

Sapphire Solar Farm

Environmental Impact Statement



Volume 3 - Appendices

Appendix H

Traffic Assessment and Road Safety Audit



Traffic Engineering

Sapphire Solar Farm - Traffic Assessment



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Revision Record

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1 Introduction

1.1 Background

TTM Consulting was engaged to undertake a traffic assessment for the proposed Sapphire Solar Farm located approximately 30km east of Inverell in Northern NSW. This report documents the findings of this investigation for inclusion in an Environmental Impact Assessment (EIS) to be lodged with the NSW DPE.

1.2 Scope

This report investigates the transport aspects associated with the operation of the site including a haulage route proposed between the site Gwydir Highway via Waterloo Road and the Western Feeder Road. Access to the site is also provided via Kings Plain Road. The scope of the transport aspects investigated include:

- Likely traffic generation and impacts.
- Access arrangements for staff and deliveries.
- Assessment of the implications and recommendation arising from a Road Safety Audit prepared independently of this report.
- Identification of any roads or intersections which need to be upgraded, in addition to mitigations for pavement impacts.
- Assessment of the outcomes of the Road Safety Audit.
- Traffic Impact Assessment.

A separate independent Road Safety Audit has been undertaken. The audit identifies issues which are assessed as part of this report.

To assess the proposed transport arrangements, the proposal has been assessed against the following guidelines and planning documents:

- RMS (RTA) Guide to Traffic Generating Developments Version 2.2 (2002).
- RMS (RTA) Road Design Guide (as amended).
- Austroads Guide to Road Design (and RMS supplements).
- Austroads Guide to Traffic Management (and RMS supplements).
- Austroads Guide to Road Safety: Part 6; Road Safety Audit Third Edition (2009).
- RMS (RTA) Traffic Control at Work Sites Version 4 (June 2010).

1.3 Site Location

The site is located approximately 30km east of Invernell, as shown in Figure 1.1. The site is accessed from either the Gwydir Highway, with immediate access to site via Waterloo Road and the Western Feeder.

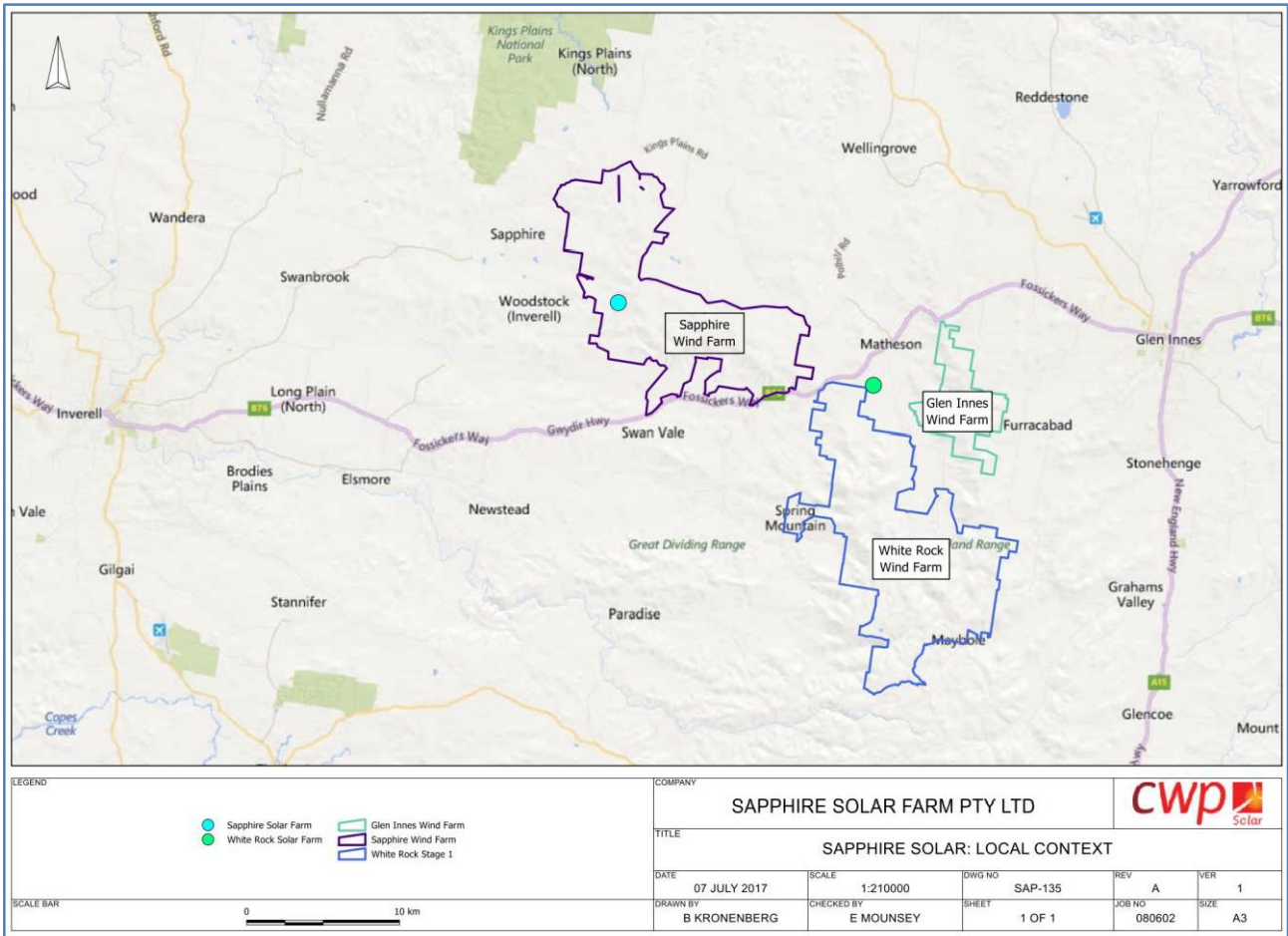


Figure 1.1: Site Location

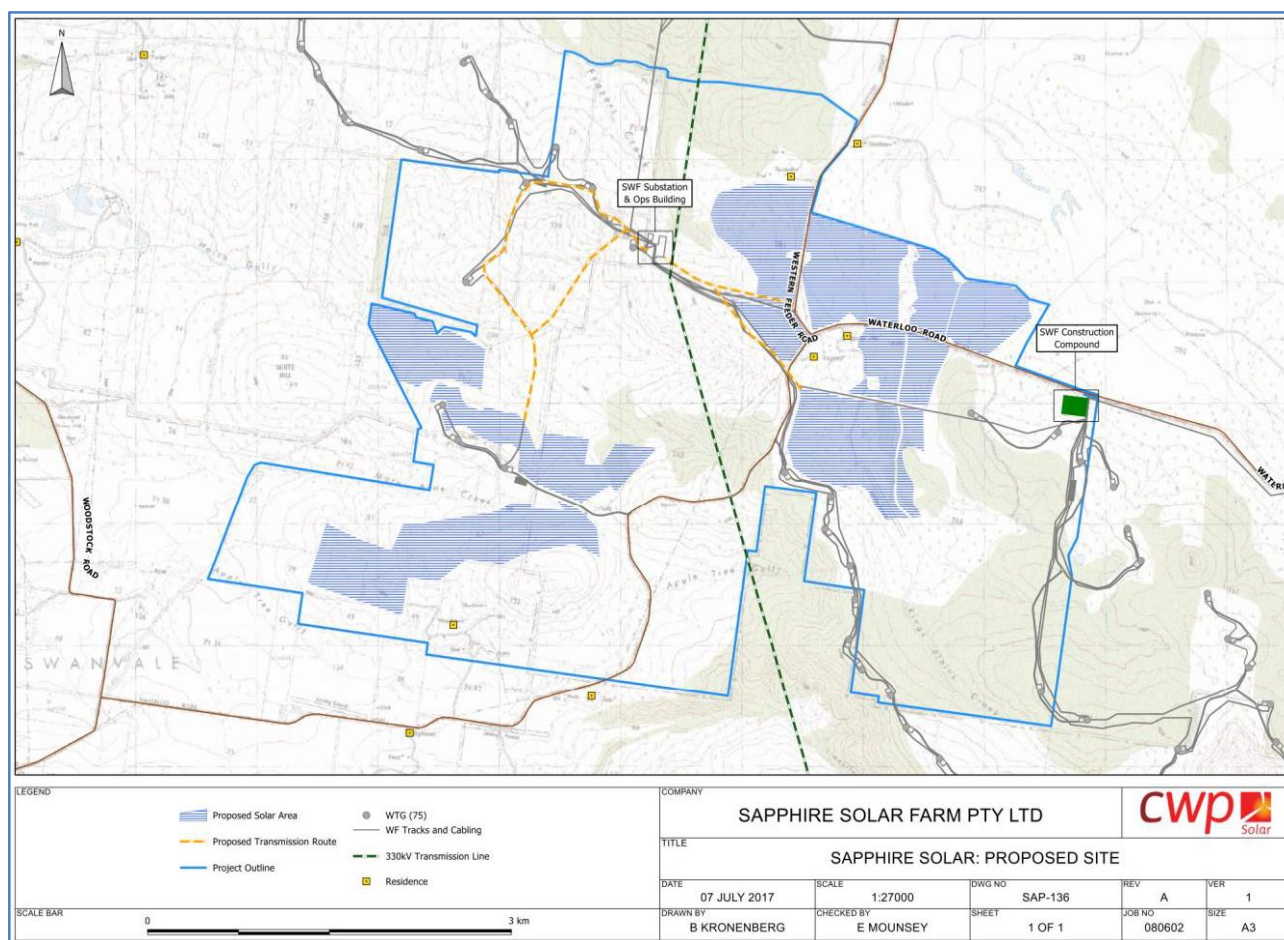


Figure 1.2: Site Area

There are two access routes to the existing area for staff and deliveries.

