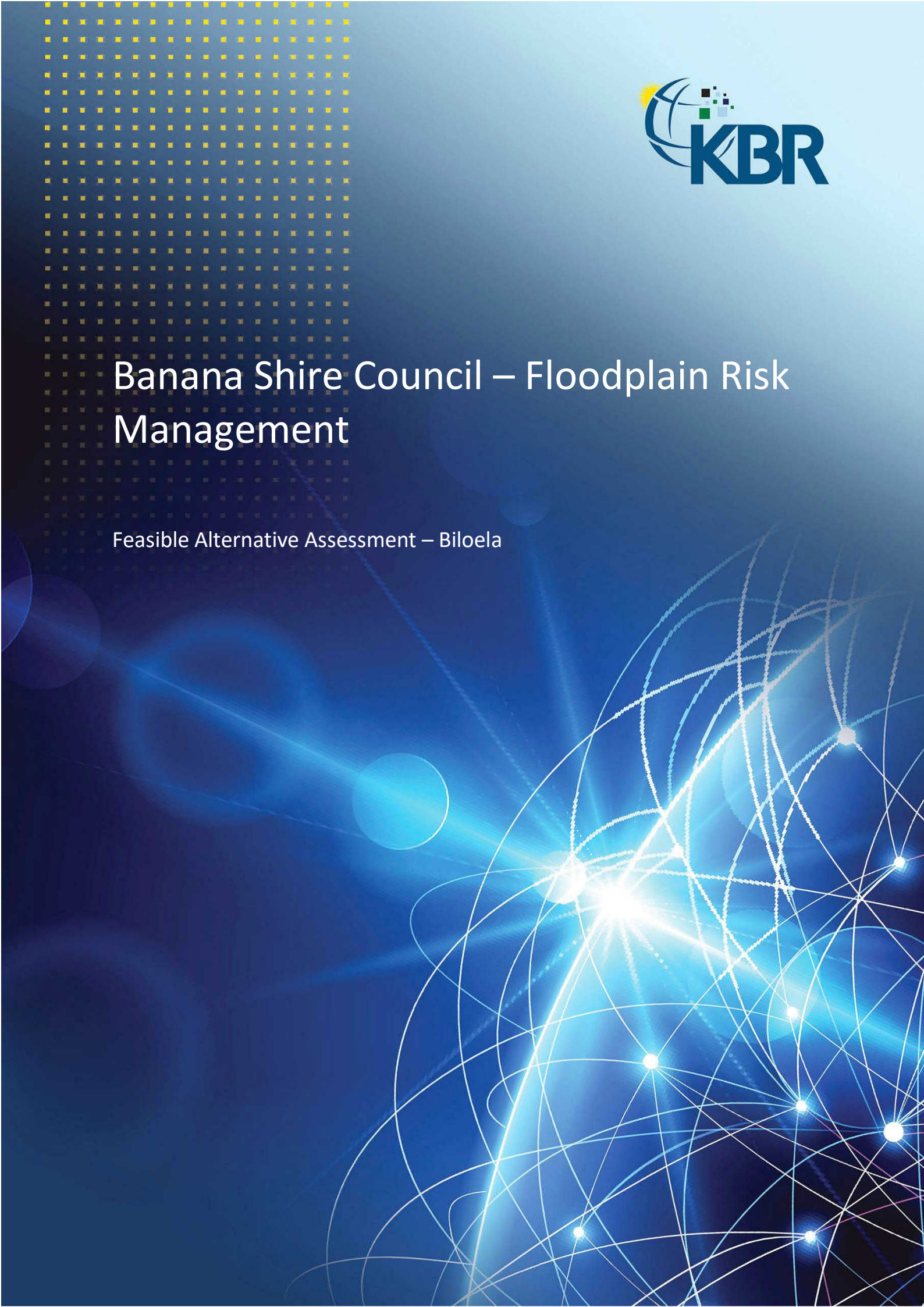
Banana Shire Council – Floodplain Risk Management

Feasible Alternative Assessment – Biloela



Banana Shire Council – Floodplain Risk Management

Feasible Alternative Assessment – Biloela

Prepared for:

BANANA SHIRE COUNCIL

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Prepared by:

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BEW956-TD-WR-REP-0002 Rev. 0

Limitations Statement

The sole purpose of this report and the associated services performed by Kellogg Brown & Root Pty Ltd (KBR) is to undertake a feasible alternative assessment in accordance with the scope of services set out in the contract between KBR and Banana Shire Council ('the Client'). That scope of services was defined by the requests of the Client, by the time and budgetary constraints imposed by the Client, and by the availability of access to the site.

KBR derived the data in this report primarily from previous flood modelling and structural mitigation review. The passage of time, manifestation of latent conditions or impacts of future events may require further exploration at the site and subsequent data analysis, and re-evaluation of the findings, observations and conclusions expressed in this report.

In preparing this report, KBR has relied upon and presumed accurate certain information (or absence thereof) relative to study area provided by government officials and authorities, the Client and others identified herein. Except as otherwise stated in the report, KBR has not attempted to verify the accuracy or completeness of any such information.

The findings, observations and conclusions expressed by KBR in this report are not, and should not be considered, an opinion concerning flood risk. No warranty or guarantee, whether express or implied, is made with respect to the data reported or to the findings, observations and conclusions expressed in this report. Further, such data, findings, observations and conclusions are based solely upon previous flood modelling outcomes in existence at the time of the investigation.

This report has been prepared on behalf of and for the exclusive use of the Client, and is subject to and issued in connection with the provisions of the agreement between KBR and the Client. KBR accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report by any third party.

Revision History

Revision	Date	Comment	Signatures			
			Originated by	Checked by	Technical Approval	Project Approval
0	30/8/19	Issued for use	A Djozan Ali Djozan 2019.09.06 10:39:19 +10'00'	M Gould Megan Gould 2019.09.06 11:01:11 +10'00'	A Densten Digitally signed by Anthony Densten Date: 2019.09.10 15:27:17 +10'00' Adobe Acrobat Reader version: 2018.011.20058	A Densten Digitally signed by Anthony Densten Date: 2019.09.10 15:27:49 +10'00' Adobe Acrobat Reader version: 2018.011.20058

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Summary

Banana Shire Council is in the process of revising their Planning Scheme in accordance with the Department of Infrastructure, Local Government and Planning (DILGP) State Planning Policy for Natural hazards, risks and resilience – Flood (July 2017). As part of their review, they are considering the back-zoning of two sites in Biloela with an overview to reduce the flood risk to the remaining township due to development of these sites.

The northern site is currently zoned as Town and classified as Rural Residential. The southern site is currently zoned as Town and is classified as Residential. Banana Shire Council is considering a change to the zoning of both sites to Rural which will discourage residential type development in these areas.

Kellogg Brown & Root Pty Ltd has undertaken a flood assessment to support this proposed change to the Planning Scheme and to consider whether there are feasible alternative options to the back-zoning.

The flood assessment demonstrates that potential development in the northern site consistent with the current Planning Scheme arrangements is predicted to result in significant impacts on the eastern and northern adjoining sites. A potential development consistent with the current Planning Scheme in the southern site is predicted to result in impacts of lesser extent and magnitude but outside tolerable limits.

A number of options were investigated as alternatives to the back-zoning option which could allow for development on these sites. More detailed assessment of these options would need to be undertaken if BSC wished to consider an alternative approach further. However, based on the review of the flood behaviour, it is considered that the adoption of an alternative option to back-zoning would be challenging without a significant reduction in the available developable area or the construction of major mitigation structures. This is due to the significant expected flow conveyance through the sites and the impacts predicted to be associated with proposed development and the requirement to elevate properties above the Design Flood Event (DFE).

Based on the outcome of this assessment, none of the alternatives considered are deemed feasible and consistent with the objectives of the State Planning Policy.

1 Introduction

In recent times Banana Shire has suffered some of its worst flooding on record with many businesses and homes flooded, people displaced and agriculture devastated. Flooding has caused significant distress and long lasting impacts leaving some residents concerned regarding a repeat event. Additionally global warming may make summer downpours more likely and more intensive at the end of the century. The way we have transformed our environment and the development of areas within a defined floodplain can leave us more exposed to risk in future from flooding.

With these concerns in mind Banana Shire Council (BSC) previously commissioned Kellogg Brown & Root Pty Ltd (KBR) to undertake a series of flood studies, develop coherent flood mitigation strategies and develop a Floodplain Management Plan for the region, encompassing the major population centres and townships. These townships included:

- Taroom
- Baralaba
- Jambin
- Wowan
- Theodore
- Biloela
- Goovigen
- Moura
- Thangool
- Dululu

The extent and scope of previous work undertaken by KBR is presented in Figure 1.1.

