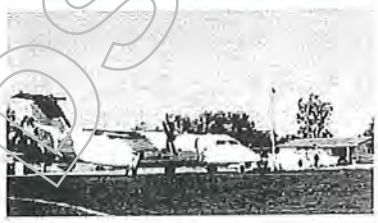
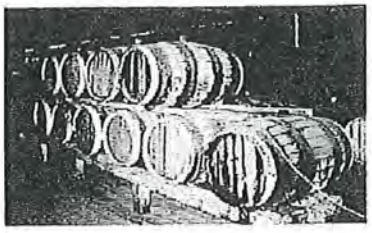
Roma
Town Council



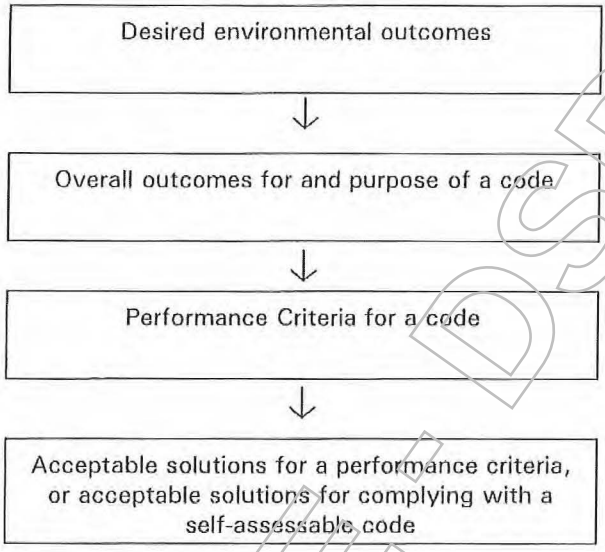
Planning Scheme



2006

(c) Performance Criteria for a code;

(d) Acceptable Solutions for a Performance Criteria, or acceptable solutions for complying with a self-assessable code.



1.12 Assessment Provisions

(1) Exempt Development

(a) The following is exempt development within the local government area of Roma:

(i) Development that is made exempt pursuant to Schedule 9 of IPA[3];

(ii) Land designated for community infrastructure – exempt development pursuant to IPA;

(iii) Development involving the supply of road transport infrastructure in existing roads;[4]

(iv) Development involving Railway activities in existing rail corridors;

(v) Development involving water cycle management infrastructure, including infrastructure for water supply, sewerage, collecting water, treating water, stream managing, disposing of waters and flood mitigation, but excluding water supply and sewerage treatment plants;

[3] Schedule 9 of IPA lists exempt development that may not be made assessable or self assessable development under the planning scheme. For further clarification, the following is exempt for the purpose of the planning scheme and is in accordance with Table 4 of Schedule 9 of the Act.;
- Operational work (including maintenance and repair work) carried out by or on behalf of a public sector entity authorised under State Law (eg Council or the Department of Main Roads) to carry out work; and
- Operational work that is ancillary works and encroachments that are carried out in accordance with requirements specified by gazette notice by the Chief Executive under the Transport Infrastructure Act 1994 (including the excavating and borrowing of material necessary for road making, maintenance and repair) or done as required by a contract entered into with the Chief Executive under the Transport Infrastructure Act Section 47.

[4] For the purpose of section 1.4(2) existing means – lawfully existing at Commencement or lawfully established after Commencement.

Application form

Environmental Protection Act 1994

Site specific application for a new environmental authority for a prescribed ERA

This is the approved form to make a site specific application for an environmental authority (EA) under sections 124 and 125 of the Environmental Protection Act 1994 *(EP Act) for an environmentally relevant activity (ERA) which is prescribed under section 19 of the EP Act.*

Only use this application form if you are applying for a new EA where:

- ☑ All of the ERA/s being applied for are prescribed under section 19 of the EP Act.
- ☑ The proposed ERA(s) do not form part of an ERA project under an existing EA.
- ☑ The proposed ERA(s) are not being carried out as part of a coordinated project.
- ☑ If more than one ERA is being applied for:
  - All ERAs are operationally interrelated, that is, the operation cannot function without all of the ERAs. Separate applications will need to be made for the ERAs that cannot be carried out as a single integrated operation.
  - The places where the ERAs will be carried out are close enough to make the integrated day to day management of the activities feasible.
  - The ERAs will be carried out under the day to day management of a single responsible person (e.g. a site manager or operations manager).
- ☑ The proposed ERA(s) do not require a development permit for a material change of use under the *Sustainable Panning Act 2009*, unless an application for the required development permit has been made.
- ☑ The application is not to dredge or extract more than 10,000 tonnes of material a year in the North Stradbroke Island region.
- ☑ The proposed ERA(s) are not:
  - to be carried out on a parcel of land within a State development area (SDA); and
  - the approved development scheme under the State Development Act for the State development area states that the development of the parcel of land for the prescribed ERA is SDA assessable development under that Act; and
  - either of the following apply-
    - you have not applied for an SDA approval for the development under the State Development Act, section 84D;
    - the SDA approval for the development under the State Development Act has lapsed under section 84H of that Act.

OR

- ☑ The administering authority has refused your amendment application and requires you to make a site-specific application for a new EA to replace your existing EA.

Recommended steps before applying

ABN 46 640 294 485

- ☑ You should read the information about applying for an EA available at the Queensland Government's business and industry portal at www.business.qld.gov.au (use the search term *'Environmental Licence')*. This website has a diagnostic tool called a 'Forms and fees finder' which will take you through a series of questions and provide a customised result which will identify any forms, fees and supporting information you need to make an application.
- ☑ You should discuss your proposal and related application requirements during a pre-lodgement meeting with the:
  - Department of Agriculture and Fisheries for prescribed ERAs 2, 3 and 4.
    You can request a pre-lodgement meeting by email at livestockregulator@daf.qld.gov.au
  - Department of Environment and Heritage Protection (EHP) for any other ERA.
    You can request a pre-lodgement meeting by please completing and lodging the form 'Application for a pre-design/pre-lodgement meeting' (EM1125[1]).

Application

OFFICIAL USE ONLY

DATE RECEIVED

FILE REF

PROJECT REF

DATE

1. Applicant details

Is there more than one applicant?

☒ No—provide the applicant's details below.

☐ Yes—provide the principal applicant's details below and all other applicants' details in attachment 1—*'Joint applicants and appointment of principal applicant'*

FULL NAME (INDIVIDUAL OR CONTACT PERSON IF APPLICANT IS A BUSINESS) Development Services	TITLE
BUSINESS NAME (IF APPLICABLE) Maranoa Regional Council	
ABN/ACN (IF APPLICABLE) 99 324 089 164	
REGISTERED SUITABLE OPERATOR NUMBER 127644	
RESIDENTIAL OR REGISTERED BUSINESS ADDRESS (NOT A POST OFFICE BOX) 1 Cartwright Street Roma	POSTCODE 4455
PHONE 1300 007 662	FACSIMILE 07 4624 6990
EMAIL	

[1] This is the publication number. The publication number can be used as a search term to find the latest version of a publication at www.qld.gov.au

planning@maranoa.qld.gov.au ☒ I WISH TO RECEIVE CORRESPONDENCE BY EMAIL	
POSTAL ADDRESS (IF DIFFERENT) PO Box 620 ROMA QLD	POSTCODE 4455

Nomination of an agent for this application
I/we nominate the below agent to act on my/our behalf and to also receive correspondence relating to this application.

NAME OF AGENT (INDIVIDUAL OR CONTACT PERSON IF THE AGENT IS A BUSINESS)	
BUSINESS NAME (INCLUDE TRADING NAME IF RELEVANT)	
POSTAL ADDRESS (WRITE 'AS ABOVE' IF THE SAME AS REGISTERED ADDRESS)	
ABN/ACN (IF APPLICABLE)	
PHONE	FACSIMILE
EMAIL ☐ I WISH TO RECEIVE CORRESPONDENCE BY EMAIL	

A suitable operator is a person or a corporation assessed under section 318I of the EP Act as being suitable to carry out an ERA and is listed on the suitable operator register on the EHP website at www.ehp.qld.gov.au (use the search words 'suitable operator register')

The number provided must be registered against a person(s) or a business with the exact same name as the applicant(s).

2. Registered suitable operator status

Are all applicants registered as a suitable operator?

☒ Yes—ensure you have provided the registered suitable operator number in the section above.

Where there is more than one applicant, provide all applicants' suitable operator registration numbers in Attachment 1.

☐ No—complete the attached 'Application to be a registered suitable operator' for the applicant. If there is more than one applicant, a separate application must be attached for each applicant.

3. Description of land where the ERA(s) will be carried out

Will the ERA/s be carried out at a fixed location?

☒ Yes—provide details below. If there is more than one location you will need to provide all details in Attachment 2.

☐ No—the location will be recorded as 'Various locations throughout the State of Queensland'.

FULL STREET ADDRESS 'See Appendix 1'	POSTCODE
LOT(S)	PLAN(S)
SPECIFIC AREA WITHIN THE LOCATION I.E. GPS OR OTHER DESCRIPTION	
PORT (IF RELEVANT)	
PROJECT NAME (IF RELEVANT)	

A site management plan (SMP) may be approved by EHP for the purposes of managing contamination on land which is listed on the Environmental Management Register or Contaminated Land Register. To find out whether there is a SMP in place you can request a search of the land on the EMR and CLR for a small fee at the Queensland Government site at www.qld.gov.au (search for 'contaminated land')

If there is a SMP in place for the land the SMP will be attached to the search results.

4. Contaminated land management

Is there a site management plan in place for any of the land subject to this application?

☐ Yes—provide details below.

☒ No

DESCRIPTION OF LAND E.G. LOT/PLAN NUMBER
SITE MANAGEMENT PLAN REFERENCE NUMBER
LOCAL GOVERNMENT AUTHORITY

ERAs with eligibility criteria and standard conditions are listed at:

5. Details of the ERA(s) being applied for

ERA NUMBER: 16	THRESHOLD: 2 (b)

www.business.qld.gov.au (use the search term 'eligibility criteria').

If you are applying for more than 3 different ERAs, attach these details of the ERAs being applied for as a separate attachment to the application.

NAME OF ERA: Extractive and Screening Activities
Does the ERA have standard conditions which you can comply with? ☐ Yes—attach details of the standard conditions you can comply with to this application. ☒ No

ERA NUMBER:	THRESHOLD:
NAME OF ERA:	
Does the ERA have standard conditions which you can comply with? ☐ Yes—attach details of the standard conditions you can comply with to this application. ☐ No	

ERA NUMBER:	THRESHOLD:
NAME OF ERA:	
Does the ERA have standard conditions which you can comply with? ☐ Yes—attach details of the standard conditions you can comply with to this application. ☐ No	

In order to make your EA application, you need to ensure any other required applications have been made prior to lodging this application. If you are not sure what approvals are required you should contact the planning area of your local government authority or if the area is within a state development area visit the Department of State Development website at: www.statedevelopment.qld.gov.au (search for 'state development area').

6. Other related approvals

Are you required to obtain any of the following approvals to conduct the ERA/s?

- A development approval from your local government authority (e.g. activities which may trigger the requirement for development approval under the local planning scheme); or
- An approval for the use of land under the *State Development and Public Works Organisation Act 1971*?

☐ Yes—Provide details below.

☒ No.

APPROVAL NAME:
LEGISLATION:
APPLICATION NUMBER:
DATE LODGED:
APPROVAL STATUS:

If there are more than 8 vehicles, provide the details of all vehicles as a separate attachment to the application.

7. Regulated waste transport ERA(s)

Is your application for an ERA 57 Regulated waste transport?

☐ Yes—provide details below.

☒ No

Type of vehicle e.g. tanker, truck	Make and model	Year of manufacture	Registration number

Matters of national environmental significance (MNES) are defined in the *Environmental Protection and Biodiversity Conservation Act 1999 (Cth)*.

A significant impact is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts.

To determine whether the proposed ERA/s will have a significant impact on MNES and for referral requirements, please refer to the guidance under the heading of 'Permits and Assessments' at the Federal Government's Department of Environment website at http://www.environment.gov.au

8. Matters of national environmental significance

Would the carrying out of the proposed ERA, or where relevant, the ERA project, be likely to have a significant impact on any of the following matters of national environmental significance?

- world heritage properties
- national heritage places
- wetlands of international importance (listed under the Ramsar Convention)
- listed threatened species and ecological communities
- migratory species protected under international agreements
- Commonwealth marine areas
- the Great Barrier Reef Marine Park
- nuclear actions (including uranium mines)
- a water resource, in relation to coal seam gas development and large coal mining development

☐ Yes—the proposal should be referred to the Federal Government Environment Minister or delegate for formal assessment and approval.

REFERENCE/REFERRAL NUMBER:

☒ No

You can find out more about what information needs to accompany the application by visiting the Queensland Government's business and industry portal and using the diagnostic tool 'Forms and fees finder: environmental authorities' available at www.business.qld.gov.au (search using the terms 'forms and fee finder').

9. Assessment of environmental impacts

Attach to this application an assessment of the likely impact of each ERA on environmental values including:

- a description of the environmental values likely to be affected by each relevant activity
- details of any emissions or releases likely to be generated by each relevant activity
- a description of the risk and likely magnitude of impacts on the environmental values
- details of the management practices proposed to be implemented to prevent or minimise adverse impacts
- details of how the land the subject of the application will be rehabilitated after each relevant activity ceases
- the proposed measures for minimising and managing waste generated by the activities.

☒ I have attached an assessment of the environmental impact and specific supporting information.

OR

Where an Environmental Impact Statement (EIS) process under Chapter 3 of the EP Act has been completed, and the environmental risk has not changed, further assessment under this part is not required.

☐ An EIS has been completed and the environmental risk has not changed.

For further guidance refer to the guideline 'Application requirements for activities with waste impacts' available at www.business.qld.gov.au (search using the terms 'application requirements waste')

10. Details of waste management

Describe the proposed measures for minimising and managing waste generated by each activity below, or as part of a separate attachment to the application.

DETAILS:

☒ I have attached a description of the proposed measures for minimising and managing waste.

An environmental offset may be required for an ERA where despite all reasonable measures to avoid and minimise impacts on certain environmental matters, there is still likely to be a significant residual impact on one or more of those matters.

You must verify the presence, whether temporary or permanent, of those environmental matters. For more information refer to the State Significant Impact Guideline at the Queensland Government website at: www.qld.gov.au (search using the term 'significant impact guideline').

Offset delivery can be staged, however for this to occur; the condition of any approved EA needs to state that both the activity and the offset may be staged. Prior to the notice of election for each stage under the *Environmental Offsets Act 2014* you are required to provide a detailed assessment of the quantum of impact of that stage and the offset obligation requirement for that stage.

11. Environmental offsets

Will the ERA(s) being applied for cause, or be likely to cause a significant residual impact to a prescribed environmental matter (other than a matter of local environmental significance)?

☐ Yes—you must attach supporting information that:

- details the magnitude and duration of the likely significant residual impact on each prescribed environmental matter (other than matters of local environmental significance) for the entire activity; and
- demonstrates that all reasonable measures to avoid and minimise impacts on each of those matters will be undertaken; and
- if the activity is to be staged, details of how the activity is proposed to be staged.

☒ No

You may nominate a date or event for when the EA will take effect should it be approved.

An event can include a phase of your project, for example commissioning of equipment.

The date the EA takes effect will be the date from which you can commence the activities as well as the date your annual fees will start to be charged (your anniversary date).

Under s.200 of the EP Act, if a development permit or State development area (SDA) approval is required in order to carry out the ERA, the EA cannot take effect until the development permit or SDA approval takes effect.

12. Take effect date or event

Do you want to nominate a date or event for the EA to take effect on?

☐ Yes- Choose which applies:

☐ I would like to nominate a take effect event, the details of the event are provided below. I understand that I must provide written notice when the event occurs and that the EA cannot take effect before a development permit or SDA approval takes effect, should either be required.

☐ I would like to nominate a take effect date, the date is provided below. I understand that the EA cannot take effect before a development permit or SDA approval takes effect, should either be required.

DETAILS OF THE TAKE EFFECT EVENT OR DATE:

☒ No—the take effect date will be the date of the decision by the administering authority. I understand that this cannot be before a

required development permit or SDA approval takes effect, should either be required.

You are required to pay an application fee at the time of application. If your application is approved you will be required to pay a fee annually. Each ERA has a regulated fee and the annual fee will be the highest annual fee of any ERA associated with the project. The first annual fee will be invoiced when the permit takes effect. Information on fees is available at www.business.qld.gov.au (using the term 'EA fees')

13. Payment of fees

Please select your payment method for the application fee below:

☐ Cheque or money order payable to the Department of Environment and Heritage Protection (attached).

☐ Cheque or money order payable to the Department of Agriculture and, Fisheries and Forestry (attached).

☒ Credit card. Please provide contact details for payment to be made over the telephone.

Telephone number:1300 007 662

14. Declaration

Note: If you have not told the truth in this application you may be liable for prosecution under the relevant Acts or Regulations.

- I do solemnly and sincerely declare that all information supplied on or with this application is true and correct to the best of my knowledge.
- I understand that it is an offence under s.480 of the *Environmental Protection Act 1994* to give to the administering authority or an authorised person a document containing information that I know to be false, misleading or incomplete in a material particular.
- I understand that it is my responsibility to comply with all conditions of an environmental authority I hold, as well as any relevant provisions in the *Environmental Protection Act 1994.*
- I understand that I am responsible for managing the environmental impacts of these activities, and that approval of this application is not an endorsement by the administering authority of the effectiveness of the management practices proposed or implemented.
- I understand that all information supplied on or with this application form may be disclosed publicly in accordance with the *Right to Information Act 2009* and the *Evidence Act 1977*.

APPLICANT NAME Maranoa Regional Council

SIGNATURE OF INDIVIDUAL APPLICANT OR AUTHORISED SIGNATORY

DATE 13/04/2016

Please submit your complete application using one of the following methods:

For ERA 2, ERA 3 or ERA 4

Mail:

Senior Environmental Scientist

Department of Agriculture and Fisheries

PO Box 102

TOOWOOMBA QLD 4350

Enquiries:

Phone: 13QGOV

Email: livestockregulator@daf.qld.gov.au

For all other ERAs use one of the following methods:

Email: palm@ehp.qld.gov.au

The email subject line should be 'Site specific application for a new environmental authority for a prescribed ERA'.

The file size limit for submission via email is 14MB. Any submission via email which exceeds 14MB will need to be broken down into separate emails, with each email clearly labelled Part X of X (e.g. Part 1 of 2), included in the subject line of the email.

Email parts and attachments must be clearly labelled to allow the application to be received without administrative delay.

Mail:

Permit and Licence Management

Department of Environment and Heritage Protection

GPO Box 2454

BRISBANE QLD 4001

Courier or hand delivery:

Permit and Licence Management

Department of Environment and Heritage Protection

Level 3, 400 George Street,

BRISBANE QLD 4001

Hours: 8.30 am—5.00 pm business days

Enquiries:

Email: palm@ehp.qld.gov.au

Phone: 13 QGOV (13 74 68)

Privacy statement
The Departments of Environment and Heritage Protection (EHP) and Agriculture and Fisheries (DAF) are collecting the information on this form to process your application for an environmental authority. This collection is authorised under sections 124 and 125 of the *Environmental Protection Act 1994*. Your personal information will only be accessed by authorised employees within these departments and will not be disclosed to any other parties unless authorised or required by law. For queries about privacy matters please email PrivacyandEthicsUnit@ehp.qld.gov.au or telephone: (07) 3330 6270.

Attachment 1 Joint applicants and appointment of principal applicant

We are joint applicants for this environmental authority and hereby appoint: _____
as the principal applicant to receive statutory documents relating to this application.

Name - individual or contact person if applicant is a business	Suitable Operator Number [2]
Business name (include trading name if relevant)	ABN/ACN (if relevant)
Residential or registered business address (not a post office box)	Phone
Postal address (if different from above)	Facsimile
Email	☐ Indicate if you do not want to receive correspondence via email
Signature	Date

Name - individual or contact person if applicant is a business	Suitable Operator Number
Business name (include trading name if relevant)	ABN/ACN (if relevant)
Residential or registered business address (not a post office box)	Phone
Postal address (if different from above)	Facsimile
Email	☐ Indicate if you do not want to receive correspondence via email
Signature	Date

Name - individual or contact person if applicant is a business	Suitable Operator Number
Business name (include trading name if relevant)	ABN/ACN (if relevant)
Residential or registered business address (not a post office box)	Phone
Postal address (if different from above)	Facsimile
Email	☐ Indicate if you do not want to receive correspondence via email

[2] To obtain an Environmental Authority all applicants must be on the register of suitable operators. If you are already registered provide your number on this attachment. If you are not registered complete the attached 'Application to be a registered suitable operator'

Attachment 2 List of locations where the ERA/s will be carried out.

Where there is more than one location list all locations and which ERA/s will be conducted at each location.

Number	Street Name	Suburb/Town	Postcode	ERA/s
51-85	George Street	Roma QLD	4455	16 2 (b)
Real Property Description Lot 343 Plan R8614		Specific area within the location i.e. GPS		

Number	Street Name	Suburb/Town	Postcode	ERA/s
	Tiffin Street	Roma QLD	4455	16 2 (b)
Real Property Description Lot 41 Plan R8614		Specific area within the location i.e. GPS		

Number	Street Name	Suburb/Town	Postcode	ERA/s
153	George Street	Roma QLD	4455	16 2 (b)
Real Property Description Lot 96 Plan M5398		Specific area within the location i.e. GPS		

Number	Street Name	Suburb/Town	Postcode	ERA/s
88-156	George Street	Roma QLD	4455	16 2 (b)
Real Property Description Lot 342 Plan WV219		Specific area within the location i.e. GPS		

Number	Street Name	Suburb/Town	Postcode	ERA/s
	Tiffin Street	Roma QLD	4455	16 2 (b)
Real Property Description Lot 21 Plan R8614		Specific area within the location i.e. GPS		

Number	Street Name	Suburb/Town	Postcode	ERA/s
Real Property Description Lot Plan		Specific area within the location i.e. GPS		

Number	Street Name	Suburb/Town	Postcode	ERA/s
Real Property Description Lot Plan		Specific area within the location i.e. GPS		

Application form

Environmental Protection Act 1994

Application to be a registered suitable operator

This approved form is to be used to apply to become a suitable operator under section 318F of the Environmental Protection Act 1994 *for the carrying out of an environmentally relevant activity (ERA).*

1. Applicant details

FULL NAME - Individual or chief executive officer if applicant is an organisation	DATE OF BIRTH- (if applicant is an individual)
ORGANISATION NAME	ORGANISATION NUMBER (e.g. ACN/ARBN)
RESIDENTIAL OR REGISTERED BUSINESS ADDRESS (not a post office box)	PHONE
Postal address (if different from above)	FACSIMILE
EMAIL	☐ Cross if you do not want to receive correspondence via email

2. Applicant suitability

Questions	No	Yes[3]
Has the applicant, or the applicant's partner[4] (and if the applicant is a company – the applicant's executive officers[5]) ever:		
• been **convicted of an environmental offence**[6] under the *Environmental Protection Act 1994*?	☐	☐ attach details
• had an environmental authority, instrument, licence or permit (however called similar to an environmental authority), **cancelled or suspended** under the *Environmental Protection Act 1994* or a corresponding law[7] (whether in Queensland or elsewhere)?	☐	☐ attach details
• had a suitable operator registration or similar registration, however called, **cancelled or suspended** under the *Environmental Protection Act 1994* or a corresponding law (whether in Queensland or elsewhere)?	☐	☐ attach details
Has the applicant ever been issued with any of the following instruments under the *Environmental Protection Act 1994:*		
• a penalty infringement notice	☐	☐ attach details
• an environmental protection order	☐	☐ attach details
• a notice requiring a transitional environmental program	☐	☐ attach details
• a notice to conduct or commission an environmental audit	☐	☐ attach details
• a notice to conduct or commission an environmental investigation	☐	☐ attach details
• a direction notice	☐	☐ attach details
• a clean up notice	☐	☐ attach details
• a cost recovery notice	☐	☐ attach details
• a restraint or enforcement order	☐	☐ attach details
• another compliance or enforcement action which is not stated above	☐	☐ attach details

[3] If yes is ticked, you must indicate if the event occurred to you individually or to a company or business in which you currently hold, or have held, a position of management or control. You must also provide complete details (including the state/territory/country in which the event occurred, the relevant legislation, location of offence or incident, date of offence or incident, amount of fine, facts and circumstances surrounding the offence or incident, details of relevant persons involved including name and positions, name of court, court reference number etc.) in an attachment. You may also attach any submission you want the chief executive to consider in assessing this information, which will be used in deciding whether you are a suitable operator. A 'relevant person' is either the applicant or any person with whom the applicant is a partner or, if a corporation, any of the corporation's executive officers.
Additionally if you answer yes to any question, the chief executive responsible for the *Environmental Protection Act 1994* may disclose your information to an administering authority of another state under a corresponding law or to the commissioner of the police service to obtain a suitability report. The commissioner of the police service may disclose your information to officials administering police services in other Australian jurisdictions for information relevant to the suitability report.

[4] Partner means—
(a) an individual who has involvement with another entity's business dealings, or
(b) a person who plays a role in managing or controlling a business along with another person.

[5] Including any other companies of which the executive officers are, or have been, an executive officer.

[6] Environmental offence means—
(a) an offence against any of the following provisions—section 260, section 291(3), chapter 7, part 2, section 357(5), section 361, chapter 8 of the *Environmental Protection Act 1994*; or
(b) an offence against a corresponding law, if the act or omission that constitutes the offence would, if it happens in Queensland, be an offence against a provision mentioned in paragraph (a).

[7] Corresponding law means under a law of the Commonwealth or another State that provides for the same or similar matters as the *Environmental Protection Act 1994*.

Applicant declaration

It is an offence to provide information that you know is false, misleading or incomplete.

I declare that the information provided is true and correct. I have attached details for any question where I have answered 'yes'.

SIGNATURE	DATE

Submit your completed registered suitable operator application via email to: palm@ehp.qld.gov.au or:

Post:
Permit and Licence Management
Department of Environment and Heritage Protection
GPO Box 2454
BRISBANE QLD 4001

Courier or hand delivery:
Permit and Licence Management
Department of Environment and Heritage Protection
Level 3, 400 George Street
BRISBANE QLD 4000
Hours: 8.30am–4.30pm business days

Further Information:
www.business.qld.gov.au
Email: palm@ehp.qld.gov.au
Phone: 13 QGOV (13 7468)

Privacy statement

The Department of Environment and Heritage Protection (the department) is committed to protecting the privacy, accuracy and security of your personal information in accordance with the *Information Privacy Act 2009*. The department is collecting your personal information to determine your suitability as a registered operator under sections 318F and 318R of the *Environmental Protection Act 1994*. Some of this information may be disclosed to the Department of Natural Resources and Mines for the purpose of the joint regulation of mining activities. If you answered yes to any question, the chief executive may disclose your information to an administering authority of another state under a corresponding law or the commissioner of the police service for the purpose of obtaining a suitability report. If the commissioner of the police service is asked for a report, the commissioner may disclose your information to officials administering police services in other Australian jurisdictions for information relevant to the suitability report.

If your application is approved your name, address and organisation number will be disclosed on the register of suitable operators which will be publicly available on the department's website. This disclosure is authorised by section 318I(1)(b) of the *Environmental Protection Act 1994*. All other information will not be disclosed to any other person or agency unless you have given us permission or we are authorised or required by law. All information supplied on this form may be disclosed publicly in accordance with the *Right to Information Act 2009* and *Evidence Act 1977*. For queries about privacy matters email: PrivacyandEthicsUnit@ehp.qld.gov.au or telephone: (07) 3330 6270.

IDAS form 11—Clearing native vegetation

(*Sustainable Planning Act 2009* version 3.1 effective 23 September 2013)

This form must be used for development applications that involve the clearing of native vegetation.

You **MUST** complete **ALL** questions that are stated to be a mandatory requirement unless otherwise identified on this form.

For all development applications, you must:

- complete *IDAS form 1—Application details*
- complete any other forms relevant to your application
- provide any mandatory supporting information identified on the forms as being required to accompany your application
- include the relevant application fee, noting that referral agency fees (where applicable) are to be paid to the referral agency.

Attach extra pages if there is insufficient space on this form.

All terms used on this form have the meaning given in the *Sustainable Planning Act 2009* (SPA) or the Sustainable Planning Regulation 2009.

This form can also be completed online using MyDAS at www.dsdip.qld.gov.au/MyDAS

Mandatory requirements

1. What type of development is proposed?

☒ Operational work for clearing vegetation made assessable under Schedule 3 of the Sustainable Planning Regulation 2009

☐ Material change of use of the premises

☐ Reconfiguring a lot

2. What type of approval is being sought?

☒ Development permit

☐ Preliminary approval

☐ Both—provide details below

Mandatory supporting information

3. Confirm that the following mandatory supporting information accompanies this application

For ALL applications	Confirmation of lodgement	Method of lodgement
A property vegetation management plan including as defined under the Vegetation Management Act 1999 schedule. Note: A property vegetation management plan must show the matters prescribed in section 11 of the Vegetation Management Regulation 2012.	☒ Confirmed	Electronic

For ALL applications	Confirmation of lodgement	Method of lodgement
A statement addressing the relevant part(s) of the State Development Assessment Provisions (SDAP).	☒ Confirmed ☐ Not applicable	Electronic
For an operational work application for which the assessment manager is the local government		
Written confirmation that the chief executive of the Department of Natural Resources and Mines is satisfied the proposed clearing is for a relevant purpose under the *Vegetation Management Act 1999*, section 22A.	☐ Confirmed ☒ Not applicable	
For an operational work application where the assessment manager is the Department of State Development, Infrastructure and Planning		
Either of the following: • written confirmation that the chief executive of the Department of Natural Resources and Mines is satisfied the proposed clearing is for a relevant purpose under the *Vegetation Management Act 1999*, section 22A; or • information identifying the relevant purpose under the *Vegetation Management Act 1999*, section 22A and demonstrating how the proposed clearing is for that purpose.	☒ Confirmed ☐ Not applicable	Electronic
For applications for a material change of use or reconfiguring a lot		
The following additional detail to be included in the property vegetation management plan: • details of the location and extent of: – infrastructure, including buildings, fences, roads and electrical, telecommunication or sewerage services; and – firebreaks and fire management lines; and • details of the way the proposed clearing complies with the relevant part(s) of the SDAP.	☐ Confirmed ☒ Not applicable	

Notes for completing this form

- The Department of Natural Resource and Mines (DNRM) website contains a comprehensive range of information about the *Vegetation Management Act 1999*.
- Question 3 for operational work applications—Under the *Vegetation Management Act 1999*, the proposed vegetation clearing is only for a relevant purpose if the applicant satisfies the chief executive of the DNRM that the development applied for is one of the purposes listed in section 22A of that Act. If the assessment manager is the local government, the applicant must obtain confirmation from the chief executive of DNRM that the proposed clearing is for a relevant purpose and provide this with the application. However, if the Department of State Development, Infrastructure and Planning (DSDIP) is the assessment manager, the applicant has the choice of either obtaining this confirmation from DNRM before making the application, or providing adequate information for the decision to be made on whether the proposed clearing is for a relevant purpose at the time the application is made.