- Route 1 – Gwydir Highway via Woodstock Road
- Route 2 – Gwydir Highway via Waterloo Road

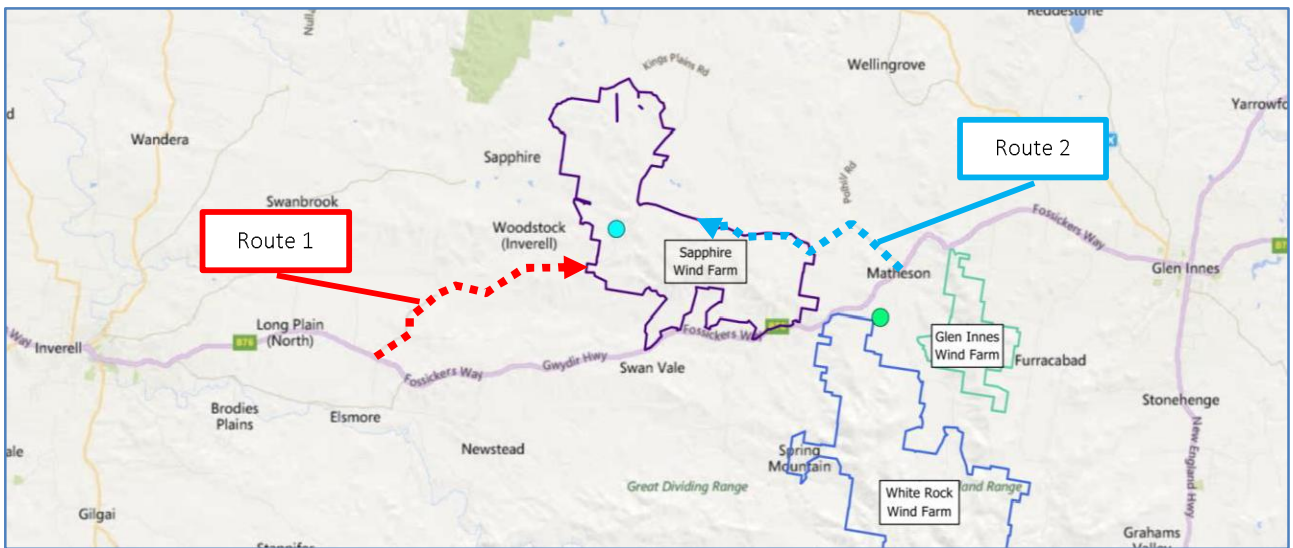


Figure 1.3: Site Access and Haulage Routes

2 The Proposal

2.1 Development Profile

The proposal is the development a solar farm. It includes the following:

- Installation of 750,000 photovoltaic (PV) panels with a combined capacity of up to 300 MW.
- Installation of battery based storage to dispatch the power generated by the panels.
- On-site modular substations at each connection point, including switchgear, communications equipment and parking spaces.

The solar panels would be fitted to either or a combination of:

- Fix tilt frames which would be orientated so the panels face upwards at approximately 300 through 25 degrees in a north, north west or north easterly direction; or
- A single-axis tracking system which would track the sun from east to west as it moves throughout the day.

2.2 Traffic Generation

2.2.1 Site Access

The Site will be accessed directly off Waterloo and Western Feeder roads. Permanent access locations are illustrated in Figure 2.1. During construction access may be required through existing gate entrances to the site to accommodate an efficient workflow.

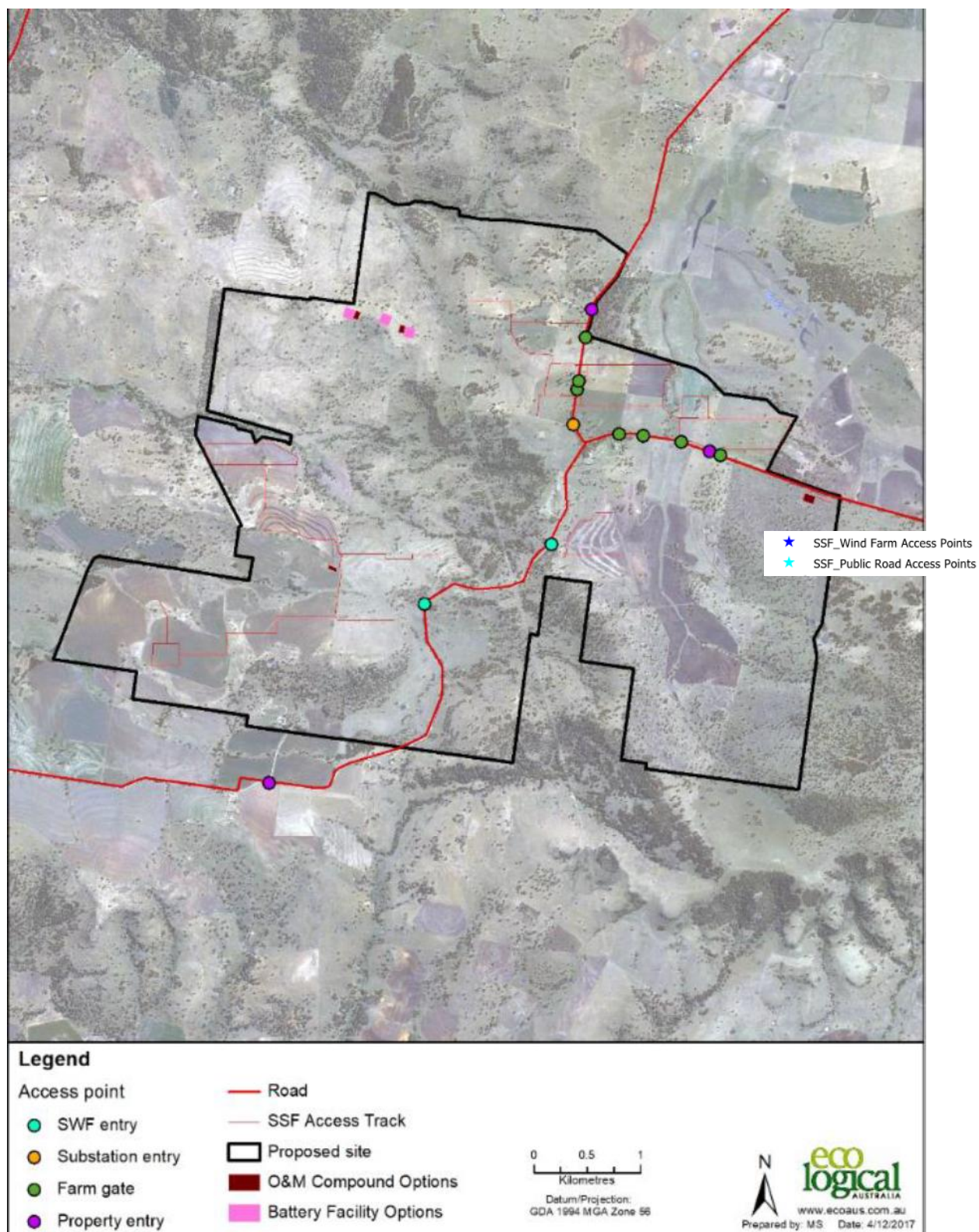


Figure 2.1: Access Locations

Waterloo Road joins the Gwydir Highway, a Roads and Maritime Services (RMS) Classified State Road southeast of the project boundary. The intersection between the Gwydir Highway and Waterloo Road has been upgraded to accommodate over-dimensional equipment for SWF, and it is not expected that further upgrades would be required for the Proposed Development.

Staffing arrangements during construction will depend on the staging of the development. A peak staffing breakdown is provided in Table 2.1.

Table 2.1: Staff Numbers

Stage	Duration	Number of Staff (estimated)	Working Hours
Construction Phase	12 - 18 months	200 Staff (peak)	Monday to Friday 7.00am to 6.00pm; Saturday 8.00am to 1.00pm; and No work on Sunday or public holiday unless an out of hours work protocol is put in place.
Operational Phase	30 year operational life	Up to 20 full time positions would operate and maintain the plant.	-

Deliveries will depend on day to day operational requirements. Heavy vehicles into the site are estimated to be up to 30 vehicles per day at the start of the construction activities. The quantity of vehicles will ramp down sharply at the completion of construction.

Overall traffic movements during construction will be up to 100 light vehicles and 30 heavy vehicles daily. It is expected that 2 staff would ride in the one car.

2.2.2 Haulage Route

The haulage process during the construction phase involves:

- Route 1 – Gwydir Highway via Woodstock Road
 - Entering Woodstock Road via Gwydir Highway
 - Entering Waterloo Road via Woodstock Road
 - Entering Western Feeder via Waterloo Road
 - Entering site access via Western Feeder
 - Unloading of truck at the subject site
 - Truck return to Gwydir Highway whilst water spraying the roadway
- Route 2 – Gwydir Highway via Waterloo Road
 - Entering Waterloo Road via Gwydir Highway
 - Entering site access via Waterloo Road
 - Unloading of truck at the subject site

- Truck return to Gwydir Highway whilst water spraying the roadway

Around 750,000 PV panels will be installed over the 12 - 18 month duration.

Hourly truck movements will be dependent on the hours of operation and days per week that the haulage occurs. For the purposes of the assessment three scenarios have been reviewed. They are:

- Scenario 1 – The haulage route is operational for 5 days per week over a 9 hour day.
- Scenario 2 – The haulage route is operational for 5 days per week over a 12 hour day.
- Scenario 3 – The haulage route is operational for 7 days per week over a 12 hour day.

Which haul scenario eventuates is likely to be subject to the determination of the application.

It is expected that of the scheduled days of operation there is a 5 percent leakage due to conditions such as bad weather or public holidays resulting in no movements on a particular day. This represents a worst-case scenario for traffic assessment purposes.

A total of 30 vehicles per day are expected during the peak of construction. At this stage, the duration of the construction period is expected to be in excess of 12 months. Over the construction period, construction vehicle volumes will vary depending on on-site demands.

3 Existing Transport Infrastructure

3.1 The Road Network

The characteristics of roads in the immediate vicinity of the site are shown below in Table 3.1.

Table 3.1: Local Road Hierarchy

Road	Speed Limit	Lanes	Road Authority
Gwydir Highway	100kph	2 lane, divided Sealed	RMS
Woodstock Road	Unsigned	2 lane, undivided Part sealed, part unsealed	Council
Waterloo Road	Unsigned	2 lane, undivided Part sealed, part unsealed	Council
Western Feeder	Unsigned	2 lane, undivided Unsealed	Council
Kings Plains Road	Unsigned	2 lane, undivided Part sealed, part unsealed	Council

All intersections within the vicinity of the site are priority controlled.

