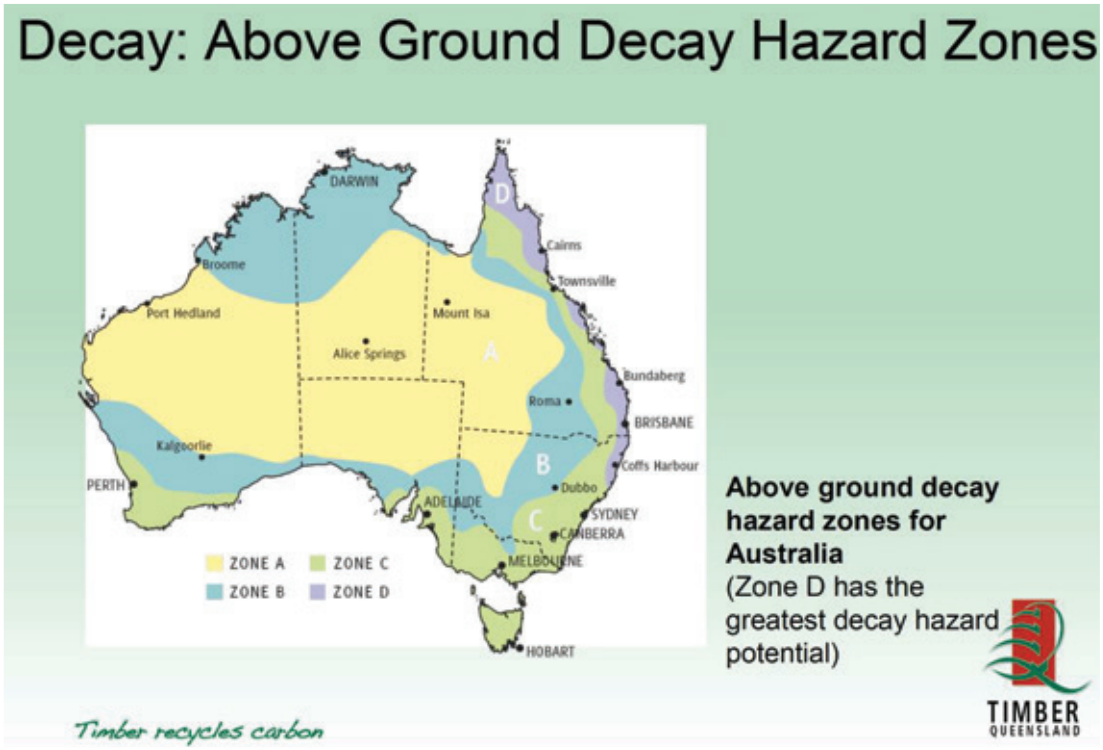

Figure 4-1: Decay Hazard Map for Australia showing that the Tumbarumba Rail Trail bridges are in the second highest decay hazard zone in Australia. The typical moisture contents in these timber bridges are 16.4% for open deck bridges and 14.2% for closed deck bridges. Decay doesn't begin in wood till the moisture content reaches 22%. The majority of decay in timber in the Snowy Valley area is due to vertical fasteners and design details that allow moisture to accumulate in and around timber elements.

4.2.2 Bacteria

In very wet environments bacteria can colonize untreated wood. Bacterial damage can include softening of the wood surface, increased permeability, and even degradation of chemical preservatives so that the wood becomes more susceptible to less chemically tolerant organisms. Usually the process bacterial attack is very slow, but under extensive exposure for long periods, damage can become significant.

4.2.3 Fungi

When exposed to favourable conditions, most types of wood become an attractive food source for a variety of decay-producing fungi. The fungi require moderate temperature, oxygen, and a moisture content of approximately 19% or greater (oven dry basis) to become active. Decay progresses most rapidly at temperatures between 10°C (50°F) and 35°C (95°F), outside this range decay growth slows considerably, and ceases when the temperature drops as low as 2°C (35°F) or rises as high as 38°C (100°F). If the wood is water-soaked, the supply of oxygen may be inadequate to support development of typical decay fungi. Thus, wood will not decay, and decay already present from prior infestation will not progress if appropriate conditions are not met.

Examples of wood preservation by environmental conditions are common. Timber pagodas in China have survived hundreds of years, and in some cases over 1,000 years, because the wood was kept dry. Entrepreneurs in the United States are recovering old growth wood from sunken transport ships and selling the recovered wood. The sunken wood has been almost perfectly preserved by being kept saturated such that oxygen is not available for decay to proceed.

Decay fungi may be generally classified into two categories by the appearance on the wood surface.