A number of documents were developed under the floodplain management study that have provided details of flood risk and mitigation strategies. The undertaking of the feasible alternative assessment has specifically referenced the following documents:

- KBR, Banana Shire Flood Study – Stage 2, Structural Measures Report, September 2016
- KBR, Banana Shire Flood Study – Stage 2, Non-Structural Measures Report Vol. 2 Flood Hazard Mapping, October 2016
- KBR, Banana Shire Flood Study – Stage 2, Floodplain Management Plan, January 2017.

Following the preparation of these documents the Department of Infrastructure, Local Government and Planning released guidance material related to State Planning Policy 'Natural hazards, risks and resilience – Flood' (July 2017). This planning document outlines the State's position in regard to flooding and requires that the risks associated with natural hazards, including the projected impacts of climate change, are avoided or mitigated to protect people and property and enhance the community's resilience to natural hazards.

BSC is reviewing their current Planning Scheme with an overview to maintain compliance with the State Planning Policy. As part of this review, BSC is considering to back-zone two sites within Biloela Township which they understand may result in significant flood risk if developed, based on the current Planning Scheme arrangements.

KBR has been commissioned by BSC to prepare a feasible alternative assessment. The assessment will support their application for changes to the Planning Scheme for back-zoning of these two properties in Biloela.

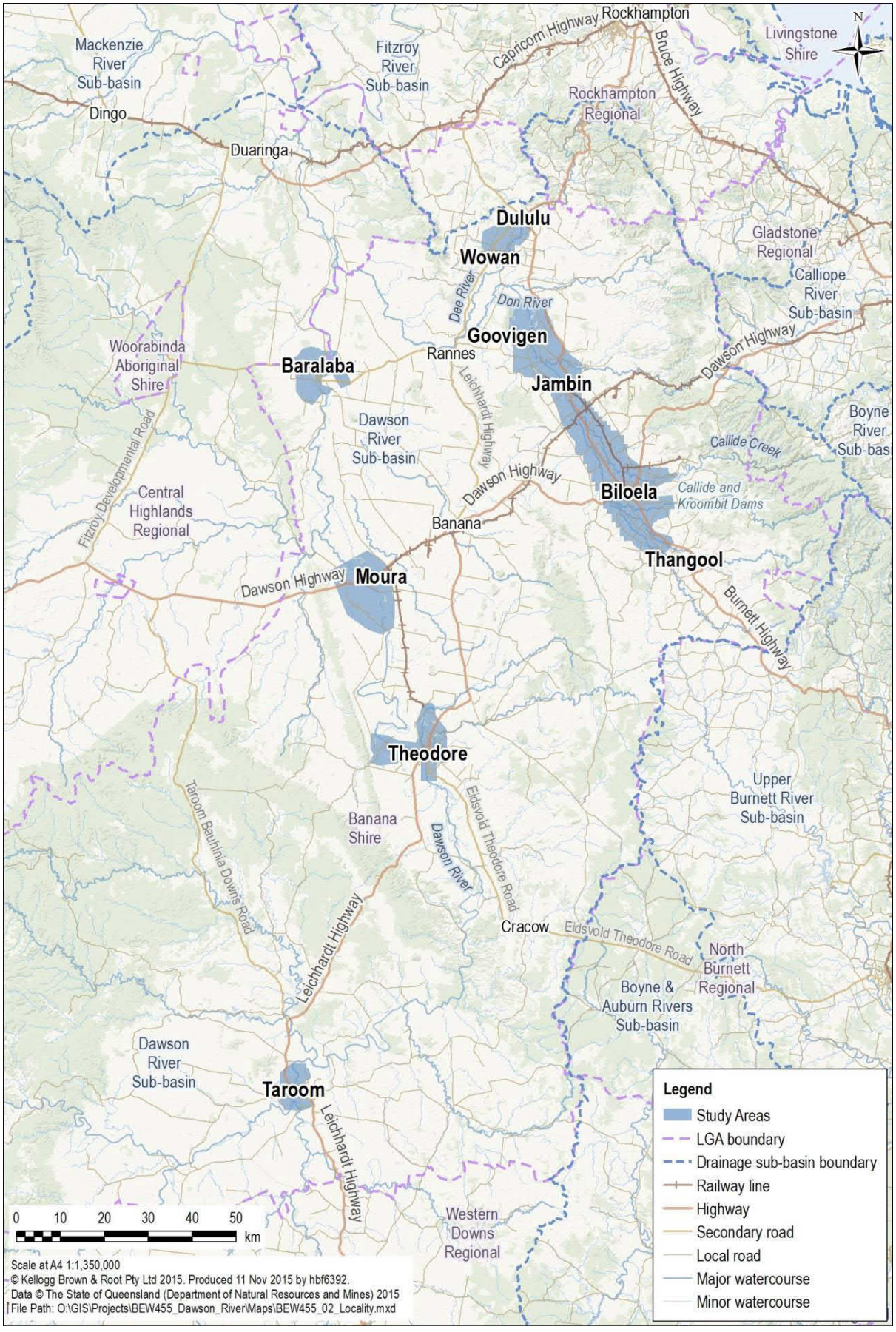


Figure 1.1 Banana Shire Flood Modelling Extents

2 Study objectives

The main objectives for the preparation of a feasible alternative assessment for Biloela are outlined below:

- investigate the flood behaviour and flood risks in the subject sites based on the flood modelling results
- investigate the existing land uses within the subject sites
- investigate the current Planning Scheme arrangements for the subject sites considering the predicted flood behaviour and risks
- investigate the proposed Planning Scheme arrangements (proposed changes) for the subject sites considering the predicted flood behaviour and risks
- investigate the consistency of the proposed changes to the Planning Scheme with the requirement of the State Planning Policy with an overview to demonstrate compliance
- identify and investigate alternative options for reducing flood risk in these areas.

3 Site descriptions

The study area covers two sites within Biloela which are being considered by BSC for potential back-zoning as part of their Planning Scheme review.

One of the sites is described as Lot 2 on SP220790 which is located to the north of Biloela. This site is bounded by Washpool Gully to the north, Dawson Highway to the east and Thalberg Avenue Park to the south. The site is predominantly flat with site levels varying approximately between RL 169 mAHD and 173 mAHD with an average slope in the order of 0.2-0.3%. This site totals an area of approximately 68 ha. This site will be named the 'northern site' for the purpose of this study.

The second site is described as Lot 1 on RP883979 and is located to the south of Biloela. This site is located to the south-west of Dakenba Road. This site is predominantly flat with its levels varying between RL 175 mAHD and 176 mAHD and an overall average slope in the order of 0.1%. This site totals an area of approximately 1.6 ha. This site will be named the 'southern site' for the purpose of this study.

Based on available aerial imagery the subject sites are predominantly farm land.

Refer to Figure 3.1 for site location.

Figure 3.1 Locality plan

4 Flood behaviour on the subject sites

4.1 NORTHERN SITE

Washpool Gully runs along the northern boundary of the northern site. This site is not predicted to be flooded in design events up to and including the 5% AEP design event. However, the site is expected to be flooded in the 2% AEP design event. Flood depths and flows through the site are significant in the 1% AEP design event.

Flooding of the site is controlled by the breakout flows from Washpool Gully. The major break out from Washpool Gully that floods the subject site occurs in a location to the north east of the site. There are also a number of smaller breakout flow paths along the Washpool Gully, further west.

The subject site is predicted to convey peak flows of up to approximately 100 m^3/s in the Defined Flood Event (DFE, defined by BSC as the 1% AEP design event plus climate change). Maximum flood depths of up to 1 m are predicted for the DFE. Peak velocities over the site are predicted to be generally less than 1 m/s.

The flood hazard on the site is predicted to range between H2 and H6 for the DFE, in accordance with the Hazard Vulnerability Classification, Australian Emergency Management Institute (2014). This means a large part of the site is unsafe for people, vehicles and some buildings. The Washpool Gully active channel area is expected to have a H5 to H6 hazard rating that generally poses a risk to all people and buildings.

Washpool Gully (along the northern boundary of the site) is predicted to have a maximum flood depth and velocity of 5 m and 2 m/s respectively in a 1% AEP design event.

4.2 SOUTHERN SITE

The southern site is located within the impact zone of Kroombit Creek. The site is predicted to be flooded as a result of break out from Kroombit Creek in a 2% AEP design event.

A maximum flow conveyance of approximately 7 m^3/s is predicted through the site in the DFE. A maximum flood depth and flow velocity of up to 0.5 m and 0.35 m/s is predicted in the southern site. The site is anticipated to have a flood hazard category of predominantly H2 to H3 (unsafe for children and elderly).

Flood maps demonstrating the flood hazard for the northern and southern sites have been prepared and are included in Appendix A.

5 Current Planning Scheme arrangements

5.1 NORTHERN SITE

The Town Planning Scheme for the Town of Biloela (prepared on June 2005 and amended on July 2008) indicates that the northern site is located within the Town Zone and falls within a Rural Residential Precinct. Refer to an extract of the Town Planning Scheme – Zoning Map for the Town of Biloela (2005) which is provided in Figure 5.3.