The intersection between the Gwydir Highway and Waterloo Road has been upgraded to accommodate over-dimensional equipment for the Sapphire Wind Farm (SWF), and it is not expected that further upgrades would be required for the proposed development. A copy of the concept plans for the intersection are included as Appendix C.

A site visit undertaken by TTM as part of the Road Safety Audit has identified that maintenance works are currently been undertaken along Waterloo Road and the Gwydir Highway.

3.2 Traffic Flows

3.2.1 Gwydir Highway

The NSW Road & Maritime Services have provided records of traffic counts on Gwydir Highway, Matheson. The 2017 survey data includes both eastbound and westbound flows. The 2015 and 2016 survey count data is for westbound flows only.

The 2017 data shows that the eastbound and westbound flows are roughly equal. For the purpose of this assessment, the estimated 2015 and 2016 eastbound flows have been estimated as that of the westbound flows.

The traffic counts as provided by RMS are presented in Table 3.2. The revised 2015 and 2016 traffic volumes are presented in Table 3.3.

Table 3.2: Existing and Historic Daily Traffic Flows on Gwydir Highway

Location	Year				
	2015	2016	2017		
	Westbound	Westbound	Eastbound	Westbound	Total
Gwydir Highway	666	667	730	739	1,469

Table 3.3: Estimated Daily Traffic Flows (2015 and 2016) on Gwydir Highway

Location	Year		
	2015	2016	2017
Gwydir Highway	1,335	1,335	1,469

The daily traffic flows recorded on Gwydir Highway are relatively low and well within the capacity of the road leaving ample spare capacity to accommodate additional traffic.

The historical records on Gwydir Highway as shown in Table 3.2 show a compound growth rate of 5.5% between 2015 and 2017. This rate has been applied to forecast traffic flows on construction commencing (assumed 2018) and ten years hence. This results in:

- 1,549 vehicles per day on Gwydir Highway in 2018.
- 2,509 vehicles per day on Gwydir Highway in 2028.

3.2.2 Local Roads

Existing traffic flows on the local roads within the vicinity of the site are negligible in comparison to the Gwydir Highway.

3.3 Road Safety

Records of road traffic crashes within the vicinity of the subject site were obtained from the NSW Roads and Maritime Services.

The records cover the five year period from 01/01/2012 to 31/12/2016. Copies of the records are attached to the Road Safety Audit.

- No crashes have occurred at the following intersections:
 - Gwydir Highway / Woodstock Road
 - Gwydir Highway / Waterloo Road

Crashes within the area were generally limited to single vehicles leaving the road and hitting an object.

It is concluded that the crash data does not identify a historical road safety issue related to the intersections providing access to the site.

4 Traffic Impacts

Traffic impacts relate to the effects of the traffic generated by the Solar Farm and conditions on roads and at intersections. Each is addressed below.

4.1 Traffic Flows

As discussed in Section 2.2 when operational the Solar Farm is forecast to generate up to 20 vehicle movements daily. These flows are relatively minor. The existing road network will not be significantly affected by the site.

4.2 Intersection Operation and Safety

As identified in the 'Road Safety Audit' sight distances at the surrounding intersections are sufficient.

As noted in Section 3.3 there is no history of crashes at the intersections surrounding the development site.

4.3 Construction and Operational Traffic Management

4.3.1 Construction Phase

Construction traffic will predominantly enter and exit the subject site via Woodstock Road and Waterloo Road. Given the increase of traffic movements recommendations and controls have been provided in the Road Safety Audit.

4.3.2 Operational Phase

As for the operation phase, operational traffic will enter and exit the site via multiple access points to Western Feeder Road and Waterloo Road. Traffic will then distribute along multiple approach and departure routes.

Due to extremely low traffic flows and good visibility at the surrounding intersections, no specific management controls are considered necessary.

5 Road Safety Audit

The separate independent Existing Stage Road Safety Audit was completed in accordance with the requirements of Austroads' Guide to Road Safety: Part 6; Road Safety Audit Third Edition (2009).

The audit identifies issues to review as part of the assessment of the proposed development. It is based on a site visit conducted during the day. It is not a guarantee of safety and does not necessarily differentiate between issues associated with the proposed development and issues that are part of daily traffic conditions in the area. Nevertheless, it provides an independent and unbiased platform from which issues can be assessed.

Issues identified in the Road Safety Audit are given a priority ranking based on the following criteria:

- Priority A (High Risk) – Highest priority for action from a safety view point.
- Priority B (Medium Risk) – Action needs to be taken from safety view point.
- Priority C (Low Risk) – Action is desirable from a safety view point.
- Priority D (Comment) – An observation which may improve overall performance or safety. It could be of wider significance and possibly outside the scope of the Road Safety Audit but may be where action should be considered.

The priority ranking is based on the subjective assessment of the audit team. The following sections discuss each of the issues and how they should be addressed. The recommendations below take into consideration the contribution of the proposed development to the safety issue. They are not necessarily the recommendations of the Road Safety audit itself.

5.1.1 Gwydir Highway

The road surface at the existing intersection at Gwydir Highway and Waterloo Road is in a poor condition due to its poor construction and the turn movements of heavy construction vehicles. This has led to many potholes and pavement defects.

Re-surfacing is required at this location.

Please note that resurfacing works will occur in accordance with the Works Authorisation Deed (WAD) that is in place between the Solar Wind Farm (SWF) and RMS. While the intersection was upgraded during construction to facilitate works, the WAD also covered 'make good provisions', and as such a bond is held by RMS in this regard. SWF will 'make good' at the end of the construction period, prior to the SSF commencing works.

Discussion – The issues are directly related to the construction phase and should be addressed.

5.1.2 Intersection of Waterloo Road / Gwydir Highway

The line marking and RRPMS at the existing intersection at Gwydir Highway and Waterloo Road is faded or been removed due to its poor construction and the turn movements of heavy construction vehicles.

Re-line marking is required at this location.

As per Section 5.1.1, the line-marking works will occur in accordance with the WAD that is in place between the SWF and RMS. While the intersection was upgraded during construction to facilitate works, the WAD also covered 'make good provisions', and as such a bond is held by RMS in this regard. SWF will 'make good' at the end of the construction period, prior to the SSF commencing works.

Discussion – The issues are directly related to the construction phase and should be addressed.

5.1.3 Summary of Road Improvements

Recommended road related requirements are presented in Table 5.1 below.

Table 5.1: Summary of Recommended Road Improvements

Location	Recommendation
Gwydir Highway	It is recommended defects are removed by way of resurfacing / reconstruction of the affected areas
Intersection of Waterloo Road / Gwydir Highway	Ensure that the line marking and RRPMS are provided as per the agreement with RMS, and regularly checked and maintained due to the construction traffic at this location.

6 Planning NSW and NSW RMS Requirements

Planning NSW has specified the Secretary's Environmental Assessment Requirements in relation to the proposed development in their letter dated 27 July, 2017. In relation to traffic and transport the following requirements are specified:

Roads and Maritime requests that the Environmental Assessment be supported by a Traffic Impact Assessment (TIA) prepared by a suitably qualified person in accordance with the Austroads Guide to Traffic Management Part 12, the complementary Roads and Maritime Supplement and RTA Guide to Traffic Generating Developments. The TIA is to address the following;

- *The total impact of existing and proposed development on the road network with consideration for a 10 year horizon.*
- *The volume and distribution of traffic generated by the proposed development.*
- *Intersection sight distances at key intersections along the nominated access route to the site.*
- *Existing and proposed site access standards.*
- *Details of proposed improvements to affected intersections, in particular assessments of impacts on safety and efficiency of junctions with the classified road network.*
- *Details of servicing and parking arrangements.*
- *Impact on public transport (public and school bus routes) and consideration for alternative transport modes such as walking and cycling.*
- *Impacts of road traffic noise and dust generated along the primary access route/s.*
- *Consideration of potential glare/reflectivity generated from on-site infrastructure towards public roads.*
- *Details of a Transport Management Plan (TMP) to identify and manage impacts of construction and operational traffic on the safety and efficiency of the affected road network. The TMP may include temporary measures such as Traffic Control Plans to address construction related traffic at specific locations. The TMP should include a Driver Code of Conduct, which may include, but not be limited to the following;*
 - *A map of the primary access routes highlighting critical locations.*
 - *Safety initiatives for transport through residential areas and/or school zones.*
 - *Consideration for coordination of construction traffic with seasonal agricultural haulage.*
 - *An induction process for vehicle operators & regular toolbox meetings.*
 - *A complaint resolution and disciplinary procedure.*
 - *Any community consultation measures for the peak construction period.*

Where road safety concerns are identified at a specific location along the identified access route/s, Roads and Maritime suggests that the TIA may be supported by a targeted Road Safety Audit undertaken by suitably qualified persons.

The current Austroads Guidelines, Australian Standards and Roads and Maritime Supplements are to be adopted for any proposed works on the classified road network.

The following issues are addressed in this report.

Table 6.1: NSW Planning and RMS Issues

Issue	Response
Road Safety Audit	An independent audit has been completed (see Attachment A).
Measures to be implemented	Gwydir Highway - It is recommended defects are removed by way of resurfacing / reconstruction of the affected areas Intersection of Waterloo Road / Gwydir Highway - Ensure that the line marking and RRPMS are provided as per the agreement with SWF and RMS, and regularly checked and maintained due to the construction traffic at this location.
Impact on the state road network with consideration for a 10 year horizon	The net increase in traffic is up to less than 5% percent on Gwydir Highway. The impacts of the expected construction and operational traffic volumes are negligible. Forecast traffic flows are within the capacity of Gwydir Highway.
Volume and distribution of traffic	when operational the Solar Farm is forecast to generate up to 20 vehicle movements daily. These flows are relatively minor.
Intersection sight distances	Sight distances at intersections are suitable.
Servicing and parking arrangements	All servicing will be via the site access. All parking will be on site.
Traffic Management for construction and operational phases	No specific traffic management measures are required.
Impact on public transport	No public transport services are affected by the proposed development. The school bus route will operate as normal, with signage warning construction traffic about children.
Impacts of road traffic noise and dust generated along the primary haul / access route/s.	Dust associated with the access road will be managed by use of water trucks. No other measures are considered necessary. Road traffic noise is addressed in a separate report.
Driver Code of Conduct	Can be conditioned as part of the Consent.