Privacy—Please refer to your assessment manager, referral agency and/or building certifier for further details on the use of information recorded in this form.

OFFICE USE ONLY

Date received _____ Reference numbers _____

The *Sustainable Planning Act 2009* is administered by the Department of State Development, Infrastructure and Planning. This form and all other required application materials should be sent to your assessment manager and any referral agency.

Department of State Development, Infrastructure and Planning
PO Box 15009 City East Qld 4002
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Response column key:
☑ Achieved
P/S Performance solution
N/A Not applicable

4.1 Concurrence environmentally relevant activities state code

Table 4.1.2: All environmentally relevant activities

Performance outcomes	Acceptable outcomes	Response	Comment
Site suitability			
PO1 The choice of the site at which the activity is to be carried out minimises serious environmental harm on areas of high conservation value and special significance, and sensitive land uses at adjacent places.	**AO1.1** Both of the following apply: (1) areas of high conservation value and special significance likely to be affected by the activity are identified and evaluated, and any adverse effects on these areas are minimised, including any edge effects on the areas (2) the activity does not have an adverse effect beyond the site. OR	✓	Areas of high conservation value and special significance likely to be affected by the construction of the channel have been assessed and are discussed in the attached Ecological Assessment report prepared by GHD and dated February 2016. The channel has been designed to work in conjunction with the already constructed Stage 1 earthen levee bank and divert water away from the town of Roma in extreme flood events. The effects of re-diverting flood waters will have an impact beyond the site; however the channel has been designed to minimise wider impacts on remnant vegetation, limit inconvenience to nearby land owners affected by the channel and ensure best hydraulic flood mitigation performance. The channel will also help to decrease flows along Bungil Creek at critical points and during flood events.
	AO1.2 Both of the following apply: (1) areas of high conservation value and special significance likely to be affected by the proposal are identified and evaluated and any adverse effects on the areas are minimised, including any edge effects on the areas (2) critical design requirements will prevent emissions having an irreversible or widespread impact on adjacent areas.	✓	Areas of high conservation value and special significance likely to be affected by the construction of the channel have been assessed and are discussed in the attached Ecological Assessment report prepared by GHD and dated February 2016. During extreme flood events, the channel will work to redirect flows to minimise widespread impact on the town of Roma and on adjacent areas.

Performance outcomes	Acceptable outcomes	Response	Comment
Location of activity on the site			
PO2 The location for the activity on the site protects all environmental values relevant to adjacent sensitive land uses.	**AO2.1** The location of the activity means there will be no adverse effect on any environmental values. OR	✓	The flood mitigation measures proposed for the town of Roma, including the proposed diversion channel, have been designed to have the least amount of disturbance on environmental values. The attached Ecological Assessment Report prepared by GHD dated February 2016 further describes the environmental communities and contains recommendations for minimising potential impacts. Upon completion of the channel it is anticipated that water flows during flood events will be better managed to protect areas of environmental value.
	AO2.2 Both of the following apply: (1) the activity and components of the activity are located on the site in a way that prevents or minimises adverse effects on the use of adjacent land and allows for effective management of the environmental impacts of the activity. (2) areas used for storing environmentally hazardous materials in bulk are located to take into consideration the likelihood of flooding.	✓	The alignment of the channel has been selected after extensive community consultation, detailed surveying and identification of site constraints. Its alignment has been chosen as it will have the least amount of environmental impact and result in the least amount of inconvenience to those whose land would be affected by the construction of the channel. The channel will prevent and minimise impact on adjoining land uses by redirecting flows away from nearby properties during major flood events. The proposal does not include storing environmentally hazardous materials in bulk.
PO3 The activity avoids adverse impacts on matters of state environmental significance or, where this is not reasonably possible, impacts are minimised and, where this is not reasonably possible, an environmental offset is provided for any significant	**AO3.1** Matters of state environmental significance likely to be affected by the activity are identified and evaluated, and any adverse effects on the matters of state environmental significance are avoided or, where this cannot be reasonably achieved, impacts are minimised, and where this cannot be reasonably achieved, an environmental offset is provided for any significant	✓	Matters of state environmental significance are discussed in the attached Ecological Assessment Report prepared by GHD dated February 2016. Water redirected away by the channel during major flood events has been considered in the context of wider

Performance outcomes	Acceptable outcomes	Response	Comment
residual impact to matters of state environmental matters that are prescribed environmental matters.	residual impact to matters of state environmental significance that are prescribed environmental matters. Editor's note: Applications for development should identify anticipated losses, and outline what actions are proposed to be undertaken to offset the loss in accordance with the *Significant Residual Impact Guideline* and the relevant *Queensland Environmental Offset Policy*.		impacts on areas of environmental significance. It has been designed to avoid adverse impacts on these areas to the greatest extent possible.
PO4 Development avoids or minimises and offsets any adverse impacts on riparian areas and ecological corridors located in a strategic environmental area.	**AO4.1** Development is set back from a waterway by at least 200 metres. AND	✓	The channel encroaches on the 200m setback but is not considered an impediment to the function of a watercourse. It will only be active during major flood events, when it is expected to work in conjunction with the Stage 1 levee and assist in diverting flows when Bungil Creek is at capacity.
	AO4.2 Development minimises adverse impacts on fish passage during works and the carrying out of the activity. AND	N/A	The channel will not have an adverse impact on fish habitat.
	AO4.3 Clearing of riparian vegetation is minimised or, where this cannot be reasonably achieved, an environmental offset is provided for any significant residual impact. AND	✓	Should an offset be required, MRC would respectfully request that it from part of a condition of approval.
	AO4.4 Natural regeneration of native plant species is facilitated in cleared riparian areas.	N/A	The proposed channel will be re-vegetated with native grasses upon completion of excavation works.
Critical design requirements			
PO5 The design of the facility at which the activity is to be carried out permits the activity to be carried out in accordance with best practice environmental management.	**AO5.1** The activity does not involve the storage, production, treatment or release of hazardous contaminants, or involve a regulated structure. OR	N/A	The activity does not involve the storage, production, treatment or release of hazardous contaminants, or involve a regulated structure.
	AO5.2 Development ensures that— (1) all storage provided for hazardous contaminants		

Performance outcomes	Acceptable outcomes	Response	Comment
	includes secondary containment to prevent or minimise releases to the environment from spillage or leaks. (2) regulated structures must comply with the *Manual for assessing consequence categories and hydraulic performance of structures*, Department of Environment and Heritage Protection, 2013. (3) containers are provided for the storage of hazardous contaminants and are secured to prevent the removal of the containers from the site by a flood event. (4) the design of the facility— (a) prevents or minimises the production of hazardous contaminants and waste, or (b) contains and treats hazardous contaminants, rather than releasing them.	N/A	The activity does not include a facility or include the use of hazardous contaminants.
PO6 Development avoids or minimises any adverse impacts from pollutants on environmental values and water quality objectives for receiving waters (surface and groundwater) on site or leaving a site located in a strategic environmental area.	**AO6.1** Development demonstrates current best practice environmental management to meet relevant environmental values and water quality objectives of the *Environmental Protection (Water) Policy* or relevant to the ERA to be carried out on the site. OR	✓	Refer to the attached Ecological Assessment Report prepared by GHD and the Hydrology and Hydraulics for Stage 2 – Regional Mitigation Options dated January 2014 and the Hydrology and Hydraulics for Stage 2 Local Mitigation Options dated December 2013.
	AO6.2 All stormwater, wastewater, discharges and overflows leaving the site are: (1) treated to the quality of the receiving waters prior to discharge, or (2) reclaimed or re-used such that there is no export of pollutants to receiving waters.	✓	Refer to above reports.

Table 4.1.3: Environmentally relevant activities in a strategic environmental area

Performance outcomes	Acceptable outcomes	Response	Comment
Concurrence ERA 16 (extractive and screening activities)—other than riverine quarry extraction **Geomorphic processes**			
PO1 Bed and bank stability is preserved.	**AO1.1** Excavation in the bed of a stream is limited to scour depth. AND	N/A	Excavation is not occurring in the bed of a stream.
	AO1.2 Excavation in the bed of a stream is less than one-third of the bed width. AND	N/A	Excavation is not occurring in the bed of a stream.
	AO1.3 Clearing of in-stream vegetation is limited to the minimum area required for the activity to be carried out. AND	N/A	There is no instream clearing of vegetation.
	AO1.4 The final stream profile does not direct flow into a bank.	N/A	The excavation will not alter the stream profile.
Concurrence ERA 16 (extractive and screening activities)—riverine quarry material extraction **Geomorphic and hydrological processes**			
PO2 Extraction must occur from areas of active deposition including: (1) aggrading bars, or (2) sand slugs, or (3) benches and islands, or (4) sediment pockets in bedrock channels.	No acceptable outcome is prescribed.	N/A	The proposal is for the construction of a diversion channel associated with Stage 2 flood mitigation works. The channel will be excavated to a depth of 3.5 metres and will be approximately 1,200m in length, requiring the excavation of approximately 130,000 tonnes of material. Some of the excavated material will be used in the construction of the Western levee, with the excess material stockpiled at the Roma tip. There will be no ongoing excavation required, only minimal maintenance (mowing and irrigation).
PO3 Excavation must not occur below the current bed level of a watercourse or waters.	No acceptable outcome is prescribed.	N/A	The channel will assist with excess flows in Bungil Creek during flooding events. It will be excavated to a depth to ensure proper function during these extreme weather events.
PO4 Bed and bank stability is preserved during the operation or the carrying out of the activity.	**AO4.1** Vehicle access tracks and crossings associated with the activity have scour protection on the bed immediately downstream of the crossing. AND	N/A	Additional vehicle access tracks and crossings of Bungil Creek will not be required. The proposed diversion channel will assist with excess flows during flood events only, and will not be a permeant water diversion.

Performance outcomes	Acceptable outcomes	Response	Comment
	AO4.2 Access ramps and tracks are kept to a minimum and constructed to minimise erosion and turbulence problems at times of high flow. AND		
	AO4.3 Ramps cut into the bank for vehicle access are orientated downstream. AND	N/A	
	AO9.4 Vehicle crossings are orientated perpendicular to the stream channel ±10°. AND	N/A	
	AO4.5 Where vehicle crossings are required, these will be at stream-bed level; OR if it can be demonstrated that stream-bed level crossings are inappropriate, any culverts for vehicle crossing are aligned with the direction of natural stream flow, when that flow is of a depth equal to the culvert height. AND	N/A	
	AO4.6 The activity includes measures to prevent stormwater erosion in drains and cuttings on the bank. AND	N/A	
	AO4.7 Stream-bed controls are located upstream and downstream of the site. AND	N/A	
	AO4.8 Excavation in the stream-bed is less than one-third of the bed width. AND	N/A	
	AO4.9 Clearing of in-stream vegetation is limited to the minimum area required for the activity to occur.	N/A	
PO5 Bed and bank stability is preserved.	**AO5.1** The stream is rehabilitated as near as possible to its natural state after the activity has been conducted. AND	N/A	
	AO5.2 Exposed bank areas are prepared to facilitate	N/A	

Performance outcomes	Acceptable outcomes	Response	Comment
	natural regeneration of native plant species. AND		
	AO5.3 Stream-bed and bank controls are retained upstream and downstream of the site of the activity.	N/A	

8.1 Queensland vegetation management state code

Response column key:
☑ Achieved
P/S Performance solution
N/A Not applicable

Table 8.1.3: General

Performance outcomes	Acceptable outcomes	Response	Comment
Clearing to reasonably avoid and minimise impacts			
PO1 Clearing only occurs where the applicant has demonstrated that the development has first reasonably avoided, and then reasonably minimised the impacts of development.	No acceptable outcome is prescribed.	✓	Remnant vegetation is mapped at both ends of the diversion channel. It is unlikely that the proposal will completely avoid disturbance to these areas. However; measures will be implemented to ensure that there is no unnecessary clearing, including clearly demarcating vegetation during removal and locating any ancillary works within areas that have already been cleared. Remnant vegetation is present all along the length of Bungil Creek and it is unlikely that the channel (given its primary function) would be able to completely avoid disturbance at any location along the watercourse.
Clearing on land in particular circumstances			
PO2 Clearing in an area must not be inconsistent with or impact on any of the following unless a better environmental outcome can be achieved: (1) a declared area, or (2) an exchange area, or (3) unlawfully cleared area, or (4) a restoration notice, or	No acceptable outcome is prescribed.	✓	Vegetation clearing will not be inconsistent with or impact on any of the identified areas in PO2.

Performance outcomes	Acceptable outcomes	Response	Comment
(5) an enforcement notice under the *Sustainable Planning Act 2009* issued for a vegetation clearing offence, or (6) a compliance notice containing conditions about the restoration of vegetation, or (7) a Land Act notice, or (8) a trespass notice if the trespass related act under the *Land Act 1994* for the notice is the clearing of vegetation on the relevant land, or (9) an area on a PMAV shown to be category A where the chief executive of the VMA reasonably believes that a vegetation clearing offence is being, or has been, committed in relation to the area.			
Clearing on land that is an environmental offset area			
PO3 Clearing on land that contains an existing environmental offset is consistent with the delivery plan or agreement for the environmental offset area. Editor's note: Environmental offset agreements may also be described as an 'agreed delivery arrangement' or 'delivery agreement'. Clearing should be	AO3.1 Clearing is consistent with the offset delivery plan or agreement for the environmental offset area. OR	N/A	Clearing will not occur in an area of existing environmental offset.
	AO3.2 An additional environmental offset is provided that is consistent with the relevant *Queensland Environmental Offsets Policy*.	N/A	

Performance outcomes	Acceptable outcomes	Response	Comment
consistent with any agreement however described.			
No clearing of vegetation as a result of the material change of use or reconfiguration of a lot			
PO4 Clearing as a result of the material change of use or reconfiguration of a lot will not occur.	No acceptable outcome is prescribed.	N/A	The proposal does not involve a material change of use or a reconfiguration of a lot. The application is for an Operational Work for a diversion channel associated with flood mitigation works.
Clearing that could already be done under an exemption			
PO5 All clearing is limited to clearing that could be done under an exemption for the purpose of the development (as prescribed under Schedule 24, Parts 1 and 2 of the Sustainable Planning Regulation 2009) prior to the material change of use application being approved.	No acceptable outcome is prescribed.	N/A	The application does not involve a material change of use.

Table 8.1.4: Public safety, relevant infrastructure and coordinated projects

Performance outcomes	Acceptable outcomes	Response	Comment
Limits to clearing			
PO1 Clearing is limited to the extent that is necessary: (1) for establishing a necessary fence, firebreak, road or vehicular track, or for constructing necessary built infrastructure (each relevant infrastructure), where the clearing cannot reasonably be avoided or minimised, or (2) as a natural and ordinary	No acceptable outcome is prescribed.	✓	The proposed clearing is required as part of the construction of a high flow diversion channel that is operationally related to flood mitigation works in Roma. The channel will divert flows away from the urban areas of Roma during flood events and help with flows when Bungil Creek reaches capacity. As remnant vegetation runs the length of Bungil Creek it is unlikely that the channel could be located to completely avoid impact. The construction of the channel is considered an integral part of the flood mitigation works in Roma and will play a

Performance outcomes	Acceptable outcomes	Response	Comment
consequence of other assessable development for which a development approval as defined under the repealed *Integrated Planning Act 1997* was given, or a development application as defined under that Act was made, before 16 May 2003, or (3) to ensure public safety, or (4) for a coordinated project and any associated ancillary works—other than a coordinated project that involves high value agriculture clearing, or irrigated high value agriculture clearing.			pivotal role in ensuring public safety during flood events.
Wetlands			
PO2 Maintain the current extent of vegetation associated with any natural wetland to protect: (1) water quality by filtering sediments, nutrients and other pollutants (2) aquatic habitat (3) terrestrial habitat.	**AO2.1** Clearing does not occur in or within 100 metres of any natural wetland. OR	N/A	The proposal will not occur within 100 metres of any natural wetland.
	AO2.2 Clearing only occurs within 100 metres of any natural wetland where: (1) the clearing does not occur within 50 metres of the defining bank of any natural wetland, or (2) the widths stipulated by Table 1 are not exceeded. OR	N/A	

Performance outcomes	Acceptable outcomes	Response	Comment
	AO2.3 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, an environmental offset is provided for any significant residual impacts from clearing of vegetation associated with a natural wetland. Editor's note: Applications for development should identify whether there is likely to be a significant residual impact and a need for an environmental offset having regard to Section 3.3 (Wetlands and watercourses) of the *Significant Residual Impact Guideline* and the relevant *Queensland Environmental Offsets Policy*.	N/A	
Watercourses and drainage features			
PO3 Maintain the current extent of vegetation associated with any watercourse or drainage feature to protect: (1) bank stability by protecting against bank erosion (2) water quality by filtering sediments, nutrients and other pollutants (3) aquatic habitat (4) terrestrial habitat.	**AO3.1** Clearing does not occur: (1) in any watercourse or drainage feature, or (2) within the relevant distance stipulated by Table 2 of the defining bank of any watercourse or drainage feature. OR	✓	Remnant vegetation at the eastern and western extent of the proposed diversion channel will be cleared to enable proper function of the proposed channel. Once constructed, the channel, including both its eastern and western extents will be revegetated with native grasses that will help both channel function and serve to ensure bank stability. The vegetation planted will help the channel to h filter sediments, nutrients and other pollutants when operational. The primary function of the channel is to redirect flows in flood events. Aside from clearing native vegetation at the time of construction, there will be no ongoing impact on terrestrial habitat.
	AO3.2 Clearing only occurs within any watercourse or drainage feature, or within the relevant distance stipulated by Table 2 of the defining bank of any watercourse or drainage feature where:	N/A	

Performance outcomes	Acceptable outcomes	Response	Comment
	(1) the clearing does not occur within 5 metres of the defining bank, or (2) the widths stipulated by Table 1 is not exceeded OR		
	AO3.3 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, an environmental offset is provided for any significant residual impact from clearing of vegetation associated with any watercourse or drainage feature. Editor's note: Applications for development should identify whether there is likely to be a significant residual impact and a need for an environmental offset having regard to Section 3.3 (Wetlands and watercourses) of the *Significant Residual Impact Guideline* and the relevant *Queensland Environmental Offsets Policy*.	✓	Should DNRM require an environmental offset, MRC would respectfully request that this requirement form part of conditions of development approval.
Connectivity (public safety and relevant infrastructure)			
PO4 In consideration of vegetation on the subject lot(s) and in the landscape adjacent to the subject lot(s), vegetation is retained that: (1) is of sufficient size and configured in a way that maintains ecosystem functioning (2) Remains in the landscape despite threatening processes.	**AO4.1** Clearing occurs in accordance with Table 3.	N/A	Remnant vegetation occurs along the length of Bungil Creek. Clearing of vegetation associated with the construction of the channel will not reduce vegetation along the length of the watercourse to less than 10ha.

Performance outcomes	Acceptable outcomes	Response	Comment
Connectivity (coordinated projects)			
PO5 In consideration of vegetation on the subject lot(s) and in the landscape adjacent to the subject lot(s), vegetation is retained that: (1) is of sufficient size and configured in a way that maintains ecosystem functioning (2) remains in the landscape despite threatening processes or where this is not reasonably possible, maintain the current extent of vegetation.	**AO5.1** Clearing occurs in accordance with Table 3. OR	N/A	
	AO5.2 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, an environmental offset is provided for any significant residual impact from clearing of vegetation that forms a connectivity area. Editor's note: Applications for development should identify whether there is likely to be a significant residual impact and a need for an environmental offset having regard to Section 3.2 (Connectivity areas) of the *Significant Residual Impact Guideline* and the relevant *Queensland Environmental Offsets Policy*.	✓	Should DNRM require an environmental offset, MRC would respectfully request that this requirement form part of conditions of development approval.
Soil erosion			
PO6 Clearing does not result in: (1) mass movement, gully erosion, rill erosion, sheet erosion, tunnel erosion, stream bank erosion, wind erosion, or scalding (2) any associated loss of chemical, physical or biological fertility—including, but not limited to water holding capacity, soil structure, organic matter, soil biology, and nutrients within or outside the lot(s) that are the subject of the application.	**AO6.1** Clearing is undertaken in accordance with a sediment and erosion control plan which avoids and minimises land degradation. OR	✓	Construction of the he proposed channel will be undertaken by MRC. Should DNRM require, a sediment and erosion control plan can be submitted prior to construction of the channel. MRC would respectfully request that if the sediment and erosion control plan is required than this requirement form part of conditions of development approval.
	AO6.2 The application is a development application where a local government is the assessment manager.		

Performance outcomes	Acceptable outcomes	Response	Comment
Salinity			
PO7 Clearing does not contribute to land degradation through: (1) waterlogging, or (2) the salinisation of groundwater, surface water or soil.	**AO7.1** Clearing does not occur in or within 200 metres of a discharge area or recharge area. OR	✓	Clearing will not occur within 200m of a discharge or recharge area.
	AO7.2 Clearing is less than: (1) 2 hectares, or (2) 10 metres wide.	✓	Clearing is less than 2 hectares.
Conserving endangered and of concern regional ecosystems			
PO8 Maintain the current extent of endangered regional ecosystems and of concern regional ecosystems.	**AO8.1** Clearing does not occur in: (1) an endangered regional ecosystem, or (2) an of concern regional ecosystem. OR	✓	Clearing is not occurring in an endangered regional ecosystem or an of concern regional ecosystem.
	AO8.2 Clearing in an endangered regional ecosystem or an of concern regional ecosystem does not exceed the width or area prescribed in Table 1. OR	N/A	
	AO8.3 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, an environmental offset is provided for any significant residual impact from clearing of endangered regional ecosystems and of concern regional ecosystems. Editor's note: Applications for development should identify whether there is likely to be a significant residual impact and a need for an environmental offset having regard to Section 3.1 (Regulated vegetation) of the *Significant*	N/A	

Performance outcomes	Acceptable outcomes	Response	Comment
	Residual Impact Guideline and the relevant *Queensland Environmental Offsets Policy*.		
Essential habitat			
PO9 Maintain the current extent of essential habitat.	**AO9.1** Clearing does not occur in an area of essential habitat. OR		
	AO9.2 Clearing in essential habitat does not exceed the widths or areas prescribed in Table 1. OR		
	AO9.3 Clearing only occurs where an area of essential habitat is isolated and small in size and at risk from threatening processes, for the prescribed species. OR		
	AO9.4 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, an environmental offset is provided for any significant residual impact from clearing of essential habitat. Editor's note: Applications for development should identify whether there is likely to be a significant residual impact and a need for an environmental offset having regard to Section 3.1 (Regulated vegetation) of the *Significant Residual Impact Guideline* and the relevant *Queensland Environmental Offsets Policy*.	✓	Should DNRM require an environmental offset, MRC would respectfully request that this form part of conditions of development approval.
Acid sulfate soils			
PO10 Clearing activities do not result in disturbance of acid sulfate soils or changes to the hydrology of the location that will either:	**AO10.1** Clearing does not occur in land zone 1, land zone 2 or land zone 3. OR	✓	The proposed channel is expected to divert flows during flood events. It will not function outside of these extreme weather events. It is unlikely that the clearing of remnant vegetation to construct the channel will result in disturbance

Performance outcomes	Acceptable outcomes	Response	Comment
(1) aerate horizons containing iron sulfides, or (2) mobilise acid or metals.			of acid sulphate soils or changes to the hydrology of the location. Construction of the channel will be undertaken by MRC.
	AO10.2 Clearing in land zone 1, land zone 2 or land zone 3 in areas below the 5 metre Australian Height Datum only occurs where: (1) it does not involve mechanical clearing (2) the acid sulfate soils are managed consistent with the *State Planning Policy*, Department of State Development infrastructure and Planning 2014, and with the Soil Management Guidelines in the *Queensland Acid Sulfate Soil Technical Manual*, Department of Science, Information Technology, Innovation and the Arts, 2014. OR		
	AO10.3 The application is a development application where a local government is the assessment manager.		

Table 8.1.5: Extractive industry

Performance outcomes	Acceptable outcomes	Response	Comment
Limits to clearing for an extractive industry			
PO1 Clearing is limited to the extent that is necessary for:	No acceptable outcome is prescribed.	✓	Construction of the channel will require the extraction of 130,000 tonnes of material. Once constructed, MRC will

Performance outcomes	Acceptable outcomes	Response	Comment
(1) dredging material from the bed of any waters (2) extracting, from a pit or quarry, rock, sand, clay, gravel, loam or other material (3) screening, washing, grinding, milling, sizing or separating material extracted from a pit or quarry (4) carrying out work that is the natural and ordinary consequence of carrying out work mentioned in subparagraphs (1), (2) and (3) above.			surrender the Extractive EA as there will be no ongoing requirement for excavation activities. Only minimal ongoing maintenance will be required, primarily mowing and irrigation.
Clearing is staged			
PO2 Clearing: (1) is staged in line with operational needs that restrict clearing to the current operational area (2) is limited to the area from which material will be extracted, and any reasonably associated infrastructure, within the term of the development approval (3) cannot occur until all required permits are obtained.	No acceptable outcome is prescribed.	✓	Clearing will not occur until all relevant permits and licenses are obtained.

Performance outcomes	Acceptable outcomes	Response	Comment
Wetlands			
PO3 Maintain the current extent of vegetation associated with any natural wetland to protect: (1) water quality by filtering sediments, nutrients and other pollutants (2) aquatic habitat (3) terrestrial habitat.	**AO3.1** Clearing does not occur in, or within 100 metres of, any natural wetland. OR	✓	Clearing will not occur within 100m of a natural wetland.
	AO3.2 Clearing only occurs within 100 metres of any natural wetland where: (1) the clearing does not occur within 50 metres of the of the natural wetland, or (2) the widths stipulated by Table 1 are not exceeded. OR		
	AO3.3 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, an environmental offset is provided for any significant residual impact from clearing of vegetation associated with a natural wetland. Editor's note: Applications for development should identify whether there is likely to be a significant residual impact and a need for an environmental offset having regard to Section 3.3 (Wetlands and watercourses) of the *Significant Residual Impact Guideline* and the relevant *Queensland Environmental Offsets Policy*.		
Watercourses and drainage features			
PO4 Maintain the current extent of vegetation associated with any watercourse or drainage feature to protect:	**AO4.1** Clearing does not occur: (1) in any watercourse or drainage feature (2) within the relevant distance stipulated in Table 2 of the defining bank of any watercourse or drainage		

Performance outcomes	Acceptable outcomes	Response	Comment
(1) bank stability by protecting against bank erosion (2) water quality by filtering sediments, nutrients and other pollutants (3) aquatic habitat (4) terrestrial habitat.	feature. OR		
	AO4.2 Clearing only occurs within any watercourse or drainage feature, or within the relevant distance stipulated by Table 2 of the defining bank of any watercourse or drainage feature where: (1) the clearing does not occur within 5 metres of the defining bank, or (2) the widths stipulated by Table 1 is not exceeded. OR		
	AO4.3 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, an environmental offset is provided for any significant residual impacts from clearing of vegetation associated with any watercourse or drainage feature. Editor's note: Applications for development should identify whether there is likely to be a significant residual impact and a need for an environmental offset having regard to Section 3.3 (Wetlands and watercourses) of the *Significant Residual Impact Guideline* and the relevant *Queensland Environmental Offsets Policy*.	✓	Should DNRM require an environmental offset, MRC would respectfully request that this request form part of conditions of development approval.
Connectivity			
PO5 In consideration of vegetation on the subject lot(s) and in the landscape adjacent to the subject lot(s), vegetation is retained that:	**AO5.1** Clearing occurs in accordance with Table 3.		

Performance outcomes	Acceptable outcomes	Response	Comment
(1) is of sufficient size and configured in a way that maintains ecosystem functioning (2) remains in the landscape despite threatening processes.			
Salinity			
PO6 Clearing does not contribute to land degradation through: (1) waterlogging, or (2) the salinisation of groundwater, surface water or soil.	**AO6.1** Clearing does not occur in or within 200 metres of a discharge area or recharge area. OR	✓	Clearing does not occur within 200 metres of a discharge area or recharge area.
	AO6.2 Clearing is less than: (1) 2 hectares, or (2) 10 metres wide.		
Conserving endangered and of concern regional ecosystems			
PO7 Maintain the current extent of endangered regional ecosystems and of concern regional ecosystems.	**AO7.1** Clearing does not occur in: (1) an endangered regional ecosystem, or (2) an of concern regional ecosystem. OR	✓	Clearing does not occur in an endangered regional ecosystem or an of concern regional ecosystem.
	AO7.2 Clearing in an endangered regional ecosystem or an of concern regional ecosystem does not exceed the width or area prescribed in Table 1. OR		
	AO7.3 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has		Should DNRM require an environmental offset, MRC would

Performance outcomes	Acceptable outcomes	Response	Comment
	been reasonably minimised, an environmental offset is provided for any significant residual impact from the clearing of endangered regional ecosystems and of concern regional ecosystems. Editor's note: Applications for development should identify whether there is likely to be a significant residual impact and a need for an environmental offset having regard to Section 3.1 (Regulated vegetation) of the *Significant Residual Impact Guideline* and the relevant *Queensland Environmental Offsets Policy*.	✓	respectfully request that this requirement form part of conditions of development approval.
Essential habitat			
PO8 Maintain the current extent of essential habitat.	**AO8.1** Clearing does not occur in an area of essential habitat. OR	✓	Clearing does not occur in an area of essential habitat.
	AO8.2 Clearing in essential habitat does not exceed the width or area prescribed in Table 1. OR		
	AO8.3 Clearing only occurs where an area of essential habitat is isolated and small in size and at risk from threatening processes, for the prescribed species. OR		
	AO8.4 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, an environmental offset is provided for any significant residual impact from the clearing of essential habitat. Editor's note: Applications for development should identify whether there is likely to be a significant residual impact and a need for an environmental offset having regard to	✓	Should DNRM require an environmental offset, MRC would respectfully request that this requirement form part of conditions of development approval.

Performance outcomes	Acceptable outcomes	Response	Comment
	Section 3.1 (Regulated vegetation) of the *Significant Residual Impact Guideline* and the relevant *Queensland Environmental Offsets Policy*.		
Acid sulfate soils			
PO9 Clearing activities do not result in the disturbance of acid sulfate soils or changes to the hydrology of the location that will either: (1) aerate horizons containing iron sulfides, or (2) mobilise acid or metals.	**AO9.1** Clearing does not occur in land zone 1, land zone 2 or land zone 3. OR	✓	Clearing will not result in the disturbance of acid sulfate or changes to the hydrology of the location. The construction of channel will be undertaken by MRC.
	AO9.2 Clearing in land zone 1, land zone 2 or land zone 3 in areas below the 5 metre Australian Height Datum only occurs where: (1) it does not involve mechanical clearing (2) the acid sulfate soils are managed consistent with the *State Planning Policy*, Department of State Development, Infrastructure and Planning, 2014, and with the *Soil Management Guidelines in the Queensland Acid Sulfate Soil Technical Manual*, Department of Science, Information Technology, Innovation and the Arts, 2014. OR		
	AO9.3 The application is a development application where a local government is the assessment manager.		