1. **Brown Rot |** Appears darker and can crack across the grain. Brown rot fungi attack the cellulose in the wood fibres. The brown colour is due to the remaining lignin (the binder which holds the cellulose structure together), which is not consumed by the fungi. The decayed wood tends to form into small cubic shaped sections, which is a sign of advanced decay.

2. **White Rot |** Appears lighter in colour and does not crack across the grain until severely degraded. In contrast to brown rot, white rot consumes both the lignin and cellulose and leaves the surface appearing generally intact, but with little or no significant mechanical strength. The surface of the decayed wood tends to have a “white” appearance.

Dry rot is a common term utilized by building inspectors to describe wood that becomes brown and crumbly and in an apparent dry condition. However, dry rot is a misnomer, because the wood must have some moisture in it to decay, although it may become dry later. A few fungi have water-conducting strands (hyphae) which are capable of carrying water, usually from the soil, into buildings or wood piles where they moisten and rot wood that would otherwise be dry. The material they are calling dry rot is frass or the residual material left after the decay causing fungal colony has moved on.

Interior decay damage can occur even when some precaution has been taken. Surface treated wood material can form cracks, which extend beyond the treated surface into untreated core material. Water can also get into the core of “protected” wood by the fungi hyphae. In either case water enters the core material and provides the adequate conditions for decay fungi to live. Wood with as little as a 10% loss in Specific Gravity (SG) due to decay can have up to 75% loss in bending strength and 80% loss in compression perpendicular to grain strength.

Figure 4-2 below shows the level of decay typically found due to vertical through bolts. A similar occurrence happens to the base of the pile when they are sitting directly on concrete. The timber soaks up the water from the concrete, which accelerates decay.

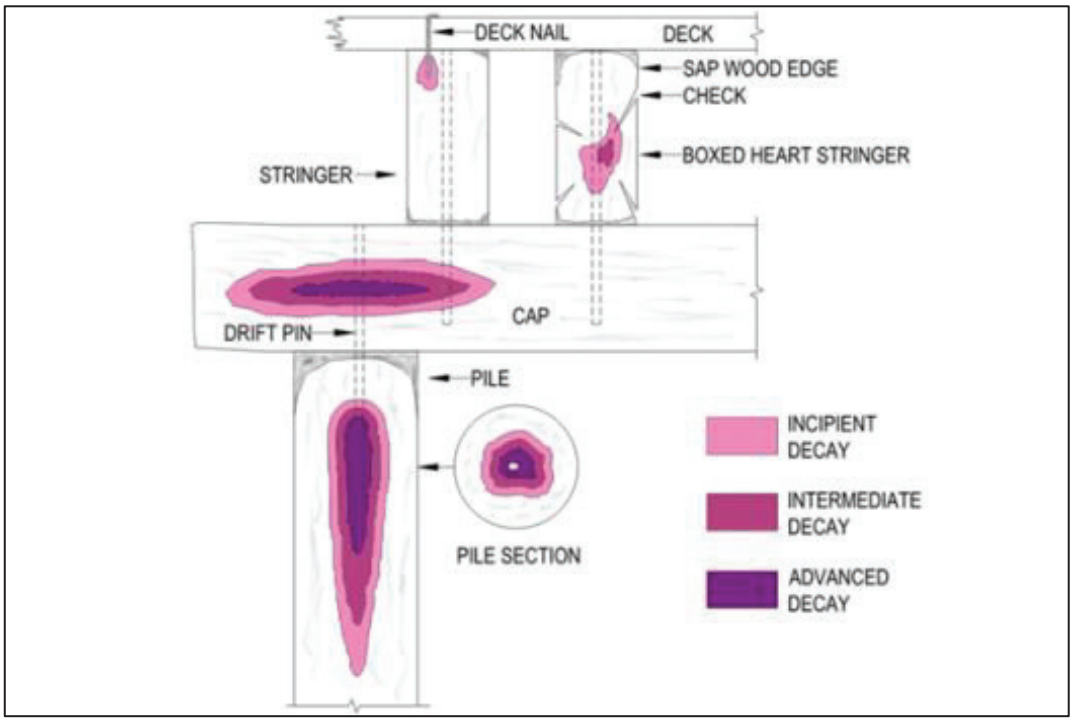

Figure 4-2: Shows the level of decay that occurs in timber due to the use of vertical fasteners. Vertical fasteners increase the rate of decay in timber as they allow moisture to travel down the fastener into the heartwood of the headstock (cap), girders (stringers), corbels and piles, therefore increasing the moisture content in the middle of these elements. The heartwood of a log element is less capable of breathing and expelling moisture than the sapwood that surrounds it, so vertical connectors funnel the moisture directly into the heartwood accelerating decay. Once the moisture content exceeds 22%, timber consuming fungi are activated and the decay process begins.