7 Summary and Conclusions

This report has examined the traffic and transport implications associated with the construction and operation of the proposed Sapphire Solar Farm located approximately 30km east of Inverell in Northern NSW.

Traffic generation associated with the development during the construction and operational phases will be low. There are no adverse impacts in relation to traffic flows.

A separate Road Safety Audit has identified areas where road improvements could be made.

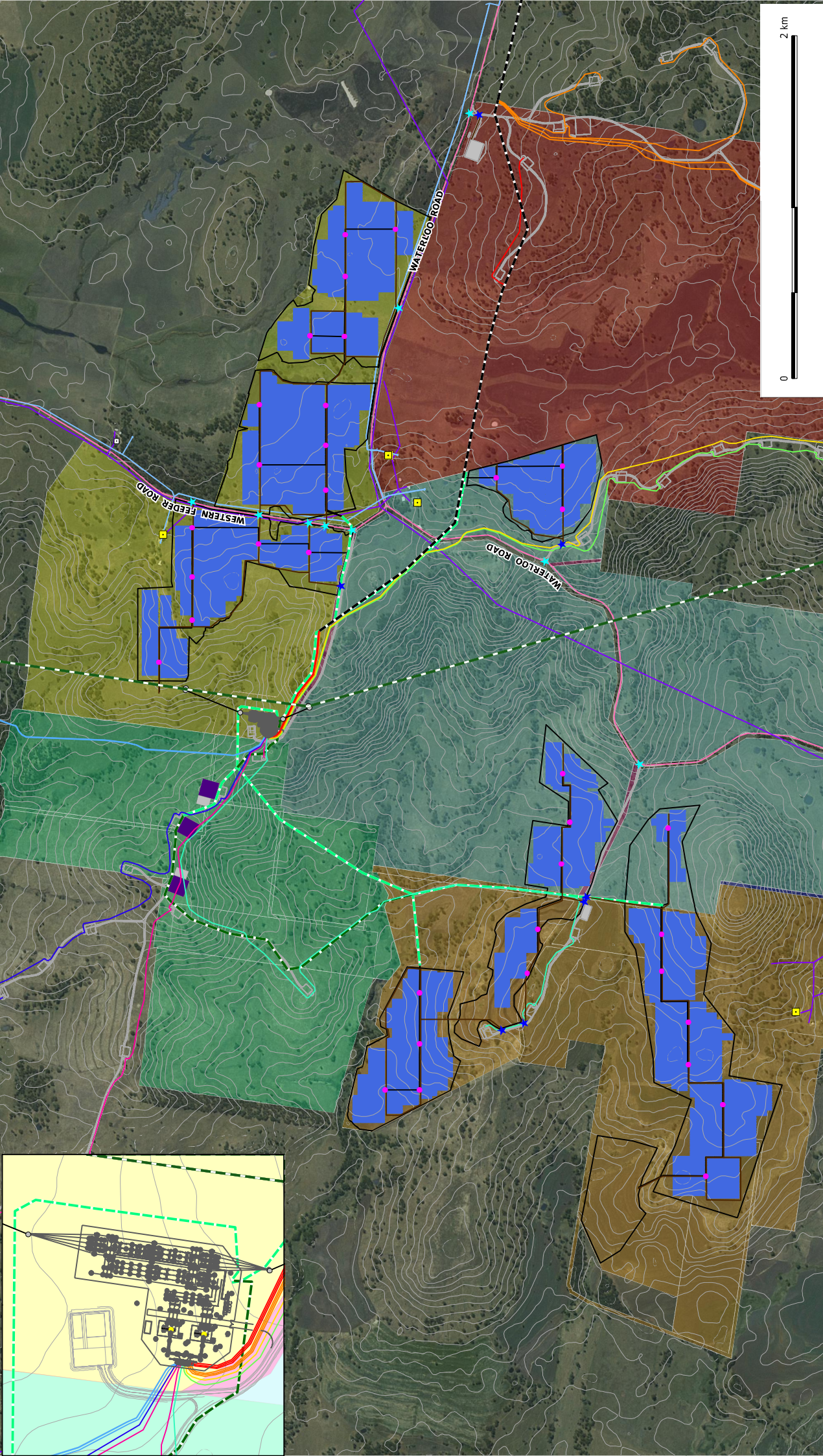
The following roadworks are recommended for the construction and operational phase:

1. Gwydir Highway: It is recommended defects are removed by way of resurfacing / reconstruction of the affected areas
2. Intersection of Waterloo Road / Gwydir Highway: Ensure that the line marking and RRPMs are provided as per the agreement with SWF and RMS, and regularly checked and maintained due to the construction traffic at this location.

The requirements of Planning NSW and the NSW Roads and Maritime Services in relation to traffic and transport have been addressed in this report.

It is concluded that subject to the recommended roadworks being implemented there are no traffic issues which would prevent the proposal from proceeding.

Appendix A Proposed Site Plan



Local Road Network

Contours

EE Assets

Telstra Assets

Existing 330 kV TL

Non-Involved (Solar)

Involved (Solar)

SWF Collector Groups

SWF_ACT_Group 1

SWF_ACT_Group 2

SWF_ACT_Group 3

SWF_Group 4

SWF_Group 5

SWF_Group 6

SWF_Group 7

SWF_Group 8

SWF_Civil Layout

SWF_PV Tracking Layout

SWF Access Tracks

SWF_Wind Farm Access Points

SWF_Public Road Access Points

SWF_O&M / Compound Options

SWF_OHL/JUG Alternate Cable Route

SWF_OHL/JUG Main Cable Route

SWF_JUG Cable Route

SWF_Inverter Locations

SWF_Battery Options

SWF_PV Inclusion Area

SWF_PV Tracking Layout

SWF Prelim Vegetation Mapping

Cropping Land

Exotic Grassland with Scattered Trees

Farm Dam

Manna Gum - Rough-barked Apple - Yellow Box Grassy Woodland/Open Forest of the New England Tableland - Derived Native Grassland- EEC (TSC Act)

Manna Gum - Rough-barked Apple - Yellow Box Grassy Woodland/Open Forest of the New England Tableland - EEC (TSC Act)

Manna Gum - Rough-barked Apple - Yellow Box Grassy Woodland/Open Forest of the New England Tableland - EEC (TSC Act)

Mine

Native Pasture

White Box Grassy Woodland of the Nandewar & Brigalow Belt South Bioregions Derived Grassland - EEC (TSC Act)

SSF Land

Council Road

Crown Road

Friend

Mosses

O'Brien

Redman

Turner

Appendix B Road Safety Audit



Traffic Engineering

Sapphire Solar Farm, Inverell NSW
Road Safety Audit





About TTM

For 30 years, we've been at the centre of the Australian development and infrastructure industry. Our unique combination of acoustics, data, traffic and waste services is fundamental to the success of any architectural or development project.

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Acoustics



Data



Traffic



Waste

Revision Record

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1 Introduction

1.1 Background

TTM Consulting has been engaged by Eco Logical Australia to undertake a Road Safety Audit for the proposed vehicular access points and the existing Gwydir highway intersections for the proposed Sapphire Solar Farm located 30km east of Inverell NSW during the construction period. This Existing Stage Road Safety Audit was requested by RMS.

This Road Safety Audit includes the following areas.

- The existing intersection of Gwydir Highway / Woodstock Road
- The existing intersection of Gwydir Highway / Waterloo Road
- The proposed / existing site access points for the solar farm, which are accessed from Waterloo Road and Western Feeder Road.

This report identifies possible safety issues and these are noted by the audit team using a combination of onsite investigations and a review of background material. Recommendations for potential remedial treatments will be made in response to each safety issue that is raised as part of this audit process.

1.2 Site Location

The location of the proposed solar farm is 30km east of Inverell, NSW, to the north of the Gwydir Highway, and adjacent to Waterloo Road and Western Feeder Road and is highlighted in Figure 1.1.



Figure 1.1 Road Safety Audit Location

The extent of the solar farm is provided in the location plane in Figure 1.2.