Table 8.1.6: High value agriculture clearing and irrigated high value agriculture clearing

Performance outcomes	Acceptable outcomes	Response	Comment
High value and irrigated high value agriculture clearing			

Performance outcomes	Acceptable outcomes	Response	Comment
Clearing is only for high value agriculture clearing or irrigated high value agriculture clearing where: (1) the land is suitable for agriculture having regard to topography, climate and soil attributes (2) there is no alternative site on the land for the clearing (3) a business plan, for activities related to the clearing, demonstrates the viability of the activities (4) where a regulation prescribes restrictions relevant to the clearing, these restrictions are complied with (5) if for irrigated high value agriculture clearing, demonstrate that the owner of the land is an eligible owner who has, or may have, access to enough water for establishing, cultivating and harvesting the crops to which the clearing relates. (1) Editor's note: Section 22DAB(3) provides for a regulation to prescribe restrictions for certain matters related to high value agriculture clearing or irrigated high value agriculture clearing.	No acceptable outcome is prescribed.	N/A	The clearing is in relation to a diversion channel associated with flood mitigation works.

Performance outcomes	Acceptable outcomes	Response	Comment
Wetlands			
PO2 Maintain the current extent of vegetation associated with any natural wetland to protect: (1) water quality by filtering sediments, nutrients and other pollutants (2) aquatic habitat (3) terrestrial habitat.	**AO2.1** Clearing does not occur in, or within 100 metres of, any natural wetland. OR	✓	Clearing will not occur in, or within, 100m of any natural wetland.
	AO2.2 Clearing only occurs within 100 metres of any natural wetland where: (1) the clearing does not occur within 50 metres of the natural wetland, or (2) the widths stipulated by Table 1 are not exceeded. OR		
	AO2.3 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, an environmental offset is provided for any significant residual impact from the clearing of vegetation associated with a natural wetland. Editor's note: Applications for development should identify whether there is likely to be a significant residual impact and a need for an environmental offset having regard to Section 3.3 (Wetlands and watercourses) of the *Significant Residual Impact Guideline* and the relevant *Queensland Environmental Offsets Policy*.		
Watercourses and drainage features			
PO3 Maintain the current extent of vegetation associated with any watercourse or drainage feature to protect:	**AO3.1** Clearing does not occur: (1) in any watercourse or drainage feature (2) within the relevant distance stipulated in Table 2 of the defining bank of any watercourse or drainage		

Performance outcomes	Acceptable outcomes	Response	Comment
(1) bank stability by protecting against bank erosion (2) water quality by filtering sediments, nutrients and other pollutants (3) aquatic habitat (4) terrestrial habitat.	feature. OR		
	AO3.2 Clearing only occurs within any watercourse or drainage feature, or within the relevant distance stipulated by Table 2 of the defining bank of any watercourse or drainage feature where: (1) the clearing does not occur within 5 metres of the defining bank, or (2) the widths stipulated by Table 1 is not exceeded. OR		
	AO3.3 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, an environmental offset is provided for any significant residual impact from clearing of vegetation associated with any watercourse or drainage feature. Editor's note: Applications for development should identify whether there is likely to be a significant residual impact and a need for an environmental offset having regard to Section 3.3 (Wetlands and watercourses) of the *Significant Residual Impact Guideline* and the relevant *Queensland Environmental Offsets Policy*.	✓	Should DNRM require an environmental offset, MRC would respectfully request that this form part of conditions of development approval.
Connectivity area			
PO4 In consideration of vegetation on the subject lot(s) and in the landscape adjacent to the subject lot(s), vegetation is retained that:	**AO4.1** Clearing occurs in accordance with Table 3.	✓	The proposed channel will require the clearing of a vegetation in a defined area of the channel. The construction and function of the channel will not impact on other vegetation on the lot or vegetation on adjoining lots.

Performance outcomes	Acceptable outcomes	Response	Comment
(1) is of sufficient size and configured in a way that maintains ecosystem functioning (2) remains in the landscape despite threatening processes.			
Soil erosion			
PO5 Clearing: (1) does not result in soil erosion stemming from: (a) mass movement, gully erosion, rill erosion, sheet erosion, tunnel erosion, stream bank erosion, wind erosion, or scalding (b) (c) any associated loss of chemical, physical or biological fertility—including, but not limited to water holding capacity, soil structure, organic matter, soil biology, and nutrients (2) maintains ecological processes, within or outside the lot(s) that are the subject of the application.	**AO5.1** Clearing is undertaken in accordance with a sediment and erosion control plan which avoids and minimises land degradation.		
Salinity			
PO6 Clearing does not contribute to land degradation through: (1) waterlogging, or (2) the salinisation of groundwater,	**AO6.1** Clearing of vegetation does not occur in, or within 200 metres of, a discharge area or recharge area. OR	✓	Clearing the vegetation will not occur in, or within, 200 metres of a discharge area or recharge area.
	AO6.2 Clearing of vegetation is less than:		

Performance outcomes	Acceptable outcomes	Response	Comment
surface water or soil.	(1) 2 hectares, or (2) 10 metres wide.		
Conserving endangered and of concern regional ecosystems			
PO7 Maintain the current extent of endangered regional ecosystems and of concern regional ecosystems, or provide a significant beneficial outcome where the clearing cannot be reasonably avoided, and impacts reasonably minimised.	**AO7.1** Clearing does not occur in: (1) an endangered regional ecosystem, or (2) an of concern regional ecosystem. OR	✓	Clearing does not occur in an endangered regional ecosystem or an of concern regional ecosystem.
	AO7.2 Clearing in an endangered regional ecosystem, or an of concern regional ecosystem does not exceed the width or area prescribed in Table 1. OR		
	AO7.3 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, an environmental offset is provided for any significant residual impact from the clearing of endangered regional ecosystem or of concern regional ecosystems, or a significant beneficial outcome is provided for the clearing of an endangered regional ecosystem or of concern regional ecosystems. Editor's note: Applications for development should identify whether there is likely to be a significant residual impact and a need for an environmental offset having regard to Section 3.1 (Regulated vegetation) of the *Significant Residual Impact Guideline* and the relevant *Queensland Environmental Offsets Policy*.	✓	Should DNRM require an environmental offset, MRC would respectfully request that this form part of conditions of development approval.
Essential habitat			

Performance outcomes	Acceptable outcomes	Response	Comment
(2) **PO8** Maintain the current extent of essential habitat.	**AO8.1** Clearing of vegetation does not occur in an area of essential habitat. OR	✓	Clearing will not occur in an area of essential habitat.
	AO8.2 Clearing of vegetation in essential habitat does not exceed the width or area prescribed in Table 1. OR		
	AO8.3 Clearing only occurs where an area of essential habitat is isolated and small in size and at risk from threatening processes, for the prescribed species. OR		
	AO8.4 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, an environmental offset is provided for any significant residual impact for the clearing of essential habitat. Editor's note: Applications for development should identify whether there is likely to be a significant residual impact and a need for an environmental offset having regard to Section 3.1 (Regulated vegetation) of the *Significant Residual Impact Guideline* and the relevant *Queensland Environmental Offsets Policy*.	✓	Should DNRM require an environmental offset, MRC would respectfully request that this form part of conditions of development approval.
Acid sulfate soils			
PO9 Clearing activities do not result in the disturbance of acid sulfate soils or changes to the hydrology of the location that will either: (1) aerate horizons containing iron sulfides, or	**AO9.1** Clearing does not occur in land zone 1, land zone 2 or land zone 3. OR	✓	Clearing activities would not result in the disturbance of acid sulfate soils or changes to the hydrology of the location.
	AO9.2 Clearing in land zone 1, land zone 2 or land zone 3 in areas below the 5 metre Australian Height Datum only occurs where: (1) it does not involve mechanical clearing		

Performance outcomes	Acceptable outcomes	Response	Comment
(2) mobilise acid or metals.	(2) the acid sulfate soils are managed consistent with the *State Planning Policy*, Department of State Development, Infrastructure and Planning, 2014, and with the *Soil Management Guidelines in the Queensland Acid Sulfate Soil Technical Manual*, Department of Science, Information Technology, Innovation and the Arts, 2014. (1) OR (2)		
	AO9.3 The application is a development application where a local government is the assessment manager.		

Table 8.1.7: Necessary environmental clearing

Performance outcomes	Acceptable outcomes	Response	Comment
Limits to clearing			
PO1 Clearing is reasonably avoided, or is limited to the extent that is necessary to: (1) restore the ecological and environmental condition of land, or (2) divert existing natural channels in a way that replicates the existing form of the natural channels, or (3) prepare for the likelihood of a natural disaster, or (4) remove contaminants from land.	No acceptable outcome is prescribed.		

Performance outcomes	Acceptable outcomes	Response	Comment
Wetlands (land restoration, natural disaster preparation)			
PO2 Maintain vegetation associated with any natural wetland to protect: (1) water quality by filtering sediments, nutrients and other pollutants (2) aquatic habitat (3) terrestrial habitat (3) or where this is not reasonably possible, rehabilitate.	**AO2.1** Clearing does not occur: (1) in any natural wetland, or (2) within 100 metres of any natural wetland. OR	N/A	Clearing will not occur in, or within 100m of, a natural wetland.
	AO2.2 Clearing only occurs within 100 metres of any natural wetland where: (1) the clearing does not occur within 50 metres of the natural wetland, or (2) the widths stipulated by Table 1 are not exceeded. OR		
	AO2.3 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, the cleared area is rehabilitated in accordance with an environmental clearing management plan.	✓	Once constructed, the channel will be vegetated with native grasses to assist with channel function.
Wetlands (natural channel diversion and contaminants removal)			
PO3 Maintain vegetation associated with any natural wetland to protect: (1) water quality by filtering sediments, nutrients and other pollutants (2) aquatic habitat (3) terrestrial habitat	**AO3.1** Clearing does not occur: (1) in any natural wetland, or (2) within 100 metres of any natural wetland. OR	N/A	Clearing will not occur in, or within 100m of, a natural wetland.
	AO3.2 Clearing only occurs within 100 metres of any natural wetland where:		

Performance outcomes	Acceptable outcomes	Response	Comment
(4) or where this is not reasonably possible, rehabilitate or maintain the current extent.	(1) the clearing does not occur within 50 metres of the natural wetland, or (2) the widths stipulated by Table 1 are not exceeded. OR		
	AO3.3 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, the cleared area is rehabilitated. OR		
	AO3.4 Where clearing is for natural channel diversion or contaminants removal, and it can be demonstrated that clearing cannot be reasonably avoided, and: (1) the extent of clearing has been reasonably minimised (2) the cleared area cannot be reasonably rehabilitated an environmental offset is provided for any significant residual impacts from clearing vegetation associated with a natural wetland. Editor's note: Applications for development should identify whether there is likely to be a significant residual impact and a need for an environmental offset having regard to Section 3.3 (Wetlands and watercourses) of the *Significant Residual Impact Guideline* and the relevant *Queensland Environmental Offsets Policy*.		
Watercourses and drainage features (land restoration and natural disaster preparation)			
PO4 Maintain vegetation associated with	**AO4.1** Clearing does not occur:		

Performance outcomes	Acceptable outcomes	Response	Comment
any watercourse or drainage feature to protect: (1) bank stability by protecting against bank erosion (2) water quality by filtering sediments, nutrients and other pollutants (3) aquatic habitat (4) terrestrial habitat. (5) or where this is not reasonably possible, rehabilitate.	(1) within any watercourse or drainage feature, or (2) within the relevant distances stipulated in Table 2 from each defining bank of any watercourse or drainage feature. OR		
	AO4.2 Clearing only occurs within any watercourse or drainage feature, or within the relevant distance stipulated by Table 2 of the defining bank of any watercourse or drainage feature where: (1) the clearing does not occur within 5 metres of the defining bank of any watercourse or drainage feature, or (2) the widths stipulated by Table 1 are not exceeded. OR		
	AO4.3 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, the cleared area is rehabilitated.	✓	Once constructed, the channel will be vegetated with native grasses to assist with channel function.
Watercourses and drainage features (natural channel diversion and contaminants removal)			
PO5 Maintain vegetation associated with any watercourse or drainage feature to protect: (1) bank stability by protecting against bank erosion	**AO5.1** Clearing does not occur: (1) within any watercourse or drainage feature, or (2) within the relevant distances stipulated in Table 2 from each defining bank of any watercourse or drainage feature.		

Performance outcomes	Acceptable outcomes	Response	Comment
(2) water quality by filtering sediments, nutrients and other pollutants (3) aquatic habitat (4) terrestrial habitat (6) or where this is not reasonably possible, rehabilitate or maintain the current extent.	OR		
	AO5.2 Clearing only occurs within any watercourse or drainage feature, or within the relevant distance stipulated by Table 2 of the defining bank of any watercourse or drainage feature where: (1) the clearing does not occur within 5 metres of the defining bank of any watercourse or drainage feature, or (2) the widths stipulated by Table 1 are not exceeded. OR		
	AO5.3 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, the cleared area is rehabilitated. OR		
	AO5.4 Where it can be demonstrated that clearing cannot be reasonably avoided, and: (1) the extent of clearing has been reasonably minimised (2) the cleared area cannot be reasonably rehabilitated an environmental offset is provided for any significant residual impact from clearing of vegetation associated with a watercourse or drainage feature. Editor's note. Applications for development should identify whether there is likely to be a significant residual impact and a need for an environmental offset having regard to Section 3.3 (Wetlands and watercourses) of the	✓	Should DNRM require an environmental offset, MRC would respectfully request that this form part of conditions of development approval.

Performance outcomes	Acceptable outcomes	Response	Comment
	Significant Residual Impact Guideline and the relevant *Queensland Environmental Offsets Policy*.		
Connectivity (land restoration and natural disaster preparation)			
PO6 In consideration of vegetation on the subject lot(s), and in the landscape adjacent to the subject lot(s), vegetation is retained that: (1) is of sufficient size and configured in a way that maintains ecosystem functioning (2) remains in the landscape despite threatening processes (7) or where this is not reasonably possible, rehabilitate.	**AO6.1** Clearing occurs in accordance with Table 3. OR		
	AO6.2 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, the cleared area is rehabilitated.	✓	Once constructed, the channel will be vegetated with native grasses to assist with channel function and integrate the development into the natural environment.
Connectivity (natural channel diversion and contaminants removal)			
PO7 In consideration of vegetation mapped on the subject lot(s) and in the landscape adjacent to the subject lot(s), vegetation is retained that: (1) is of sufficient size and configured in a way that maintains ecosystem functioning (2) remains in the landscape despite threatening processes (8) or where this is not reasonably possible, rehabilitate, or maintain the current extent.	**AO7.1** Clearing occurs in accordance with Table 3. OR		
	AO7.2 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, the cleared area is rehabilitated. OR		
	AO7.3 Where it can be demonstrated that clearing cannot be reasonably avoided, and: (1) the extent of clearing has been reasonably minimised	✓	Should DNRM require an environmental offset, MRC would respectfully request that this form part of conditions of development approval.

Performance outcomes	Acceptable outcomes	Response	Comment
	(2) the cleared area cannot be reasonably rehabilitated an environmental offset is provided for any significant residual impact from clearing vegetation that forms a connectivity area. Editor's note: Applications for development should identify whether there is likely to be a significant residual impact and a need for an environmental offset having regard to Section 3.2 (Connectivity areas) of the *Significant Residual Impact Guideline* and the relevant *Queensland Environmental Offsets Policy*.		
Soil erosion			
PO8 Clearing does not result in or accelerate land degradation resulting from: (1) mass movement, gully erosion, rill erosion, sheet erosion, tunnel erosion, stream bank erosion, wind erosion, or scalding (2) any associated loss of chemical, physical or biological fertility—including, but not limited to water holding capacity, soil structure, organic matter, soil biology, and nutrients (9) within and outside the lot(s) that are the subject of the application.	**AO8.1** Clearing is undertaken in accordance with a sediment and erosion control plan which reasonably avoids and minimises land degradation.	✓	Clearing will not result in or accelerate land degradation.
Salinity			
PO9 Clearing does not contribute to, or	**AO9.1** Clearing does not occur in, or within 200 metres of,	✓	Clearing will not occur in, or within, 200 metres of a

Performance outcomes	Acceptable outcomes	Response	Comment
accelerate, land degradation through: (1) waterlogging, or (2) the salinisation of groundwater, surface water or soil.	a discharge area or recharge area. OR		discharge area or recharge area.
	AO9.2 Clearing is less than: (1) 2 hectares, or (2) 10 metres wide.		
Essential habitat (land restoration and natural disaster preparation)			
PO10 Clearing does not occur in essential habitat, or where this is not reasonably possible, rehabilitate where the clearing cannot be reasonably avoided and impacts reasonably minimised.	**AO10.1** Clearing does not occur in essential habitat. OR	✓	Clearing would not occur in an essential habitat.
	AO10.2 Clearing in essential habitat does not exceed the widths or areas prescribed in Table 1. OR		
	AO10.3 Clearing only occurs where an area of essential habitat is isolated and small in size and at risk from threatening processes, for the prescribed species. OR		
	AO10.4 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, the cleared area is rehabilitated.		
Essential habitat (natural channel diversion and contaminants removal)			
(10) **PO11** Clearing does not occur in essential habitat, or where this cannot reasonably be avoided, rehabilitate or maintain the current extent of essential habitat.	**AO11.1** Clearing does not occur in essential habitat. OR	✓	Clearing would not occur in an essential habitat.
	AO11.2 Clearing in essential habitat does not exceed the widths or areas prescribed in Table 1. OR		

Performance outcomes	Acceptable outcomes	Response	Comment
	AO11.3 Clearing only occurs where an area of essential habitat is isolated and small in size and at risk from threatening processes, for the prescribed species. OR		
	AO11.4 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, the cleared area is rehabilitated. OR		
	AO11.5 Where it can be demonstrated that clearing cannot be reasonably avoided, and: (1) the extent of clearing has been reasonably minimised (2) the cleared area cannot be reasonably rehabilitated an environmental offset is provided for any significant residual impact from clearing of essential habitat. Editor's note: Applications for development should identify whether there is likely to be a significant residual impact and a need for an environmental offset having regard to Section 3.1 (Regulated vegetation) of the *Significant Residual Impact Guideline* and the relevant *Queensland Environmental Offsets Policy*.		
Clearing regional ecosystems (land restoration and natural disaster preparation)			
(11) **PO12** Clearing does not occur in endangered regional ecosystems, of concern regional ecosystems or least concern regional ecosystems, or where this is not reasonably possible, rehabilitate where the clearing cannot be reasonably	**AO12.1** Clearing does not occur in: (1) an endangered regional ecosystem, or (2) an of concern regional ecosystem, or (3) a least concern regional ecosystem. OR	✓	The channel would be vegetated with native grasses that would assist with channel function and help integrate the channel in the natural environment.

Performance outcomes	Acceptable outcomes	Response	Comment
avoided and impacts reasonably minimised.			
	AO12.2 Clearing: (1) maintains the natural floristic composition and range of sizes across the application area, or (2) does not exceed the widths or areas prescribed in Table 1. OR		
	AO12.3 Where it can be demonstrated that clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, the cleared area is rehabilitated.		
Clearing regional ecosystems (natural channel diversion and contaminants removal)			
(12) **PO13** Clearing does not occur in endangered regional ecosystems, of concern regional ecosystems or least concern regional ecosystems, or where this cannot be reasonably be avoided, rehabilitate or maintain the current extent of endangered regional ecosystems and of concern regional ecosystems.	**AO13.1** Clearing does not occur in: (1) an endangered regional ecosystem, or (2) an of concern regional ecosystem, or (3) a least concern regional ecosystem. OR		
	AO13.2 Clearing: (1) maintains the natural floristic composition and range of sizes across the application area, or (2) does not exceed the widths or areas prescribed in Table 1. OR		

Performance outcomes	Acceptable outcomes	Response	Comment
	AO13.3 Where it can be demonstrated that clearing cannot be reasonably avoided and the extent of clearing has been reasonably minimised, endangered regional ecosystems and of concern regional ecosystems are rehabilitated. OR		
	AO13.4 Where clearing an endangered regional ecosystem or of concern regional ecosystem and it can be demonstrated that clearing cannot be reasonably avoided, minimised or rehabilitated, an environmental offset is provided for any significant residual impact from clearing an endangered regional ecosystem or of concern regional ecosystem. Editor's note: Applications for development should identify whether there is likely to be a significant residual impact and a need for an environmental offset having regard to Section 3.1 (Regulated vegetation) of the *Significant Residual Impact Guideline* and the relevant *Queensland Environmental Offsets Policy*.	✓	Should DNRM require an environmental offset, MRC would respectfully request that this form part of conditions of development approval.
Acid sulfate soils			
PO14 Clearing does not result in, or accelerate, the disturbance of acid sulfate soils or changes to the hydrology of the location that will either: (1) aerate horizons containing iron sulfides, or (2) mobilise acid or metals.	**AO14.1** Clearing vegetation does not occur in: (1) land zone 1, land zone 2 or land zone 3 (2) areas below the 5 metre Australian Height Datum where acid sulfate soils are present. OR	✓	Clearing will not result in, or accelerate, the disturbance of acid sulfate soils or changes to the hydrology of the location.
	AO14.2 Clearing in land zone 1, land zone 2 or land zone 3 in areas below the 5 metre Australian Height Datum only		

Performance outcomes	Acceptable outcomes	Response	Comment
	occurs where: (1) it does not involve mechanical clearing (2) the acid sulfate soils are managed consistent with the *State Planning Policy*, Department of State Development, Infrastructure and Planning, 2014, and with the Soil Management Guidelines in the *Queensland Acid Sulfate Soil Technical Manual*, Department of Science, Information Technology, Innovation and the Arts, 2014. OR		
	AO14.3 The application is a development application where a local government is the assessment manager.		

Table 8.1.8: Weed or pest management

Performance outcomes	Acceptable outcomes	Response	Comment
Limits to clearing for weed or pest management			
PO1 Clearing is limited to the extent necessary to: (1) control non-native plants or declared pests, or (2) provide access for control of non-native plants or declared pests if no alternative route exists.	No acceptable outcome is prescribed	✓	Clearing is required to construct a diversion channel associated with flood mitigation works. The works involve clearing of vegetation at the eastern and western extent of the channel. Once the channel is constructed, MRC will continue ongoing maintenance of the channel including routine pest control.
Wetlands			

Performance outcomes	Acceptable outcomes	Response	Comment
PO2 Maintain vegetation associated with a natural wetland to protect: (1) water quality by filtering sediments, nutrients and other pollutants (2) aquatic habitat (3) terrestrial habitat.	**AO2.1** Mechanical clearing does not occur within 5 metres of a natural wetland. AND	N/A	The application is for the construction for a diversion channel associated with flood mitigation works for the town of Roma. It is not for the purpose of Mechanical weed control.
	AO2.2 Clearing only occurs: (1) within a 1.5 meter radius from the base of the stem of individual non-native or declared plants, or (2) to the extent necessary to provide access for the control of the non-native or declared plants. AND		
	AO2.3 Clearing for access tracks running parallel to a natural wetland is not to be located within 10 metres of the natural wetland.		
Watercourses and drainage features			
PO3 Maintain vegetation associated with any watercourse or drainage feature to protect: (1) bank stability by protecting against bank erosion (2) water quality by filtering sediments, nutrients and other pollutants (3) aquatic habitat (4) terrestrial habitat.	**AO3.1** Mechanical clearing does not occur within 20 metres of the defining bank of a watercourse or drainage feature. AND		
	AO3.2 Clearing only occurs: (1) within a 1.5 metre radius from the base of the stem of individual non-native or declared plants, or (2) to the extent necessary to provide access for the control of the non-native or declared plant. AND		
	AO3.3 Clearing for access tracks running parallel to a		

Performance outcomes	Acceptable outcomes	Response	Comment
	watercourse or drainage feature are not be located within 10 metres of the defining bank of the watercourse or drainage feature.		
Soil erosion			
PO4 Clearing does not result in: (1) mass movement, gully erosion, rill erosion, sheet erosion, tunnel erosion, stream bank erosion, wind erosion, or scalding (2) any associated loss of chemical, physical or biological fertility—including, but not limited to water holding capacity, soil structure, organic matter, soil biology and nutrients within or outside the lot(s) that are the subject of the application.	**AO4.1** Mechanical clearing retains 50 per cent of the ground cover (dead or alive) in each 50 by 50 metre (0.25 hectare) area. AND	✓	Once constructed, the channel will be revegetated with native grasses that will allow proper channel function and will help to prevent mass movement, gully erosion, rill erosion, sheet erosion, tunnel erosion, stream bank erosion, wind erosion or scalding.
	AO4.2 New access tracks, necessary to gain access to a weed infestation, do not: (1) exceed 5 metres in width (2) de-stabilise the banks of any watercourse or drainage feature as a result of crossing construction or use.	N/A	No new access tracks are proposed along the watercourse.
Conserving remnant vegetation that are regional ecosystems			
PO5 Clearing activities: (1) maintain the natural floristic composition and range of sizes of each species of the regional ecosystem evenly spaced across the application area (2) do not remove mature trees.	**AO5.1** Mechanical clearing does not exceed the limitations defined in Table 4. AND	N/A	The application is for the construction for a diversion channel associated with flood mitigation works for the town of Roma. It is not for the purpose of Mechanical weed control.
	AO5.2 Soil absorbed broad spectrum herbicides are not: (1) applied via aerial application, or (2) ground applied on a broad acre basis, or	N/A	The application is for the construction for a diversion channel associated with flood mitigation works for the town of Roma. It is not for the purpose of Mechanical weed control.

Performance outcomes	Acceptable outcomes	Response	Comment
	(3) used inconsistently with the product directions.		
Requirements for dense regional ecosystems			
(13) **PO6** The removal of canopy vegetation does not occur in the regional ecosystems listed in Table 5.	**AO6.1** Clearing and associated soil disturbance in regional ecosystems listed in Table 5 occurs only: (1) within a 1.5 metre radius from the base of the stem or individual non-native or declared plants, or (2) to the extent necessary to provide access for the control of the non-native or declared plant.	N/A	
Acid sulfate soils			
PO7 Clearing activities do not result in disturbance of acid sulfate soils or changes to the hydrology of the location that will either: (1) aerate horizons containing iron sulfides, or (2) mobilise acid or metals.	**AO7.1** Clearing does not occur in land zone 1, land zone 2 or land zone 3. OR	N/A	
	AO7.2 Clearing in land zone 1, land zone 2 or land zone 3 in areas below the 5 metre Australian Height Datum only occurs where: (1) it does not involve mechanical clearing (2) the acid sulfate soils are managed consistent with the *State Planning Policy*, Department of State Development, Infrastructure and Planning, 2014, and with the Soil Management Guidelines in the *Queensland Acid Sulfate Soil Technical Manual*, Department of Science, Information Technology, Innovation and the Arts, 2014. OR	N/A	

Performance outcomes	Acceptable outcomes	Response	Comment
	(a) **AO7.3** The application is a development application where a local government is the assessment manager.	N/A	

Table 8.1.9: Thinning

Performance outcomes	Acceptable outcomes	Response	Comment
Clearing limited to specific regional ecosystems			
PO1 Clearing for the purpose of thinning does not occur in the regional ecosystems listed in Table 6, except where clearing is solely for removing native plants not naturally occurring within the regional ecosystem.	No acceptable outcome is prescribed.	N/A	The application is for the construction of a channel associated with flood mitigation works. It is not for the purpose of thinning.
Retained vegetation density			
PO2 Clearing must retain a density of vegetation consistent with the natural floristic composition of the regional ecosystem.	**AO2.1** The vegetation density is consistent with a representative reference site of the same regional ecosystem. OR	✓	The construction of the channel will not result in a density reduction of vegetation that is inconsistent with similar ecosystems.
	AO2.2 The vegetation density is consistent with the natural floristic composition of the regional ecosystem as demonstrated by, bio condition benchmarks for regional ecosystem condition assessment, the *Regional Ecosystem Description Database* and supplementary data, or the Queensland Herbarium.		
Wetlands			
PO3 Maintain vegetation associated with any natural wetland to protect: (1) water quality by filtering sediments,	**AO3.1** Mechanical clearing does not occur within 20 metres of a natural wetland.	N/A	Clearing will not occur within 20 metres of a natural wetland.

Performance outcomes	Acceptable outcomes	Response	Comment
nutrients and other pollutants (2) aquatic habitat (3) terrestrial habitat.			
Watercourses and drainage features			
PO4 Maintain vegetation associated with any watercourse or drainage feature to protect: (1) bank stability by protecting against bank erosion (2) water quality by filtering sediments, nutrients and other pollutants (3) aquatic habitat (4) terrestrial habitat.	**AO4.1** Mechanical clearing does not occur within 20 metres from the defining bank of a watercourse or drainage feature.	✓	The application is for the construction of a diversion channel associated with flood mitigation works. Once constructed the channel will be vegetated with native grasses that will assist with bank stability and protect against bank erosion.
Soil erosion			
PO5 Clearing does not result in soil erosion stemming from: (1) mass movement, gully erosion, rill erosion, sheet erosion, tunnel erosion, stream bank erosion, wind erosion, or scalding (2) any associated loss of chemical, physical or biological fertility — including, but not limited to water holding capacity, soil structure, organic matter, soil biology, and	**AO5.1** Mechanical clearing must: (1) retain 50per cent of the ground cover (dead or alive) in each 50 by 50 metre (0.25 hectare) area (2) not occur on slopes in excess of 10 per cent.	✓	The construction of a channel will not result in soil erosion. The channel will be replanted with native grasses that will assit in preventing soil erosion.

Performance outcomes	Acceptable outcomes	Response	Comment
nutrients within or outside the lot(s) that are the subject of the application.			
Conserving remnant vegetation that are regional ecosystems			
PO6 Clearing of vegetation: (1) maintains the natural floristic composition and range of sizes of each species of the regional ecosystem evenly spaced across the application area (2) does not remove habitat trees.	**AO6.1** Thinning must retain mature trees and habitat trees. AND	N/A	The application is for a diversion channel not associated with thinning.
	AO6.2 Thinning must retain immature trees to: (1) return the immature tree density to a more typical level (2) retain representatives of all the species that occur in the regional ecosystem in about the proportion to what would normally exist (3) retain the range of tree sizes that would normally occur (4) space immature trees as evenly as possible across the thinned area. AND	N/A	The application is for a diversion channel not associated with thinning.
	AO6.3 Thinning is not undertaken: (1) by ground application of soil absorbed broad spectrum herbicides, or (2) aerial application of any herbicides.	N/A	
Acid sulfate soils			

Performance outcomes	Acceptable outcomes	Response	Comment
PO7 Clearing activities do not result in disturbance of acid sulfate soils or changes to the hydrology of the location that will either: (1) aerate horizons containing iron sulfides, or (2) mobilise acid or metals.	**AO7.1** Clearing does not occur in land zone 1, land zone 2 or land zone 3. OR		
	AO7.2 Clearing in land zone 1, land zone 2 or land zone 3 in areas below the 5 metre Australian Height Datum only occurs where: (1) it does not involve mechanical clearing (2) the acid sulfate soils are managed consistent with the *State Planning Policy*, Department of State Development, Infrastructure and Planning, 2014, and with the Soil Management Guidelines in the *Queensland Acid Sulfate Soil Technical Manual* a, Department of Science, Information Technology, Innovation and the Arts, 2014. OR		
	AO7.3 The application is a development application where a local government is the assessment manager.		