4.3 Preventing Decay Utilizing Borate Salt Rod Diffusers:

Another complimentary method of controlling decay, should it commence due to the less frequent occurrence of ideal decay progression conditions, is to install Borate salt rod diffusers. These are included as an additional option at this stage due to budget constraints and can be installed at a later date during maintenance works to increase the longevity of the structures. The vitrified glass borate salt rod (anahydrous) upon reaching a moisture content of approximately 22%, emits an alkaline brine throughout the wood cellular structure up to a radius of 150 mm from the rod. This brine neutralises the acidic enzyme that is secreted by a growing decay colony. Without the enzyme chemically attacking the cellular structure of the wood, decay cannot proceed. If diffusers are installed into the timber structure as insurance against the occurrence of ideal decay producing conditions and these diffusers are maintained throughout the life of the structure, then the achievement of the design life requirements for the structures proposed, is Guaranteed. Australian hardwoods, particularly the class 1 and 2 durability timbers can have a significantly longer life expectancy than previously thought based on the former statistical average element lifetimes.

5.0 REFURBISHMENT RECOMMENDATIONS & COST ESTIMATES

Based on the information compiled from both the visual inspection and brief SWT testing, the bridge will require several repairs/replacement to repurpose the railway bridge as a rail trail bridge for pedestrian and cycle use. Three (3) options have been developed to refurbish the structure into a rail trail bridge. Option 1 utilizes the entire existing structure in its 'current' condition with a new deck and handrail system installed on top of the existing rail ties (transoms). Depending on the results of the full inspection this option cannot be guaranteed a 5kPa load rating unless high strength fibres are used and can only be rated for a service life of 10-15 years based on the existing condition of the elements and the connection details used. Option 2 involves removing the existing railway line and transoms, repairing/replacing substructure and superstructure elements where required with kind for kind elements and adding in addition hardwood log girders where required. A hardwood deck system with a code compliant handrail and cycle rail system will be fitted on top of the girders utilizing a horizontal connection system that achieves a 25-50 year design life for this option along with a 5kPa load rating. Option 3 will result in the longest design life (75-100 years) as this option involves installing a new treated glulam superstructure and deck with handrail system on top of the restored existing substructure.

All options include the remaining hardwood elements to be diffused with Borate salt rods to increase the life of the structure by preventing decay as described above in **Section 4.3**. Also included for options 2 and 3 is the restoration and repair works required to use the existing steel plated girders that span over the creek and is the main reason the structured in listed under the Queensland Heritage Act.

See below for full descriptions of the options and the detailed repair work tables and low level (level D) cost estimates.

5.1 Option 1 - Short Term Refurbishment (10-15 Years)

Option 1 utilizes the entire existing structure in its 'current' condition with a new deck and handrail system installed on top of the existing rail ties (transoms). The existing railway bridge structure will be left un-touched and approximately 6 timber joists will be installed full length along the top of the existing transoms. A hardwood deck will be installed on top of the joist formation along with a code compliant handrail and cycle rail system. This option will likely be the lowest cost but also carries the shortest expected lifespan. Depending on the results of the full inspection this option cannot be guaranteed a 5kPa load rating unless high strength fibres are used to restore the posts, girders and corbels. This option can only be rated for a service life of 10-15 years based on the existing condition of the elements and the connection details used.

See Table 5-1 and the cost estimate below for more details of this option. Also refer to **Figure 6-2** for a photo narrative of this type of refurbishment used for a similar railway bridge along the same railway line closer to the township of Bundaberg. **Figure 6-5** shows similar type of fixes using high strength fibres and can be see below.

Table 5-1 | Option #1 – Build New Deck off Existing Structure

Component	Component Location	Repair Recommendations
Abutment and Back/Wing walls	AB1 and AB2	Use existing formation in current condition.
All Pile/Frame Bents	All Substructure	Use existing elements in current condition. Install 1m length of high strength fibre at the bottom of 25% of the posts.
Girders & Corbels	All Superstructure	Use existing elements in current condition. Install high strength fibre reinforcement along the bottom of 20% of the girders.
Transoms and Railway Track	All Spans (Deck)	Use existing elements in current condition.
Joist	All Spans	Install 6 new full length hardwood (F17) joists, approximate size - 100mm x 250mm
Deck	All Spans	Install new hardwood deck planks. 38-50mm thick and 2.5m clear width between cycle rails.
Handrail & Cycle Rail	All Spans	Install new handrail system consisting of vertical balustrade panels and a cycle rail 1.4m off deck height.
Substructure Hardwood Elements	All Bents	Diffuse all structural substructure hardwood elements with Borate Salt rods to prevent any further deterioration.
Superstructure Hardwood Elements	All Spans	(Optional) Diffuse all structural superstructure hardwood elements with Borate Salt rods to prevent any further deterioration.