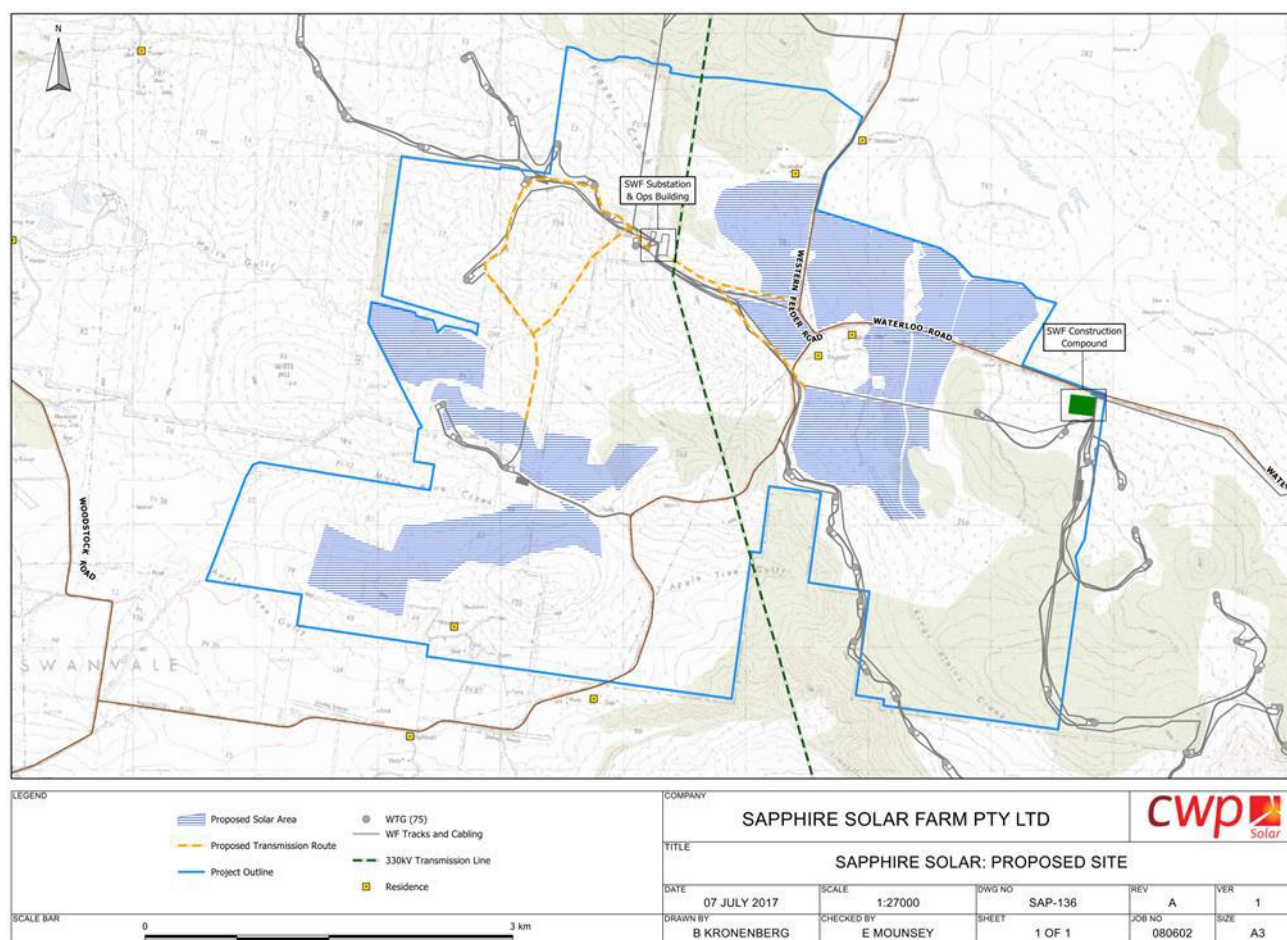


Figure 1.2 Extent of Proposed Solar Farm

1.3 Audit Stage

This report results from an Existing Stage Road Safety Audit, which has been undertaken in accordance with the requirements of Austroads' Guide to Road Safety: Part 6; Road Safety Audit Third Edition (2009). The audit report generally follows the format and topics outlined in the Austroads Checklist 6 for Detailed Design stage audits.

This audit covers only the study area and has sought to identify potential safety hazards. However, the auditors would like to point out that no guarantee is made that every deficiency or hazard has been identified. Further, if all recommendations in this report were to be followed, this would not guarantee that the study area is 'safe'; rather, adoption of the recommendations should improve the level of safety at this location.

1.4 Audit Team

The persons undertaking in this road safety audit are;

- Richard V Jones – Senior Road Safety Auditor (Team Leader); TTM Consulting Pty Ltd
- Ben Williamson – Senior Road Safety Auditor, TTM Consulting Pty Ltd

1.5 Site Inspection

A site inspection of the audit area was conducted on Wednesday 15 and Thursday 16 November 2017. The inspection was conducted in the day and at night to assess the conditions noted in Austroads. The weather condition during the inspection was dry with overcast skies with a little rainfall. The inspection was carried out on foot and by car.

1.6 Proposed Solar Farm

The proposed Sapphire Solar Farm (SSF) development is a 170 MW utility scale electricity generation works comprised of solar photovoltaic (PV) modules, steel racking and piled supports, battery-based storage facilities, electrical power conversion units, underground and/or above ground electrical cabling, telecommunications equipment, amenities and storage facilities, vehicular access and parking areas, along with security fencing and gates.

The Proposed Development is located on land, some of which include the same parcels as the Sapphire Wind Farm (SWF) project, within the Inverell Shire Local Government Area (LGA) 30 km east of Inverell in northern NSW. General access to the site is from either the Gwydir Highway or Kings Plains Road with immediate access to the study area via Woodstock Road, Waterloo Road, Western Feeder Road.

The existence and proximity of SWF provides the opportunity to co-locate certain facilities and share the same point of connection to the TransGrid 330 kV network through the SWF substation. This connection option will minimise the overall impact of the development while maximising the use of an existing connection asset and aligns with the proposed New England Renewable Energy Hub currently being evaluated by TransGrid, the Australian Renewable Energy Agency (ARENA) and the NSW Government.

Surrounding land is primarily agricultural in use, with associated dwellings comprising a mix of involved and non-involved residences, totalling eight within a 2km radius of the study area. Of note, all eight residences are associated with SWF either through a host or neighbour agreement and consultation with all owners has been ongoing from inception of the proposed solar development.

2 Existing Road Environment

2.1 Road Network

The Road Safety Audit was carried out in the area that covers the following roads and their classification:

Table 2-1: Road Classifications

Road	Speed Limit	Lanes	Classification	Management
Gwydir Highway	100km/h	2 (Undivided Rural Asphalt Road)	Rural	RMS
Waterloo Road	100km/h	1 Rural Gravel Road (5-7m wide)	Rural	Inverell / Glen Innes
Woodstock Road	100km/h	1 Rural Gravel / Asphalt Road (5-7m wide)	Rural	Inverell
Western feeder Road	100km/h	1 Rural Gravel Road (5-7m wide)	Rural	

There is no existing street lighting within this rural area. The posted speed limit on the Gwydir Highway is 100km/h, the other roads noted in Table 2-1 are not sign posted and therefore are assumed to have a rural speed limit of 100km/h. It was noted during the site visit that vehicle speeds were estimated to be between 50km/h to 80km/h along these roads.

2.2 Traffic Counts

Traffic counts for 2017 were obtained from the RMS Traffic Volume Viewer website, which provided the following information. (Table 2-2)

Table 2-2 : Traffic Volumes on Gwydir Highway

Road	Location	Station ID	Daily Eastbound Vol	Daily Westbound Vol
Gwydir Highway	94m West of Tamboura Close	6133	730	739
Gwydir Highway	420m Est of Abbots Road	6134		929

The construction of the Wind Farm in the local area has increased the daily traffic volumes to the levels noted above, in particular at Station ID 6134, as the 2016 volume was only 762. It is worth noting that the existing traffic volumes would not be typical of the normal traffic volumes without any major construction traffic along the Gwydir Highway.

2.3 Construction Traffic

At present, there is considerable construction traffic using the Gwydir Highway, Waterloo Road and other local roads as part of the construction of the Sapphire Wind Farm. The total estimated heavy vehicles for the wind farm construction is 7288 over a construction period of 22 months. (Sapphire Wind Farm – Construction Traffic and Access Management Plan – November 2016)

It is noted that the construction of the Solar Farm will not commence until the Wind Farm projects is complete. The Sapphire Solar Farm proposes to utilise 4565 heavy vehicles over a construction period of 18-

20 months. This is a reduction of 2723 (37%) heavy vehicles over a similar construction period. It is also assumed that the solar farm construction traffic haulage route will be the same as the approved route for the wind farm. The intersection of Gwydir Highway and Waterloo Road is 18.7km west from Glen Innes and will provide the primary access to the site from the state road network. This intersection was upgraded for the Sapphire Wind Farm project to the arrangement shown in Figure 2.1.

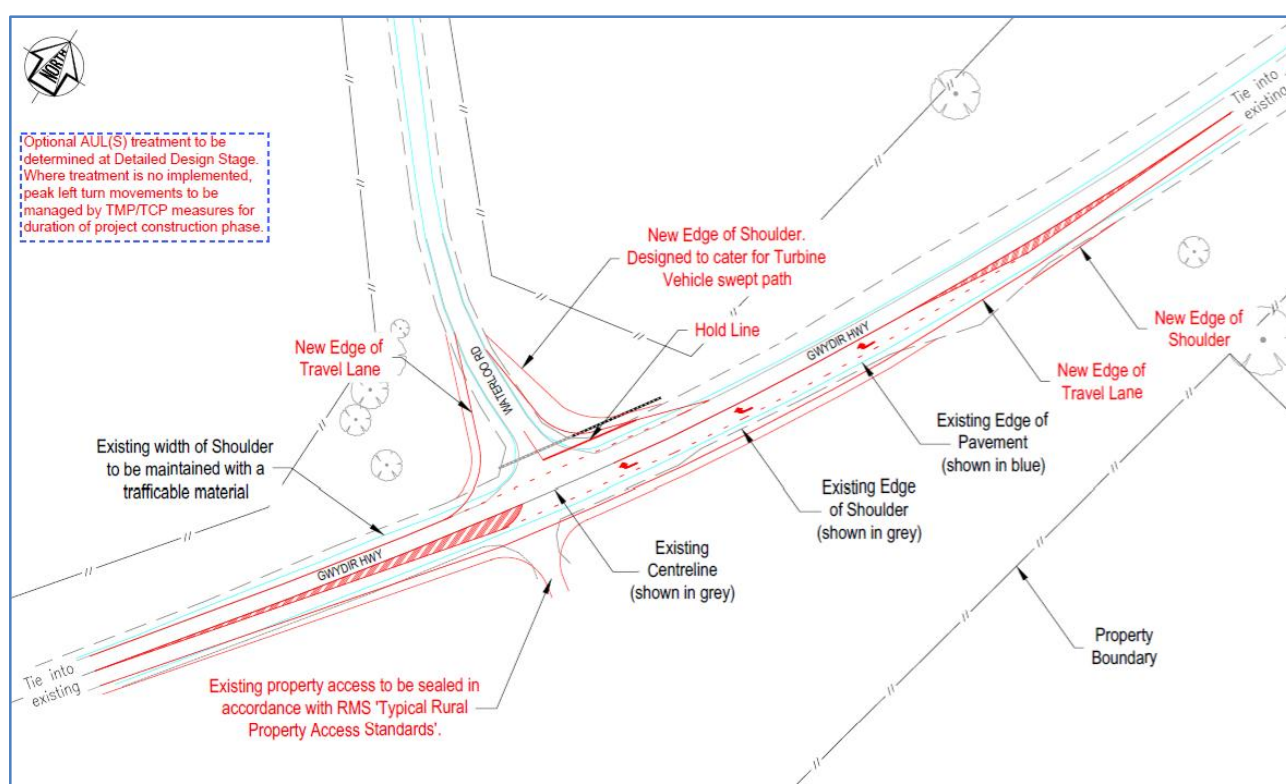


Figure 2.1 : Approved Road Intersection Upgrade at Gwydir Hwy / Waterloo Rd for Wind Farm Construction

Based on the information noted above, the construction vehicles for the solar farm will utilise the recently upgraded Gwydir Highway / Waterloo Road as the primary construction route.