Table 8.1.10: Encroachment

Performance outcomes	Acceptable outcomes	Response	Comment
Clearing limited to specific regional ecosystems			
PO1 Clearing for the purpose of encroachment only occurs in the regional ecosystems listed in Table 7.	No acceptable outcome is prescribed.	N/A	Clearing is not for the purpose of encroachment.
Mature trees			
PO2 Clearing for the purpose of	**AO2.1** Clearing of encroachment, based on ground	N/A	

Performance outcomes	Acceptable outcomes	Response	Comment
encroachment: (1) results in the restoration of the regional ecosystem (2) does not remove habitat trees.	assessment: (1) retains all mature trees, habitat trees and groves (2) retains representatives of all immature, non-encroaching species (3) may remove non-native species and native species, that do not belong in that regional ecosystem, from the clearing area. OR		
	AO2.2 Clearing of encroachment is limited to: (1) those areas where encroachment was not visible on aerial photographs taken in the year 1950 to present (2) retain habitat trees and mature trees of all non-encroaching species.	N/A	
Wetlands			
PO3 Maintain vegetation associated with a wetland to protect: (1) water quality by filtering sediments, nutrients and other pollutants (2) aquatic habitat (3) terrestrial habitat.	**AO3.1** Mechanical clearing does not occur within 20 metres of the defining bank of a natural wetland. AND	N/A	
	AO3.2 The application of soil absorbed broad spectrum herbicides does not occur within 50 metres of the defining bank of a natural wetland.	N/A	
Watercourses and drainage features			
PO4 Clearing associated with a	**AO4.1** Mechanical clearing does not occur within 20		

Performance outcomes	Acceptable outcomes	Response	Comment
watercourse or drainage feature is protected in a manner that maintains: (1) bank stability by protecting against bank erosion (2) water quality by filtering sediments, nutrients and other pollutants (3) aquatic habitat (4) terrestrial habitat.	metres of the defining bank of a watercourse or drainage feature. AND		
	AO4.2 The application of soil absorbed broad spectrum herbicides does not occur within 50 metres of the defining bank of a watercourse or drainage feature.	N/A	
Soil erosion			
PO5 Clearing does not result in: (1) mass movement, gully erosion, rill erosion, sheet erosion, tunnel erosion, stream bank erosion, wind erosion, or scalding (2) any associated loss of chemical, physical or biological fertility — including, but not limited to water holding capacity, soil structure, organic matter, soil biology and nutrients within or outside the lot(s) that are the subject of the application.	**AO5.1** Mechanical clearing: (1) is limited to slopes less than 5 per cent (2) retains 50 per cent of the ground cover (dead or alive) in each 50 by 50 metre (0.25 hectare) area.	N/A	
Acid sulfate soils			
PO6 Clearing activities do not result in disturbance of acid sulfate soils or	**AO6.1** Clearing does not occur in land zone 1, land zone 2 or land zone 3.	N/A	

Performance outcomes	Acceptable outcomes	Response	Comment
changes to the hydrology of the location that will either: (1) aerate horizons containing iron sulfides, or (2) mobilise acid or metals.	OR		
	AO6.2 Clearing in land zone 1, land zone 2 or land zone 3 in areas below the 5 metre Australian Height Datum only occurs where: (1) it does not involve mechanical clearing (2) the acid sulfate soils are managed consistent with the *State Planning Policy*, Department of State Development, Infrastructure and Planning,2014, and with the Soil Management Guidelines in the *Queensland Acid Sulfate Soil Technical Manual*, Department of Science, Information Technology, Innovation and the Arts, 2014. OR	N/A	
	AO6.3 The application is a development application where a local government is the assessment manager.	N/A	

Table 8.1.11: Fodder

Performance outcomes	Acceptable outcomes	Response	Comment
Limits to fodder harvesting			
PO1 Clearing for fodder harvesting: (1) occurs only in the following areas: (a) Balonne Shire Council (b) Barcaldine Shire Council (c) Barcoo Shire Council	No acceptable outcome is prescribed.	N/A	The application is not for fodder harvesting.

Performance outcomes	Acceptable outcomes	Response	Comment
(d) Blackall Tambo Regional Council (e) Bulloo Shire Council (f) Diamantina Shire Council (g) Goondiwindi Regional Council (h) Longreach Regional Council (i) Maranoa Regional Council (j) Murweh Shire Council (k) Paroo Shire Council (l) Quilpie Shire Council (m) Western Downs Regional Council (n) Winton Shire Council (2) is limited to the extent necessary to provide fodder for stock.			
Conserving vegetation that contains endangered regional ecosystems and of concern regional ecosystems			
PO2 Clearing: (1) does not occur in vegetation that contains endangered regional ecosystems (2) is limited to vegetation that contains of concern regional ecosystems	No acceptable outcome is prescribed.		

Performance outcomes	Acceptable outcomes	Response	Comment
6.5.3, 11.5.13, 6.5.5 and 4.7.3, and by selective harvesting where it does not remove more than 3 in 10 fodder trees.			
Cleared vegetation			
PO3 Cleared vegetation is not moved from where it falls.	No acceptable outcome is prescribed.		
Conserving the fodder resource			
PO4 Fodder harvesting does not reduce the total extent of the fodder in the regional ecosystem listed in Tables 8 and 9 on a lot to below 50 per cent of its current extent within any 10 year period.	**AO4.1** Fodder harvesting is limited to the regional ecosystems and harvesting methods listed in Tables 8 and 9, and: (1) is limited to areas that have not been harvested in the past 10 years (2) retained vegetation is not harvested within 10 years of the harvesting of an adjacent area which has been subject to either strip harvesting or block harvesting.		
Wetlands			
PO5 Maintain vegetation associated with any natural wetland to protect: (1) water quality by filtering sediments; nutrients and other pollutants (2) aquatic habitat (3) terrestrial habitat.	**AO5.1** Mechanical clearing does not occur within 20 metres of any natural wetland. OR		
	AO5.2 Strip harvesting or block harvesting does not occur within 100 metres of any natural wetland.		
Watercourses and drainage features			

Performance outcomes	Acceptable outcomes	Response	Comment
PO6 Maintain vegetation associated with any watercourse or drainage feature to protect: (1) bank stability by protecting against bank erosion (2) water quality by filtering sediments, nutrients and other pollutants (3) aquatic habitat (4) terrestrial habitat.	**AO6.1** Mechanical clearing does not occur within 20 metres from the defining bank of any watercourse or drainage feature. OR		
	AO6.2 Strip harvesting or block harvesting does not occur within 100 metres of the defining bank of any watercourse or drainage feature.		
Soil erosion			
PO7 Clearing does not result in: (1) mass movement, gully erosion, rill erosion, sheet erosion, tunnel erosion, stream bank erosion, wind erosion, or scalding (2) any associated loss of chemical, physical or biological fertility — including, but not limited to water holding capacity, soil structure, organic matter, soil biology and nutrients within or outside the lot(s) that are the subject of the application.	**AO7.1** Strip harvesting or block harvesting: (1) does not occur on a slope that exceeds 5 per cent (2) is aligned across the slope. OR		
	AO7.2 Harvesting occurs using selective harvesting or breaker harvesting methods.		
Salinity			
PO8 Clearing does not contribute to land	**AO8.1** Clearing does not occur in or within 200 metres of		

Performance outcomes	Acceptable outcomes	Response	Comment
degradation through: (1) waterlogging, or (2) the salinisation of groundwater, surface water or soil.	a discharge area or recharge area, or salinity warning area. OR		
	AO8.2 Clearing is less than: (1) 2 hectares, or (2) 10 metres wide.		
Conserving vegetation			
PO9 Fodder harvesting activities: (1) retain at least: (a) 50 per cent of the predominant canopy cover of the vegetation over each 300 by 300 metre (9 hectare) area when selective harvesting or narrow strip harvesting (b) 55 per cent of the predominant canopy cover of the vegetation over each 300 by 300 metre (9 hectare) area when block harvesting or wide strip harvesting (2) maintain the range of species of the regional ecosystem at the locality.	**AO9.1** Selective harvesting does not: (1) harvest more than 5 in 10 individual fodder trees in any given area (2) remove non-fodder species beyond that needed to provide access for harvesting, or (3) involve mechanical clearing within 50 metres of a scarp or an area of instability, in the following regional ecosystems 6.7.1, 6.7.6, 6.7.14, 6.7.15, 6.7.16, 11.7.1, 11.7.2 and 11.7.5. OR		
	AO9.2 Strip harvesting or block harvesting only occurs in regional ecosystems listed in Table 8. AND		
	AO9.3 Block harvesting: (1) is limited to the harvesting area and width of retained		

Performance outcomes	Acceptable outcomes	Response	Comment
	vegetation listed in Table 10 (2) retains non-fodder species with height of 4 metres or more within the harvested area (3) does not occur in fodder regional ecosystems that are less than 10 hectares in area or 500 metres in width (4) tracks between blocks are limited to a width of 10 metres. OR		
	AO9.4 Wide strip harvesting: (1) occurs where the harvested strip is 70-135 metres in width (2) retains a minimum of 165 metres wide strip of retained vegetation on either side of the cleared strip (3) only occurs for a 800 metre length with the retention of a 200 metre wide patch of vegetation at the end of each length (4) does not occur in fodder regional ecosystems that are less than 10 hectares in area or 500 metres in width. OR		
	AO9.5 Narrow strip harvesting: (1) occurs where the harvested strip is 20 to 50 metres in width (2) retains vegetation on either side of the strip a width at		

Performance outcomes	Acceptable outcomes	Response	Comment
	least equal to the width of the harvested strip (3) does not occur in fodder regional ecosystems listed in Tables 8 and 9 that are less than 10 hectares in area or 500 metres in width.		
Essential habitat			
PO10 Maintain the current extent of essential habitat.	**AO10.1** Fodder harvesting does not occur in essential habitat. OR	N/A	
	AO10.2 Clearing in essential habitat does not exceed the width or area prescribed in Table 1. OR	N/A	
	AO10.3 Where it can be demonstrated that the clearing cannot be reasonably avoided, and the extent of clearing has been reasonably minimised, an environmental offset is provided for any significant residual impact from clearing of essential habitat. Editor's note: Applications for development should identify whether there is likely to be a significant residual impact and a need for an environmental offset having regard to Section 3.1 (Regulated vegetation) of the *Significant Residual Impact Guideline* and the relevant *Queensland Environmental Offsets Policy*.	N/A	
Fodder species			
PO11 Fodder harvesting consists predominantly of fodder species.	**AO11.1** Fodder harvesting consists predominantly of fodder species and only occurs in the regional ecosystems listed in Tables 8 or 9.	N/A	

Maranoa Regional Council

Roma Flood Mitigation Study - Stage 2

Ecological Assessment Report

February 2016

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Abbreviations and acronyms

Abbreviation/ acronym	Definition
DEHP	(Queensland) Department of Environment and Heritage Protection
DNRM	(Queensland) Department of Natural Resources and Mines
DotE	(Commonwealth) Department of the Environment
DSDIP	(Queensland) Department of State Development, Infrastructure and Planning
DSITI	(Queensland) Department of Science, Information Technology and Innovation
EO Act	(Queensland) *Environmental Offsets Act 2015*
EP Act	(Queensland) *Environment Protection Act 1994*
EPBC Act	(Commonwealth) *Environment Protection and Biodiversity Conservation Act 1999*
EPP (Water)	(Queensland) *Environmental Protection (Water) Policy 2009*
Fisheries Act	(Queensland) *Fisheries Act 1994*
km	kilometre
LP Act	(Queensland) *Land Protection (Pest and Stock Route Management) Act 2003*
MNES	Matter of National Environmental Significance
MRC	Maranoa Regional Council
MSES	Matter of State Environmental Significance
NC Act	(Queensland) *Nature Conservation Act 1992*
NC Wildlife Regulation	(Queensland) *Nature Conservation (Wildlife) Regulation 2006*
RE	Regional Ecosystem
SP Act	(Queensland) *Sustainable Planning Act 2009*
SP Regulation	(Queensland) *Sustainable Planning Regulation 2009*
TEC	Threatened Ecological Community
VM Act	(Queensland) *Vegetation Management Act 1999*
Water Act	(Queensland) *Water Act 2000*

1. Introduction

1.1 Overview

Following the flood events of 2010, 2011 and 2012, Maranoa Regional Council (MRC) has been assessing and implementing flood mitigation measures for the township of Roma. The mitigation project has been divided into two main stages. Stage 1 has been completed and involved construction of a 5.2 kilometre (km) long levee embankment west of Bungil Creek. Stage 2 is proposed to include a levee adjacent to the western bank of Bungil Creek (termed the 'Western levee') together with a diversion drain to the east of Bungil Creek (termed the 'Eastern diversion').

As part of concept planning for Stage 2, GHD was previously engaged by MRC in 2013 to undertake an initial ecological assessment that included a desktop review and field survey at several targeted locations of potential impact. Subsequently, to provide more specific data to inform detailed design of Stage 2, GHD has been commissioned to undertake a second ecological assessment to ground-truth ecological values within the proposed footprints of the Western Levee and the Eastern Diversion. This report has been prepared to provide the findings of the second ecological assessment.

1.2 Purpose of this report

GHD was engaged by MRC to undertake an ecological assessment of the proposed Stage 2 flood mitigation works for Roma. The area of investigation for this assessment comprised the proposed footprints of the Western levee and the Eastern diversion, referred to as the 'Project footprint.' The specific objectives of the assessment are identified as follows:

- Undertake a desktop review and field survey to identify and describe ecological values within the Project footprint.
- Identify any ecological constraints to the proposed works and provide recommendations for solutions.

Given the time interval between the 2013 assessment and the 2015 assessment, preparation of the current report also provides opportunity to identify implications of changes in environmental legislation that have occurred since preparation of the previous report.

1.3 Limitations

Access to four properties was not granted (Lot 2 on SP110498; Lot 1 on SP110498; Lot 21 on R8614; and Lot 96 on M5398), such that the ecological values on these properties could not be assessed during the field survey.

1.4 Structure of this report

This report provides the following information:

- In Section 1, an overview of the project and key objectives of the assessment
- In Section 2, an overview of the legislation relevant to ecological values
- In Section 3, a description of the methods employed during the assessment
- In Section 4, a description of the existing environment
- In Section 5, identification of ecological constraints and recommendations regarding environmental approvals required for the Project

2. Relevant legislation

2.1 Commonwealth legislation

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the principal environmental legislation administered by the Commonwealth Government. Part 3 of the EPBC Act determines that an action that is likely to have a significant impact on Matters of National Environmental Significance (MNES) cannot be undertaken without prior approval from the Minister who administers the EPBC Act. An action that the Minister decides is likely to have a significant impact on MNES is deemed a 'controlled action' and requires assessment under the provisions of the EPBC Act.

MNES protected by the EPBC Act include:

- World heritage properties (section 12 and 15A)
- National heritage places (sections 15B and 15C)
- Wetlands of international importance (under the Ramsar convention)
- Threatened species and ecological communities (sections 18 and 18A)
- Migratory species (sections 20 and 20A)
- Commonwealth marine areas (sections 23 and 24A)
- The Great Barrier Reef Marine Park (section 24B and 24C)
- Nuclear actions
- A water resource, in relation to coal seam gas development and large coal mining developments

The *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013) identifies criteria to assist in deciding whether or not a proposed action may require a referral under the EPBC Act.

2.2 Queensland legislation

2.2.1 Sustainable Planning Act 2009

The purpose of the *Sustainable Planning Act 2009* (SP Act) is to achieve ecological sustainability by:

- Managing the process by which development takes place, including ensuring that the process is accountable, effective and efficient and delivers sustainable outcomes;
- Managing the effects of development on the environment; and
- Providing for the coordination and integration of planning at the local, regional and state levels.

2.2.2 Vegetation Management Act 1999

The *Vegetation Management Act 1999* (VM Act) provides a framework for the regulation of woody, terrestrial native vegetation located outside of protected areas. The stated purpose of the VM Act is to regulate the clearing of native vegetation in a way that:

- Conserves remnant vegetation that is an endangered, of concern or least concern RE

- Conserves vegetation in declared areas
- Ensures clearing does not cause land degradation
- Prevents biodiversity loss
- Maintains ecological processes
- Manages the environmental effects of the clearing to ensure the above purposes are obtained
- Reduce greenhouse gas emissions

The VM Act provides for the establishment and mapping of Regional Ecosystems (REs) that encompass vegetation community descriptions within a geological and bioregional context, and for the creation and use of clearing codes (among other things). In addition, it provides a process for applying to change RE mapping and for the investigation and prosecution of clearing offences. Details on what clearing activities require assessment against the various regional clearing codes authorised under the VM Act are provided by the *Sustainable Planning Regulation 2009* (SP Regulation).

2.2.3 Nature Conservation Act 1992

The *Nature Conservation Act 1992* (NC Act) provides for the conservation of nature through protection of all native plants and animals in Queensland. Protection is provided under the NC Act through conservation of land as protected areas and wildlife protection outside of protected areas. Actions impacting on protected native flora and fauna are regulated under the NC Act. Permits for disturbance to native flora and fauna can be administered under the NC Act.

The Queensland *Nature Conservation (Wildlife) Regulation 2006* (NC Regulation) is subordinate to the NC Act and lists flora and fauna species considered to be extinct in the wild, endangered, vulnerable, near threatened or special least concern in Queensland.

2.2.4 Land Protection (Pest and Stock Route Management) Act 2002

The *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act) identifies declared pest plant and animal species, and provides for their control. The LP Act imposes a legal responsibility on all landowners to control declared species on their land (subject to certain conditions). Specific management actions are required by landholders depending on the classification of declared pests under the Act, with three separate categories of declared pest prescribed including Class 1, Class 2 and Class 3. Landowners are required to remove Class 1 and Class 2 pests from their property and prevent them spreading to other areas. Class 3 pests cannot be sold or traded but are required to be controlled only if growing adjacent to an environmentally sensitive area (as declared by local councils).

2.2.5 Environmental Protection Act 1994

The *Environmental Protection Act 1994* (EP Act) provides a regulatory framework for the protection and management of the Queensland environment. The objective of the EP Act is to protect Queensland's environment while allowing for development that is ecologically sustainable.

The environmental values of Queensland's waterways are protected under the EP Act and the *Environmental Protection (Water) Policy 2009* (EPP (Water)).

2.2.6 Environmental Protection (Water) Policy 2009

The EPP (Water) is subordinate legislation that supports the EP Act. The EPP (Water) provides environmental values and water quality objectives for all Queensland waters. Environmental

values are defined by the EPP (Water) as the qualities of waterways that need to be protected to ensure that the ecological, social and economic values and uses of the waterway are maintained.

2.2.7 Water Act 2000

The *Water Act 2000* (Water Act) is the primary statutory document that establishes a system for water planning, allocation and use, and includes allocation of water resources for environmental purposes. The purpose of the Water Act is to advance sustainable management and efficient use of water and other resources. The Water Act provides for a number of activities including the measurement and management of water, construction, control and management of works for conservation and protection, irrigation and water supply, drainage, flood control and prevention, improvement of the flow in, or changes to watercourses, protection and improvement of the physical integrity of watercourses, lakes and springs.

2.2.8 Fisheries Act 1994

The *Fisheries Act 1994* (Fisheries Act) provides for the management, use, development and protection of fisheries resources and fish habitats and the management of aquaculture activities. The Act's objective is to provide for the use, conservation and enhancement of the community's fisheries resources and fish habitats through the application of the principles of ecologically sustainable development.

The Fisheries Act provides legislative guidance with regard to the maintenance of fish movement through waterways, including identification of when there is a requirement to obtain approval prior to construction of a waterway barrier.

2.2.9 Environmental Offset Policy 2014

The Environmental Offset Framework was introduced by the Queensland Government in July 2014 and is aimed at streamlining the State environmental offsets assessment process, in addition to aligning the offsets requirements across the levels of Commonwealth, State and Local government. In accordance with the *Environmental Offsets Act 2015* (EO Act), where a project is likely to have significant residual impacts to Matter of State Environmental Significance (MSES), the proponent can be required to supply compensation for those values. These offsets can comprise a financial contribution, establishment of a land based offset, or a combination of both.

Pursuant to Schedule 2 of the *Environmental Offset Regulation 2014* (the Offset Regulation), a MSES that can require offsets can include:

- Regulated vegetation
- Connectivity areas
- Wetlands and watercourses
- Protected wildlife habitat
- Protected areas
- State marine parks
- Fish habitat areas
- Waterway providing fish habitat
- Marine plants
- Legally secured offset areas

The *Queensland Environmental Offsets Policy: Significant Residual Impact Guideline* (MSES Guideline) (DEHP, 2014) identifies criteria to assist in deciding whether or not a proposed action may require a referral under the EO Act.

3. Methods

3.1 Desktop assessment

An initial desktop assessment was undertaken to identify ecological characteristics that are known to occur within the Project footprint. The desktop assessment involved a review of the following databases and mapping layers:

- **Protected Matters Search Tool:** The Commonwealth Department of the Environment (DotE) Protected Matters Search tool was used to identify MNES including listed species and communities that are predicted to occur in or adjacent to the Project footprint, based on bioclimatic modelling, knowledge of species' distributions and habitat preferences. The search area was a 2 km buffer around a point that approximated the centre of the Project footprint (-26.5687, 148.8025).
- **Wildlife Online:** The Department of Science, Information Technology and Innovation (DSITI) Wildlife Online database was searched to retrieve historical records of flora and fauna species previously recorded within the vicinity of the Project footprint. The search area was a 2 km buffer around a point that approximated the centre of the Project footprint (-26.5687, 148.8025).
- **Protected Plants Flora Survey Trigger Map:** The Department of Environment and Heritage Protection (DEHP) Flora Survey Trigger Map was viewed to determine the extent of the High Risk Area within the site.
- **Regulated Vegetation Map**: The Queensland Department of Natural Resources and Mines (DNRM) Regulated Vegetation Management Map was viewed to determine the extent of remnant vegetation within and adjacent to the Project footprint, and the Vegetation Management Supporting Map was viewed to determine the types of mapped REs.
- **Essential Habitat Map**: The DEHP Essential Habitat mapping was viewed to determine if vegetation within the Project footprint has been identified as Essential Habitat for a species of wildlife listed as endangered, vulnerable or special least concern under provisions of the NC Act.
- **State Planning Policy Interactive Mapping System**: The Department of State Development, Infrastructure and Planning (DSDIP) State Planning Policy Interactive Mapping System was viewed to determine matters of state interest under the *Sustainable Planning Act 2009* that are of relevance to the Project footprint.
- **Atlas of Living Australia**: The Atlas of Living Australia is a collaborative project of the Federal Government's National Research Infrastructure for Australia, collating native flora and fauna data from the academic, scientific and environmental community. This was reviewed to obtain additional information for significant species records.

3.2 Field assessment

A field assessment was undertaken by a Senior Ecologist on 3 December 2015 to verify the findings of the desktop assessment and collect additional site-specific information. The field survey involved comprehensively traversing the Project footprint on foot whilst assessing the following ecological attributes.

3.2.1 Vegetation communities

The floristic structure and composition of terrestrial vegetation communities within the Project footprint was described in accordance with the Queensland Herbarium's *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (Neldner *et al.*, 2012). Quaternary level assessments were undertaken and involved recording the following attributes:

- Land zone (geology)
- Land form, slope, aspect and soils
- Dominant flora species composition
- Height and cover of each strata comprising the existing vegetation community
- Presence and abundance of weed species
- Evidence and extent of disturbance

Particular attention was afforded to determining the presence of any threatened ecological communities (TECs) under the EPBC Act, and verification of the status and extent of remnant REs under the VM Act. Where discrepancies were noted between the DNRM mapping and the on-ground extent of remnant vegetation, spatial data for the actual boundary was recorded with a hand-held global positioning system (GPS). Where discrepancies were noted between the DNRM mapping and the on-ground vegetation structure, percent canopy cover was measured along 100 m transects to determine remnant status of vegetation.

3.2.2 Flora species

An inventory of flora species within the Project footprint was recorded during the field survey. Search effort was focussed on detecting the actual or likely presence of flora species that are of conservation significance under the EPBC Act and the NC Act.

3.2.3 Terrestrial fauna habitat

This component involved an assessment of the terrestrial fauna habitat values of vegetation within the Project footprint in terms of describing the structural complexity of habitat together with the type and condition of habitat resources. This included a habitat suitability assessment for species of conservation significance under the EPBC Act and the NC Act.

3.2.4 Aquatic values

An aquatic assessment was undertaken to describe the aquatic ecology values of Bungil Creek. The following information was recorded:

- Substrate type and composition
- Condition of the bed and bank
- Surface water depth
- Type and availability of habitat structure and attributes
- Riparian zone characteristics

- Visual water quality observations
- Existing disturbances

3.3 Likelihood of occurrence assessment

For conservation significant flora and fauna species that were identified by the desktop assessment as potentially occurring in proximity to the Project footprint, a likelihood of occurrence assessment was undertaken to inform the impact identification process. This is a precautionary approach to supplement the opportunistic searches undertaken during the field survey. For each species, this assessment considered information relating to habitat preferences, distribution, and previous records.

The likelihood of occurrence ranking attributed to each species was based on the following framework:

- **Unlikely to occur:** Species has not been recorded in the region (i.e. no records from desktop searches) AND/OR current known distribution does not encompass the Project footprint AND/OR suitable habitat is generally lacking from the Project footprint.
- **May occur:** Species has not been recorded in the region (desktop searches) although species' distribution incorporates Project footprint AND potentially suitable habitat occurs within the Project footprint.
- **Likely to occur:** Species has been recorded in the region (i.e. records detected by desktop searches) AND suitable habitat is present within the Project footprint.
- **Confirmed present:** Species recorded during field surveys within the Project footprint.

4. Existing environment

4.1 Flora species

Results of the desktop assessment are summarised as follows:

- The Protected Matters Search Tool identified that no nationally threatened flora species are predicted to occur within the 2 km search radius (refer Appendix A).
- The Wildlife Online search revealed that no threatened flora species have previously been recorded within the 2 km search radius (refer Appendix B).
- The Protected Plants Flora Survey Trigger Map identified that the Project footprint is not located within a High Risk Area (refer Appendix C). This confirms that no flora species of conservation significance have been recorded in the vicinity.
- No Essential Habitat for any flora species of conservation significance is mapped within, or in proximity to, the Project footprint (refer Appendix D).

The field survey recorded a moderate diversity of flora species within the Project footprint. The highest diversity of flora species was recorded in riparian habitats, with a low diversity recorded where the Project footprint traverses agricultural land. All flora species that were recorded during the field survey have a status of least concern or introduced under the NC Act. No flora species of conservation significance under the EPBC Act or the NC Act were recorded during the field survey or are considered likely to occur.

4.2 Vegetation communities

4.2.1 Threatened ecological communities

The desktop assessment identified that two Threatened Ecological Communities (TECs) listed under the EPBC Act have the potential to occur in proximity to the Project footprint, namely:

- Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions
- Weeping Myall Woodlands

The field survey did not identify the presence of any TECs within the Project footprint. The field survey noted the presence of a community dominated by *Acacia pendula* (weeping myall) within an adjacent property, located approximately 320 m north of the Eastern diversion. Access to this property would be necessary to confirm whether or not this vegetation community meets the criteria necessary to constitute the TEC.

4.2.2 Remnant Regional Ecosystems

The desktop assessment identified that while a large proportion of the Project footprint supports non-remnant vegetation, areas of remnant REs are mapped at three locations along the Western levee and at either end of the Eastern diversion. These areas of remnant REs are also mapped as MSES Regulated Vegetation. A map identifying the spatial extent and identity of REs as mapped by DNRM is provided as Figure 1.

The field survey recorded two RE types within the Project footprint. These are identified in Table 1. The field survey noted that a number of refinements to DNRM's RE map can be made based on the on-ground vegetation characteristics. A map of ground-truthed REs within the Project footprint is provided as Figure 2, and the discrepancies between the DNRM mapping and the ground-truthed mapping are summarised as follows:

- Western levee
  - Riparian vegetation along Bungil Creek is mapped by DNRM as a mixed polygon of remnant RE 11.3.25 and RE 11.3.2. The status of the mixed polygon under the VM Act is of concern sub-dominant. The field survey noted that only RE 11.3.25 is present within the Project footprint, which has a status of least concern under the VM Act.
  - The boundary of DNRM's remnant RE polygon (described above) is more extensive than the on-ground remnant vegetation at several locations. Specifically, areas of parkland vegetation that has been previously cleared are currently mapped as remnant vegetation, but the vegetation community is highly modified and does not support the floristic structure and composition analogous with remnant RE.
- Eastern diversion
  - A mixed polygon of RE 11.3.25 and RE 11.3.2 is mapped by DNRM along the Eastern diversion. Part of this polygon was observed to be non-remnant vegetation as land has been previously cleared for agricultural purposes. Ground-truthing noted that the remainder of the polygon can be split up into two polygons within the Project footprint, specifically, the riparian vegetation was only RE 11.3.25, and a polygon of only RE 11.3.2 was observed on the adjacent floodplain. While historic disturbance of the RE 11.3.2 vegetation was evident, the height of the canopy trees and the percent canopy cover met the requirements to constitute remnant vegetation under the VM Act.