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WOOD RESEARCH AND DEVELOPMENT

Splitters Creek Bridge - Option 1 - Rehabilitation Works for Converting into a Pedestrian and Cycle Bridge Installl New 2.5m Wide Deck System on top of existing structure with 5kPa Load Rating - Cost Estimate (Level D)

ITEM	DESCRIPTION	TOTAL
	Engineering & Project Management, Site Set-up & Running Costs & Machinery Hire	
1	Structural Engineering, Bridge Survey, CAD drawings, Work Approvals, Project Management and Supervision	$182,150
2	Crew Mobilisation, Site establishment, running costs and disestablishment	$40,400
3	Demolitions: removal of bridge superstructure	$0
4	Bridge access (EWP booms and scaffolding) including any additional tracks down to bridge	$190,000
5	Machinery (Crane, Excavator) Hire	$80,000
6	Shipping material to job site	$25,000
	Sub Total:	**$517,550**

	Supply and Installation	
7	Substructure Repairs including High strength Pile Wraps as per Table 5-1	$88,200
8	Superstructure Repair of Existing Elements and New Joist System as per Table 5-1	$352,500
9	New Deck and Code Compliant Handrail (with cyclerail) System as per Table 5-1	$618,600
10	Steel Girder Repairs - Re-coating	$0
11	(Optional) Diffuse Superstructure timber: Supply & install Borate Salt Rods & bungs	$91,500
12	Diffuse Substructure timber: Supply & install Borate Salt Rods & bungs	$186,500
13	Approach Works to be completed by trail contractor	$0
	Sub Total:	**$1,337,300**

Total:	**$1,854,850**
Contingency (20%)	**$370,970**
GST (10%):	**$222,582**
Grand Total:	**$2,448,402**

Additional Notes:
ASSUMES PILES BELOW GROUND AND CONCRETE FOUNDATION ARE GOOD FOR SUPPORTING A 5KPA PEDESTRIAN LOAD.
Price includes engineering analysis, As built drawings and sign-off by P.Eng. Mobilization travel is for travel to the jobsite, for the crew as well as project preparations prior to leaving. 4 level II technicians, to work 6 day weeks 10 hours per day.
It is anticipated that it will take 14 weeks to perform retrofit tasks. This is an estimate only.

5.2 Option 2 - Intermediate Term Refurbishment (25-50 years)

Option 2 involves removing the existing railway line and transoms, repairing/replacing substructure and superstructure elements where required with kind for kind elements and adding in addition hardwood log girders where required. A hardwood deck system with a code compliant handrail and cycle rail system will be fitted on top of the girders utilizing a horizontal connection system that achieves a 25-50 year design life for this option along with a 5kPa load rating. This option has a longer service life than option 1 and can be guaranteed a 5kPa load rating due to the replacement of poor existing elements

See Table 5-2 and the cost estimate below for more details of this option. Also refer to **Figure 6-3** for a photo narrative of this type of refurbishment used for a rail trail bridge along the Mary to Bay Rail Trail in the Fraser Coast Region.

Table 5-2 | Option #2 – Kind for Kind Refurbishment

Component	Component Location	Repair Recommendations
Abutment and Back/Wing walls	AB1 and AB2	Use existing formation in current condition.
All Pile/Frame Bents	Cross/Sash Bracing	Use existing elements in current condition.
All Pile/Frame Bents	Posts	Replace 10% of posts using a new posting section and install 1m length of high strength fibre at the bottom of 25% of the posts.
Girders & Corbels	All Superstructure	Replace 10% of deteriorated girders and corbels where required.
Girders	All Spans	Install a third hardwood log girder line in-between the existing two girder lines.
Steel Plated Girders	Centre 2 Spans	Remove both steel plated girders and appropriately re-coat and re-install.
Transoms and Railway Track	All Spans (Deck)	Remove existing Transoms and railway track.
Deck	All Spans	Install new hardwood deck planks. 50mm thick and 2.5m clear width between cycle rails.
Handrail & Cycle Rail	All Spans	Install new handrail system consisting of vertical balustrade panels and a cycle rail 1.4m off deck height.
Substructure Hardwood Elements	All Bents	Diffuse all structural substructure hardwood elements with Borate Salt rods to prevent any further deterioration.
Superstructure Hardwood Elements	All Spans	(Optional) Diffuse all structural superstructure hardwood elements with Borate Salt rods to prevent any further deterioration.