There are existing construction traffic signs at the required intersections along the Gwydir Highway, Woodstock Road, Waterloo Road and Western Feeder Road. These are all clearly visible to approaching drivers on these roads,

2.4 Crash History

TTM requested crash data for the past five years from RMS for the locality of the area. The extent of the crashes in the area are indicated in Figure 2.2.

There have been no crashes at the intersections of Woodstock Road and Waterloo Road with the Gwydir Highway, and also no crashes along Woodstock Road, Waterloo Road and Western Feeder Road within the vicinity of the proposed Solar Farm.

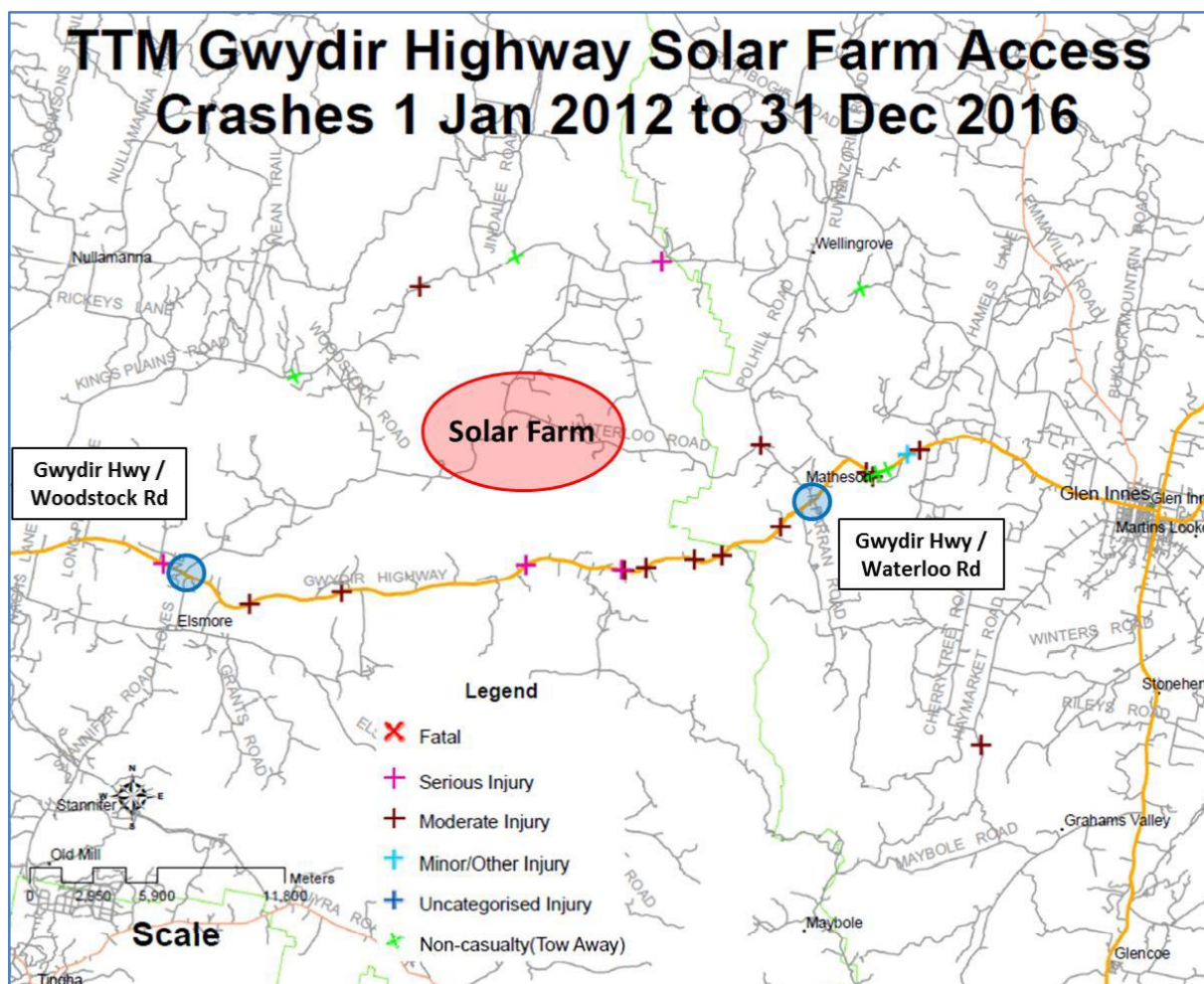


Figure 2.2 : RMS 5 Year Crash Data (2012 to 2016)

One moderate injury crash occurred in 2015 on Waterloo Road, 40m east of Polhill Road, which involved a lorry driving on the incorrect side of the road.

2.5 Plans / Documentation

A set of the plans noting the proposed Solar Farm is provided in the appendices of this report.

3 Road Safety Audit Findings

3.1 Audit Criteria

A ranking system for each of the issues has been adopted using the following priority ratings in Table 3-1:

Table 3-1 Road Safety Audit – Priority Ratings

Priority	Risk Ranking	Suggested Treatment Approach
A	High	Highest priority for action from a safety view point
B	Medium	Action needs to be taken from safety view point
C	Low	Action is desirable from a safety view point
D	Comment	An observation which may improve overall performance or safety, Be of wider significance and possibly outside the scope of this RSA, but where action should be considered


It is noted that the priority ranking is based on the subjective assessment of the audit team.


4 Formal Statement

4.1 Audit Team Statement

We, the undersigned, declare that we have reviewed the material and data listed in this report and identified the safety and operational deficiencies outlined in the preceding sections.

It should be noted that while every effort has been made to identify potential safety hazards, no guarantee can be made that every deficiency has been identified. We recommend that points of concern be investigated and necessary corrective actions are undertaken.

Richard V Jones – Senior Road Safety Auditor (Team Leader) 24/11/17

Ben Williamson – Senior Road Safety Auditor..... 24/11/17


Appendix A Road Safety Audit Findings


Reviewer: Richard V Jones (TTM Consulting)



Responder:


Date: 24/11/17


Date:


Item	DRG	Audit Findings/Recommendations	Rankings	Client		
				Accept Yes/No	Response	Status
1		<p>The intersection of Gwydir Highway and Woodstock Road is likely to be used by local construction workers from Inverell. The main movement will be left from Gwydir Highway to Woodstock Road and then right out from Woodstock Road to Gwydir Highway.</p> <p>Due to the vegetation to the east of the intersection, there is a risk that drivers attempting to exit Woodstock Road may pull out in front of approaching westbound traffic on Gwydir Highway, resulting in a side swipe / t-bone crash.</p>  <p><i>It is recommended that vegetation is cut back to the desired SISD and regularly maintained.</i></p>	Low			

Item	DRG	Audit Findings/Recommendations	Rankings	Client		
				Accept Yes/No	Response	Status
2		<p>The intersection of Gwydir Highway and Waterloo Road is the primary construction access for the solar farm. The main movement will be right from Gwydir Highway to Waterloo Road and then left out from Waterloo Road to Gwydir Highway.</p> <p>Due to the vegetation to the west and east of the intersection, there is a risk that drivers attempting to exit Waterloo Road may pull out in front of approaching westbound / eastbound traffic on Gwydir Highway, resulting in a side swipe / t-bone crash.</p>  <p><i>It is recommended that vegetation is cut back to the desired SISD and regularly maintained.</i></p>	Low			

Item	DRG	Audit Findings/Recommendations	Rankings	Client		
				Accept Yes/No	Response	Status
3		<p>The road surface at the existing intersection at Gwydir Highway and Waterloo Road is in a poor condition due to its poor construction and the turn movements of heavy construction vehicles. This has led to many potholes and pavement defects.</p> <p>There is a risk that turning or passing vehicles will attempt to swerve pass these defects and thus may lose control of their vehicle, in particular during wet weather conditions. Their focus is also likely to be on these defects and not approaching vehicles at this intersection.</p> <p>This increases the risk of a crash at this location and could lead personal injury.</p>   <p><i>It is recommended that these defects are removed by way of resurfacing / reconstruction of the affected areas</i></p>	Medium / High			

Item	DRG	Audit Findings/Recommendations	Rankings	Client		Status
				Accept Yes/No	Response	
4		<p>The line marking and RRPMS at the existing intersection at Gwydir Highway and Waterloo Road is faded or been removed due to its poor construction and the turn movements of heavy construction vehicles. There is a risk that drives using this intersection may not align correctly and encroach into the movement of an approaching / passing vehicle. This may lead to a side swipe / head on crash at this location.</p>  <p><i>Ensure that the line marking and RRPMS are provided as per the agreement with RMS, and regularly checked and maintained due to the construction traffic at this location.</i></p>	High			

Item	DRG	Audit Findings/Recommendations	Rankings	Client		Status
				Accept Yes/No	Response	
5		<p>On Waterloo Road, at 55m from Gwydir Highway, there is a culvert at the edge of the road. There are missing guide posts here, but have been replaced with traffic bollards.</p> <p>These bollards are easily knocked or removed, thus leaving the drop into the culvert with no warning to drivers. There is a risk that drivers will not see this, in particular during the hours of darkness, and crash into the verge when opposing vehicles are approaching. .</p>  <p><i>It is recommended that all locations along Waterloo Road is reviewed for the provision of guide posts and to implement these where necessary.</i></p>	Low			

Item	DRG	Audit Findings/Recommendations	Rankings	Client		Status
				Accept Yes/No	Response	
6		<p>On the local gravel roads, there are various locations where guide posts have been removed, knocked down or simply were not provided. There is a risk, in particular during the hours of darkness, that drivers would not see culverts, bends, access points and other hazards as the guide post highlighting these hazards are missing. This could lead to a driver leaving the gravel road into the verge, ditch or culvert, possibly resulting in injury.</p>  <p><i>It is recommended that all locations along the local gravel roads are reviewed for the provision of guide posts and to implement these where necessary. Also, maintenance checks should be carried out on a monthly basis during the construction to ensure damaged / missing guide posts are replaced.</i></p>	Low			