Table 1 Regional Ecosystems within the Project footprint

RE identity	VM Act status	Description*	Location	Representative photograph
11.3.25	Least concern	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	Western levee; Eastern diversion	
11.3.2	Of concern	*Eucalyptus populnea* woodland on alluvial plains	Eastern diversion	

*Source: Regional Ecosystem Description Database (Queensland Herbarium, 2015)

Paper Size A4

0 100 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Highway
- Road
- Watercourse
- Stage 2 Western Levee
- Stage 2 Eastern Diversion
- Cadastre

Regional Ecosystems - DNRM V8

- Category A or B area containing of concern regional ecosystems
- Category A or B area that is a least concern regional ecosystems
- Non Remnant

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Job Number	41-29431
Revision	0
Date	09 Feb 2016

DNRM Regional Ecosystem Map Figure 1

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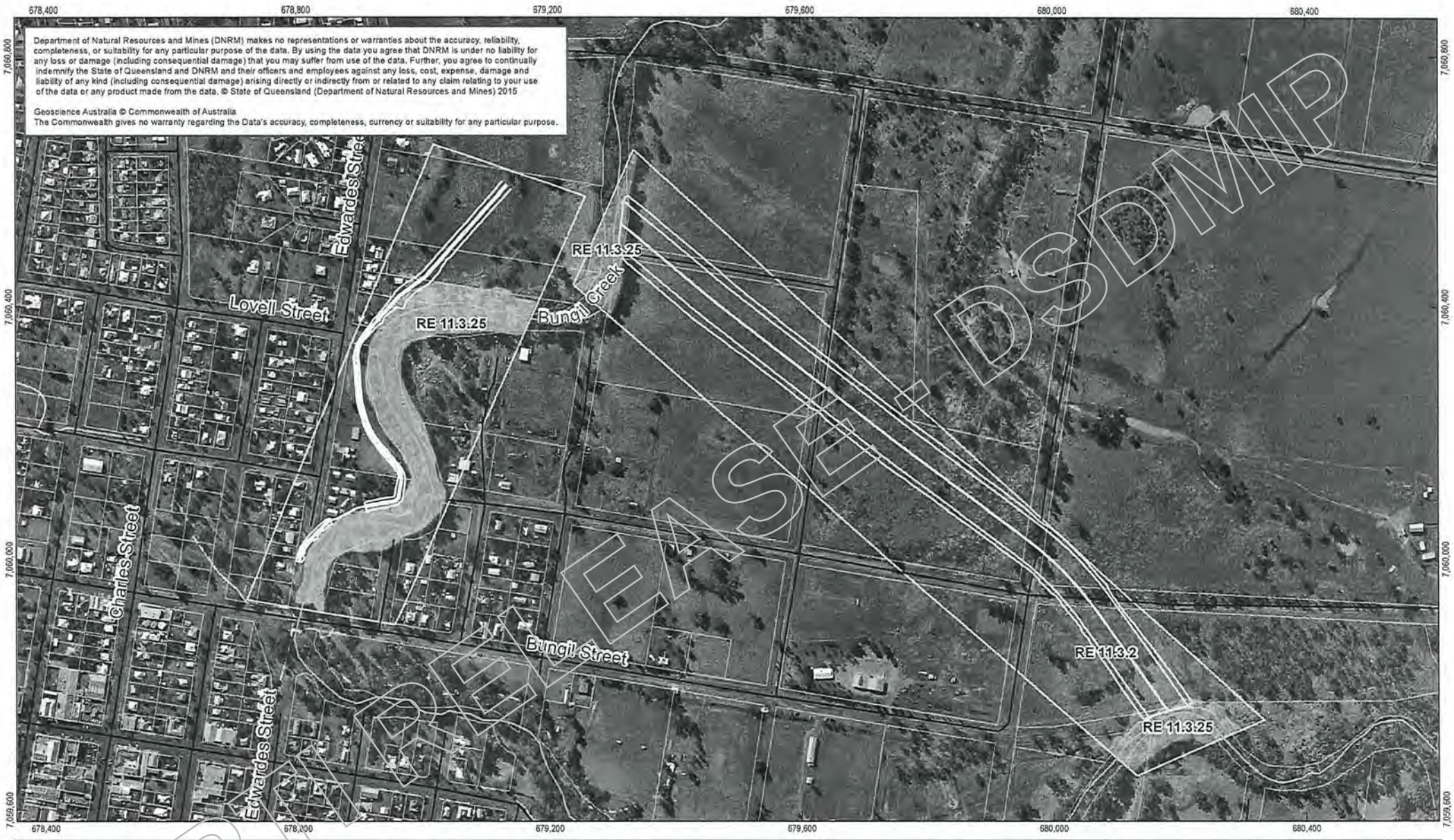
145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: © Commonwealth of Australia (Geoscience Australia): Watercourses/2007; DNRM: Locality, Roads/2010, Cadastre, River/2012,Regional Ecosystems/2015; DTMR: Aerial/2011;



Paper Size A4

0 100 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Highway
- Road
- Watercourse
- Stage 2 Western Levee
- Stage 2 Eastern Diversion
- Property Boundary
- Area subject to ground truthing

Regional Ecosystems - Ground Truthed

- Category A or B area containing of concern regional ecosystems
- Category A or B area that is a least concern regional ecosystems

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Date 09 Feb 2016

Ground-truthed Regional Ecosystem Map

Figure 2

\\ghdnet\ghd\AU\Brisbane\Projects\41\29431\GIS\Maps\Deliverables\Ecology\4129431_002_rev_a.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: © Commonwealth of Australia (Geoscience Australia): Watercourses/2007; DNRM: Locality, Roads/2010, Cadastre, River/2012; GHD: Regional Ecosystems/2015; DTMR: Aerial/2011;

4.3 Terrestrial fauna

Results of the desktop assessment are summarised as follows:

- The Protected Matters Search Tool identified that 11 nationally threatened terrestrial fauna species are predicted to occur within the 2 km search radius (refer Appendix A).
- The Wildlife Online search revealed that three terrestrial fauna species of conservation significance have previously been recorded within the 2 km search radius (refer Appendix B), namely:
  - Koala (*Phascolarctos cinereus*) that is vulnerable under the EPBC Act and NC Act
  - Yakka skink (*Egernia rugosa*) that is vulnerable under the EPBC Act and NC Act
  - Grey snake (*Hemiaspis damelii*) that is endangered under the NC Act
- The MSES mapping identifies remnant riparian vegetation within the Project footprint is MSES Protected Wildlife Habitat.
- Essential Habitat for yakka skink is mapped along Bungil Creek 280 m upstream from the Project footprint, with the yakka skink record located 1.4 km from the upstream extent of the Project footprint (refer Appendix D).

The field survey noted that terrestrial fauna habitat values are generally restricted to areas of remnant vegetation within the Project footprint. In particular, the riparian vegetation provides a structurally complex habitat, with a diversity of feeding, nesting, sheltering and breeding resources at the canopy, shrub and ground levels. Notable observations included the following:

- The riparian vegetation is composed of mature eucalypt trees that provide potentially suitable habitat for koala. Bark exfoliations potentially consistent with koala use were observed during the field survey. It is likely that the riparian vegetation would function as a habitat corridor that koalas would occasionally transition through, rather than frequent or permanent habitat use.
- Large woody debris and hollow-tree stumps were observed within the riparian vegetation. These features provide potentially suitable habitat for the reptile species of conservation significance that are known to occur in the vicinity (i.e. yakka skink, grey snake).

The likelihood of occurrence assessment for conservation significant fauna that were predicted by the desktop assessment to potentially occur within the Project footprint is provided in Table 2. No additional threatened species are considered likely to occur within the Project footprint. Three migratory species are considered likely to occur based on the availability of potentially suitable habitat together with records of the species:

- Great egret (*Ardea alba*) that is migratory under the EPBC Act and special least concern under the NC Act
- Cattle egret (*Ardea ibis*) that is migratory under the EPBC Act and special least concern under the NC Act
- Rainbow bee-eater (*Merops ornatus*) that is migratory under the EPBC Act and special least concern under the NC Act

Table 2 Likelihood of occurrence for terrestrial threatened and migratory species

Scientific name	Common name	EPBC Act status	NC Act status	Distribution and preferred habitat*	Likelihood of occurrence
Birds					
Erythrotriorchis radiatus	Red goshawk	Vulnerable	Endangered	This species has a very sparse and discontinuous distribution over a wide area, from the Kimberleys, Western Australia, across northern Australia, and down the east coast of Queensland to northern New South Wales. It occupy a range of habitats, often at ecotones, including coastal and sub-coastal tall open forest, tropical savannahs crossed by wooded or forested watercourses, woodlands, the edges of rainforest and gallery forests along watercourses, and wetlands that include melaleuca and casuarina species.	*May occur.* Potentially suitable habitat is present but no previous records exist within the desktop search extent.
Geophaps scripta scripta	Squatter pigeon (southern)	Vulnerable	Vulnerable	The squatter pigeon (southern) occurs on the inland slopes of the Great Dividing Range; with a distribution that extends from the Burdekin-Lynd divide in central Queensland, west to Charleville and Longreach, east to the coast from Proserpine to Port Curtis, and south to scattered sites in south-eastern Queensland. It inhabits open grassy woodland on sandy soils interspersed with low gravely ridges, in proximity to water.	*May occur.* Potentially suitable habitat is present but no previous records exist within the desktop search extent.
Grantiella picta	Painted honeyeater	Vulnerable	Vulnerable	The species is sparsely distributed from south-eastern Australia to north-western Queensland and eastern Northern Territory. The painted honeyeater inhabits mistletoes in habitats that eucalypt forests/woodlands and riparian woodlands of black box and river red gum.	*May occur.* Potentially suitable habitat is present but no previous records exist within the desktop search extent.
Rostratula australis	Australian Painted Snipe	Endangered; migratory	Vulnerable	The Australian painted snipe has been recorded at scattered wetland locations throughout much of Queensland. It has been recorded from habitats including shallow inland wetlands, including temporary and permanent lakes, swamps and claypans.	*May occur.* Potentially suitable habitat is present but no previous records exist within the desktop search extent.
Mammals					
Chalinolobus dwyeri	Large-eared pied bat	Vulnerable	Vulnerable	The species' distribution is poorly known. Records exist from Shoalwater Bay in Queensland, through to Ulladulla in New South Wales. It roosts in caves, crevices in cliffs and mines, generally in dry sclerophyll forests and woodlands as well as higher altitude moist rainforest and eucalypt forest.	*Unlikely to occur.* No suitable habitat is present and no previous records exist within the desktop search extent.

Scientific name	Common name	EPBC Act status	NC Act status	Distribution and preferred habitat*	Likelihood of occurrence
Dasyurus hallucatus	Northern quoll	Endangered	Endangered	In Queensland, the species is known to occur from south of Rockhampton, to Weipa in the north, and extends west to the vicinity of Carnarvon Range National Park. The northern quoll does not have highly specific habitat requirements, however, rocky areas associated with open woodland and open forest are considered optimal habitat for the northern quoll.	*Unlikely to occur.* No suitable habitat is present and no previous records exist within the desktop search extent.
Nyctophilus corbeni	South-eastern long-eared bat	Vulnerable	Vulnerable	The greater long-eared bat is typically known from south-east Australia, especially the Murray-Darling Basin. It generally inhabits woodland vegetation, including box and ironbark woodlands in arid and semi-arid inland areas.	*May occur.* Potentially suitable habitat is present but no previous records exist within the desktop search extent.
Phascolarctos cinereus	Koala	Vulnerable	Vulnerable	In Queensland, the species contains scattered populations throughout eucalypt woodlands along watercourses within semi-arid areas further west. The greatest density of koalas occurs in south-east Queensland, with lower densities occurring through central and eastern areas including the Brigalow Belt.	***Likely to occur.*** Potentially suitable habitat is present and previous records exist within the desktop search extent.
Reptiles					
Delma torquate	Collared delma	Vulnerable	Vulnerable	The collared delma is known to occur in central and south-east Queensland. It normally inhabits eucalypt-dominated woodlands and open-forests, with rocks, logs, bark and other coarse woody debris, and mats of leaf litter.	*May occur.* Potentially suitable habitat is present but no previous records exist within the desktop search extent.
Egernia rugosa	Yakka skink	Vulnerable	Vulnerable	The known distribution of the Yakka skink extends from the coast to the hinterland of sub-humid to semi-arid eastern Queensland. The yakka skink is endemic to dry open forests, woodlands and rocky areas of central and eastern Queensland. Yakka skinks live in communal burrow complexes, and often take refuge among low vegetation or under heaped dead timber, logs, rocks and in deep rock crevices.	***Likely to occur.*** Potentially suitable habitat is present and previous records exist within the desktop search extent.
Furina dunmalli	Dunmall's snake	Vulnerable	Vulnerable	Dunmall's snake occurs primarily in the Brigalow Belt region in the south-eastern interior of Queensland. This species is typically found in areas of Brigalow, riverside woodland and open forest on natural levees. Habitats featuring cracking clay and sandy substrates are known to be utilised by the species.	*May occur.* Potentially suitable habitat is present but no previous records exist within the desktop search extent.
Migratory species					
Apus pacificus	Fork-tailed swift	Migratory	Special least concern	Habitat preferences include open country from semi-deserts to coasts. Common and widespread across Australia (Pizzey and Knight, 2007).	*May occur.* Potentially suitable habitat is present but no previous records exist within the desktop search extent.

Scientific name	Common name	EPBC Act status	NC Act status	Distribution and preferred habitat*	Likelihood of occurrence
Ardea alba	Great egret	Migratory	Special least concern	Inhabits shallows of rivers, estuaries, tidal mudflats, freshwater wetlands, sewage ponds, irrigation areas and larger dams. This species is widespread throughout Australia (Pizzey and Knight, 2007).	***Likely to occur.*** Potentially suitable habitat is present and previous records exist within the desktop search extent.
Ardea ibis	Cattle egret	Migratory	Special least concern	Occurs in stock paddocks, croplands, wetlands, tidal mudflats and drains. Widespread distribution in northern and eastern Australia, summer-Autumn migrant to Queensland (Pizzey and Knight, 2007).	***Likely to occur.*** Potentially suitable habitat is present and previous records exist within the desktop search extent.
Cuculus optatus	Oriental cuckoo	Migratory	Special least concern	This species occurs in northern and eastern Australia. It primarily inhabits mixed forests.	*May occur.* Potentially suitable habitat is present but no previous records exist within the desktop search extent.
Gallinago hardwickii	Latham's snipe	Migratory	Special least concern	Lathams's snipe occurs in wetlands in either permanent or ephemeral fresh or saline waters. The types of habitats range from wetlands with low, dense vegetation, grasslands or heaths, bogs, and artificial habitats close to human activity.	*May occur.* Potentially suitable habitat is present but no previous records exist within the desktop search extent.
Merops ornatus	Rainbow bee-eater	Migratory	Special least concern	The rainbow bee-eater is found in riparian areas containing eucalyptus forests and woodlands, mangroves and coastal forests, dry woodlands and open forests near wetlands and watercourses.	***Likely to occur.*** Potentially suitable habitat is present and previous records exist within the desktop search extent.
Motacilla flava	Yellow wagtail	Migratory	Special least concern	This species occurs in a variety of damp or wet habitats with low vegetation.	*May occur.* Potentially suitable habitat is present but no previous records exist within the desktop search extent.
Myiagra cyanoleuca	Satin flycatcher	Migratory	Special least concern	Satin flycatchers inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests.	*Unlikely to occur.* No suitable habitat is present and no previous records exist within the desktop search extent.
Rhipidura rufifrons	Rufous fantail	Migratory	Special least concern	In east and south-east Australia, the rufous fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts with a dense shrubby understorey often including ferns. When on passage, they are sometimes recorded in drier sclerophyll forests and woodlands often with a shrubby or heath understorey.	*Unlikely to occur.* No suitable habitat is present and no previous records exist within the desktop search extent.

* Note: The distribution and habitat requirements have been sourced from DotE's Species Profile and Threats (SPRAT) database on 17 December 2015 via http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

4.4 Aquatic values

Results of the desktop assessment are summarised as follows:

- The Protected Matters Search Tool identified that one nationally threatened fish species is predicted to occur within the 2 km search radius (refer Appendix A), namely Murray cod (*Maccullochella peelii*).
- The Wildlife Online search revealed that no fish species of conservation significance have previously been recorded within the 2 km search radius (refer Appendix B).
- The MSES mapping identifies that no declared fish habitat, no high ecological value waters, and no high ecological value significance wetlands are mapped within the Study

The field survey noted that Bungil Creek is a highly disturbed ephemeral watercourse with an extensively cleared catchment and a narrow riparian vegetation zone and cattle grazing. Within the Project footprint, the creek has a primarily sandy substrate with some cobbles present. There was tall, mature riparian vegetation present; however, the width of the riparian vegetation was less than 20 m. Abundant large snags, woody debris, trailing vegetation, undercut banks and pools of water were observed and these characteristics provide a variety of habitat for aquatic fauna including fish when water is present.

The field survey noted that there is potential for Murray cod to be present within Bungil Creek during times of moderate to high flow. Generally, this species is found in waters up to 5 m deep and in areas with complex structural cover including rocks, snags, woody debris or overhanging banks. The Murray cod is most frequently found in main river channels and larger tributaries. It can also be found in floodplain channels when they contain water; although this usage appears limited.

5. Ecological constraints and recommendations

5.1 Overview

Ecological values that were identified within the Project footprint may be subject to two predominant impacts from the Project, namely:

- Direct removal as a result of levee construction or other earthworks
- Changes to the hydrological regime

Key ecological constraints that were identified by the assessment are identified in the sections below, together with corresponding recommendations for the Project, as relevant. A summary of ecological approval requirements for the Project is provided in Table 3.

5.2 Flora species

No constraints with regards to flora species have been identified by this assessment.

5.3 Threatened ecological communities

An area of Weeping Myall Woodland may be present adjacent to the Project footprint[1]. Based on the current alignment, no direct impact to this community will occur (i.e. no vegetation clearing is proposed in proximity to the community). However, potential indirect impacts to this community may be experienced through changes to inundation depth, duration and/or frequency as a result of construction of the diversion drain. In this regards, the Commonwealth government's listing advice for this community states that:

> *"The Weeping Myall Woodlands generally occur on flat areas, shallow depressions or gilgais on raised (relict) alluvial plains. These areas are not associated with active drainage channels and are rarely if ever flooded (White et al. 2002; Keith 2004)."*

As such, any proposal to modify the current flooding regime of this community in terms of depth, duration and/or frequency of inundation has the potentially to impact this MNES. In order to confirm whether this vegetation meets the criteria necessary to constitute the TEC, permission to access the relevant property would need to be obtained and a survey can be undertaken to quantify the cover and composition of the community. Given the proximity of the vegetation to the alignment and the potential for indirect impact as a result of changes to inundation patterns, it is recommended that the need for an EPBC Referral be assessed following finalisation of the footprint and flood modelling.

5.4 Remnant Regional Ecosystems

Remnant REs are present within the alignment for the Western levee and the Eastern diversion. It is unlikely that the proposal will completely avoid impacts to REs given the extent of remnant vegetation along the entire length of the creek. The footprint within areas of remnant RE identified by Figure 2 should be minimised during Project design and construction.

The remnant REs within and adjacent to the Project footprint are riparian communities that are characteristically tolerant of occasional flooding, and as such it is not anticipated that the Project will lead to deterioration or reduced extent of remnant REs beyond the clearing zone.

[1] Note that access to the relevant property was not possible during the field survey such that it cannot currently be confirmed whether the vegetation meets the criteria to constitute the TEC.

The clearing extent should be clearly demarcated during vegetation removal so as to avoid any accidental clearing. Any ancillary works such as laydown areas should be located within areas that have already been cleared.

5.5 Terrestrial fauna

Terrestrial fauna habitat that may support threatened species (koala, yakka skink, grey snake) is present within the alignment for the Western levee and the Eastern diversion. Given the extent of habitat along the entire length of the creek, it is unlikely that clearing of suitable fauna habitat will be avoided. Similarly to above, the footprint within areas of remnant RE identified by Figure 2 should be minimised during Project design and construction.

With regards to yakka skink, the Commonwealth government's *Draft referral guidelines for the national listed Brigalow Belt reptiles* states that important habitat for this species is defined as:

> *"Any contiguous patch of suitable habitat, particularly remnant vegetation, where a colony is known or identified."*

Given the relatively recent yakka skink record in close proximity to the Project footprint within remnant vegetation that is contiguous with remnant vegetation in the Project footprint, this is likely to constitute important habitat for yakka skink.

With regards to the koala, the Project footprint meets the criteria of Commonwealth government's koala habitat assessment tool to constitute habitat critical to survival of the koala.

An assessment of the potential for significant impacts to MNES is recommended to be undertaken once the proposed clearing extent is known. This will identify whether submission of an EPBC Referral is required. .

Preparation of a Significant Species Management Program is recommended to comply with the provisions of the NC Regulations and is to be approved by DEHP prior to the commencement of works.

5.6 Aquatic values

One threatened fish species has the potential to occur within Bungil Creek, namely Murray cod. Works are currently not proposed within the watercourse, such that impacts to this species are unlikely. It is recommended that any works within the defined banks of the watercourse are avoided.

Should any change in design propose construction across Bungil Creek or propose works that will alter the watercourse, an application for a waterway barrier permit under the Fisheries Act may be necessary (unless the applicable self-assessable code can be complied with).

As the Project will alter overland flow, approval under the Water Act will be necessary. Schedule 15B of the *Water Regulation 2002* provides for the construction of levees. The proposed works constitute a Category 3 levee and consequently the State Development Assessment Provisions Module 7 will apply.

Table 3 Summary of ecological constraints and approvals

Legislation	Constraint	Recommendations	Approval required
Commonwealth			
EPBC Act	• Potential presence of Weeping Myall Woodland TEC adjacent to the Project footprint	• Seek approval to access the relevant property to confirm the on-ground characteristics of the vegetation. Alternatively, assume that the vegetation does meet the TEC criteria and undertake an assessment against the EPBC Act Significant Impact Guidelines following finalisation of the footprint and flood modelling.	Modification of the current flooding regime of this community in terms of depth, duration and/or frequency of inundation has the potentially to impact this TEC. Following finalisation of the footprint and flood modelling, an assessment should be made to determine whether preparation of an EPBC Referral is necessary.
	• Potential presence of significant species within the Project footprint (koala; yakka skink).	• Minimise the clearing footprint within areas of remnant REs, as possible.	Given the presence of a relatively recent yakka skink record in close proximity to the proposed works, together with the presence of potentially suitable habitat for yakka skink within the Project footprint, it is recommended that the need for an EPBC referral is considered. The Project may also result in the reduction of habitat critical to the survival of koala, and this should also be considered in terms of whether an EPBC referral is required.
Queensland			
VM Act	• Mapped RE is intersected by the Project footprint.	• Minimise the clearing footprint within areas of remnant REs, as possible.	Although the proposed works are classified by the SP Regulation as 'community infrastructure' (water cycle management), the clearing exemption for community infrastructure will not apply unless carried out on designated land. The approval options for the Project are: • Seek formal community infrastructure designation over the affected land;

Legislation	Constraint	Recommendations	Approval required
			OR • Apply for operational woks approval to undertake clearing. Further, as on-ground observations noted discrepancies with the certified RE mapping, MRC may either accept the current mapping or prepare a Property Map of Assessable Vegetation (PMAV) application to refine the type and extent of REs.
NC Act (flora)	Nil. No flora species of conservation significance are known or expected to occur within the Project footprint.	N/A	As the Project footprint is not located within a High Risk Trigger Area (refer Appendix C), there is currently no requirement to undertake a Protected Plants Assessment in accordance requirements identified by the *Nature Conservation (Wildlife Management) Regulation 2006*. As all flora species to be removed are least concern, there is no requirement for a Protected Plants (Clearing Permit).
NC Act (fauna)	• Potential animal breeding places are present within the Project footprint. • Potential presence of significant species (koala; yakka skink).	• Minimise the clearing footprint within areas of remnant REs, as possible. • Engage a licensed fauna-spotter catcher when undertaking clearing.	A Significant Species Management Program is to be prepared and submitted to DEHP for approval to comply with the requirements of the provisions of the NC Regulations.
Water Act	• Interfering with overland flow	• Minimise the clearing footprint within the riparian zone, as possible. • Prepare and implement an erosion and sediment control plan.	Schedule 15B of the *Water Regulation 2002* provides for the construction of levees. The proposed works constitute a Category 3 levee and consequently the State Development Assessment Provisions Module 7 will apply.

Legislation	Constraint	Recommendations	Approval required
Fisheries Act	• Watercourse	• No works are to be undertaken within the watercourse.	Works are currently not proposed within the watercourse. Should any change in design propose construction across Bungil Creek or propose works that will alter the watercourse, an application for a waterway barrier permit under the Fisheries Act may be necessary (unless the works can be completed under the relevant self-assessable code).
EO Act	• MSES Regulated Vegetation	• Minimise the clearing footprint within areas of mapped MSES Regulated Vegetation, as possible.	Provision of an offset under the EO Act may be necessary if significant residual impacts to an MSES are predicted to occur. If clearing of the of concern REs can be limited to a width of 20 m and an area of 3 ha, the MSES *Significant Impact Guidelines* state that a significant residual impact is unlikely to occur, in which case the project will not require an environmental offset for impacts to MSES Regulated Vegetation.

6. References

Keith, D. (2004) Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT. NSW Department of Environment and Conservation, Sydney.

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The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

Appendices

Appendix A – Protected Matters Search Tool results

Australian Government
Department of the Environment

EPBC Act Protected Matters Report

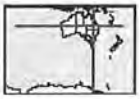
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 20/11/15 14:10:34

Coordinates
Buffer: 2.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	4
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	12
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	11
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	22
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Banrock station wetland complex	1100 - 1200km
Narran lake nature reserve	300 - 400km upstream
Riverland	1100 - 1200km
The coorong, and lakes alexandrina and albert wetland	1300 - 1400km

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	Community may occur within area
Weeping Myall Woodlands	Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat may occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat may occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Fish		
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
Dasyurus hallucatus Northern Quoll [331]	Endangered	Species or species habitat may occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Delma torquata		
Collared Delma [1656]	Vulnerable	Species or species habitat may occur within area
Egernia rugosa		
Yakka Skink [1420]	Vulnerable	Species or species habitat known to occur within area
Furina dunmalli		
Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus		
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat may occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Defence - ROMA TRAINING DEPOT

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Cuculus saturatus Oriental Cuckoo, Himalayan Cuckoo [710]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area

Extra Information

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Acacia nilotica subsp. indica Prickly Acacia [6196]		Species or species habitat may occur within area
Asparagus africanus Climbing Asparagus, Climbing Asparagus Fern [66907]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Parthenium hysterophorus Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]		Species or species habitat likely to occur within area
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-26.5687 148.8025

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Parks and Wildlife Commission NT, Northern Territory Government
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix B – Wildlife Online results

Queensland Government

Wildlife Online Extract

Search Criteria: Species List for a Specified Point
Species: All
Type: All
Status: All
Records: All
Date: All
Latitude: -26.5687
Longitude: 148.8025
Distance: 2
Email: megan.ward@ghd.com
Date submitted: Friday 20 Nov 2015 13:11:46
Date extracted: Friday 20 Nov 2015 13:20:03

The number of records retrieved = 205

Disclaimer

As the DSITIA is still in a process of collating and vetting data, it is possible the information given is not complete. The information provided should only be used for the project for which it was requested and it should be appropriately acknowledged as being derived from Wildlife Online when it is used.

The State of Queensland does not invite reliance upon, nor accept responsibility for this information. Persons should satisfy themselves through independent means as to the accuracy and completeness of this information.

No statements, representations or warranties are made about the accuracy or completeness of this information. The State of Queensland disclaims all responsibility for this information and all liability (including without limitation, liability in negligence) for all expenses, losses, damages and costs you may incur as a result of the information being inaccurate or incomplete in any way for any reason.