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WOOD RESEARCH AND DEVELOPMENT

Splitters Creek Bridge - Option 2 - Rehabilitation Works for Converting into a Pedestrian and Cycle Bridge Kind-for-Kind Replacement of Defective Elements and a new hardwood deck system - 2.5m Wide Deck & 5kPa Loading Cost Estimate (Level D)

ITEM	DESCRIPTION	TOTAL
	Engineering & Project Management, Site Set-up & Running Costs & Machinery Hire	
1	Structural Engineering, Bridge Survey, CAD drawings, Work Approvals, Project Management and Supervision	$182,150
2	Crew Mobilisation, Site establishment, running costs and disestablishment	$40,400
3	Demolitions: removal of bridge rail ties (transoms)	$100,000
4	Bridge access (EWP booms and scaffolding) including any additional tracks down to bridge	$300,000
5	Machinery (Crane, Excavator) Hire	$150,000
6	Shipping material to job site	$25,000
	Sub Total:	**$797,550**

	Supply and Installation	
7	Substructure Repairs including Pile Posting and Wraps as per Table 5-2	$343,700
8	Superstructure Repairs including Girders & Corbel repair/replacement as per Table 5-2	$440,500
9	New Deck and Code Compliant Handrail (with cyclerail) System as per Table 5-2.	$696,000
10	Steel Girder Repairs - Re-coating	$150,000
11	(Optional) Diffuse Superstructure timber: Supply & install Borate Salt Rods & bungs	$129,600
12	Diffuse Substructure timber: Supply & install Borate Salt Rods & bungs	$189,200
13	Approach Works to be completed by trail contractor	$0
	Sub Total:	**$1,949,000**

Total:	**$2,746,550**
Contingency (20%)	**$549,310**
GST (10%):	**$329,586**
Grand Total:	**$3,625,446**

Additional Notes:
ASSUMES PILES BELOW GROUND AND CONCRETE FOUNDATION ARE GOOD FOR SUPPORTING A 5KPA PEDESTRIAN LOAD.
Price includes engineering analysis, As built drawings and sign-off by P.Eng. Mobilization travel is for travel to the jobsite, for the crew as well as project preparations prior to leaving. 4 level II technicians, to work 6 day weeks 10 hours per day.
It is anticipated that it will take 28 weeks to perform retrofit tasks. This is an estimate only.

5.3 Option 3 - Long Term Refurbishment (75-100 years)

Option 3 will result in the longest design life (75-100 years) as this option involves installing a new treated glulam superstructure and deck with handrail system on top of the restored existing substructure. This option involves removing the existing deck and superstructure system, restoring the existing substructure and install new glulam caps on top of the trimmed posts. New pre-fabricated glulam girders, deck and handrail system will be installed on top of the new caps with a new load rating of 5kPa (note, the load rating can be increased if service vehicles are required to cross the structure). See Appendix B for more information on treated glulam timber.

See Table 5-3 and the cost estimate below for more details of this option. Also refer to Figure 6-4 for a photo narrative of this type of refurbishment used for a rail trail bridge along the Brisbane Valley Rail Trail in the Somerset Regional Council district.

Table 5-3 | Option #3 – Restore Substructure and Install New Glulam Superstructure and Deck System

Component	Component Location	Repair Recommendations
Abutment and Back/Wing walls	AB1 and AB2	Use existing formation in current condition.
All Pile/Frame Bents	Cross/Sash Bracing	Use existing elements in current condition.
All Pile/Frame Bents	Posts	Replace 10% of posts using a new posting section and install 1m length of high strength fibre at the bottom of 25% of the posts.
Girders & Corbels	All Superstructure	Remove existing Girders and Corbels.
Transoms and Railway Track	All Spans (Deck)	Remove existing Transoms and railway track.
Steel Plated Girders	Centre 2 Spans	Remove both steel plated girders and appropriately re-coat and re-install.
Girders	All Spans	Install new glulam girders and lateral bracing system.
Deck	All Spans	Install new glulam deck panels. 80mm thick and 2.5m clear width between cycle rails.
Handrail & Cycle Rail	All Spans	Install new handrail system consisting of vertical balustrade panels and a cycle rail 1.4m off deck height.
Substructure Hardwood Elements	All Bents	Diffuse all structural substructure hardwood elements with Borate Salt rods to prevent any further deterioration.