Item	DRG	Audit Findings/Recommendations	Rankings	Client		Status
				Accept Yes/No	Response	

Appendix B Crash Data

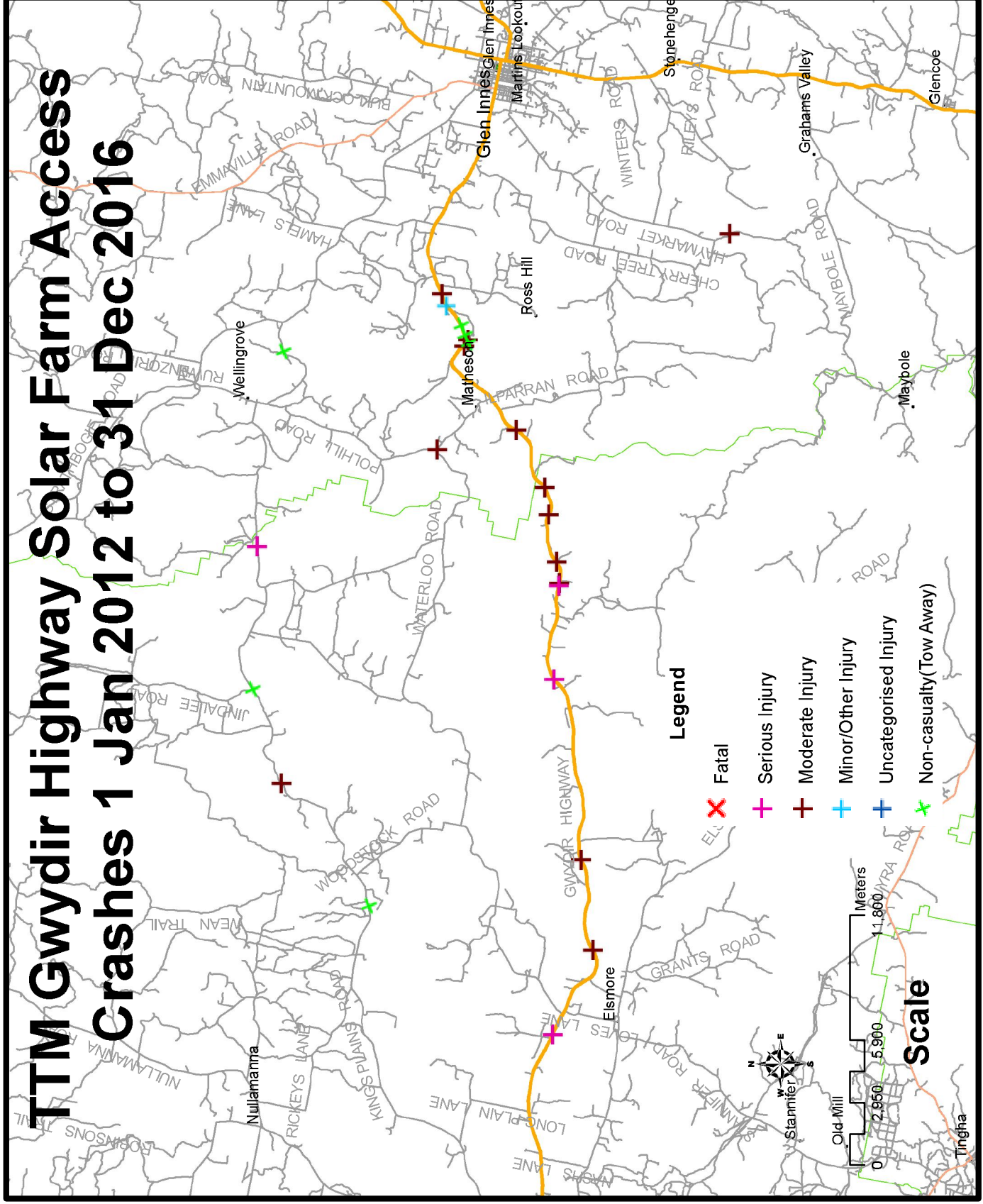
#Holiday Periods																	
New Year	0	0.0%	Easter	1	4.2%	Queen's BD	0	0.0%	Christmas	0	0.0%	Easter SH	1	4.2%	Sept./Oct. SH	2	8.3%
Aust. Day	0	0.0%	Anzac Day	0	0.0%	Labour Day	0	0.0%	January SH	1	4.2%	June/July SH	0	0.0%	December SH	0	0.0%

Note: Crash self reporting, including self reported injuries began Oct 2014. Trends from 2014 are expected to vary from previous yrs. More unknowns are expected in self reported data.

Rep ID: REG01 Office: Grafton User ID: baldwinm

TTM Gwydir Highway Solar Farm Access

Crashes 1 Jan 2012 to 31 Dec 2016



Detailed Crash Report

Crash No.	Data Source	Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash-Detailed	Killed	Seriously Inj.	Moderately Inj.	Minor/Other Inj.	Uncateg'd Inj.	SF	
Northern Region																									
Glen Innes Severn LGA																									
Furracabad																									
Haymarket Rd																									
789195	P	08/03/2012	Thu	22:30	800 m	S CHERRY TREE RD	2WY	CRV	Fine	Dry	100	1	TRK	M45	N in HAYMARKET RD	Unk	Proceeding in lane	MC	0	0	1	0	0	S	
E47437740							RUM	85	Off rt/lft bnd=>obj	Tree/bush															
Glen Innes																									
Gwydir Hwy																									
797072	P	15/05/2012	Tue	22:30	13 km	W GLEN INNES TN	2WY	STR	Fine	Dry	80	1	TRK	M24	E in GWYDIR HWY	80	Proceeding in lane	MC	0	0	1	0	0	F	
E48269577							RUM	71	Off rd left => obj	Fence (prior to 2014)															
Matheson																									
Gwydir Hwy																									
1063744	S	17/02/2015	Tue	15:40	12 km	W DERBY ST	2WY	CRV	Fine	Dry	100	1	WAG	M22	E in GWYDIR HWY	Unk	Pull out opposite	NC	0	0	0	0	0	S	
E56914905							RUM	85	Off rt/lft bnd=>obj	S/Barrier - Guardrail															
1111509	S	17/08/2016	Wed	07:30	450 m	W ROSE HILL RD	2WY	CRV	Fine	Dry	100	1	CAR	F35	W in GWYDIR HWY	Unk	Proceeding in lane	MC	0	0	1	0	0	S	
E253982895							RUM	83	Off rt/lft bnd=>obj	Tree/bush															
1073874	P	14/06/2015	Sun	00:01	1.08 km	W ROSEHILL RD	2WY	STR	Fine	Dry	100	1	TRK	F37	E in GWYDIR HWY	100	Proceeding in lane	OC	0	0	0	1	0	F	
E58243718							RUM	73	Off rd right => obj	Drain/culvert															
782848	P	31/01/2012	Tue	08:20	10 m	E SINCLAIR LOOKO OT	2WY	CRV	Fog or mist	Wet	Unk	1	WAG	F82	E in GWYDIR HWY	60	Proceeding in lane	NC	0	0	0	0	0	S	
E47102538							RUM	85	Off rt/lft bnd=>obj	Signpost															
1116239	P	08/08/2015	Sat	16:08	200 m	E SINCLAIRE LOOKOUT OT	2WY	CRV	Fine	Dry	100	1	M/C	M28	W in GWYDIR HWY	80	Proceeding in lane	MC	0	0	1	0	0		
E58570533							RUM	80	Off left/right bend																
1054994	S	18/11/2014	Tue	16:00	2 km	W WATERLOO RD	2WY	CRV	Fine	Dry	100	1	TRK	F73	E in GWYDIR HWY	Unk	Proceeding in lane	MC	0	0	1	0	0	S	
E850327290							RUM	85	Off rt/lft bnd=>obj	Tree/bush															
782238	P	24/01/2012	Tue	11:30	9.2 km	W WST FURRACABAD RD	2WY	CRV	Raining	Wet	80	1	CAR	M18	W in GWYDIR HWY	95	Proceeding in lane	NC	0	0	0	0	0	S	
E47154479							RUM	80	Off left/right bend																
Waterloo Rd																									
1061861	P	08/03/2015	Sun	07:30	40 m	E POLHILL RD	2WY	CRV	Fog or mist	Dry	100	2	LOR	M46	W in WATERLOO RD	70	Incorrect side	MC	0	0	1	0	0		
E58201553							RUM	20	Head on				TRK	M35	E in WATERLOO RD	Unk	Proceeding in lane								
Wellingrove																									
Wellingrove Rd																									
1107836	P	04/04/2016	Mon	12:00		at FOSSICKING RESERVE GTE	2WY	CRV	Fine	Dry	100	2	WAG	M18	W in WELLINGROVE RD	5	Perform U-Turn	NC	0	0	0	0	0	S	
E60429525							RUM	40	U turn				TRK	M46	W in WELLINGROVE RD	0	Stationary								
Inverell LGA																									