The Planning Scheme provides the overall outcomes sought for the Town – Rural Residential Precinct as shown in Figure 5.1.

The overall outcomes sought for the **Town - Rural Residential Precinct** are:

i. Land is predominantly used for dwelling houses on small rural lots;
ii. Low population densities in the Zone mean that people enjoy a rural lifestyle with accessibility to community facilities;
iii. The nature of the land within the Zone is essentially residential and therefore the size and scope of rural activities is limited;
iv. Uses such as animal husbandry and hobby farm cropping and agriculture are of a scale that do not result in adverse impacts on residential amenity;
v. New rural residential development is located such that it represents an infill of existing available rural residential land, or is an extension of existing rural residential development;
vi. New rural residential development respects the natural values and rural landscape values of the land and the surrounding area, by being visually non-intrusive or sufficiently buffered from these areas;
vii. Reticulated water supply is available and is to be provided to all new development;
viii. The majority of land in the Zone is afforded an urban standard of road access;
ix. Allotment size in the rural residential zone is sufficient to permit the sustainable on-site treatment and disposal of domestic effluent;
x. Low key uses which provide otherwise unprovided essential goods and services to the immediate rural residential community are located within the Zone, where potential impacts on residential amenity due to traffic, noise, and the built environment are minimised;
xi. Commercial and industrial uses are generally inconsistent with the residential nature of land within the Precinct.

Figure 5.1 Outcome Sought for Town-Rural Residential

5.2 SOUTHERN SITE

The Town Planning Scheme for the Town of Biloela (prepared on June 2005 and amended on July 2008) indicates that the southern site is located within the Town Zone and falls within a Residential Precinct. Refer to an extract of the Town Planning Scheme – Zoning Map for Town of Biloela (2005) which is provided in Figure 5.3.

The Planning Scheme provides the overall outcomes sought for the Town – Residential Precinct as shown in Figure 5.2.

The overall outcomes sought for the **Town – Residential Precinct** are:

i. Land within the Precinct is predominantly used for detached housing;
ii. Land is generally provided with urban standard services;
iii. Development on land which is not intended to be provided with a reticulated sewerage system, uses on-site effluent disposal systems which do not adversely impact on ground or surface water resources;
iv. Uses that are not in the Residential Use Class such as churches, community facilities, and local recreation facilities are only located in the Precinct where such uses are of a scale, size, appearance and built form which is consistent with residential amenity of the area;
v. Other uses not in the Residential Use Class are not generally located within the Precinct

Figure 5.2 Outcome Sought for Town- Residential

BSC is concerned that the type of development allowed by the current Planning Scheme for the subject sites may result in flood impacts in the surrounding areas and/or loss of floodplain storage as both of the sites provide flow conveyance in the DFE.

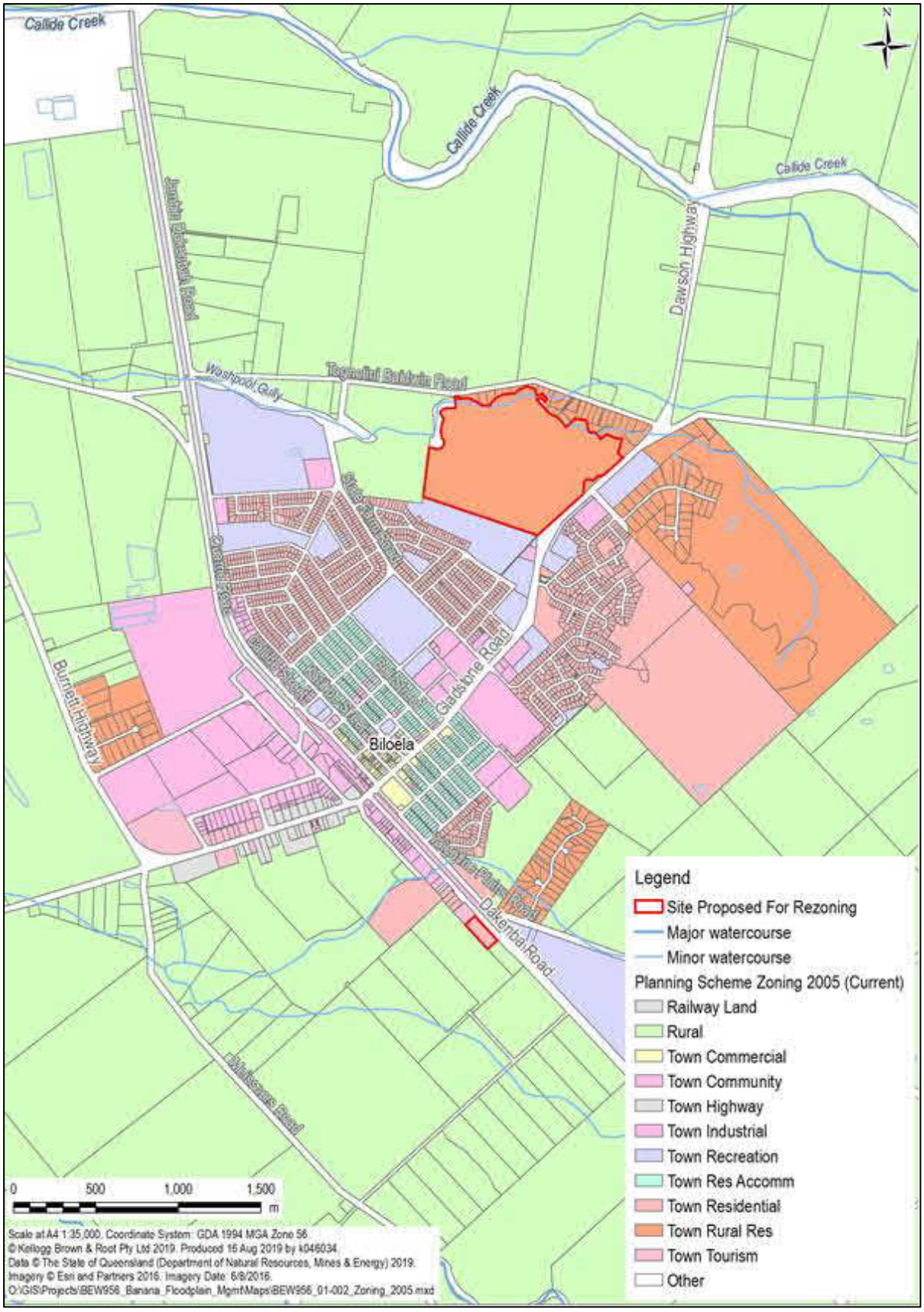


Figure 5.3 Town Planning Scheme Map No. ZONE-7

6 Flood impact assessment

KBR has previously developed detailed flood models for the region. These flood models have been adopted as the baseline models for this current study for Biloela and used to undertake an impact assessment of potential development on the subject sites.

6.1 DEVELOPMENT CASE SCENARIOS

The Banana Shire Flood Study Stage 2 – Floodplain Management Plan (KBR, January 2017) has recommended planning and development control measures as non-structural flood measures to manage the flood risks and enhance the resilience of the community in a flood event. The objective is to change peoples' behaviour through land use planning and development controls in addition to emergency management and community education. The recommendations for planning and development control measures include:

- 1% AEP flood event with climate change is adopted as the Defined Flood Event (DFE)
- proposed Banana Shire Council Planning Scheme includes a flood code that sets performance outcomes and outlines acceptable solutions
- proposed Banana Shire Council Planning Scheme provides guidance on the information required to be submitted with Development Applications
- adoption of 500 mm freeboard for habitable floors above the DFE and 300 mm allowance above the DFE where the building is non-habitable and for overland flow paths.

For this assessment, a development case was defined for each subject site based on the recommended planning and development control measures, by raising the proposed northern and southern sites to the levels of DFE plus 500 mm freeboard.

Note that although the current Planning Scheme identifies the defined floor levels as the 1% AEP + 600 mm freeboard, this assessment has considered development levels associated with the recommended DFE level (1% AEP plus climate change + 500 mm freeboard).

It is understood that this approach is conservative as it assumes that the entire site (and not only the building platforms) will be raised to the DFE level plus 500 mm of freeboard. However, it is reasonable to assume that the roads and external lot areas would not be significantly lower than the building platform level once an earthwork design is undertaken to raise the building platforms to the required level. Additionally, any lot and road layout provided for these areas is expected to include a dense residential component that would not allow the road to be significantly lower than the building platform level.

Furthermore, any proposed layout would likely not provide opportunity for significant conveyance of flow through the roads. The final design would need to demonstrate achievement of a reasonable flood hazard category for the roads (for pedestrian and vehicles safety) which will potentially result in raising the road design levels to minimize the flood depths. Therefore, raising of the entire development footprint is considered appropriate for this assessment.

Based on the above, the minimum development levels for the northern and southern sites were determined as shown in Table 6.1.