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WOOD RESEARCH AND DEVELOPMENT

Splitters Creek Bridge - Option 3 - Rehabilitation Works for Converting into a Pedestrian and Cycle Bridge Repair/Replace Substructure and New Glulam Superstructure and Deck for 5kPa Loading & 2.5m clear width - Cost Estimate (Level D)

ITEM	DESCRIPTION	TOTAL
	Engineering & Project Management, Site Set-up & Running Costs & Machinery Hire	
1	Structural Engineering, Bridge Survey, CAD drawings, Work Approvals, Project Management and Supervision	$182,150
2	Crew Mobilisation, Site establishment, running costs and disestablishment	$40,400
3	Demolitions: removal of bridge superstructure	$280,000
4	Bridge access (EWP booms and scaffolding) including any additional tracks down to bridge	$330,000
5	Machinery (Crane, Excavator) Hire	$270,000
6	Shipping material to job site	$25,000
	Sub Total:	**$1,127,550**
	Supply and Installation	
7	Substructure Repairs including Pile Posting and Wraps, New Caps and Cross Bracing Re-installation as per Table 5-3	$503,200
8	New Glulam Superstructure Elements (girders and cross bracing) as per Table 5-3	$457,900
9	New Deck and Code Compliant Handrail (with cyclerail) System as per Table 5-3	$832,400
10	Steel Girder Repairs - Re-coating	$150,000
11	Diffuse Substructure timber: Supply & install Borate Salt Rods & bungs	$184,700
12	Approach Works to be completed by trail contractor	$0
	Sub Total:	**$2,128,200**

Total:	**$3,255,750**
Contingency (15%)	**$488,363**
GST (10%):	**$374,411**
Grand Total:	**$4,118,524**

Additional Notes:
ASSUMES PILES BELOW GROUND AND CONCRETE FOUNDATION ARE GOOD FOR SUPPORTING A 5KPA PEDESTRIAN LOAD.
Price includes engineering analysis, As built drawings and sign-off by P.Eng. Mobilization travel is for travel to the jobsite, for the crew as well as project preparations prior to leaving. 4 level II technicians, to work 6 day weeks 10 hours per day.
It is anticipated that it will take 24 weeks to perform retrofit tasks. This is an estimate only.

6.0 CONCLUSION

Wood Research and Development was commissioned by Mike Haliburton Associates to complete a detailed visual inspection and refurbishment options report based on the current condition of Splitters Creek Railway Bridge. The main objective of the investigation was to establish the general condition of the primary structural elements, and to assess what techniques could be utilized to safely repurpose the structure into a rail trail bridge for pedestrian and cyclist use.

It was determined that the substructure elements (timber frame and pile bents) in Splitters Creek Railway Bridge are in overall poor condition. The timber superstructure (girders and corbels) was also deemed to be in poor condition while the deck of the structure appears to be in fair-poor condition. However, to repurpose as a rail trail bridge the deck will require refurbishment works to ensure safety for the pedestrians and cyclists. The structure has been given an overall condition state rating of 3.

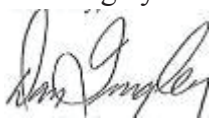
This rating was based from a small sample size of NDT field data collected and it is highly recommended to conduct a detailed inspection of the entire bridge. See **Figure 6-1** and **Appendix A** for more detail about this technology. This will gain a higher level of accuracy for the recommended repair options listed and costed in **Section 5**.

Based on the information compiled from both the visual inspection and brief SWT testing, the bridge will require several repairs/replacement to repurpose the railway bridge as a rail trail bridge for pedestrian and cycle use. Three (3) options have been developed to refurbish the structure into a rail trail bridge. Option 1 utilizes the entire existing structure in its 'current' condition with a new deck and handrail system installed on top of the existing rail ties (transoms). Depending on the results of the full inspection this option cannot be guaranteed a 5kPa load rating unless high strength fibres are used to restore the existing elements and can only be rated for a service life of 10-15 years (condition state rating of 3) based on the existing condition of the elements and the connection details used. Option 2 involves removing the existing railway line and transoms, repairing/replacing substructure and superstructure elements where required with kind for kind elements and adding in addition hardwood log girders where required. A hardwood deck system with a code compliant handrail and cycle rail system will be fitted on top of the girders utilizing a horizontal connection system that achieves a 25-50 year design life (condition state rating of 2) for this option along with a 5kPa load rating. Option 3 will result in the longest design life (75-100 years) as this option involves installing a new glulam superstructure and deck/handrail system on top of the restored existing substructure.
Examples of the recommended refurbishment options can be found in Figures 6-2 to 6-4. Option 3 offers the longest design life and improves the Overall Condition State Rating to 1 based on the following assumptions:

a) Overall Condition State Rating 1 – 100% Remaining Life (80 years)
b) Overall Condition State Rating 2 – 80% Remaining Life (64 years)
c) Overall Condition State Rating 3 – 30% Remaining Life (24 years)
d) Overall Condition State Rating 4 – 5% Remaining Life (4 years)
e) Overall Condition State Rating 5 – 1% Remaining Life (< 2 years)

All options include the remaining hardwood elements to be diffused with Borate salt rods to increase the life of the structure by preventing decay as described above in **Section 4.3**. Also included for options 2 and 3 is the restoration and repair works required to use the existing steel plated girders that span over the creek and is the main reason the structured in listed under the Queensland Heritage Act. Finally, it is highly recommended that all exposed bright wood be treated with Copper Naphthenate and seal end-grain with a paraffin wax sealant.