Detailed Crash Report

Crash No.	Data Source	Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash-Detailed	Killed	Seriously Inj.	Moderately Inj.	Minor/Other Inj.	Uncateg'd Inj.	SF Factors
Elsmore																								
Gwydir Hwy																								
1023799 P	22/03/2014	Sat	20:50	1.46 km	E DODDS LANE	2WY	CRV	Fine	Dry	100	1	CAR	F30	W in GWYDIR HWY	80	Proceeding in lane	MC	0	0	1	2	0	0	S
E54036227						RUMt	87	Off lft/bnd=>obj					Drain/culvert											
1087780 P	19/11/2015	Thu	10:15	22 km	E INVERELL TN	2WY	STR	Fine	Dry	100	1	UTE	M58	W in GWYDIR HWY	80	Proceeding in lane	MC	0	0	1	0	0	0	
E59366322						RUMt	70	Off road to left																
Inverell																								
Kings Plains Rd																								
785394 P	06/02/2012	Mon	04:50	4 km	E RICKEYS LANE	2WY	STR	Fine	Dry	100	1	CAR	F62	W in KINGS PLAINS RD	80	Proceeding in lane	NC	0	0	0	0	0	0	
E195363694						RUMt	67	Struck animal					Straying stock											
Kings Plains																								
Kings Plains Rd																								
1102439 S	19/05/2016	Thu	14:30	10 m	W JINDALEE RD	TJN	CRV	Fine	Dry	100	1	TRK	M19	E in KINGS PLAINS RD	Unk	Proceeding in lane	NC	0	0	0	0	0	0	S
E61912869						RUMt	81	Off left/rt bnd=>obj					Tree/bush											
Long Plain																								
Gwydir Hwy																								
791221 P	09/04/2012	Mon	04:30	200 m	E PRINCES HWY	2WY	STR	Fine	Dry	100	1	CAR	M64	W in GWYDIR HWY	100	Proceeding in lane	SC	0	1	0	0	0	0	F
E47387611						RUMt	71	Off rd left => obj					Signpost											
Sapphire																								
Kings Plains Rd																								
823013 P	14/11/2012	Wed	13:10	32 km	E INVERELL TN	2WY	CRV	Fine	Dry	100	1	M/C	M64	W in KINGS PLAINS RD	60	Proceeding in lane	MC	0	0	1	0	0	0	S
E51588880						RUMt	86	Off left/left bend																
Swan Vale																								
Gwydir Hwy																								
1007867 P	18/12/2013	Wed	16:30	27 km	W DERBY ST	2WY	STR	Fine	Dry	100	1	TRK	M17	W in GWYDIR HWY	100	Proceeding in lane	SC	0	2	0	0	0	0	S
E103756702						RUMt	74	On road-out of cont.																
843614 P	12/06/2013	Wed	09:40	24 km	W GLEN INNES TN	2WY	CRV	Overcast	Dry	100	1	CAR	M30	W in GWYDIR HWY	100	Proceeding in lane	MC	0	0	1	0	0	0	S
E51824940						RUMt	83	Off rt/rt bnd=>obj					Embankment											
1091597 P	14/09/2015	Mon	13:15	40 km	E INVERELL TN	2WY	STR	Fine	Dry	100	1	TRK	M61	W in GWYDIR HWY	100	Proceeding in lane	MC	0	0	1	0	0	0	F
E59136646						RUMt	71	Off rd left => obj					Tree/bush											
1097137 P	14/03/2016	Mon	08:30	300 m	E SWAN BROOK BDGE	2WY	CRV	Fine	Dry	100	1	TRK	M23	E in GWYDIR HWY	100	Proceeding in lane	SC	0	1	0	1	0	0	S
E60361606						RUMt	81	Off left/rt bnd=>obj					Tree/bush											

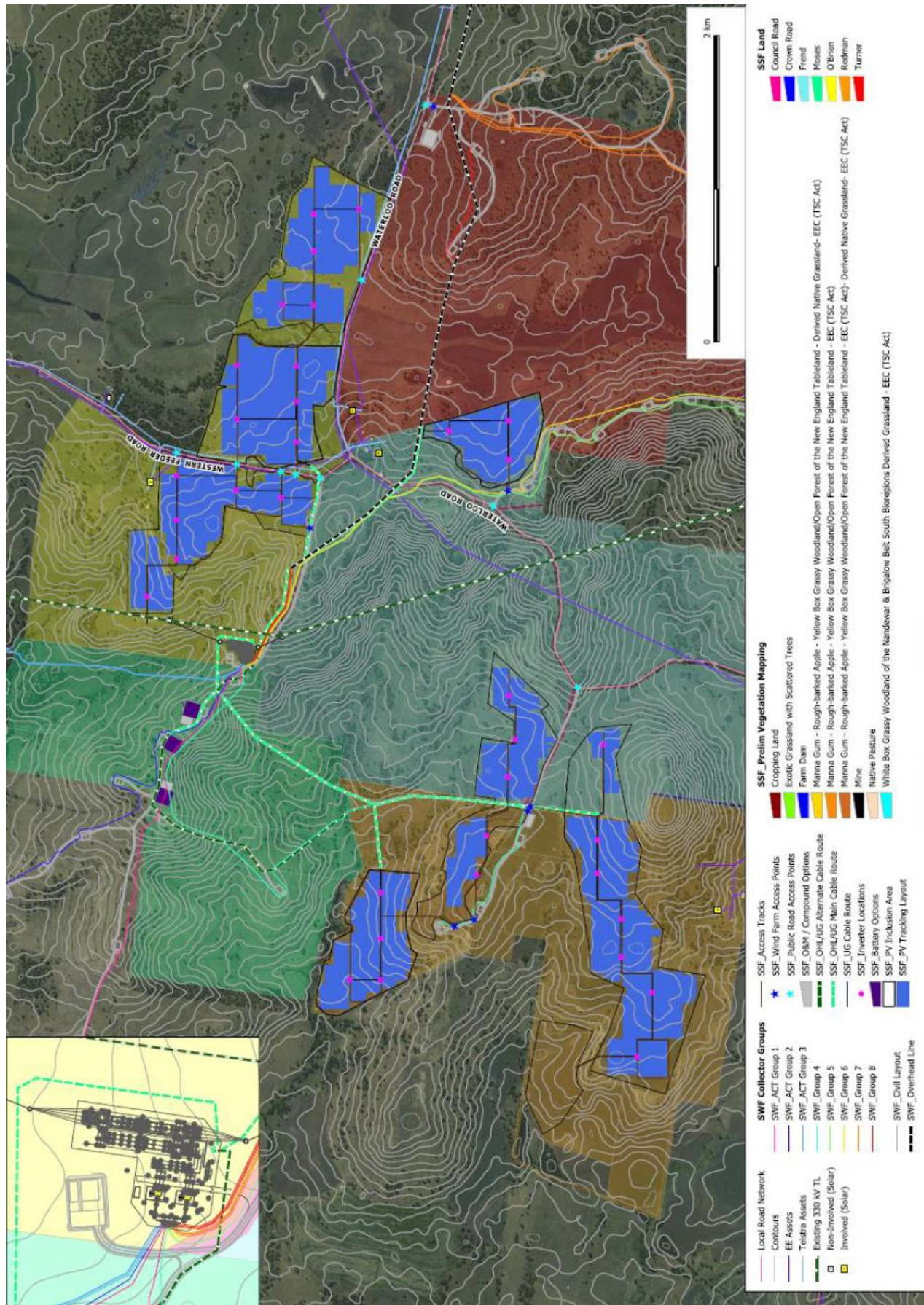
Detailed Crash Report

Crash No.	Data Source	Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash-Detailed	Killed	Seriously Inj.	Moderately Inj.	Minor/Other Inj.	Uncat'g'd Inj.	SF		
852747	P	25/09/2013	Wed	18:00	5 km	E SWAN BROOK BDGE	2WY	STR	Fine	Dry	100	1	TRK	F38	W in GWYDIR HWY	90	Proceeding in lane	MC	0	0	2	0	0			
E52382452							RUM	73	Off rd right ==> obj				Embankment													
1063351	S	26/03/2015	Thu	05:45	20 km	W WEST FARRACABAD RD	2WY	STR	Fine	Dry	100	1	CAR	F23	E in GWYDIR HWY	Unk	Proceeding in lane	MC	0	0	1	0	0			
E57331233							RUM	71	Off rd left ==> obj				Fence													
Wellingrove																										
Kings Plains Rd																										
1049133	P	20/09/2014	Sat	03:20	7.285 km	W POLHILL RD	2WY	STR	Fine	Dry	100	1	CAR	M27	W in KINGS PLAINS RD	Unk	Proceeding in lane	SC	0	1	0	1	0			
E56180858							RUM	71	Off rd left ==> obj				Tree/bush													

Report Totals: Crashes: 24 Fatal Crashes(FC): 0 Serious Injury Crashes(SC):4 Moderate Injury Crashes(MC): 13 Minor/Other Injury Crashes(OC): 1 Uncategorised Injury Crashes(UC): 0 Non-Casualty Crashes(NC): 6 Killed(K): 0 Seriously Injured(S): 5 Moderately Injured(M): 14 Minor/Other Injured(O): 5 Uncategorised Injured(U): 0

Crashid dataset TTM Gwydir Highway and Surround Crashes 1 Jan 2012 to 31 Dec2016
 Crash self reporting, including self reported injuries began Oct 2014. Trends from 2014 are expected to vary from previous yrs. More unknowns are expected in self reported data.
 Reporting yrs 1996-2004 and 2017 onwards contain uncategorised inj crashes.

Appendix C Plans



Appendix C Concept Plan – Gwydir Highway / Waterloo Road



Optional AUL(S) treatment to be determined at Detailed Design Stage.
Where treatment is no implemented, peak left turn movements to be managed by TMP/TCP measures for duration of project construction phase.

New Edge of Shoulder.
Designed to cater for Turbine Vehicle swept path

New Edge of Travel Lane

Hold Line

Existing width of Shoulder to be maintained with a trafficable material

Existing Centreline (shown in grey)

Existing Edge of Shoulder (shown in grey)

Existing Pavement (shown in blue)

New Edge of Travel Lane

New Edge of Shoulder

Property Boundary

Existing property access to be sealed in accordance with RMS 'Typical Rural Property Access Standards'.

Gold Coast
Level 2, 428 Upper Edward Street, Spring Hill 4000
P: 071 38314442
E: enquiries@bitziosconsulting.com.au
Spring Hill 4000, 3 Gladstone Street, Newmarket NSW 2042
P: 021 9527 6302

BITZIOS
-consulting
traffic engineering • transport planning

REVISIONS
User: 201
Drawn: N.B.
Date: 25.11.2016

Scale @ A3
0 5 10 15 20 25 30 35
1:750

Project: Sapphire Wind Farm TIA
Title: Gywir Hwy / Waterloo Rd Intersection Configuration CHR(s) + BAL Annotated Plan

Design: N.B.
Drawn: N.B.
Checked: A.E.
Date: 25.11.2016
Issue: 001
Project number: P2908
Sheet number: 1