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	amphibians	Bufonidae	*Rhinella marina*	cane toad	Y			6
animals	amphibians	Hylidae	*Litoria peronii*	emerald spotted treefrog		C		1/1
animals	amphibians	Hylidae	*Litoria rubella*	ruddy treefrog		C		1/1
animals	amphibians	Hylidae	*Cyclorana cultripes*	grassland collared frog		C		1
animals	amphibians	Hylidae	*Cyclorana verrucosa*	rough collared frog		C		1
animals	amphibians	Hylidae	*Litoria fallax*	eastern sedgefrog		C		4
animals	amphibians	Hylidae	*Litoria caerulea*	common green treefrog		C		25/25
animals	amphibians	Myobatrachidae	*Crinia parinsignifera*	beeping froglet		C		1
animals	birds	Acanthizidae	*Gerygone fusca*	western gerygone		C		7
animals	birds	Acanthizidae	*Gerygone olivacea*	white-throated gerygone		C		15
animals	birds	Acanthizidae	*Smicrornis brevirostris*	weebill		C		17
animals	birds	Acanthizidae	*Acanthiza uropygialis*	chestnut-rumped thornbill		C		3
animals	birds	Acanthizidae	*Acanthiza chrysorrhoa*	yellow-rumped thornbill		C		13
animals	birds	Accipitridae	*Elanus axillaris*	black-shouldered kite		C		2
animals	birds	Accipitridae	*Accipiter fasciatus*	brown goshawk		C		1
animals	birds	Accipitridae	*Hieraaetus morphnoides*	little eagle		C		1
animals	birds	Accipitridae	*Accipiter cirrocephalus*	collared sparrowhawk		C		1
animals	birds	Accipitridae	*Aquila audax*	wedge-tailed eagle		C		1
animals	birds	Accipitridae	*Milvus migrans*	black kite		C		7
animals	birds	Acrocephalidae	*Acrocephalus australis*	Australian reed-warbler		SL		2
animals	birds	Aegothelidae	*Aegotheles cristatus*	Australian owlet-nightjar		C		1
animals	birds	Anatidae	*Biziura lobata*	musk duck		C		1
animals	birds	Anatidae	*Anas gracilis*	grey teal		C		3
animals	birds	Anatidae	*Anas sp.*					1
animals	birds	Anatidae	*Cygnus atratus*	black swan		C		1
animals	birds	Anatidae	*Aythya australis*	hardhead		C		1
animals	birds	Anatidae	*Anas superciliosa*	Pacific black duck		C		21
animals	birds	Anatidae	*Chenonetta jubata*	Australian wood duck		C		13
animals	birds	Anatidae	*Anas platyrhynchos*	northern mallard	Y			9
animals	birds	Anatidae	*Dendrocygna eytoni*	plumed whistling-duck		C		1
animals	birds	Anhingidae	*Anhinga novaehollandiae*	Australasian darter		C		3
animals	birds	Apodidae	*Hirundapus caudacutus*	white-throated needletail		SL		1
animals	birds	Ardeidae	*Nycticorax caledonicus*	nankeen night-heron		C		2
animals	birds	Ardeidae	*Ardea alba modesta*	eastern great egret		SL		2
animals	birds	Ardeidae	*Ardea intermedia*	intermediate egret		C		2
animals	birds	Ardeidae	*Ardea pacifica*	white-necked heron		C		5
animals	birds	Ardeidae	*Egretta novaehollandiae*	white-faced heron		C		9
animals	birds	Ardeidae	*Ardea ibis*	cattle egret		SL		1
animals	birds	Artamidae	*Cracticus nigrogularis*	pied butcherbird		C		19
animals	birds	Artamidae	*Artamus leucorynchus*	white-breasted woodswallow		C		7
animals	birds	Artamidae	*Cracticus torquatus*	grey butcherbird		C		12
animals	birds	Artamidae	*Strepera graculina*	pied currawong		C		9
animals	birds	Artamidae	*Cracticus tibicen*	Australian magpie		C		29
animals	birds	Cacatuidae	*Nymphicus hollandicus*	cockatiel		C		11
animals	birds	Cacatuidae	*Cacatua galerita*	sulphur-crested cockatoo		C		10
animals	birds	Cacatuidae	*Eolophus roseicapillus*	galah		C		35

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike		C		17
animals	birds	Campephagidae	*Lalage tricolor*	white-winged triller		C		8
animals	birds	Charadriidae	*Vanellus miles miles*	masked lapwing (northern subspecies)		C		7
animals	birds	Charadriidae	*Vanellus tricolor*	banded lapwing		C		1
animals	birds	Charadriidae	*Vanellus miles*	masked lapwing		C		6
animals	birds	Climacteridae	*Climacteris picumnus*	brown treecreeper		C		1
animals	birds	Columbidae	*Ocyphaps lophotes*	crested pigeon		C		33
animals	birds	Columbidae	*Geopelia striata*	peaceful dove		C		3
animals	birds	Columbidae	*Columba livia*	rock dove	Y			9
animals	birds	Coraciidae	*Eurystomus orientalis*	dollarbird		C		5
animals	birds	Corcoracidae	*Corcorax melanorhamphos*	white-winged chough		C		4
animals	birds	Corcoracidae	*Struthidea cinerea*	apostlebird		C		23
animals	birds	Corvidae	*Corvus sp.*					1
animals	birds	Corvidae	*Corvus orru*	Torresian crow		C		33
animals	birds	Corvidae	*Corvus bennetti*	little crow		C		2
animals	birds	Corvidae	*Corvus coronoides*	Australian raven		C		7
animals	birds	Cuculidae	*Scythrops novaehollandiae*	channel-billed cuckoo		C		2
animals	birds	Cuculidae	*Cacomantis pallidus*	pallid cuckoo		C		1
animals	birds	Cuculidae	*Centropus phasianinus*	pheasant coucal		C		1
animals	birds	Cuculidae	*Eudynamys orientalis*	eastern koel		C		2
animals	birds	Estrildidae	*Taeniopygia bichenovii*	double-barred finch		C		1
animals	birds	Estrildidae	*Taeniopygia guttata*	zebra finch		C		2
animals	birds	Falconidae	*Falco peregrinus*	peregrine falcon		C		1
animals	birds	Falconidae	*Falco longipennis*	Australian hobby		C		4
animals	birds	Falconidae	*Falco cenchroides*	nankeen kestrel		C		8
animals	birds	Halcyonidae	*Dacelo novaeguineae*	laughing kookaburra		C		15
animals	birds	Halcyonidae	*Todiramphus sanctus*	sacred kingfisher		C		5
animals	birds	Hirundinidae	*Petrochelidon ariel*	fairy martin		C		2
animals	birds	Hirundinidae	*Hirundo neoxena*	welcome swallow		C		13
animals	birds	Hirundinidae	*Petrochelidon nigricans*	tree martin		C		4
animals	birds	Maluridae	*Malurus leucopterus*	white-winged fairy-wren		C		3
animals	birds	Maluridae	*Malurus lamberti*	variegated fairy-wren		C		3
animals	birds	Maluridae	*Malurus cyaneus*	superb fairy-wren		C		8/1
animals	birds	Megaluridae	*Megalurus gramineus*	little grassbird		C		1
animals	birds	Megaluridae	*Cincloramphus mathewsi*	rufous songlark		C		2
animals	birds	Meliphagidae	*Manorina melanocephala*	noisy miner		C		25
animals	birds	Meliphagidae	*Philemon citreogularis*	little friarbird		C		15
animals	birds	Meliphagidae	*Acanthagenys rufogularis*	spiny-cheeked honeyeater		C		4
animals	birds	Meliphagidae	*Plectorhyncha lanceolata*	striped honeyeater		C		12
animals	birds	Meliphagidae	*Ptilotula penicillata*	white-plumed honeyeater		C		8
animals	birds	Meliphagidae	*Philemon corniculatus*	noisy friarbird		C		3
animals	birds	Meliphagidae	*Lichmera indistincta*	brown honeyeater		C		11
animals	birds	Meliphagidae	*Gavicalis virescens*	singing honeyeater		C		1
animals	birds	Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater		C		23
animals	birds	Meliphagidae	*Manorina flavigula*	yellow-throated miner		C		21
animals	birds	Meropidae	*Merops ornatus*	rainbow bee-eater		SL		3

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Monarchidae	*Grallina cyanoleuca*	magpie-lark		C		43
animals	birds	Monarchidae	*Myiagra inquieta*	restless flycatcher		C		1
animals	birds	Motacillidae	*Anthus novaeseelandiae*	Australasian pipit		C		4
animals	birds	Nectariniidae	*Dicaeum hirundinaceum*	mistletoebird		C		1
animals	birds	Oriolidae	*Oriolus sagittatus*	olive-backed oriole		C		2
animals	birds	Oriolidae	*Sphecotheres vieilloti*	Australasian figbird		C		9
animals	birds	Otididae	*Ardeotis australis*	Australian bustard		C		2
animals	birds	Pachycephalidae	*Colluricincla harmonica*	grey shrike-thrush		C		1
animals	birds	Pachycephalidae	*Pachycephala rufiventris*	rufous whistler		C		3
animals	birds	Pardalotidae	*Pardalotus punctatus*	spotted pardalote		C		1
animals	birds	Pardalotidae	*Pardalotus striatus*	striated pardalote		C		20
animals	birds	Passeridae	*Passer domesticus*	house sparrow	Y			21
animals	birds	Pelecanidae	*Pelecanus conspicillatus*	Australian pelican		C		2
animals	birds	Phaethontidae	*Phaethon lepturus*	white-tailed tropicbird		SL		2
animals	birds	Phalacrocoracidae	*Phalacrocorax sulcirostris*	little black cormorant		C		1
animals	birds	Phalacrocoracidae	*Phalacrocorax carbo*	great cormorant		C		1
animals	birds	Phalacrocoracidae	*Microcarbo melanoleucos*	little pied cormorant		C		5
animals	birds	Phasianidae	*Coturnix ypsilophora*	brown quail		C		2
animals	birds	Podargidae	*Podargus strigoides*	tawny frogmouth		C		4
animals	birds	Podicipedidae	*Tachybaptus novaehollandiae*	Australasian grebe		C		1
animals	birds	Pomatostomidae	*Pomatostomus temporalis*	grey-crowned babbler		C		2
animals	birds	Psittacidae	*Trichoglossus chlorolepidotus*	scaly-breasted lorikeet		C		5
animals	birds	Psittacidae	*Barnardius zonarius*	Australian ringneck		C		7
animals	birds	Psittacidae	*Parvipsitta pusilla*	little lorikeet		C		2
animals	birds	Psittacidae	*Platycercus adscitus*	pale-headed rosella		C		17
animals	birds	Psittacidae	*Psephotus haematonotus*	red-rumped parrot		C		4
animals	birds	Psittacidae	*Melopsittacus undulatus*	budgerigar		C		1
animals	birds	Psittacidae	*Northiella haematogaster*	blue bonnet		C		2
animals	birds	Psittacidae	*Trichoglossus haematodus moluccanus*	rainbow lorikeet		C		24
animals	birds	Psittacidae	*Aprosmictus erythropterus*	red-winged parrot		C		6
animals	birds	Ptilonorhynchidae	*Ptilonorhynchus maculatus*	spotted bowerbird		C		3
animals	birds	Rallidae	*Fulica atra*	Eurasian coot		C		1
animals	birds	Rallidae	*Gallinula tenebrosa*	dusky moorhen		C		1
animals	birds	Recurvirostridae	*Himantopus himantopus*	black-winged stilt		C		2
animals	birds	Rhipiduridae	*Rhipidura albiscapa*	grey fantail		C		3
animals	birds	Rhipiduridae	*Rhipidura leucophrys*	willie wagtail		C		32
animals	birds	Sturnidae	*Sturnus vulgaris*	common starling	Y			26
animals	birds	Threskiornithidae	*Threskiornis spinicollis*	straw-necked ibis		C		10
animals	birds	Threskiornithidae	*Threskiornis molucca*	Australian white ibis		C		6
animals	birds	Threskiornithidae	*Platalea regia*	royal spoonbill		C		1
animals	birds	Timaliidae	*Zosterops lateralis*	silvereye		C		2
animals	mammals	Emballonuridae	*Saccolaimus flaviventris*	yellow-bellied sheathtail bat		C		2
animals	mammals	Molossidae	*Mormopterus lumsdenae*	northern free-tailed bat		C		1
animals	mammals	Peramelidae	*Isoodon macrourus*	northern brown bandicoot		C		1
animals	mammals	Phalangeridae	*Trichosurus vulpecula*	common brushtail possum		C		2
animals	mammals	Phascolarctidae	*Phascolarctos cinereus*	koala		V	V	5

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	mammals	Pteropodidae	*Pteropus alecto*	black flying-fox		C		1
animals	mammals	Pteropodidae	*Pteropus scapulatus*	little red flying-fox		C		9
animals	mammals	Vespertilionidae	*Scotorepens greyii*	little broad-nosed bat		C		1
animals	mammals	Vespertilionidae	*Scotorepens balstoni*	inland broad-nosed bat		C		2
animals	ray-finned fishes	Cyprinidae	*Carassius auratus*	goldfish	Y			1
animals	reptiles	Chelidae	*Chelodina expansa*	broad-shelled river turtle		C		1
animals	reptiles	Elapidae	*Pseudechis australis*	king brown snake		C		1/1
animals	reptiles	Elapidae	*Demansia psammophis*	yellow-faced whipsnake		C		1
animals	reptiles	Elapidae	*Furina diadema*	red-naped snake		C		1
animals	reptiles	Elapidae	*Denisonia devisi*	De Vis' banded snake		C		2
animals	reptiles	Elapidae	*Hemiaspis damelii*	grey snake		E		2/2
animals	reptiles	Gekkonidae	*Heteronotia binoei*	Bynoe's gecko		C		2/2
animals	reptiles	Gekkonidae	*Gehyra dubia*			C		1/1
animals	reptiles	Scincidae	*Egernia striolata*	tree skink		C		1
animals	reptiles	Scincidae	*Ctenotus spaldingi*			C		1
animals	reptiles	Scincidae	*Tiliqua rugosa*			C		3/1
animals	reptiles	Scincidae	*Cryptoblepharus australis*	inland snake-eyed skink		C		1
animals	reptiles	Scincidae	*Egernia rugosa*	yakka skink		V	V	1
animals	reptiles	Scincidae	*Tiliqua scincoides*	eastern blue-tongued lizard		C		1/1
animals	reptiles	Scincidae	*Anomalopus leuckartii*			C		4
animals	reptiles	Typhlopidae	*Anilios wiedii*	brown-snouted blind snake		C		1
animals	reptiles	Varanidae	*Varanus varius*	lace monitor		C		3/1
animals	uncertain	Indeterminate	*Indeterminate*	Unknown or Code Pending		C		2
plants	higher dicots	Acanthaceae	*Ruellia simplex*		Y			3/3
plants	higher dicots	Anacardiaceae	*Schinus terebinthifolius*		Y			1/1
plants	higher dicots	Anacardiaceae	*Schinus molle var. areira*	pepper tree	Y			1/1
plants	higher dicots	Asteraceae	*Tridax procumbens*	tridax daisy	Y			1/1
plants	higher dicots	Asteraceae	*Vittadinia pterochaeta*	rough fuzzweed		C		1/1
plants	higher dicots	Asteraceae	*Parthenium hysterophorus*	parthenium weed	Y			1/1
plants	higher dicots	Asteraceae	*Senecio madagascariensis*	fireweed	Y			1/1
plants	higher dicots	Asteraceae	*Sonchus oleraceus*	common sowthistle	Y			1/1
plants	higher dicots	Bignoniaceae	*Dolichandra unguis-cati*	cat's claw creeper	Y			1/1
plants	higher dicots	Boraginaceae	*Cynoglossum australe*			C		1/1
plants	higher dicots	Brassicaceae	*Rapistrum rugosum*		Y			1/1
plants	higher dicots	Brassicaceae	*Sisymbrium irio*	london rocket	Y			1/1
plants	higher dicots	Campanulaceae	*Wahlenbergia gracilis*	sprawling bluebell		C		1/1
plants	higher dicots	Chenopodiaceae	*Atriplex muelleri*	lagoon saltbush		C		1/1
plants	higher dicots	Convolvulaceae	*Ipomoea cairica*		Y			2/2
plants	higher dicots	Euphorbiaceae	*Euphorbia serpens*		Y			1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia hirta*		Y			1/1
plants	higher dicots	Geraniaceae	*Erodium crinitum*	blue crowfoot		C		1/1
plants	higher dicots	Loranthaceae	*Amyema congener subsp. rotundifolia*			C		1/1
plants	higher dicots	Moraceae	*Morus alba*	white mulberry	Y			1/1
plants	higher dicots	Nyctaginaceae	*Boerhavia pubescens*			C		1/1
plants	higher dicots	Oleaceae	*Jasminum didymum subsp. lineare*			C		1/1
plants	higher dicots	Onagraceae	*Oenothera speciosa*		Y			1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	higher dicots	Oxalidaceae	*Oxalis thompsoniae*			C		1/1
plants	higher dicots	Rosaceae	*Prunus persica var. persica*		Y			1/1
plants	higher dicots	Rubiaceae	*Asperula conferta*			C		1/1
plants	higher dicots	Salicaceae	*Salix babylonica*	weeping willow	Y			1/1
plants	higher dicots	Sapindaceae	*Cardiospermum grandiflorum*	heart seed vine	Y			1/1
plants	higher dicots	Solanaceae	*Cestrum parqui*	green cestrum	Y			1/1
plants	higher dicots	Solanaceae	*Solanum nodiflorum*		Y			1/1
plants	higher dicots	Solanaceae	*Lycium ferocissimum*	African boxthorn	Y			2/2
plants	higher dicots	Verbenaceae	*Phyla canescens*		Y			1/1
plants	lower dicots	Ranunculaceae	*Clematis microphylla*			C		1/1
plants	monocots	Alliaceae	*Nothoscordum borbonicum*		Y			2/2
plants	monocots	Arecaceae	*Phoenix dactylifera*		Y			1/1
plants	monocots	Asparagaceae	*Asparagus africanus*	ornamental asparagus	Y			1/1
plants	monocots	Asparagaceae	*Asparagus plumosus*	feathered asparagus fern	Y			1/1
plants	monocots	Cyperaceae	*Cyperus rotundus*	nutgrass	Y			1/1
plants	monocots	Poaceae	*Cynodon dactylon var. dactylon*		Y			1/1
plants	monocots	Poaceae	*Sporobolus coromandelianus*		Y			1/1
plants	monocots	Poaceae	*Urochloa mosambicensis*	sabi grass	Y			1/1
plants	monocots	Poaceae	*Rytidosperma tenuius*			C		1/1
plants	monocots	Poaceae	*Triticum aestivum*	wheat	Y			1/1
plants	monocots	Poaceae	*Arundo donax*		Y			1/1

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992*. The codes are Extinct in the Wild (PE), Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (C) or Not Protected ( ).

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999*. The values of EPBC are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V).

Records – The first number indicates the total number of records of the taxon for the record option selected (i.e. All, Confirmed or Specimens).
This number is output as 99999 if it equals or exceeds this value. The second number located after the / indicates the number of specimen records for the taxon.
This number is output as 999 if it equals or exceeds this value.

Appendix C – Protected Plant Trigger Map

Protected Plants Flora Survey Trigger Map

Legend

- Coordinates
- High risk area
- Cadastral line
  Property boundaries shown are provided as a locational aid only
- Freeways / motorways / highways
- Secondary roads / streets

LOCALITY DIAGRAM

This map shows areas where particular provisions of the Nature Conservation Act 1992 apply to the clearing of protected plants.

This map is produced at a scale relevant to the size of the area selected and should be printed as A4 size in portrait orientation.

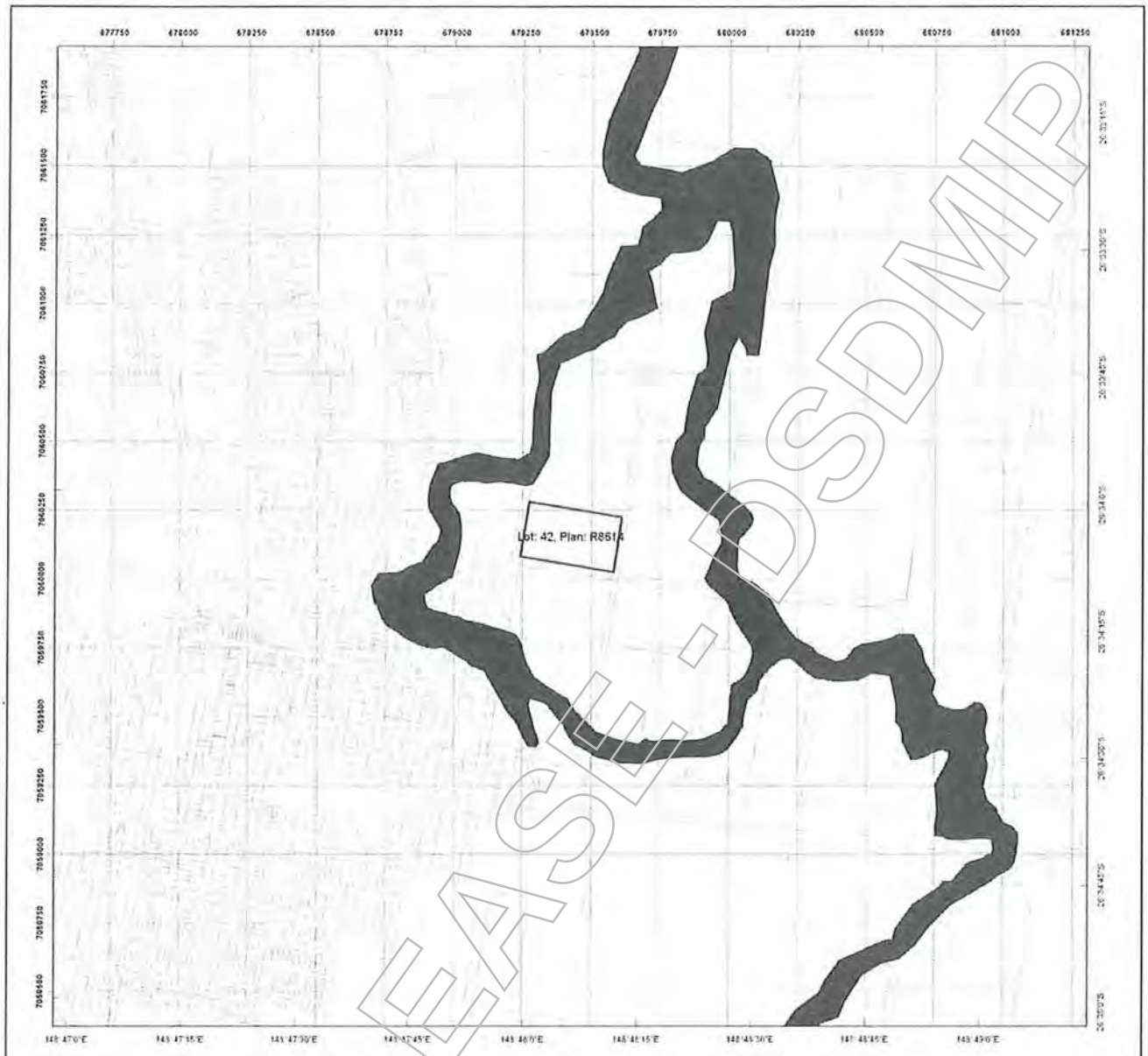
For further information or assistance with interpretation of this product, please contact the Department of Environment and Heritage Protection at palm@ehp.qld.gov.au

N

0 490 980 1,470 1,960 2,450 m

This product is projected into:
GDA 1994 Queensland Albers

Appendix D – Regulated Vegetation Management Map



Regulated Vegetation Management Map

Legend

- Lot and Plan
- Category A area (Vegetation offsets compliance notices/VDecs)
- Category B area (Remnant vegetation)
- Category C area (High-value regrowth vegetation)
- Category R area (Reef regrowth watercourse vegetation)
- Category X area (Vegetation not regulated under the VMA)
- Water
- Area not categorised
- Cadastral line
- Property boundaries shown are provided as a locational aid only

Queensland Government

LOCALITY DIAGRAM

N

0 200 400 600 800 1,000 m

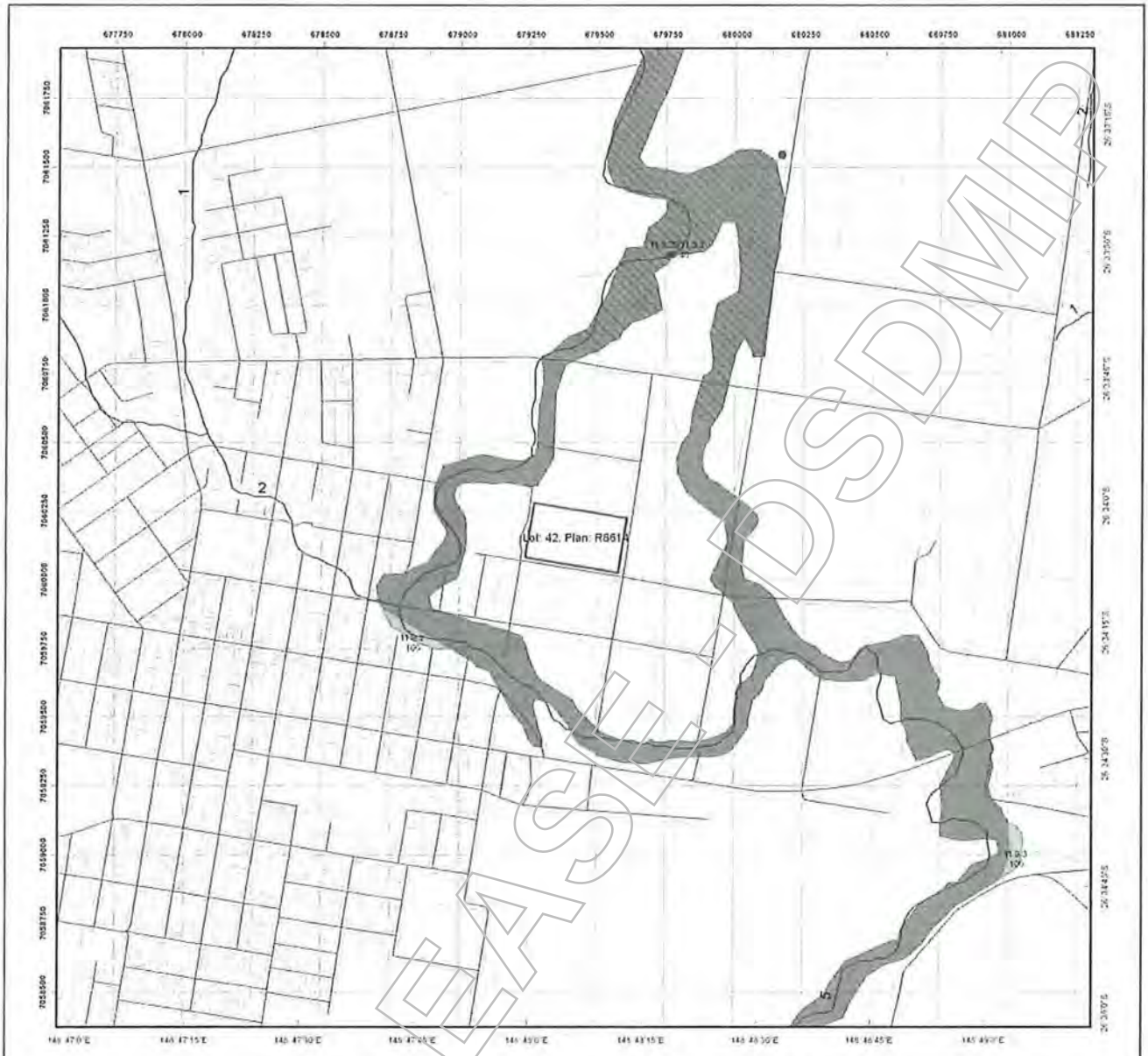
This product is projected into:
GDA 1994 MGA Zone 55

Disclaimer:
While every care is taken to ensure the accuracy of this product, the Department of Natural Resources and Mines makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which you might incurr as a result of the product being inaccurate or incomplete in any way and for any reason.

Additional information required for the assessment of vegetation values is provided in the accompanying "Vegetation Management Supporting map". For further information go to the web site: www.dnrm.qld.gov.au or contact the Department of Natural Resources and Mines.

Digital data for the regulated vegetation management map is available from the Queensland Spatial Portal at http://www.information.qld.gov.au/

This map is updated on a monthly basis to ensure new PMAVs are included as they are approved.



Vegetation Management Supporting Map

Legend

- Lot and Plan
- Category A or B area containing endangered regional ecosystems
- Category A or B area containing of concern regional ecosystems
- Category A or B area that is a least concern regional ecosystem
- Category A or B area containing remnant vegetation
- Category A or B area under Section 20AH
  These areas are edged in yellow and filled with the remnant RE Status
- Category C area containing endangered regional ecosystems
- Category C area containing of concern regional ecosystems
- Category C area that is a least concern regional ecosystem
- Category C area containing high value regrowth vegetation
- Category C area under Section 20AI
  These areas are edged in purple and filled with the remnant RE Status
- Non Remnant
- Water
- Wetland on the vegetation management wetlands map
- Essential habitat on the essential habitat map
- Essential habitat species record
- Watercourse on the vegetation management watercourse and drainage feature map
  (Stream order shown as black number against stream where available)
- Roads
- National Parks, State Forest and other reserves
- Cadastral line
  Property boundaries shown are provided as a locational aid only

Queensland Government

LOCALITY DIAGRAM

N

0 150 300 450 600 750 m

This product is projected into:
GDA 1994 MGA Zone 55

Labels for Essential Habitat are centred on the area of enquiry.

Regional ecosystem linework has been compiled at a scale of 1:100 000, except in designated areas where a compilation scale of 1:50 000 is available. Linework should be used as a guide only. The positional accuracy of RE data mapped at a scale of 1:100 000 is +/- 100 metres.

Disclaimer:
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Additional information may be required for the purposes of land clearing or assessment of a regional ecosystem map or PMAV applications. For further information go to the web site: www.dnrm.qld.gov.au or contact the Department of Natural Resources and Mines.

Digital data for the vegetation management watercourse and drainage feature map, vegetation management wetlands map, essential habitat map and the vegetation management remnant and regional ecosystem map are available from the Queensland Spatial Portal at http://www.information.qld.gov.au/

Vegetation Management Act 1999 - Extract from the essential habitat database

Essential habitat is required for assessment under the:

- State Development Assessment Provisions - Module 8: Native vegetation clearing which sets out the matters of interest to the state for development assessment under the *Sustainable Planning Act 2009*, and
- Self-assessable vegetation clearing codes made under the *Vegetation Management Act 1999*

Essential habitat for one or more of the following species is found on and within 1.1 km of the identified subject lot/s or on and within 2.2 km of an identified coordinate on the accompanying essential habitat map.
This report identifies essential habitat in Category A, B and Category C areas.
The numeric labels on the essential habitat map can be cross referenced with the database below to determine which essential habitat factors might exist for a particular species.
Essential habitat is compiled from a combination of species habitat models and buffered species records.
The Department of Natural Resources and Mines website (http://www.dnrm.qld.gov.au) has more information on how the layer is applied under the State Development Assessment Provisions - Module 8: Native vegetation clearing and the *Vegetation Management Act 1999*.
Regional ecosystem is a mandatory essential habitat factor, unless otherwise stated.
Essential habitat, for protected wildlife, means a category A area, a category B area or category C area shown on the regulated vegetation management map-

1) (a) that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database; or
2) (b) in which the protected wildlife, at any stage of its life cycle, is located.

Essential habitat identifies endangered or vulnerable native wildlife prescribed under the *Nature Conservation Act 1994*.

Essential habitat in Category A and B (Remnant vegetation species record) areas:1100m Species Information

(no results)

Essential habitat in Category A and B (Remnant vegetation species record) areas:1100m Regional Ecosystems Information

(no results)

Essential habitat in Category A and B (Remnant vegetation) areas:1100m Species Information

(no results)

Essential habitat in Category A and B (Remnant vegetation) areas:1100m Regional Ecosystems Information

(no results)

Essential habitat in Category C (High value regrowth vegetation) areas:1100m Species Information

(no results)

Essential habitat in Category C (High value regrowth vegetation) areas:1100m Regional Ecosystems Information

(no results)

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Document Status

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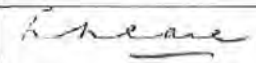
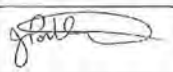
		Name	Signature	Name	Signature	Date
A	M Ward	K Keane	Draft	J Postlethwaite	Draft	23-12-15
0	M Ward	K Keane		J Postlethwaite		10-02-16

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Executive summary

Introduction

Following the recent flood events in Roma which occurred in 2010, 2011 and 2012, Maranoa Regional Council commissioned GHD to investigate flood mitigation options to address regional and local flood risk. To enable the Council's project team to understand the regional and local flooding issues and risks, comprehensive hydrology and hydraulic modelling was undertaken. The flood mitigation project has been undertaken in two stages to align with government funding mechanisms and timeframes.

Stage 1 of the investigations resulted in the recommendation of a 5 km (approximate) long levee, which is scheduled to begin construction in September 2013. The results of modelling and other supportive assessments are contained within the *Maranoa Regional Council, Roma Flood Mitigation Project, Stage 1, Hydrology and Hydraulic Assessment Report* (GHD, 2013a). The Stage 1 assessment showed that, following the construction of the proposed Stage 1 Levee, the number of properties in Roma that would be at risk of above-floor flooding from a storm event of equal magnitude to the 2012 event will be reduced from approximately 590 to around 100.

Stage 2 was undertaken to ascertain through a multi-discipline approach other mitigation options to further reduce the risk to the township from ***regional and local flood events.*** The investigations considered high flow diversion channels, localised levees, and retarding basins. The purpose of investigating mitigation on both a regional and local level was to ***holistically*** address flood risk within Roma and look at opportunities to reduce above-floor flooding even further. The Regional Stage 2 investigation and findings are documented in this report. Local flooding and drainage investigations and findings are discussed separately in the *Maranoa Regional Council, Roma Flood Mitigation Project Stage 2 Local Flood Mitigation Assessment* (GHD, 2013b).

Methodology and Data Collection

The Stage 2 assessment has been undertaken in an integrated way and considered:

- 'Regional' flood mitigation –flood runoff generated from the Bungil Creek catchment from a range of historic and design storm events.
- 'Major Local' flooding and drainage mitigation – considered mid-scale mitigation options within the town of Roma to mitigate flooding that occurs due to a combination of local runoff and regional tailwater effects, such as occurs through the Long Drain system (one of Roma's major urban drainage routes) and in the vicinity of the Railway Dam.
- 'Minor Local' flooding and drainage mitigation –local stormwater drainage issues that occur on a regular basis due to local runoff, including road cross-drainage.
- This report details the Regional mitigation assessment, which reflects the assessment and relationship at the Major Local and Minor Local levels. The methodology undertaken for the Stage 2 Regional mitigation investigation comprised the following steps:
- Preliminary Assessment
  - Confirmation of Stage 1 Levee alignment
  - Data collection including ecological and geomorphological assessments
  - Refinement of local hydrology model
- Council's adoption of a Design Flood Event for comparison of options

- Identification of individual mitigation options
- Integrated hydraulic modelling, incorporating the findings of Stage 1 work to date
- Assessment of mitigation options
  - Flood level benefit analysis at locations of interest
  - Property inundation impact analysis
  - Multi-criteria analysis
- Establishment of preferred combination mitigation options
- High-level feasibility assessment of preferred options
  - High-level cost-benefit analysis
  - Recommended mitigation scheduling

Identification of Regional Flood Mitigation Options

A number of potential flood mitigation options were identified through the Stage 1 community engagement process. The performance and viability of the various options were explored as a part of these Stage 2 investigations. In addition, GHD carried out site visits to ascertain the feasibility of flood mitigation options within the Stage 2 investigation area. A preliminary ecological desk based study and initial field assessment was carried out to help identify any potential environmental constraints within the study area.