Dan Tingley Ph.D., P. Eng. (Canada), MIEAust, CPEng, RPEQ



Senior Wood Technology/ Structural Engineer
Wood Research and Development

Andrew La Spina

Timber Structural Engineer
Wood Research and Development
Wood Research and Development

(a)

(b)

Figure 6-1: Photos showing global failure of a timber log girders. Both failures were caused by advanced decay in the ends of the girders and transverse shear failures. The primary cause of this decay was due to vertical fasteners. These failures were found in elements with SWT values in the 3k µs (photos a. above) to 6k µs range (photos b. below). Typically similar bending extreme tensile fibre failures in log girders occur in zones of decay where there are over 2k µs SWT values. Similarly if vast portions of the log girder have SWT values over 3k µs the failures may occur.

Figure 6-2: The above photo series demonstrates an Option 1 type of refurbishment (build off existing railway bridge) used for the construction of a pedestrian bridge along the same railway line as Splitters Creek Bridge and is located just off Quay Street on the North-East outskirts of Bundaberg CDB. The existing railway bridge was left un-touched and a new hardwood deck system with handrails was installed. Six 100mm x 250mm timber joists were placed on top of the existing transoms (rail ties) with a 38-50mm thick hardwood deck installed on top. This option will likely be the lowest cost but also carries the shortest expected lifespan. As seen in the bottom left photo above, one of the girders has failed and fallen out creating a 'weak' point along the bridge. Due to a high residual capacity of timber and the continuous joists, a complete failure of the bridge (span) hasn't occurred yet but is only a matter of time unless extensive maintenance is undertaken.

(a)

(b)

(c)

Figure 6-3: The above photo series demonstrates Option 2 type of fix (hardwood) used for the construction of two Mary to Bay Rail Trail Bridges. Seen above in photo (a) is the construction of a frame bent using an intermediate cap which was installed on top of the existing pile stubs. This allowed the hardwood posts, cross bracing and cap to be installed at the correct reference height. Also note the yellow plugs that indicate that Decaystop® rods have been installed. Photo (b) shows the girders being installed using a horizontal connection system and a rubber liner between the timber girder and concrete pier. In photo (c) the pre-panelised deck is installed along with the modulus handrail and cycle rail system.

Figure 6-4: The photo series above demonstrates Option 3 type of fix that was done for Jimmy Gully Bridge along the BVRT. The existing poor condition superstructure was removed and the piles were repaired with high strength fibre or posted with new section. New glulam back wall, caps, girders and deck system was installed utilising a horizontal connection detail.

Figure 6-5: The repair of Meachams Bridge in Cassowary Coast. The bridge was retrofitted with fibre reinforcement on the bottom of the girders, some corbels and girders were injected with a high strength epoxy. Some piles were also wrapped with high strength fibre and injected with epoxy, then the entire bridge was diffused with borate salt rods to neutralize decay growth.

APPENDIX

Appendix A – Additional Information about Stress Wave Timer Technology

A typical inspection by Wood Research and Development (WRD) includes the use of non-destructive test equipment identified as EPHOD® (Electronic Pulse Highlight and Outline Diagnostic) compression wave technology. The EPHOD® equipment was utilized to complete stress wave measurements along with other WRD techniques to locate internal decay in a non-destructive nature. Stress wave times are recorded on the accessible timber structural elements within the scope of the inspection.

The 'raw' SWT data is the number recorded in the field for each member tested across a measured distance i.e. diameter or width. The 'adjusted' SWT data is calculated using a calibrated 300mm gauge length to standardize the data into categories where it can be analysed based on its magnitude. When the through wave time values (adjusted for a 300mm gauge length, treatment, temperature, submersion or other factors that affect the SWT results such as species) exceed 700 microseconds (µs) but are below 1000µs (shown in yellow) the area measured is capable of carrying its own dead weight and an unknown live load at the localized area where the reading is recovered. When the times exceed 1000µs (shown in red) the element is not capable of carrying its own dead weight at that localized area. Readings in excess of 2200µs are indicative of cavities within the member. When the values reach numbers over 3300µs, the element can no longer support its own dead load and is at risk of failing at any point. The element can often be red with high SWT values and still be in place in the bridge. This doesn't mean the element is sound and the SWT data is wrong. It means that other criteria are impacting the situation such as fasteners which might be holding the element in place even though it is red throughout. **Figure 6-7** shows the colour scheme correlating to the SWT readings utilized in this report.