Table 6.1 Minimum development levels

Minimum Development Level	Maximum Flood Level around the site in DFE (m AHD)	Minimum Development Level Adopted (m AHD)
Northern Site	174.5	175.0
Southern Site	176.4	176.9

The post development scenario was simulated for the 2% AEP and 1% AEP design events, the DFE and PMF (Probable Maximum Flood).

The results for the development case scenario were then compared to baseline scenario results to allow for assessment of the potential impacts of the proposed development (as allowed under the current Planning Scheme, with proposed controls as per the Floodplain Management Plan recommendations). Flood impacts are presented for the 2% AEP, 1% AEP, DFE and PMF events in Appendix A.

Flood maps demonstrating the flood hazard for the proposed northern and southern developments for the DFE are included in Appendix A. Hazard 'afflux' maps are also included for the DFE demonstrating where the hazard classification has increased or decreased as a result of development.

6.2 IMPACTS ASSESSMENT – NORTHERN SITE

Based on the flood modelling results, development of the northern site as per the current Planning Scheme arrangements (as described above) is predicted to result in significant changes in flood behaviour and significant flood impacts as outlined below.

Afflux

The proposed development is predicted to result in significant increases in the maximum flood depths (afflux) to the east and north of the proposed development. Afflux of up to approximately 1.4 m is predicted to the east of the site (which also includes a number of dwellings) under the DFE. Afflux of up to 500 mm is predicted to the north of the site as a result of the proposed development under the DFE (which also includes a number of dwellings).

Afflux of up to approximately 1.2 m and 250 mm is predicted to the east and north of the site respectively as a result of the proposed development in a 2% AEP design event.

Afflux of up to approximately 1.4 m and 700 mm is predicted to the east and north of the site respectively as a result of the proposed development in a PMF event.

These impacts are anticipated to occur as a result of significant loss of conveyance due to development.

Changes in Peak Flow Velocities

The proposed development is predicted to result in increased peak velocities to the north and east of the site due to significant changes to the flood behaviour around the site. The greatest increases are anticipated between the proposed development and the Washpool Gully with increases of up to approximately 0.5 m/s.

Changes to the Flood Hazard

The proposed development is predicted to worsen the flood hazard to the north and east of the northern site by 1 to 2 categories.

6.3 IMPACT ASSESSMENT – SOUTHERN SITE

Based on the flood modelling results, development of the southern site as per the current Planning Scheme arrangements (as described above) is predicted to result in some changes in flood behaviour and in flood impacts as outlined below.

Afflux

Afflux of up to 150 mm is predicted to the north-east of the site as a result of the proposed development under the DFE. The impact zone includes a section of Dakenba Road and Valentine Plains Road as well as a residential area.

Afflux of up to approximately 50 mm is anticipated locally (in a limited area to the north-east of the site) as a result of the proposed development in a 2% AEP design event.

Afflux of up to approximately 200 mm is predicted to the north of the site in a PMP event.

Changes in Peak Flow Velocities

No major changes in the peak velocities are anticipated as a result of the proposed development under the DFE.

Changes to the Flood Hazard

The proposed development is predicted to worsen the flood hazard to the north-east of the southern site by 1 category.

7 Proposed changes to the Planning Scheme

An extract from the Draft BSC Planning Scheme 2016 – Zoning Map provided by BSC shows that both the northern and southern sites are planned to be re-zoned from Town to Rural.

The Planning Scheme provides the overall outcomes sought for the Rural Zone as shown in Figure 7.1.

(1) → The purpose of the Rural Zone Code is to¶
(a) → provide for rural uses and activities; and¶
(b) → provide for other uses and activities that are compatible with:¶
(i) → existing and future rural uses and activities; and¶
(ii) → the character and environmental features of the Zone; and¶
(c) → maintain the capacity of rural land for rural uses and activities by protecting and managing significant natural resources and processes.¶
(2) → The purpose of the Code will be achieved through the following overall outcomes:¶
(a) → intensive animal industries minimise or avoid adverse impacts on surrounding land uses;¶
(b) → development is sensitive and responsive to the rural character and scenic amenity and maintains vegetation cover in significant areas;¶
(c) → development, having regard to its location and design, protects people and premises from natural hazards and contamination;¶
(d) → extractive industries and associated processing occur in a way that significant environmental impacts are contained within the site and provides for the effective site rehabilitation;¶
(e) → development adjacent to an extractive resource or transport route permits the efficient extraction of the entire resource, the safe and efficient transport of materials to and from the site and provides effective and on-going separation of extractive industry activity from any sensitive uses;¶
(f) → non-resident workforce accommodation is incompatible with the purpose of the Rural Zone and are located in a more suitable zone;¶
(g) → tourism uses only locate where they have a nexus with the surrounding rural activities or places with high environmental values;¶
(h) → infrastructure is provided at a standard normally expected in rural locations and is allowed to operate safely and efficiently without interference by incompatible uses or works;¶
(i) → development is separated from existing and potential industry land uses located in rural areas including established uses identified in the Special Industry Zone;¶
(j) → and where affected by an overlay for:¶
(iii) → bushfire or flood risk:¶
(A) → the use and works support and do not unduly burden disaster management response or recovery activities;¶
(B) → development does not result in an increase in unacceptable risk to people or property as a result of exposure to natural hazards and environmental constraints affecting the land;¶
(C) → works are resilient to and do not contribute to an increase in the severity of natural hazard events;¶
(D) → works retain the natural processes and protective function of landforms and vegetation in natural hazard areas;¶

Figure 7.1 Outcome Sought for Rural Zone

The re-zoning of these sites to 'Rural' reflects their existing predominant land use and reduces the potential for new urban types of land uses, which are sensitive to flooding, from expanding into an area subject to known flooding.

The rural zone will enable the existing land use activities to continue and for flooding impacts on new development to be assessed and regulated through the provision of the Flood Assessment Benchmarks in the Rural Zone Code.

The effect of this zoning change will make urban development inconsistent with the zone and discourage urban uses from establishing in this area.

An extract from the Draft BSC Planning Scheme 2016 is included in Figure 7.2.

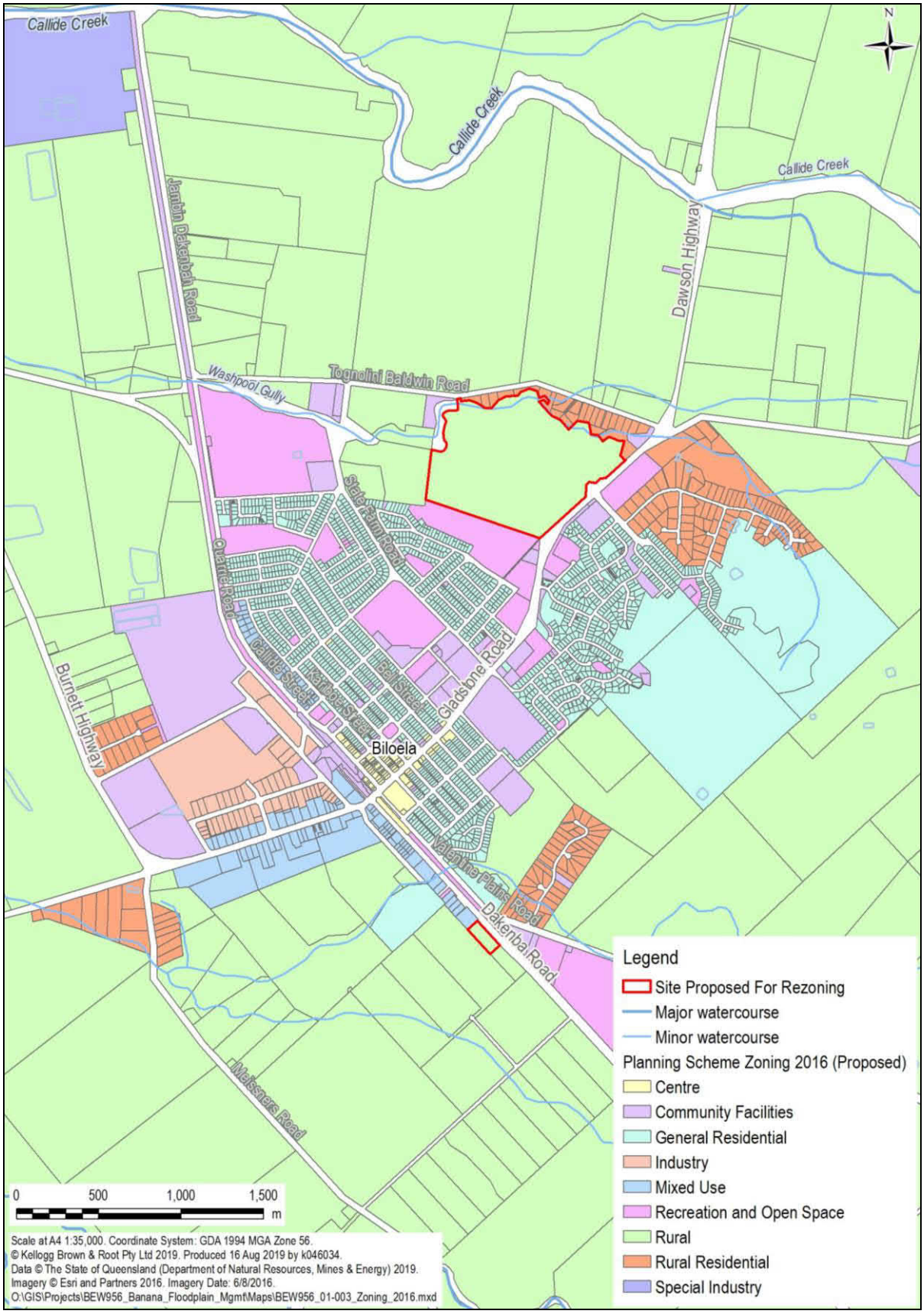


Figure 7.2 Extract from Draft BSC Planning Scheme 2016

8 Consistency of the Proposed Planning Scheme Approach with the requirements of the State Planning Policy

The State Planning Policy State 'Natural hazards, risks and resilience – Flood' (July 2017) seeks to ensure that:

> 'The risks associated with natural hazards, including the projected impacts of climate change, are avoided or mitigated to protect people and property and enhance the community's resilience to natural hazards.'

The State Planning Policy – State interest policy 4 requires that:

> 'Development in bushfire, flood, landslide, storm tide inundation or erosion prone natural hazard areas:
>
> (a) avoids the natural hazard area
>
> (b) where it is not possible to avoid the natural hazard area, development mitigates the risks to people and property to an acceptable or tolerable level'

The approach taken by the proposed Planning Scheme of avoiding the establishment of urban uses on the subject sites aligns with State Planning Policy of avoiding the natural hazard areas.

9 Feasible alternatives assessment

9.1 NORTHERN SITE

Based on the flood assessment undertaken, a potential development consistent with the arrangements of the current Planning Scheme is anticipated to result in significant flood impacts to the areas to the north and east of the site including road network and a number of dwellings.

A number of alternate development options were investigated to potentially mitigate the impacts and allow for the current zoning to be retained for the site. The mitigation options investigated are as follows:

- Provision of a flood levee by raising Tognolini Baldwin Road and Dawson Highway to protect properties facing Washpool Gully up to the DFE. This option is presented in the Banana Shire Flood Study Stage 2 – Structural Measures Report, August 2016 along with an indication of its benefits, impacts and costs. This option is anticipated to provide flood mitigation benefits to the northern site. However, further modelling and assessment of this option would need to be undertaken for better understanding of the benefits and impacts.
- Incorporate planning controls to the northern site to restrict the amount of fill associated with the development. The required minimum building platform level could be achieved by the use of a high set building arrangement, such as a suspended slab on stilts structure. The objective for this option is to minimise the flood impacts by restricting the fill whilst still achieving the required minimum building platform levels. No flood modelling has been undertaking for assessment of this option. Further assessment would need to be undertaken to determine the allowable fill on the site if BSC considers this option as a feasible alternative.
- Provision of a drainage channel through the site to compensate the loss of flow conveyance from development. Preliminary flood modelling and assessment of this option was undertaken which indicated that only an unreasonably wide channel would lead to an option with no impact. Further assessment is required to determine a channel configuration which may result in no impact. However, there is no guarantee that further assessment would find a solution.
- Provision for partial back-zoning. An option was considered to potentially exclude a portion of the site (from its northern part) from the current Planning Scheme arrangement and only allow for development in a portion of the site to the south. Initial assessment indicated that this option has the potential for mitigation of the impacts. However, further assessment is required to determine the proportion of the site which could be used for development.

9.2 SOUTHERN SITE

Based on this current flood assessment, a potential development consistent with the arrangements of the current Planning Scheme is anticipated to result in flood impacts to the north-east of the site. The extent and magnitude of the impacts are significantly less than the northern site. A number of options which could be adopted to minimise the impacts are outlined below. It is noted that these are high level options only and will need further assessment to confirm their effectiveness.

- provision of drainage channels through the site

- provision of partial back-zoning
- restriction on the amount of fill on the subject site and imposition of development conditions requiring high-set buildings only in this development.

10 Outcome of feasible alternatives assessment

Based on the flood assessment undertaken, potential development consistent with the arrangements of the current Planning Scheme is anticipated to result in flood impacts in the vicinity of both subject sites. BSC is seeking to re-zone the two sites to 'Rural' which is consistent with State Planning Policy. Alternative development options have been considered in the previous section and are discussed further below.

The Banana Shire Flood Study Stage 2 – Structural Measures Report, August 2016 considers the construction of a levee as a potentially viable structural option for Biloela Township subject to further studies. However, Structural solutions such as the construction of a flood levee are not considered to be feasible for the following reasons:

- The limited growth of Biloela can be accommodated within areas free of flood hazards, for example, areas east of Biloela Township.
- The construction of a levee would be at a significant cost to the rate payers of Biloela. These costs would be associated with the required technical investigation and design, land resumption, construction and maintenance. Given that these sites are not required for future expansion of Biloela, the cost benefit of such a significant investment would be unlikely to be justified unless the whole town was to significantly benefit.

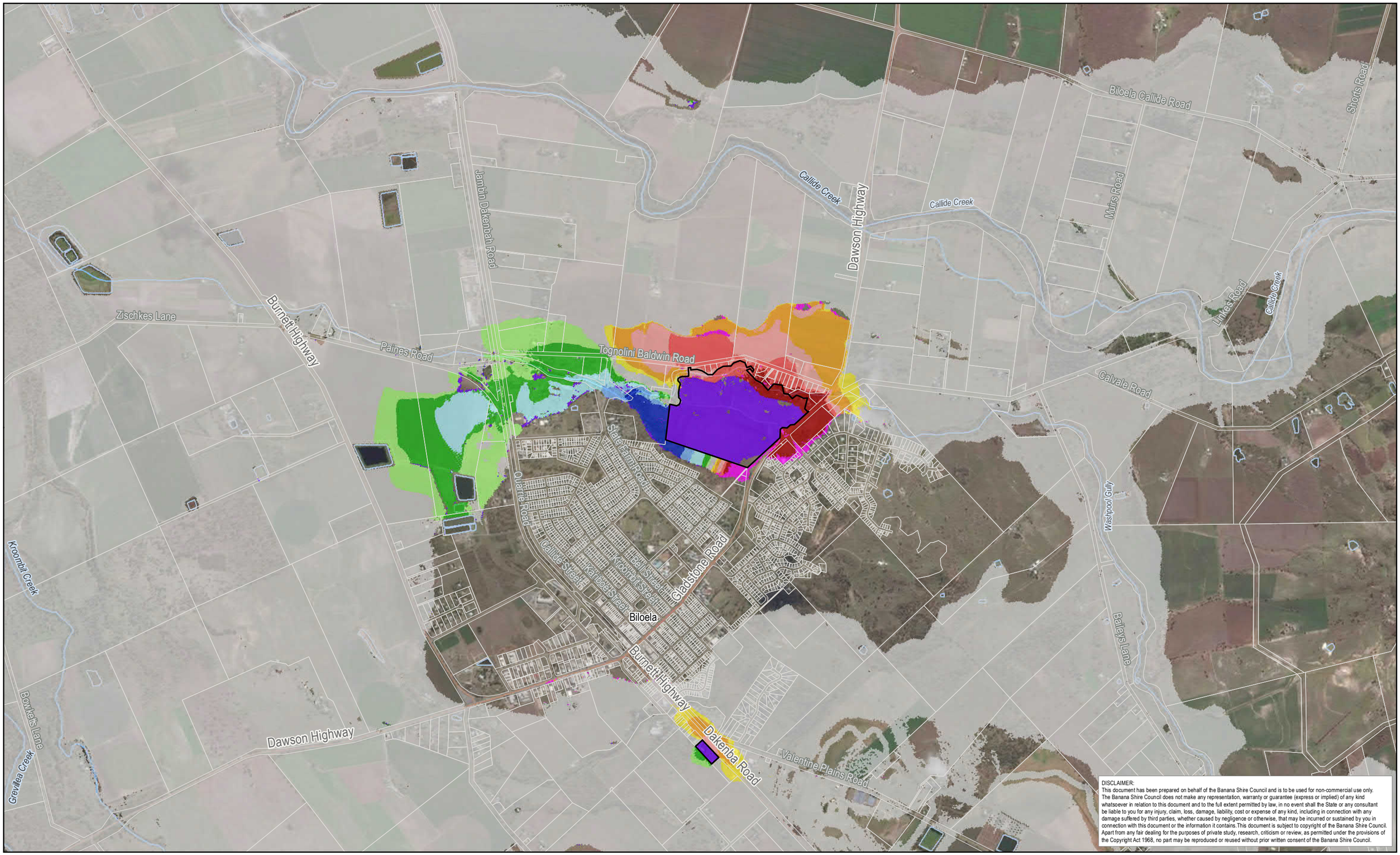
Other potential mitigation options such as imposing planning control on the proposed development (such as allowing high-set buildings only to maintain minimal impacts on the flood conveyance) are also not considered feasible for the following reasons.