Flood mitigation options that were identified by the community, MRC and GHD included:

- Eastern diversion and extension
- Localised levees including the western, eastern, and hotel levees
- Western diversion
- Retarding basins
- Expansion and elevation changes at Shady's Lagoon

In addition to the options identified above, the removal of the Warrego Highway and Railway embankments were investigated to assess the impacts and to inform consultation with TRM and QR. Removal of the Hay-Roma Dam was also investigated to better understand how the dam structure influences flood flows within the floodplain.

A total of 23 individual flood mitigation options were modelled and assessed and targeting the following areas:

- Further reduce regional flooding impacts in the township
- Reduce flooding risk near the high-value industrial areas to the east of Roma
- Reduce flood impacts along Warrego Highway, in particular near high-value commercial properties
- Reduce the tailwater level near Shady's Lagoon/Long Drain outlet to benefit urban drainage
- Maintain flood flow harvesting to Hay Roma Dam

The individual options were then assessed and either put forward for further consideration, or discounted as not being viable. Further considered options were used to design seven (7) 'combination' mitigation options. These combination options were assessed in detail and based on their performance and impacts on the environment were either supported or discounted.

Hydrologic and Hydraulic Modelling

The hydrologic and hydraulic modelling developed and calibrated in Stage 1 of the Roma project were further enhanced during the Stage 2 assessment, specifically in the urbanised section of the model domain. Hydrologic modelling (URBS) for Stage 2 included higher resolution rainfall-runoff routing of the local catchments of Roma. This improved local URBS model was created so as to provide more detailed local inflow hydrographs in the urbanised areas of Roma. This allowed more detailed assessment of the impacts of regional options and the relationship with the local stormwater systems and major drainage patterns.

The hydraulic modelling undertaken for this study was based on an updated version of the 10 m grid cell, 2D hydrodynamic Two-dimensional Unsteady Flow (TUFLOW) model of Roma and the surrounding Bungil Creek floodplain developed for *Maranoa Regional Council, Roma Flood Mitigation Project, Stage 1, Hydrology and Hydraulic Assessment Report* (GHD, 2013a). Updates to this existing model included the following:

- Refinements to the Manning's n roughness map layer, particularly within the township area to better represent details of the local catchment
- Incorporation of additional survey data and additional structure details (listed in Section 0) received following the Stage 1 investigation for more accurate representation of the terrain, drainage structures and stormwater drainage system
- Refinements to terrain data to improve the representation of channel sections, inverts and road/rail levels
- More detailed inflow hydrographs within the township area based on a revised hydrology

This hydraulic model was used to model the base case scenario of the Stage 1 Levee in place, for comparative purposes and to assess the effects of the identified flood mitigation options, both individually and in combination.

Preferred Mitigation Options

The flood mitigation benefits of individual mitigation options and combination mitigation options were assessed using an approach that included the following:

- Analysis of changes in regional flood levels at specific locations of interest
- Analysis of the number of properties that would remain at risk of above-floor inundation and for the combination options
- A multi-criteria analysis of social, environmental and infrastructure impact (combinations only)

The results of these assessments formed the basis for the selection of two preferred mitigation options. Mitigation Combination 6 being considered the most beneficial option, with Mitigation Combination 7 being the next recommended option. Further details about these mitigation options are outlined below, with further details in Figure 8-1 within the report:

- **Regional Mitigation Combination 6**
  - Eastern Levee (to the east of the Bungil Creek Bridge) (with 2 sets 6 No. 600 mm diameter pipes with flap gate)
  - Western Levee (continuation of Stage 1 Levee south to the junction of Bungil Creek and Shady's Lagoon) (with 1 set 4 No. 600 mm diameter pipes with flap gate)
  - Extended Eastern Diversion Channel D (60 m wide, 3.5 m deep)
  - Bungil Creek Widening at Bungil Street Bridge
  - Levees around Properties within Floodplain

- Western Diversion Drain B

- **Regional Mitigation Combination 7**
  - Eastern Levee (with 2 sets 6 No. 600 mm diameter pipes with flap gate)
  - Western Levee (with 1 set 4 No. 600 mm diameter pipes with flap gate)
  - Extended Eastern Diversion Channel D (60 m wide, 3.5 m deep)
  - Bungil Creek Widening at Bungil Street Bridge
  - Levees around Properties within Floodplain

With Combination 6 in place and the Stage 1 Levee, it is expected that approximately 73 buildings are likely to experience above-floor flooding during a 2012 equivalent event.

With the secondary preference Combination 7 and the Stage 1 Levee, it is expected that approximately 77 buildings are likely to experience above-floor flooding during a 2012 equivalent event.

Feasibility of Preferred Mitigation Options

A high-level feasibility assessment was undertaken on the preferred mitigation Combinations 6 and 7. A cost-benefit analysis was performed, where the indicative Capital Expenditures (CAPEX) required for the implementation of each combination option were compared with the provided reduction in the cost of flood damages.

As expected, the benefit-cost ratio for the regional Combination works is slightly less the Stage 1 works. To gain the flood mitigation benefit as funding and infrastructure renewal opportunities arise, a staged approach for implementation is recommended. Further economic analysis of these works, incorporating 'soft costs' associated with the flood damage experienced, should be undertaken in future stages of consideration. The suggested order of implementation, and approximate associated cost, has been provided in Table i.

Table i Recommended scheduling and approximate CAPEX of regional Combination 6/7 flood mitigation works

Stage Sequencing	Description	Approximate Capital Cost Estimate*
1	Install Western, Eastern, and Hotel Levees	$999,000
2	Construct Eastern Diversion (section north of Warrego Highway)	$1,555,000
3	Construct Eastern Diversion Extension including crossings at Warrego Highway and Rail	$4,325,000
4	Construct Western Diversion including crossings at Warrego Highway and Rail	$2,866,000

Recommendations

Combination 6 is recommended as the hydraulically preferred option. However, Combination 7 has been presented as a slightly more affordable option (does not include the Western Diversion). The disadvantage of Combination 7, however, is that the Major Local drainage assessment results are dependent on the Western Diversion drain works as they allow the establishment of the required stormwater pipe gradients. This is especially true for the improvements proposed along Station Street, as discussed in the *Maranoa Regional Council,*

Roma Flood Mitigation Project, Stage 2 Local Flood Mitigation Assessment (GHD, August 2013).

In addition, it is recommended that a floodplain management plan be developed for Roma that incorporates not just the Stage 1 and 2 flood mitigation options, but will also allow for reduced risk evacuation routes and planning for future development.

Acronyms

Acronym	Definition
1D	One-dimensional
2D	Two-dimensional
AAD	Average annual damages
AEP	Annual Exceedence Probability
AHD	Australian Height Datum
ARI	Average Recurrence Interval
ARR	Australian Rainfall and Runoff, 1987
BOM	Bureau of Meteorology
CBA	Cost Benefit Analysis
CRC-FORGE	A regional catchment-based rainfall data source
DEM	Digital Elevation Model
DTM	Digital Terrain Model
EMR/CLR	Environmental Management and Contaminated Land Registers
GHD	GHD Pty Ltd
IFD	Intensity Frequency Duration
km	Kilometre
km2	Square kilometre
km3	Cubic kilometre
LiDAR	Light detection and ranging data
m	Metre
m2	Square metre
m3	Cubic metre
Manning's n	Manning's n roughness coefficient
MCA	Multi Criteria Analysis
mm	Millimetre
MRC	Maranoa Regional Council
NCCOE	National Committee on Coastal and Ocean Engineering
PMF	Probable maximum flood
PMP	Probable maximum precipitation
QRA	Queensland Reconstruction Authority
RCBC	Reinforced concrete box culvert
TMR	Department of Transport and Main Roads
TUFLOW	Two-dimensional Unsteady Flow Software
URBS	Unified River Basin Simulator tool
WaterRIDE	Water Resources Integrated Development Environment Software
yr	Year

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Appendices

1. Introduction

1.1 Background

Roma has a long history of flooding. During 2010 and 2011, there were significant floods experienced in Roma. In 2012, an unprecedented storm event occurred with the following consequences:

- One fatality resulted from the event
- Approximately 580 properties experienced above floor flooding, with approximately 1,028 properties within the flood extent
- Significant damage costs resulting from the flood events
- The storm was greater than a 1 in 100 year event
- An estimated 2,200 m^3/s flow rate at the peak of the flood

As a result of these floods, MRC commissioned GHD to undertake a flood study of the Bungil Creek floodplain in Roma The study also included developing a flood mitigation strategy to support the Council's business case for flood funding.

GHD's commission was to investigate mitigation options to address regional flooding. The assessment was undertaken in a two staged approach to align with funding timeframes and Councils aspiration to commence construction of mitigation works as soon as practical. The assessment stages comprised:

- **Stage 1** to investigate mitigation options that would reduce risk from **regional flooding**
- **Stage 2** to investigate mitigation options that would **further reduce risk from regional flooding and local flooding**

In both Stage 1 and 2, the project aim was to "reduce the risk of above floor flooding in Roma from a storm event equal to the 2012 flood".

Stage 1 of these investigations resulted in the recommendation for the construction of a levee, referred to as the 'Stage 1 Levee', which is scheduled to begin construction in September 2013 (see Section 1.2). The earlier study is documented in *The Maranoa Regional Council, Roma Flood Mitigation Project, Stage 1, Hydrology and Hydraulic Assessment Report* (GHD, 2013a), referred to as the 'Stage 1 Flood Study report'.

Stage 2 investigations (see Figure 1-1) aimed to ascertain other mitigation options that further reduce flood risk for the community and focussed on those areas of the township that would still be at risk of above flood flooding following the construction of the Stage 1 levee. The Stage 2 assessment was undertaken in a tiered approach, considering not only the regional flooding risk, but also integrated the investigation with Local Major and Minor stormwater drainage and flooding issues. The study included the assessment of:

- 'Regional' Mitigation –flooding from rainfall and runoff generated across the Bungil Creek catchment.
- 'Major Local' Drainage Mitigation –mitigation options to address stormwater drainage and flooding in the Major drainage (including watercourses such as the Long Drain). The investigation considered flooding that occurs due to a combination of local runoff and effects of varying tailwater within the Bungil Creek due to varying floodwater depths.

- 'Minor Local' Drainage Mitigation – considers local stormwater drainage issues that occur on a regular basis due to local runoff, including road cross-drainage.

The purpose of this report is to document the results and findings of the flood modelling, potential mitigation options to reduce flood risks Regional flooding events. The report also outlines the costs and benefits to the community from the implementation of the proposed Stage 2 mitigation works in combination with the already defined benefits of the Stage 1 Levee.

The Major and Minor Local drainage mitigation options investigation as part of the Stage 2 study are documented separately in the *Maranoa Regional Council, Roma Flood Mitigation Project, Stage 2 Local Flood Mitigation Assessment* (GHD,2013b), subsequently referred to as the 'Stage 2 Local Drainage Mitigation Report'.

LEGEND

- Highway
- Road
- Watercourse
- Stage 1 Levee July 2013 Reference Design
- Tuflow Major Local Hydraulic Model Boundary
- Tuflow Regional Hydraulic Model Boundary
- Minor Local Drainage Investigations
- Cadastre

1:40,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study

Stage 2 Study Areas
Regional, Major Local & Minor Local

Job Number	41-25323
Revision	0
Date	11 Oct 2013

Figure 1-1

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Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: ©Commonwealth of Australia (Geoscience Australia) Watercourses/2007, DNRM Locality, Roads/2010, Cadastre, River/2012, GHD Flood Surfaces, Sample Points, Levee/2013, Google Earth Pro Imagery (Extracted 10/12/2012) Created By: LS

1.2 Stage 1 Levee Alignment

The Stage 1 Levee alignment was updated since the completion of the Stage 1 Flood Study report (GHD, 2013a). *The Maranoa Regional Council, Roma Flood Mitigation Project, Stage 1 Hydrology and Hydraulic Assessment* (GHD, 2013a) resulted in adoption of the March 2013 Stage 1 Levee Reference Design alignment, which was initially adopted for this Stage 2 Regional assessment. The March 2013 Stage 1 Levee Reference Design alignment was then put forward to community consultation. Following the consultation process, a number of changes were incorporated into the levee design to address community concerns and following detailed surveying and the identification of services and other site constraints such as protected vegetation. This alignment adjustment was undertaken to maintain the intended hydraulic flood mitigation performance while avoiding identified remnant vegetation, accommodating the airport and reducing inconvenience to those whose land would be affected by the construction of the levee.

During the course of the Stage 2 investigations, a number of alternative alignments were proposed that incorporated the stakeholder consultation adjustments. A final alignment was confirmed in July and is referred to as the July 2013 Stage 1 Levee Reference Design. The updated levee alignment was integrated into this stage of the study.

The March 2013 and July 2013 Stage 1 Levee Reference Design alignments are shown together in Figure 1-1.

Because the Stage 2 analysis is dependent on integration of the proposed Stage 1 Levee, some level of assumption regarding the Stage 1 Levee was necessary. The following assumptions were made in regards to Stage 1 works:

- In recognition of the previous changes to the Stage 1 Levee alignment, it should be noted that impacts of the Stage 2 suggested measures are likely to change if the constructed Stage 1 Levee alignment is different from what is modelled in this study
- This Stage 2 assessment is for works undertaken in addition to the Stage 1 Levee. Any benefit of these works as described in this report and the subsequent Stage 2 Local Mitigation Report (GHD, 2013b) is dependent on the completion of the Stage 1 Levee

1.3 Scope

The scope for Stage 2 included the following tasks. Those documented in this Regional report are ***bolded Italics***:

- Environmental assessment of Stage 2 Investigation Area
- Integrated flood and drainage modelling, comprising:
  - ***Regional flood mitigation options development and assessment (10 options)***
  - Major Local drainage and flood mitigation options development and assessment (five options)
  - Minor Local drainage improvement options assessment (16 cases as described in the *Drainage Master Plan for Roma* [Engeny, December 2012]; however some of these cases were addressed by the Major Local flood mitigation options.)
- ***Multi-criteria options assessment based on wide-ranging considerations including the results of the environmental assessment, integrated flood and drainage modelling and stakeholder consultation***

- ***Concept design (for each of the final three preferred regional flood mitigation scenarios), cost estimation and cost/benefit analysis*** (for the ***regional***, major and minor drainage options)

The general layout for this report is provided in Table 1-1. A locality map which shows the Stage 2 study area map is presented in Figure 1-1.

Table 1-1 Report Layout

Section	Description
Section 1	**Introduction** to the project including scope, qualifications, and general assumptions
Section 2	General **methodology** used to approach and complete the investigation
Section 3	Discusses the **regional flood mitigation options**, the identification and design process, and additional regional options considered
Section 4	discusses the **hydrology** assessment undertaken to provide rainfall and runoff inputs to the hydraulic modelling;
Section 5	outlines the **hydraulic** modelling performed to assess flooding conditions
Section 6	discusses each of the 23 **individual options** investigated for flood mitigation along with the hydraulic modelling results for each option
Section 7	outlines the 7 **combination options** that were investigated along with the hydraulic modelling results for each combination
Section 8	Discusses the **selection of preferred options**
Section 9	The **conclusions** that could be made based on the completed hydraulic modelling
Section 10	**Recommendations** for next steps
Section 11	provides a **glossary** of technical terms used throughout the report; in addition, a description of design flood events and flood risk in included in Appendix G
Section 12	**references**

1.4 Study Limitations

This report: has been prepared by GHD for Maranoa Regional Council and may only be used and relied on by Maranoa Regional Council for the purpose agreed between GHD and the Maranoa Regional Council as set out in section 1 of this report. The following qualifications apply to this study:

- GHD otherwise disclaims responsibility to any person other than Maranoa Regional Council arising in connection with this report
- GHD also excludes implied warranties and conditions, to the extent legally permissible
- The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in this report and are subject to the scope limitations set out in this report
- The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared
- The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect
- GHD has prepared this report on the basis of information provided by Maranoa Regional Council and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information
- GHD has prepared the preliminary cost estimate/prices set out in Section 9 of this report using information reasonably available to the GHD employees who prepared this report; and based on assumptions and judgments made by GHD
- The Cost Estimate has been prepared for the purpose of performing a cost benefit analysis for the conceptual design and must not be used for any other purpose
- The Cost Estimate is a preliminary estimate only. Actual prices, costs and other variables may be different to those used to prepare the Cost Estimate and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD does not represent, warrant or guarantee that the works can or will be undertaken at a cost which is the same or less than the Cost Estimate

2. Methodology and data collection

2.1 Stage 2 Methodology

The Roma Flood Mitigation Study has been progressed in two stages (Stage 1 and Stage 2), as a holistic investigation that addressed flooding and drainage issues across Regional and Major and Minor Local Drainage levels. This was achieved through the following:

- Description of existing flooding conditions
- Identification of flood mitigation options
- Integrated hydraulic modelling
- Comparison of benefits and
- Analysis and selection of preferred flood mitigation options

Figure 2-1 shows the integrated methodology undertaken in Stage 2. Individual phases of the Stage 2 methodology are described in Sections 2.1.1 to 2.1.6.

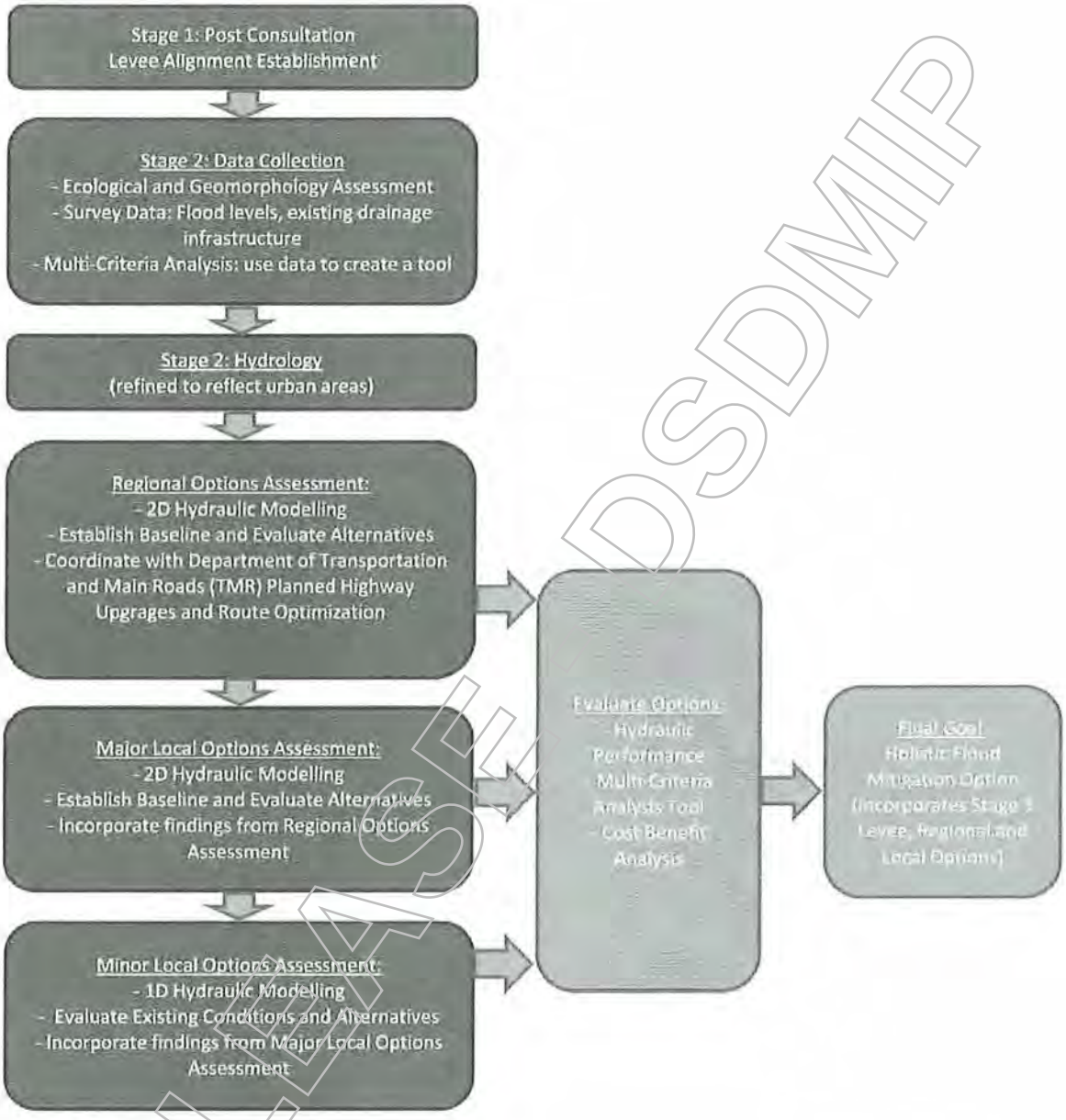

Figure 2-1 Methodology

2.1.1 Preliminary Stages

The initial phase of the Stage 2 investigation was to confirm the status of the Stage 1 Levee alignment and concurrent stakeholder consultation process, as described in Section 1.2.

Simultaneously, additional data collection was undertaken to update information available in Stage 1. The additional data was gathered and used as input to the multi-criteria analysis process and included ecological and geomorphological assessments.

The Stage 1 hydrology model was updated, maintaining the previously-developed regional hydrology and augmenting the delineation of local hydrology as described in Section 3. This was necessary to provide the level of accuracy required to undertake the more detailed flooding and drainage assessment required for Stage 2, particularly in Roma's urban areas.

2.1.2 Design Flood Event (DFE)

Different historic and design flood events were used to compare the performance of the mitigation options considered as outlined below.

- At the Regional scale, the options were against the historic 2012 flood event in the Bungil Creek catchment. This is consistent with the overall project aim to reduce risk from an event similar to the 2012 flood event.
- For the Major Local drainage and flooding assessment, the options were tested against the 100 year ARI local design storm event and included varying the tailwater levels in the point of discharge in Bungil Creek. For comparative purposes the 2 year ARI tailwater level from the regional flooding was adopted. This is consistent with best practice, as given in Queensland SPP1/3. In 2012, local flooding was exacerbated by backwater effects from Bungil Creek. In 2012, rainfall intensities locally in Roma have been estimated as being less than 100 year ARI intensity. Therefore for the purposes of assessing the impacts of local flooding and appropriate mitigation options in combination with a regional flood effect in the creek, the 100 year ARI event was considered more appropriate.
- For the Minor Local drainage assessment and in accordance with the Capricornia Municipal Development Guidelines for Maranoa Regional Council, the 5 year ARI r storm event for minor drainage and 100 year ARI major storm event were adopted.

2.1.3 Identification of Mitigation Options

A number of flood mitigation options were identified as a result of the Stage 1 community engagement process and ongoing discussions with MRC officers. In addition, site visits and engineering assessments of existing infrastructure and drainage pathways were undertaken to develop and understanding of site constraints and potential solutions. These ideas were taken into conceptual design phase for modelling in the Stage 2 study, based on the topography and constraints of the sites selected. In some instances these designs were taken through multiple iterations in order to find the most viable flood mitigation solutions.

2.1.4 Integrated Hydraulic Modelling

Subsequent to refining the local hydrology, a holistic investigation of further regional and local mitigation options was undertaken using enhanced hydraulic modelling. The modelling was based on an updated 10 m grid cell 2D hydrodynamic TUFLOW model for the regional flooding. A finer resolution, consisting of a local 3 m grid cell, covered the developed areas to the west and south of the Stage 1 Levee. PC Drains models were developed to assess minor local drainage and flooding issues. These differing resolutions were required as the 10 m cell size was too coarse for the assessment of smaller scale flood mitigation options within the urban used areas of the town. The 3 m grid cell model also incorporated a number of smaller culvert crossings and stormwater drainage structures.

At each level of assessment, individual mitigation options were identified and modelled in the relevant hydraulic model. Analysis of impact on flood levels and impact to property inundation was undertaken, with the preferred options taken into a subsequent stage to model combinations of options. Preferred mitigation options or combinations identified ona hydraulic performance basis were chosen

2.1.5 Assessment of Mitigation Options (Process)

Three analyses were undertaken to differentiate the benefit provided by the various flood mitigation options.

Flood Level at Specified Reference Points

Locations of particular interest as identified by Council and as targeted by the mitigation options were chosen for comparison of flood levels between flood mitigation options. Multiple points were mapped to show the change in flood level between base case and flood mitigation option case, and a selection were tabulated for comparison of benefit in the analysis process. These points are shown in Figure 2-2. Options that were progressed into next phases of assessment were those that showed greater reduction in flood level at locations of interest, and minimal increases in flood level in other areas.

Impact on Property Inundation

The objective of MRC in mitigating the flood impacts to Roma is to reduce the number of houses experiencing above-floor flooding. This is different to a below-floor flooding, where a property may experience inundation but the depth of flood water does not reach the level of the floor of habitable floor of the house or other building i.e. commercial premises.

An analysis was undertaken to determine the benefit provided by the flood mitigation options to properties. Results are presented in terms of the 'change of flooding' predicted at a property between the base case and mitigation option case. Table 2-1 shows the categories of impact on property inundation, explaining both the flooding scenario at a particular property under the base line condition (left-hand column) and under the flood mitigation option scenario (top). These two scenarios determine the 'change of flooding' category, whereby a property experience:

- Above-floor flooding under both the base case and mitigation option case
- Does not experience above-floor flooding in either case
- Is protected from above-floor flooding under the design event in the mitigation option case (no longer flooded) or
- Experiences a worsening of impact with newly-experienced above-floor flooding due to changes caused by the mitigation option case

Mitigation options reducing the number of properties experiencing above flood flooding were analysed further to produce the best outcomes possible during the multi-criteria analysis.

Table 2-1 Categories adopted to measure the change in the flood impact on property

		Flood Mitigation Option		
		Outside the flood extent	Below-floor flooding	Above-floor flooding
Existing Case	Outside the flood extent	**Properties remain at reduced risk** of being flooded	**Properties remain at reduced risk** of being flooded	Properties **At higher risk** of above floor flooding
	Below-floor flooding	**Properties remain at reduced risk** of being flooded	**Properties remain at reduced risk** of being flooded	Properties **At higher risk** of above floor flooding
	Above-floor flooding	**Properties at reduced risk** of being flooded	**Properties at reduced risk** of being flooded	Properties **At higher risk** of above floor flooding

Note: [1] Flooding refers to above-floor flooding.

LEGEND

- Sample Point ID
- Highway
- Road
- Watercourse
- Stage 1 Levee March 2013 Reference Design
- Tuflow Regional Hydraulic Model Boundary
- Cadastre

1:30,000 @ A3

0 500 1,000
Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study

Regional Hydraulic Model Results
Key Locations

Job Number 41-25323
Revision 0
Date 14 Oct 2013

Figure 2-2

Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Multi Criteria Analysis

A Multi-Criteria Analysis (MCA) tool was developed to evaluate each option for its potential footprint impacts and the potential effects on the floodplain. Social, environmental, and infrastructure impacts were considered as a part of the analysis, which involved identifying decision criteria, scoring of criteria for each option, weighting the importance of various criteria and determining a total weighted impact score for each option. This is further described in Table 2-2.

Table 2-2 Multi-Criteria Analysis Process

Process	Description
Decision Criteria	Develop a set of social, environmental, and economic criteria to score potential adaptions options
Scoring	Assess the value associated with the consequences of each option for each criterion
Weighting	Assign weights for each of the criterion to reflect their relative importance to the decision
Weighted Scoring	Combine the weights and scores for each option to derive an overall value

The purpose of the MCA was to provide a systematic tool for evaluating each option considered during the Stage 2 flood mitigation options analysis. For further details of the MCA process, refer to the memorandum included in Appendix D.

2.1.6 Feasibility of Preferred Options

To aid MRC to progress the findings of this flood mitigation study, a high-level feasibility study was undertaken on the preferred flood mitigation options. This included a cost-benefit analysis and a recommendation for the pashing of the works. The cost-benefit analysis was undertaken according to the standard methodology of comparing the Average Annual Damages cost to the CAPEX of the proposed mitigation works. Scheduling was recommended based on those components providing the most benefit for the cost and ease of implementation. A more detailed description of the cost benefit analysis methodology is included in Section 7.

2.2 Data Collection

2.2.1 Qualifications

For the purpose of this Stage 2 report, data was gathered from several sources. The following should be noted:

- Data provided by third parties, including information used in the development of the Stage 1 hydraulic model, was not checked or verified
- The local stormwater drainage pipe network layers for the Major Local hydraulic model were adopted directly from the study documented in the *Roma Flood Mitigation Project, Flood Study and Report, Stage 1* (Engeny, May 2012)
- (Engeny, 2012), and were not checked or verified against survey
- Only major hydraulic structures were included within the Regional model, i.e. bridges and large diameter culverts; local drainage pipes greater than 450 mm diameter were included in addition to the major hydraulic structures within the Major Local model

- For the MCA, zoning, CLR/EMR and utilities data was obtained from council and other sources. It is assumed that the data is accurate for evaluation of concepts discussed in this report; however, the data may not be current. Utility locations should be verified as a part of any detail design
- Flood survey points were used for calibration of the hydraulic model and the Stage 1 modelling, as described in detail in the Stage 1 report. The survey occurred after the peak of the flood, which may have created some inaccuracy

2.2.2 Previous Studies

Previous studies referenced for this study include:

- *Roma Flood Mitigation Project, Flood Study and Report, Stage 1* (Engeny, May 2012)
- *Drainage Master Plan for Roma, Final Report* (Engeny, December 2012)
- *Roma Flood Mitigation Project Stage 1 – Hydrology and Hydraulic Assessment Report* (GHD, April 2013)

2.2.3 Database of Properties

A database of property locations, floor levels and building type was collated by GHD for the Stage 1 assessment. Collated data includes lot and plan number, owner details, property address, ground level, floor level of buildings on the property and floor construction type.

The database was built from the several sources, including:

- Bennett & Bennett survey (2012) provided to GHD on the 31st January, 2013
- Engeny property database (.mif file and spreadsheet), based on 2002 survey, provided to GHD on the 5th February, 2013
- Stakeholder engagement database developed by Engeny with EngagementPlus provided to GHD on the 7th February, 2013
- QRA flood damage records for Roma as provided by MRC;
- Drive-by observations by MRC staff; and
- Cadastral data as provided by MRC

This database was subsequently updated with further survey collected by Bennett & Bennett (2013). The updated database forms the basis for the assessment of property flooding impacts and residual flooding risk for the Stage 2 assessment. Updated properties can be seen in Figure 2-3

LEGEND

- Highway
- Road
- Watercourse
- Stage 1 Levee July 2013 Reference Design
- Cadastre

1:30,000 @ A3

0 500 1,000
Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study

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Date	11 Oct 2013

Properties with Updated Floor Levels

Figure 2-3

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Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: ©Commonwealth of Australia (Geoscience Australia) Watercourses/2007, USGS - Relief/2009, DNRM - Locality, Roads/2013, Cadastre, River/2013, GHD, Flood Surfaces, Sample Points, Levee/2013, Bennett & Bennett Surveyors & Planners - Property Floor Heights/2012. Created By: LS

2.2.4 Hydrologic Model

Model

The URBS hydrology model developed as part of Stage 1 was adopted for Stage 2, with adjustments as described in Section 4.1.2. The following data formed part of the update.