Readings are recovered in a clock-like format to ensure no cavity or deteriorated timber was missed. These directions typically include a 2/8, 3/9 and 4/10 reading. **Figure 6-6** below depicts the typical SWT configuration for round and rectangular timber cross sections.

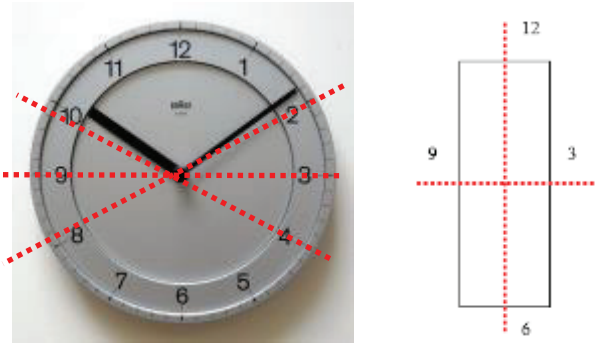


Figure 6-6: SWT configurations for round and rectangular timber

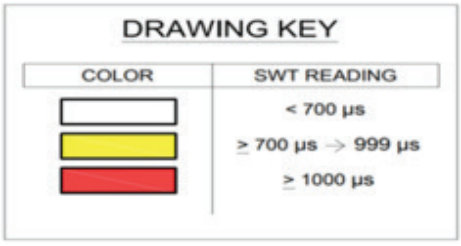


Figure 6-7: Stress Wave Timer Results Drawing Key

Appendix B – Additional Information about Penta Treated Glulam Timber

Glulam timber manufactured from a wide range of timber species that is treated with Pentachlorophenol (Penta), a synthetic preservative treatment that is used only for heavy construction timbers such as railway ties, utility poles and bridge timbers. Penta, being an oil-based preservative treatment, has low solubility and is water repellent therefore has a very low leach rate.

Over 60 years ago, Pentachlorophenol was formulated to contain high levels of toxicity to act as a mass defoliant. Produced as polychlorinated dioxins 2,3,7,8-T or 2,4,5-T, Pentachlorophenol was highly toxic and ultimately dangerous to humans. These formulations are now banned or heavily restricted and the Pentachlorophenol formulation used to preservative-treat timber has a completely different dioxin with a much lower toxicity but still must be handled with care – same as for any treated timber. By minimising direct contact with immediate water environment, this significantly reduces impact on the environment. All glulam members are pre-fabricated in the factory where it is cut to length and all holes drilled before treatment. Where possible; avoid any cutting, drilling of treated timber whether in the factory or on site however, when it is required, appropriate PPE must be worn.
Heavy duty wood preservatives, such as Penta, are applied to wood in specialised high pressure treatment cylinders at wood treatment facilities. With oil-borne preservatives such as Penta, bleeding after application can occur. To reduce this, timbers are vacuum-treated, extracting excess treatment solution that has not been fixed in the wood. Performing a double vacuum treatment is a standard practice for penta-treated wood intended for use in sensitive environments, such as open water locations. These vacuuming procedures reduce the chance that the Penta and carrier solution will migrate into the environment through water runoff. With the majority of penta-treated glulam being used in the superstructure of bridges, this minimising the contact of penta-treated glulam to the environment.

Over the last 30 years, there have been multiple examinations by US, Canadian and private agencies of treated timber's environmental effects on organisms and surrounds. Through due diligence, Penta is the right product to treat its glulam beams and will not adversely impact the environment. Penta readily degrades in the environment by chemical, microbiological, photolysis and photochemical processes. Photolysis appears to be a significant process for degradation since a measured photolysis half-life has been reported to be 52 minutes in running water under sunlight.

Glulam Elements – Material Specification Summary	
Material	Engineered Timber - Glulam
Typical Timber Species	Slash Pine, Douglas Fir, Southern Yellow Pine, Radiata Pine
Treatment	Pentachlorophenol (member incised, holes pre-drilled and pressure treated)
Treatment Concentration	9 kg/m^3
Weight of Timber (Density)	550-700 kg/m^3 (depending on timber species and strength grade)
Design Life	75-100 years (with minimal to no maintenance required)
Typically Panel Size	0.65m long x 2.5m wide x 80mm thick (can vary pending on design specifications)
Load Capacity	From 1kPa to 5kPa to SM1600 loading

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