- These areas are not required to accommodate growth of Biloela. Sufficient urban land exists in Biloela outside the flood impact zone. Such planning conditions will create disadvantages to the development.
- These type of developments may achieve the minimum building floor level requirement but may not comply with other development requirements such as providing safe vehicular or pedestrian access to the development during a major flood event. This is not consistent with the intent of the State Planning Policy.

Based on the outcome of this study none of the potential mitigation options discussed in this report are deemed feasible alternatives to back-zoning.

Appendix A

Flood maps



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KBR

ABN 91 007 660 317

BEW956-0001-TD-HY-GIS-0001-0001

POSITION	NAME	SIGNATURE
PREPARED	A. DJOZAN	
MAPPED	P. CAMERON	
CHECKED	A. DENSTEN	
APPROVED	A. DENSTEN	

Legend

- Site Proposed For Rezoning
- Was wet now dry
- Was dry now wet

Difference (m)

- < -0.30
- -0.30 – -0.20
- -0.20 – -0.10
- -0.10 – -0.05
- -0.05 – -0.03
- -0.03 – 0.03
- 0.03 – 0.05
- 0.05 – 0.10
- 0.10 – 0.20
- 0.20 – 0.30
- > 0.30

Banana SHIRE SHIRE OF OPPORTUNITY

Locality: Biloela **Projection:** GDA 1994 MGA Zone 56

0 0.5 1 kilometres

Scale at A3 - 1:30,000

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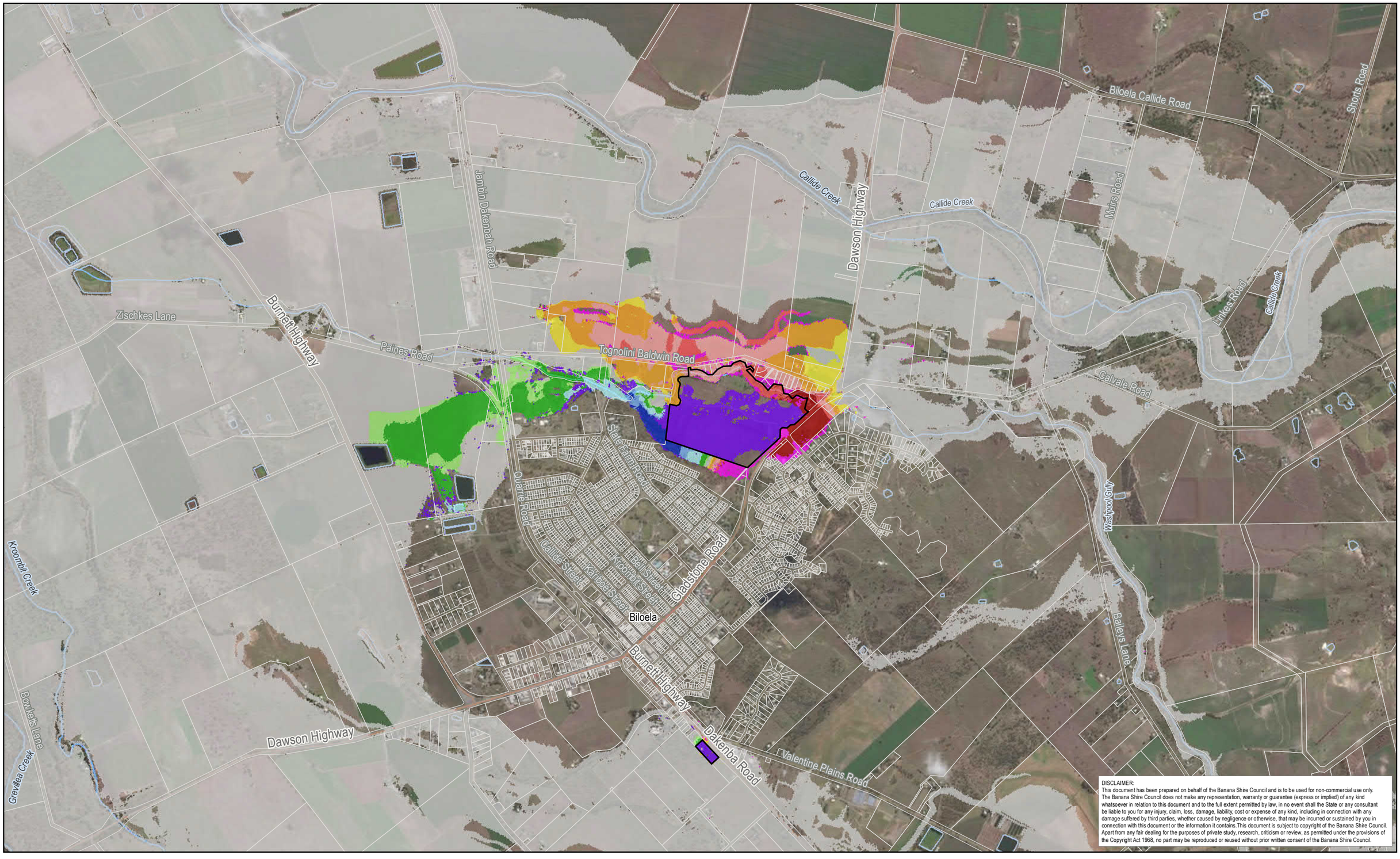
Model Result: CAL_10m_100y_cc_dev01_test_h

Banana Shire Council
Feasible Alternative Assessment
Biloela
Flood Difference
1% AEP Design Event
Plus Climate Change (DFE)

01-FAA-001	
21/08/19	
0	



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KBR

ABN 91 007 660 317

BEW956-0001-TD-HY-GIS-0001-0002

POSITION	NAME	SIGNATURE
PREPARED	A. DJOZAN	
MAPPED	P. CAMERON	
CHECKED	A. DENSTEN	
APPROVED	A. DENSTEN	

Legend

- Site Proposed For Rezoning
- Was wet now dry
- Was dry now wet

Difference (m)

- < -0.30
- -0.30 – -0.20
- -0.20 – -0.10
- -0.10 – -0.05
- -0.05 – -0.03
- -0.03 – 0.03
- 0.03 – 0.05
- 0.05 – 0.10
- 0.10 – 0.20
- 0.20 – 0.30
- > 0.30

Banana SHIRE
SHIRE OF OPPORTUNITY

Locality: Biloela **Projection:** GDA 1994 MGA Zone 56

0 0.5 1
kilometres

Scale at A3 - 1:30,000

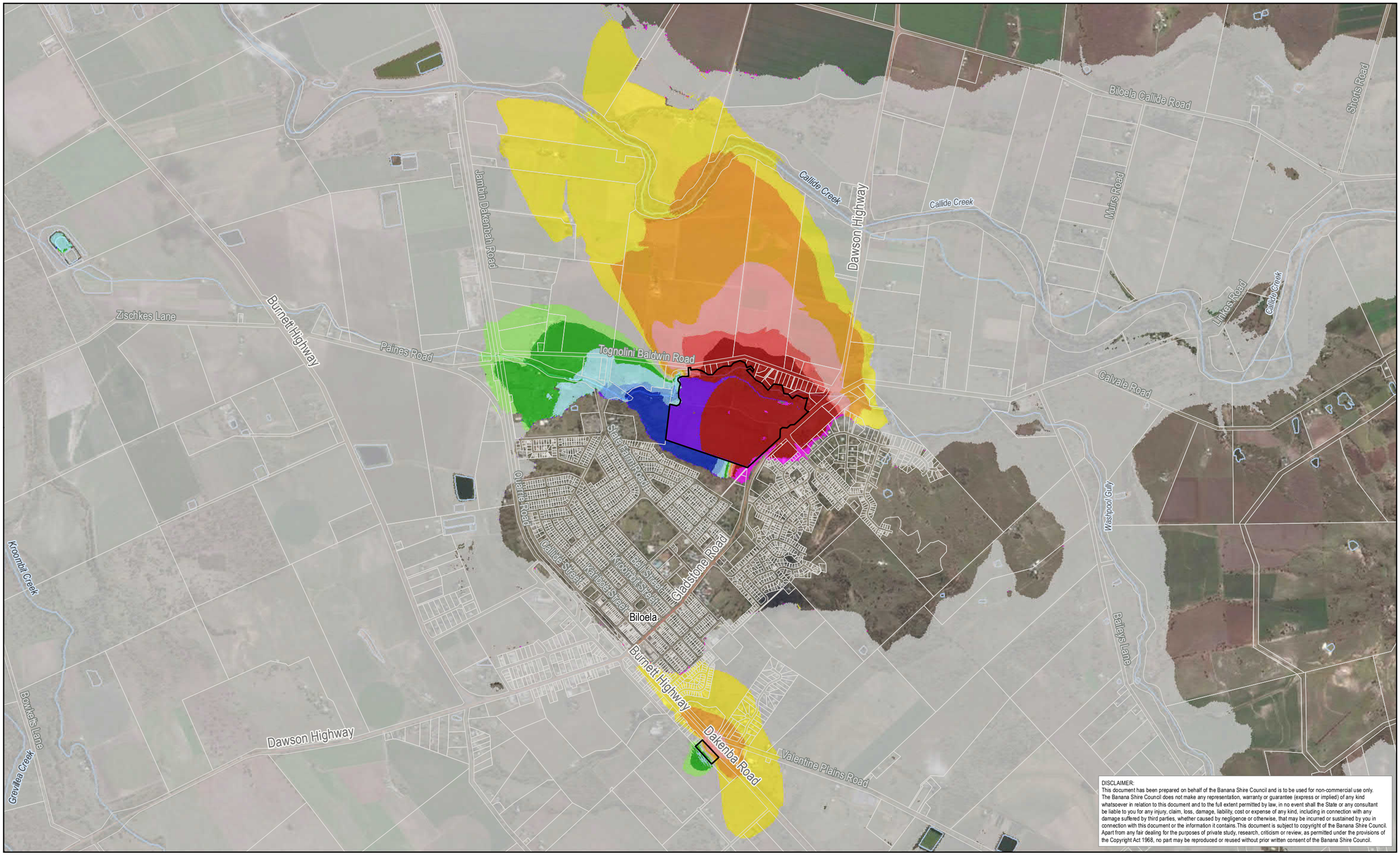
Model Result: afflux_CAL_10m_50y_dev02_minus_baseline_h

Banana Shire Council
Feasible Alternative Assessment
Biloela
Flood Difference
2% AEP Design Event

01-FAA-002

21/08/19

0



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KBR

BEW956-0001-TD-HY-GIS-0001-0003

POSITION	NAME	SIGNATURE
PREPARED	A. DJOZAN	
MAPPED	P. CAMERON	
CHECKED	A. DENSTEN	
APPROVED	A. DENSTEN	

Legend

- Site Proposed For Rezoning
- Was wet now dry
- Was dry now wet

Difference (m)

- < -0.30
- -0.30 – -0.20
- -0.20 – -0.10
- -0.10 – -0.05
- -0.05 – -0.03
- -0.03 – 0.03
- 0.03 – 0.05
- 0.05 – 0.10
- 0.10 – 0.20
- 0.20 – 0.30
- > 0.30

Banana SHIRE
SHIRE OF OPPORTUNITY

Locality: Biloela **Projection:** GDA 1994 MGA Zone 56

0 0.5 1
kilometres

Scale at A3 - 1:30,000

Model Result: afflux_CAL_10m_PMP3h_dev02_minus_baseline_h

Banana Shire Council
Feasible Alternative Assessment
Biloela
Flood Difference
PMP Event

01-FAA-003

21/08/19

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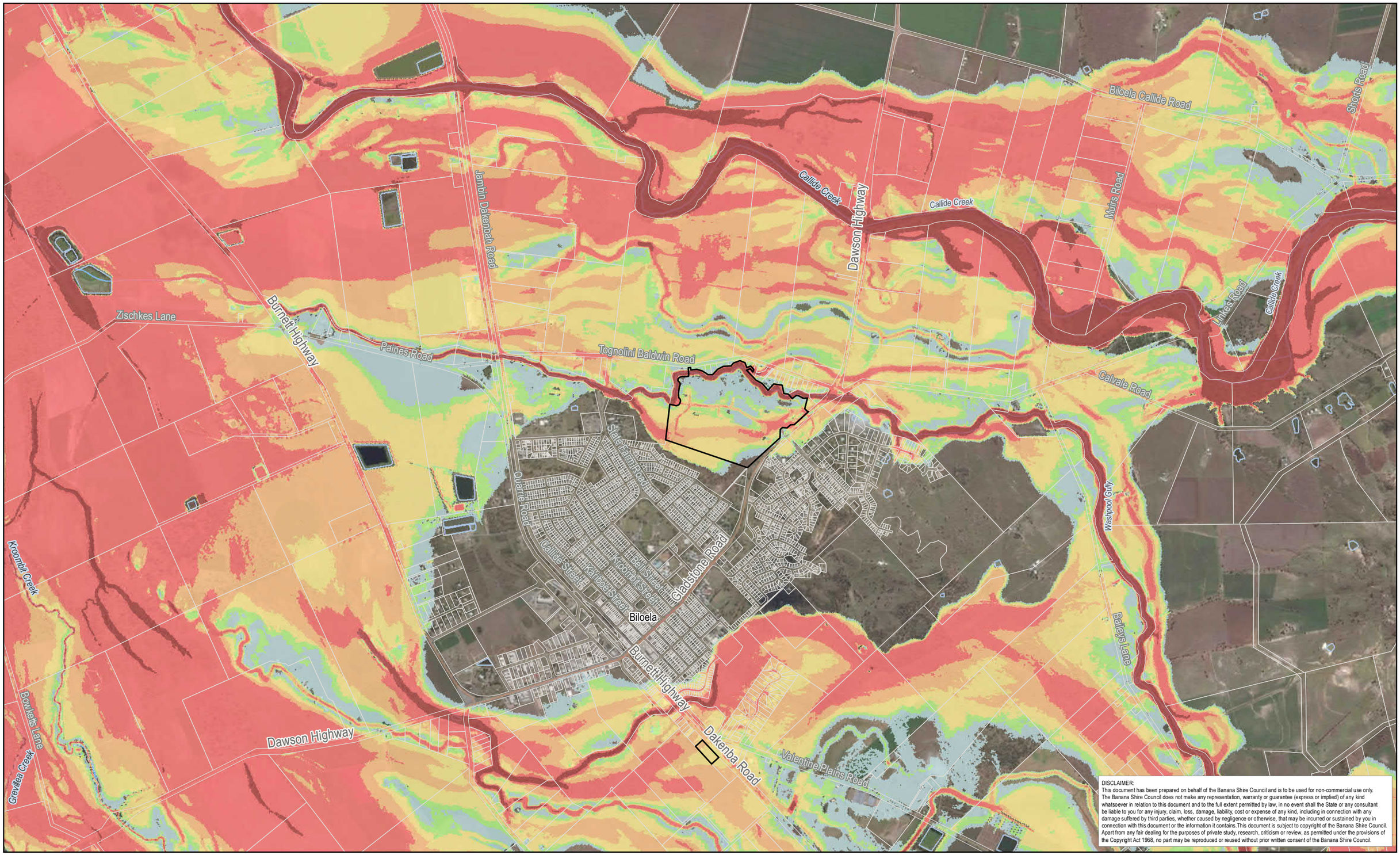


KBR

ABN 91 007 660 317

BEW956-0001-TD-HY-GIS-0001-0004

POSITION	NAME	SIGNATURE
PREPARED	A. DJOZAN	
MAPPED	P. CAMERON	
CHECKED	A. DENSTEN	
APPROVED	A. DENSTEN	

Legend

Site Proposed For Rezoning

Hazard Vulnerability Classification (cumulative)
- H1 Generally safe
- H2 Unsafe for small vehicles
- H3 Unsafe for all vehicles, children and the elderly
- H4 Unsafe for vehicles and all people
- H5 Buildings vulnerable to structural damage
- H6 All buildings vulnerable to failure

Banana SHIRE SHIRE OF OPPORTUNITY

Locality: Biloela **Projection:** GDA 1994 MGA Zone 56

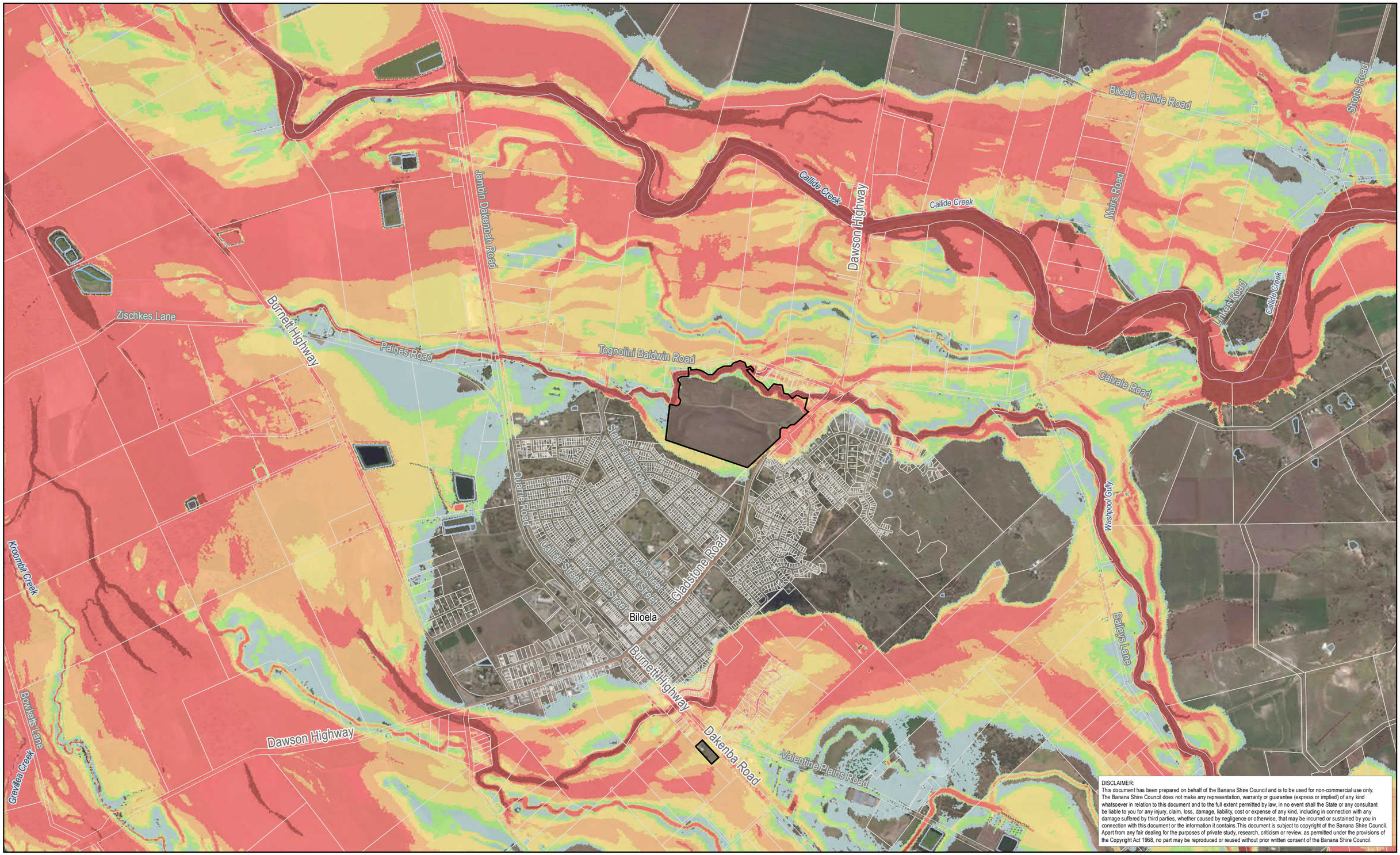
0 0.5 1 kilometres

Scale at A3 - 1:30,000

Model Result: CAL_10m_100y_CC_NS_100_test_ZAEM1_Max

Banana Shire Council
Feasible Alternative Assessment
Biloela
Flood Hazard
Baseline Scenario-DFE

01-FAA-004	
21/08/19	
0	



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ABN 91 007 660 317

BEW956-0001-TD-HY-GIS-0001-0005

POSITION	NAME	SIGNATURE
PREPARED	A. DJOZAN	
MAPPED	P. CAMERON	
CHECKED	A. DENSTEN	
APPROVED	A. DENSTEN	

Legend

Site Proposed For Rezoning

Hazard Vulnerability Classification (cumulative)
- H1 Generally safe
- H2 Unsafe for small vehicles
- H3 Unsafe for all vehicles, children and the elderly
- H4 Unsafe for vehicles and all people
- H5 Buildings vulnerable to structural damage
- H6 All buildings vulnerable to failure

Banana SHIRE SHIRE OF OPPORTUNITY

Locality: Biloela **Projection:** GDA 1994 MGA Zone 56

0 0.5 1
kilometres

Scale at A3 - 1:30,000

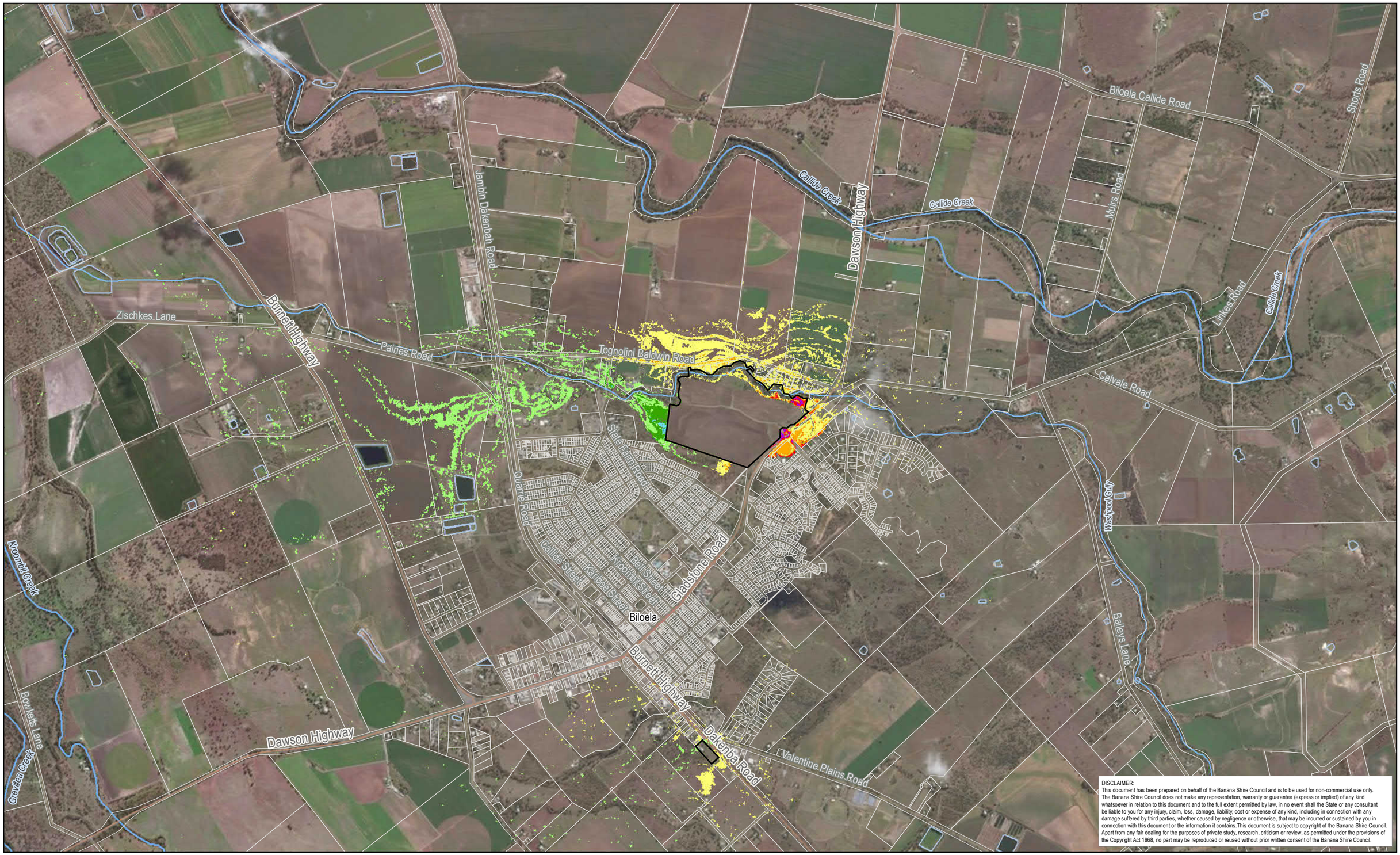
Model Result: CAL_10m_100y_CC_NS_dev02_ZAEM1_Max

Banana Shire Council
Feasible Alternative Assessment
Biloela
Flood Hazard
Developed Case Scenario-DFE

01-FAA-005

21/08/19

0



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ABN 91 007 660 317

BEW956-0001-TD-HY-GIS-0001-0006

POSITION	NAME	SIGNATURE
PREPARED	A. DJOZAN	
MAPPED	P. CAMERON	
CHECKED	A. DENSTEN	
APPROVED	A. DENSTEN	

Legend

Site Proposed For Rezoning

Hazard Classification Difference

-5
-4
-3
-2
-1
0
1
2
3
4

Banana Shire – Shire of Opportunity

Locality: Biloela **Projection:** GDA 1994 MGA Zone 56

0 0.5 1
kilometres

Scale at A3 - 1:30,000

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Model Result: Hazard_Difference_CAL_10m_100y_CC_NS_Dev02_ZAEM1_Max_Minus_100_

Banana Shire Council
Feasible Alternative Assessment
Biloela
Changes In Flood Hazard
Developed Case Scenario-DFE
Minus Baseline Scenario-DFE

01-FAA-006

21/08/19

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