- The Draft Roma Strategic Plan (as included in Appendix A of the *Drainage Master Plan for Roma, Final Report* (Engeny, December 2012)) was used to inform land use and adjustment of contributing areas in the fully-developed case for the URBS hydrological model of Roma

Local rainfall

- CRC-FORGE rainfall intensity data was generated for the location of Roma using the associated software
- Pluviograph data for the 2012 event was used as described for the Stage 1 hydrology
- Rainfall losses were adopted as used in Stage 1, with adjustment as described in Section 4.2.5

Land use data

- Land use was determined according to the Roma Strategic Plan (Appendix A of the Drainage Master Plan for Roma (Engeny, 2012))

2.2.5 Hydraulic Model

Model

The TUFLOW hydraulic model developed as part of Stage 1 was adopted for Stage 2 with adjustments as described in Section 5

Topographic data

A 1 m grid digital elevation model (DEM) covering the study area was provided to GHD by MRC. Data was created using LiDAR survey information. The DEM was used as the basis for the local catchment delineation in the hydrology assessment and the terrain grid for the regional and major local hydraulic models.

Aerial photography

MRC supplied aerial photography of Roma from 2012 following the peak of the flood event. A non-flooded aerial from 2008 was also provided. The Department of Transport and Main Roads (TMR) in Roma provided a high-resolution aerial from 2011. The aerial photography was used to inform land use coefficients in the hydrology modelling and verify locations of drainage, bridge structures and properties.

Stormwater pipe networks

Stormwater pipe data was utilised as provided by MRC from the previous Engeny study (Engeny, 2012).

Structures

The Stage 2 hydraulic model includes additional structures which were not included in the Stage 1 Model. For these additional structures, information regarding structure sizes and inverts were obtained from the following sources:

- Survey by Bennett & Bennett (2012)
- Bridge structural drawings from TMR
- Data provided by Council (email 23 May 2013); and
- Local stormwater drainage network information from TUFLOW model files provided by Council from the Engeny study (2012)

2.2.6 Additional Survey

Bennett & Bennett undertook additional survey for this study. This included the following:

- Additional survey in the vicinity of Clayton Road (July 2013)
- Additional survey of property floor levels (May 2013)

3. Regional Flood Mitigation Options

3.1 Identification Process

As a result of the Stage 1 community engagement process, a number of flood mitigation ideas were identified. Flood mitigation options that were identified by the community and council included:

- Eastern diversion and extension
- Localised levees including the western, eastern, and hotel levees
- Western diversion
- Retarding basins
- Expansion and elevation changes at Shady's Lagoon
- Widening of Bungil Creek Floodplain North of Roma
- Re-route of urban drainage to the west of Roma

In addition to the options identified above, the removal of the Warrego Highway and Railway embankment were investigated to ascertain the influence these significant structures have on the flood flow characteristics and to inform discussions with TRM and QR. Removal of the Hay-Roma Dam was investigated as well, so that the hydraulic function could be better understood in the vicinity of the dam. The effects of flood levels in the Bungeworgorai Creek and the Belone downstream of Roma were also considered for the potential effects on flooding in Roma (see Section 3.4.3).

3.2 Design Process

For diversions, the design process involved examining the peak flow experienced in the floodplain during the design event and determining what the excess flow was beyond Bungil Creek's capacity. Diversions were sized to accommodate a portion of that flow, while remaining within the allowable land-use constraints and within size limits considered to be constructible.

For levees, heights were designed to reduce risk of flooding during the design flood event. Locations of the levees were chosen based on hydraulic performance and to provide a level of protection for the most properties as possible.

3.3 Description of Options Modelled

The modelled Stage 2 regional flood mitigation options investigated are tabulated in Table 3-1 below and shown in Figure 3-1.

Table 3-1 Regional flood mitigation options

Option	Name	Description
1	Eastern Levee	Levee within the floodplain east of Bungil Creek, along Clayton Road and Warrego Highway. Levee length: 1,000 m
2	Western Levee	Two sections of levee west of Bungil Creek, with an opening at Shady's Lagoon. In some areas, due to limited available space between properties and the creek, a low flood wall may be required in place of an earth embankment. Northern section: from the Stage 1 levee to the southern

Option	Name	Description
		end of Edwardes Street (800 m) Southern section: from Bungil Street to the corner of Tiffin Street and Warrego Highway (800 m) Combined levee length: 1,600 m
3	Alternative Western Levee	Similar to the Western Levee option, however with a small section of the Stage 1 levee (east of the Stage 2 levee) removed. Stage 2 levee length: 1,600 m
4	Eastern Diversion Channel A	Diversion drain from Bungil Creek from East Miscamble Street to Creek Street. Channel length: 1,350 m Channel width: 100 m Channel depth: 1 m
5	Eastern Diversion Channel B	Diversion drain from Bungil Creek from East Miscamble Street to Creek Street. Channel length: 1,350 m Channel width: 40 m Channel depth: 3.5 m
6	Eastern Diversion Channel C	Diversion drain from Bungil Creek from East Miscamble Street to Creek Street. Channel length: 1,350 m Channel width: 60 m Channel depth: 3.5 m
7	Eastern Diversion Channel D	An alternative alignment of the Eastern Diversion Channel. Diversion drain from Bungil Creek from end of Stage 1 Levee to Creek Street. Channel length: 1,200 m Channel width: 60 m Channel depth: 3.5 m
8	Extended Eastern Diversion Channel A	Diversion drain from Bungil Creek from East Miscamble Street to Creek Street, extended from Creek Street to south of the railway. Channel length: 2,550 m Channel width: 100 m Channel depth: 1 m New crossing will be required at Warrego Highway (not modelled). Existing railway crossing to be upgraded (model allowed for similar crossing configuration as existing conditions)
9	Extended Eastern Diversion Channel B	Diversion drain from Bungil Creek from East Miscamble Street to Creek Street, extended from Creek Street to south of the railway. Channel length: 2,550 m Channel width: 40 m Channel depth: 3.5 m New crossing will be required at Warrego Highway (not modelled). Existing railway crossing to be upgraded (model allowed for similar crossing configuration as existing conditions)
10	Extended Eastern Diversion Channel C	Diversion drain from Bungil Creek from East Miscamble Street to Creek Street, extended from Creek Street to south of the railway.

Option	Name	Description
		Channel length: 2,550 m Channel width: 60 m Channel depth: 3.5 m New crossing will be required at Warrego Highway (not modelled). Existing railway crossing to be upgraded (model allowed for similar crossing configuration as existing conditions)
11	Extended Eastern Diversion Channel D	An alternative alignment of the Eastern Diversion Channel. Diversion drain from Bungil Creek from end of Stage 1 Levee to Creek Street, extended from Creek Street to south of the railway Channel length: 2,600 m Channel width: 60 m Channel depth: 3.5 m New crossing will be required at Warrego Highway (not modelled). New crossing will be required at the railway (bridge crossing modelled with 5% pier blockage and 600 m deck)
12	Eastern Diversion Channel B with Levees	Combination of: Eastern Diversion Channel B (described above); Levee along western bank of diversion channel; and Levee along eastern bank of Bungil Creek from start of diversion channel to approximately opposite Tiffin Street. Channel length: 1,350 m Channel width: 40 m Channel depth: 3.5 m Levee length: 2,800 m
13	Western Diversion Drain A	Formalisation of Western Drain from Riggers Road to Bungil Creek, with off-take to Roma-Hay Dam. Main diversion channel length: 2,000 m Channel width: 40 m New crossing will be required at Warrego Highway (not modelled). Existing railway crossing to be upgraded (model allowed for similar crossing configuration as existing conditions)
14	Western Diversion Drain B	Formalisation of Western Drain from Riggers Road to Stein Road (leading to Roma-Hay Dam), high flows re-enter Bungil Creek via existing overland flow path. Channel length: 3,700 m Channel width: 45 m New crossing will be required at Warrego Highway (not modelled). Existing railway crossing to be upgraded (model allowed for similar crossing configuration as existing conditions)
15	Ashburn Road Retarding Basin	Retarding basin south of Bungil Street at Ashburn Road Basin volume: approx. 60,000 m3
16	Explorers Inn Retarding Basin	Retarding basin near Explorers Inn/Creek Street, with outlet channel leading to Bungil Creek south of Warrego Highway. Basin volume: approx. 125,500 m3 New crossing will be required for the outlet channel at Warrego Highway (not modelled).
17	Shady's Lagoon Extension	Shady's Lagoon extended and channel connecting to

Option	Name	Description
		Bungil Creek widened. Culvert downstream of Bungil Street upsized to a 5 m x 1.8 m RCBC. Basin volume: approx. 40,000 m3
18	Bungil Creek Widening near Hay-Roma Dam	Earthworks to open up floodplain east of Hay-Roma Dam. Volume of earthworks: approx. 403,000 m3
19	Bungil Creek Widening at Bungil Street Bridge	Removal of Bungil Street Bridge and culvert downstream of bridge, in conjunction with minor channel shaping at bridge location. This represents a "best case" scenario in which the new crossing at Bungil Street does not obstruct flows through the creek.
20	Remove Warrego Highway	Removal of Warrego Highway embankment and associated crossings from Western Drain to Bungil Creek. This scenario was run to investigate the degree to which the current highway embankment obstructs flows across the floodplain.
21	Remove Railway Embankment	Removal of railway embankment and associated crossings from Western Drain to Bungil Creek. This scenario was run to investigate the degree to which the current railway embankment obstructs flows across the floodplain.
22	Remove Warrego Hwy and Railway Embankment	Removal of Warrego Highway and railway embankments and associated crossings from Western Drain to Bungil Creek.
23	Levees around Properties in Floodplain	Levee around properties north and south of Warrego Highway that were identified as being of high commercial value. Depending on available space, this may be a combination of earth embankment and/or flood wall. Levee length: approx. 1,600 m

LEGEND

- Highway
- Road
- Watercourse
- Cadastre
- Tuflow Regional Hydraulic Model Boundary

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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Regional Flood Mitigation Options

Figure 3-1

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3.4 Description of Other Options Considered

In addition to the individual and combination options, the following options were also assessed at a high level. It was considered that the viability of these options did not warrant detailed modelled.

3.4.1 Widening of Bungil Creek Floodplain North of Roma

To evaluate the effects of providing additional floodplain storage north of Roma, an option was investigated in which a large area of the floodplain opposite Mcphie Street (east of Bungil Creek) was excavated to provide additional conveyance during large flood events. Preliminary testing of this option indicated that removal of approximately 4,350,000 m^3 of soil, while substantially decreasing flood levels upstream of Mcphie Street, did not noticeably impact flood levels south of Miscamble Street.

Due to the large scale of earthworks involved with this option and the lack of reduction in flood levels within the main urbanised area of Roma achieved, this option was discounted and was not assessed further.

3.4.2 Option for Urban Drainage to the West

Feasibility of re-routing urban drainage from potential future development in West Roma to the adjacent catchment, outside of the Bungil Creek catchment was considered. Consistent with the Roma Planning Scheme (2009), it is anticipated that the area in western Roma will be developed in the coming years. As these developments occur, the imperviousness of the area will increase, thus increasing flow rates and affecting timing of peak flows, which will worsen downstream flooding. It is possible that flows from this area could be diverted to the adjacent catchment as shown in Figure 3-1. The cost for such diversions would depend on the distance between the development and the catchment boundary. Alternatively, Council can require that developers in this area match existing runoff rates from proposed development sites, by installation of stormwater detention systems.

3.4.3 Effects of Bungeworgorai Creek

During public consultation for Stage 1, concerns were raised regarding the effects of flooding in the Bungeworgorai Creek downstream of Roma. The Bungeworgorai is a major watercourse that joins with Bungil Creek approximately 20 km downstream of Roma. During the 2012 flood event, the Bungeworgorai Creek experienced flooding. Because Bungil Creek merges with the Bungeworgorai Creek, GHD considered what effects flooded conditions in the Bungeworgorai might have on flooding conditions in Roma.

When Bungeworgorai Creek is in flood, the downstream tailwater level for Bungil Creek at their confluence will be higher, reducing conveyance along the Bungil Creek floodplain, and potentially causing floodwaters to back up through the system. However, given the considerable distance between Roma and the confluence of Bungil Creek and Bungeworgorai Creek, it is unlikely that Bungeworgorai Creek water levels will have a significant impact on flood levels within Roma, 20 km upstream.

Additionally, Bungil Creek is relatively constricted as it passes the Hay-Roma Dam, so this constriction is likely to have more of an impact on flood levels than the downstream conditions in Bungeworgorai Creek. As indicated by the modelling results of the 'Bungil Creek Widening at Hay-Roma Dam' option, widening the floodplain at this constriction point, while decreasing flood levels in the vicinity of the dam, had an insignificant impact on flood levels within Roma itself, suggesting that high tailwater conditions within Bungeworgorai Creek are unlikely to significantly influence flood levels within Roma.

The sensitivity of flood levels within Roma to downstream boundary conditions was also investigated by modelling a scenario in which the slope applied at the downstream boundary condition (a TUFLOW-generated stage-discharge curve) was reduced from 1 in 800 to 1 in 1600. The sensitivity results indicated that while flood levels up to approximately 700 m upstream of the downstream boundary location were affected, flood levels upstream of Hay-Roma Dam (approximately 1200 m upstream of the boundary) did not change noticeably.

4. Hydrology

Hydrology is study of the rainfall and runoff process; in particular the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of rainfall events. The following sections discuss the hydrology work completed as a part of Stage 2 investigations.

4.1 Overview

4.1.1 The Roma Catchment

The Bungil Creek catchment is a relatively small catchment upstream of Roma. It covers an area of approximately 1400 km^2. The catchment is located on the southern foothills of the Carnarvon Range. Bungil Creek flows in a fairly constant southerly direction; approximately 70 km further downstream from Roma, Bungil Creek joins with the Balonne River which is part of the greater Murray-Darling system.

The flooding experienced at Roma can be caused by two different mechanisms:

- Local flood flow resulting from very localised rainfall within the Roma urban area and its immediate surroundings; and
- Regional flood flows resulting from the rainfall over the wider Bungil Creek catchment area

Annual average rainfall throughout the Bungil Creek catchment is relatively constant. The mean annual rainfall is approximately 700 mm.

There is a degree of variability in regard to monthly rainfall, and records show that the summer months dominate rainfall totals within the catchment.

Generally, major flooding in the Bungil Creek is considered to be infrequent. However, under certain meteorological conditions such as tropical low pressure systems, heavy rainfalls can occur throughout the catchment which results in significant riverine flooding.

For the purposes of this regional mitigation options study, both regional and local contributing catchment areas must be modelled so as to provide the most accurate results for flooding in the township of Roma.

4.1.2 Updates to Existing Hydrology

Hydrology modelling has been undertaken for this area in a number of past studies. These include Unified River Basin Simulator (URBS) and XP-RAFTS hydrologic models developed for the following reports:

- *The Bungil Creek Flood Study – Hydrology Report* (EGIS, 2002)
- *Roma Flood Mitigation Project, Flood Study and Report, Stage 1* (Engeny, May 2012)
- *Drainage Master Plan for Roma* (Engeny, December 2012)
- *Roma Flood Mitigation Project, Stage 1 Hydrology and Hydraulics Assessment Report* (GHD, 2013a)

For this Stage 2 study, the calibrated regional hydrology URBS model as created for and described in Section 4 of the GHD Stage 1 Flood Study report (GHD, 2013a) was used to develop inflow hydrographs to Bungil Creek upstream of Roma.

Additional modelling was undertaken to determine the local hydrology included in this study. The five local sub-catchments that were included as part of the Stage 1 regional model formed the

basis for the revised model. The following modifications were made to update and refine the hydrology modelling of the local catchment:

- Additional local catchment area was added to include areas contributing to the Railway Dam and areas to the east of Bungil Creek.
- Rainfall was also updated to ensure that aerial reduction factors were not applied to the local rainfall.

Two development scenarios for the township of Roma were modelled in URBS:

- Roma with land use and urbanisation as currently exists
- Roma with land use and urbanisation fully-developed as defined in the Draft Roma Strategic Plan as included in the *Drainage Master Plan for Roma, Final Report* (Engeny, 2012b)

4.1.3 Calibration

The calibration process for the regional hydrology is documented within the *Stage 1 Hydrology and Hydraulics Assessment Report* (GHD, 2013). The regional model was calibrated against historical recorded floods using data from existing flood gauges and surveyed flood water levels collected from past events.

The local hydrology model URBS as created for this study was not calibrated. No data exists to relate rainfall and runoff values along major or minor drainage lines within Roma, excluding Bungil Creek. The following methodology was used as a part of the local hydrology assessment:

- Calibration data was not available for local rainfall and runoff. Verification of peak flows was undertaken with the Rational Method and against some limited survey information and anecdotal evidence of flood water depths and extent.
- The land use types across Roma were assessed via aerial imagery to develop roughness maps and to establish typical values for imperviousness. Hydrological losses used in the calibrated regional URBS hydrological were adopted for the local hydrological model, with some adjustments made to account for increased local impervious areas.

4.1.4 Selected Design Flood Event

The 2012 flood event was the largest on record for Roma. Typically, a 100 year ARI storm event is the recommended design event for flood planning (*Queensland State Planning Policy 1/03 Guideline*, June 2003) but the MRC adopted the slightly larger 2012 regional event as the design flood event for this study.

In addition to hydrological modelling of the 2012 event, a standard range of average recurrence interval (ARI) events were modelled to assess the behaviour of the catchment resulting from different storm events. Modelled ARIs included the 1 in 2, 5, 10, 20, 50, 100, 200, 500, 1,000, 2,000, 5,000, 10,000, 100,000 year events and the probable maximum precipitation (PMP) event

4.2 Model Setup

To develop a hydrological representation of the rainfall-runoff movement of surface water in a catchment, the following inputs are required:

- Subcatchment physical characteristics, i.e. shape, size and slope for each of the contributing areas. The corresponding network of subcatchments that best demonstrates the path of runoff reaching a reference point.
- Identification of reference points for hydrographs

- Land use types in order to identify roughness and imperviousness of the study area
- Intensity and spatial/temporal distribution of rainfall
- Initial and continuing runoff losses

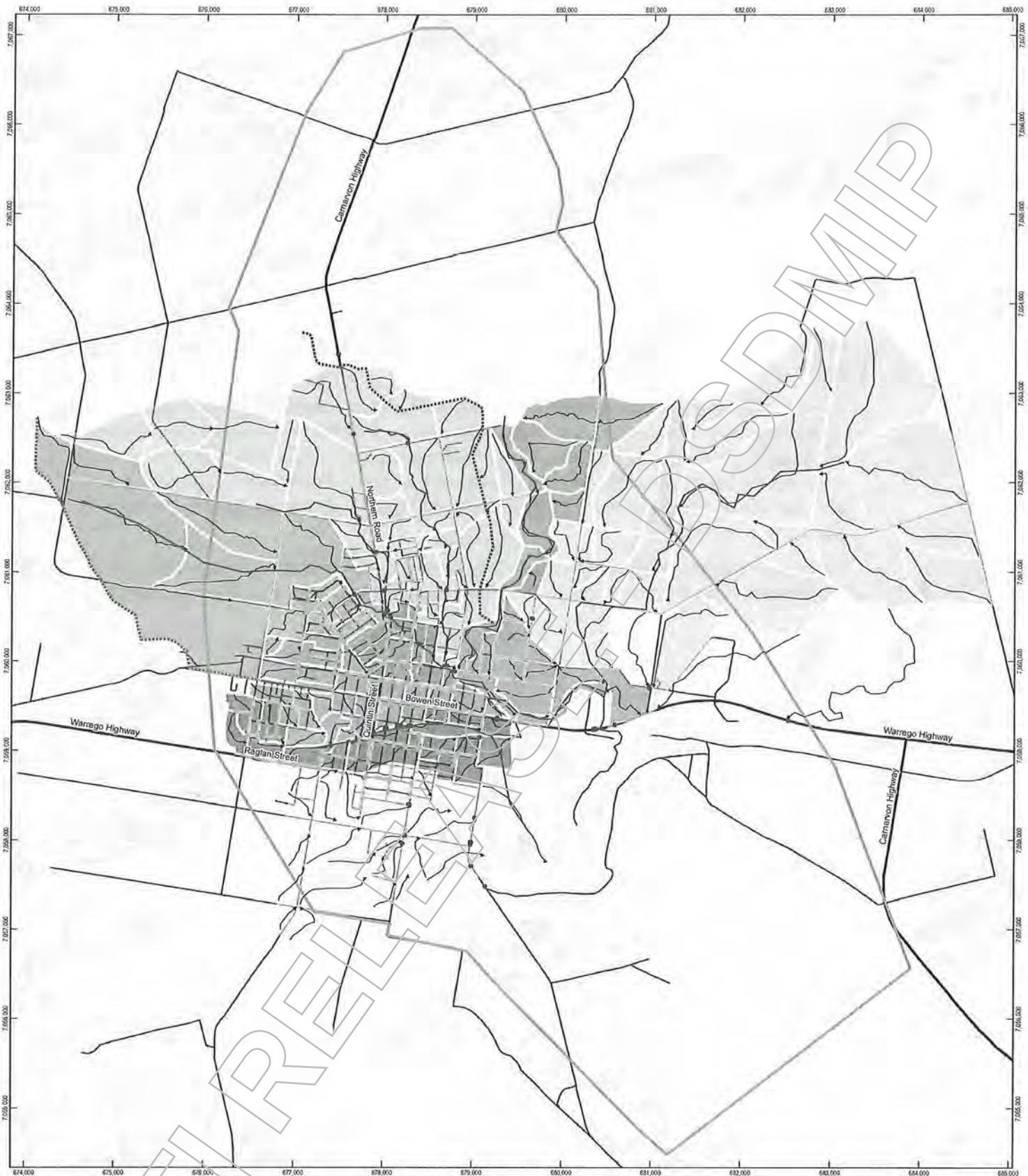
The following subsections describe the data that was input for each of these parameters to create the URBS model for the local catchments of Roma.

4.2.1 Sub-catchment Delineation

The catchment delineation used for this study is shown in Figure 4-1. The local sub-catchment area as modelled in the Stage 1 hydrological model was extended to increase the railway dam catchment and contributing catchment to the east of Roma.

The eight delineated areas were refined to provide a detailed representation of local hydrology, with delineation undertaken based on topographic analysis of drainage paths and sub-catchment delineation for Roma as reported in the Master Drainage Plan (Engeny, 2012). This process resulted in refinement to include 216 smaller subareas, as shown in Figure 4-1. Discussions with MRC staff during a field visit on the 30 May, 2013 confirmed the general direction and timing of overland flow as delineated.

The longest flow paths were identified according to topographically-defined overland drainage lines or roads, based on the surcharge of the stormwater drainage during large storm events.



LEGEND

- Stormwater Pit
- Highway
- Road
- Stage 1 Levee March 2013 Reference Design
- Catchment Boundary for Possible Future Development Diversions
- Stormwater Pipe
- Major Flowpaths
- Approx Drainage Path
- Culvert
- Tuflow Regional Hydraulic Model Boundary
- Cadastre

Local Subcatchments

- Bungil
- East
- FSOUTH
- LDRAI1
- LDRAI2
- LDRAI3
- LDRAIU
- NW
- RWAY

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Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Local Subcatchment Delineation

Figure 4-1

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Data Source: ©Commonwealth of Australia (Geoscience Australia). Watercourses/2007, USGS - Relief/2009, DNRM Locality, Roads/2010, Cadastre, River/2012, GHD Catchments, Drainage & Flow Paths, Levee/2013 Created By: LS

4.2.2 Hydrograph Locations

Runoff resulting from rainfall on a catchment is represented by a hydrograph, a temporally varying flow pattern across the duration of a storm event. These flows can then be used to assess the capacity of the receiving system to manage the quantity of stormwater, and predict flood levels.

Key locations in Roma were identified for flow accumulation, in particular at stormwater infrastructure inlets and channels. Detailing infrastructure and flows at these locations enables surcharge to occur when applying runoff to the hydraulic model. Modelled hydrographs were chosen and applied to locationswithin the town, such as dams, defined overland flow channels, discharges to Bungil Creek and major drainage structures. Locations where the runoff hydrographs were applied are described further in Section 5.2 of the hydraulic model development

4.2.3 Land Use and Imperviousness

Existing urbanisation in Roma was assessed through the 2011 aerial photograph provided by the Department of Transport and Main Roads (DTMR). An approximate calculation of impervious versus pervious areas in typical high, medium and low (rural) density residential blocks was undertaken. Each subarea was then given a weighted urbanisation based on the proportion of the area under each density of development.

The imperviousness values for non-residential areas were based on those from the Master Drainages Study (Engeny, 2013). Table 4-1 gives the adopted imperviousness for each of the modelled land use types in Roma.

Table 4-1 Land Use and Impervious Percentage

Land Use	Impervious Percentage*
Rural	5
Rural Residential	10
Medium Density Residential	28
High Density Residential	45
Industrial	80

Based on characterisation of the existing urbanises areas of Roma, a second version of local hydrology was undertaken whereby land use was assigned using the fully-developed urbanisation scenario for Roma, as described in the Roma Strategic Plan in Appendix A of the Drainage Master Plan for Roma (Engeny, 2012b). The results of this hydrology assessment were used for the Stage 2 Regional assessment described in this report. This model, while conservative compared to the existing urbanisation, was adopted so as to design mitigation options that benefit Roma into the future. It should be noted that future hydrology may differ from that modelled in this report, according to patterns of development and potential future changes in land use zoning and climate change.

4.2.4 Local Rainfall

Rainfall used for the Stage 1 Regional URBS model had aerial reduction factors applied, as the upstream Bungil Creek catchment is large. The model also accounted for spatial variation of rainfall intensity across the different contributing sub-catchments.

For the local hydrology modelling, local rainfall was derived without an aerial reduction factor since the contributing catchment is sufficiently small to assume spatial consistency of intensity. The

BOM Intensity-Frequency-Duration tool, based on Australian Rainfall and Runoff 1987 (ARR87), was used to calculated local rainfall for Roma for ARIs from 2 to 100 year ARI (see Appendix A).

A comparison was undertaken of BoM IFD data and generated CRC-FORGE data (which includes an aerial reduction factor) to assess the suitability of subsequently using the CRC-FORGE as a basis for the estimation of extreme rainfall events as per the methodology in Section 3.6.3, Book 6 of ARR87. Probable Maximum precipitation (PMP) was calculated using the *Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method* (Bureau of Meteorology, June 2003) on the local Roma catchment. The PMP locally in Roma was estimated to equate to an event of 1 million year ARI.

Flood events larger than the 100 year ARI event were used to model additional flooding scenarios to inform the assessment of flood damages for the cost-benefit analysis.

4.2.5 Rainfall Losses

Losses for the local hydrology were adapted from the losses calibrated for the regional hydrology. Losses were reduced by 20% to account for the increased imperviousness of the local sub-catchments compared to the regional. For larger events, initial losses for the local hydrology were capped at 30 mm, with reducing initial losses for the most extreme flood event estimations. A summary of the adopted local losses, and a comparison to the adopted regional losses, is provided in Table 4-2.

Table 4-2 Comparison of losses for local hydrology compared to Stage 1 regional hydrology

	Local URBS Model		Regional URBS Model	
ARI (years)	Initial losses (mm)	Continuing Losses (mm)	Initial losses (mm)	Continuous Losses (mm)
2	41.6	1	52	1
5	36	1	45	1
10	32	1	40	1
20	24	1	30	1
50	24	1	30	1
100	24	1	30	1
200	30	1	40	1
500	30	1	50	1
1k	15	1	50	1
2k	15	1	50	1
5k	15	1	50	1
10k	0	1	50	1
50k	0	1	50	1
PMF	0	1	50	1
2012	30	1	60	1

4.3 Critical Storm Duration

The critical storm duration, described as the length of storm event that produces the peak runoff for a particular ARI storm and catchment, was calculated and verified for the local Roma catchment according to the following steps:

1. Peak flows were extracted for all storm durations and compared at five key locations within the stormwater drainage system. Key locations were chosen for points of flow accumulation within the stormwater system such as in dams and through the Long Drain, each with between three to five subcatchments contributing to the hydrograph at that point. The three storm durations resulting in maximum peak flows at these locations were recorded
2. A Rational Method calculation was undertaken for each of the key locations to compare against the three most critical durations recorded from the previous step
3. The three most critical durations for the 100 year ARI event were run through the Stage 2 Regional hydraulic model to verify or check the action of flows across the system and determine which duration resulted in not just peak flows but peak flood levels

Based on Step 1,the results showed that the 1 hour storm duration produced the peak local flow at the majority of key locations across a variety of ARIs. The 1 hour storm peaks were closely followed by the 3 hour duration peaks (see Appendix A1). Step 2, the manual Rational Method (see Appendix A), resulted in calculation of local peak flows that were generally within 20 percent of those predicted by the URBS model. This is considered a satisfactory verification for an urbanised catchment according to industry standard. Times of concentration as calculated using the Rational Method (approximately equivalent to critical duration) were generally between 0.5-1.5 hours at the locations selected.

Hydrological models calculate peak flow hydrographs, but these do not always have a direct relationship to peak flood levels within the system. This is due to the effects of volume and timing, particularly in more complex subcatchment networks such as experienced locally in Roma. To assess this and further check which storm duration should be adopted as the critical design event, the Regional hydraulic model (described in Section 5.2) was run using hydrographs from the 1 hour, 3 hour and 9 hour, 100 year ARI events. Although the 1 hour storm duration often produced the peak local flows based on the URBS hydrographs (as discussed in Section 3 and shown in Appendix A), the additional volume and timing of flows of a 3 hour duration event through the Long Drain system resulted in higher peak water levels according to the hydraulic model. As such, the 3 hour storm duration was adopted as the design event for the local inflows for all ARIs.

5. Hydraulic Modelling

5.1 Refinement of Hydraulic Model

The TUFLOW modelling package was used to model the Regional Flood Mitigation Options in this study. TUFLOW (WBM-BMT, 2010) is a 2D unsteady flow hydrodynamic modelling tool specifically oriented towards establishing flow and inundation patterns in rivers and floodplains as well as urban areas. TUFLOW solves the depth-averaged 2D shallow water equations for flows based on the creation of a digital elevation model (DEM), surface inflows, surface roughness and boundary conditions. It also allows the incorporation of 1D sections within the 2D domain where required to accurately represent certain features including hydraulic structures. TUFLOW is recognised as an industry standard hydrodynamic modelling package within Australia for free-surface flows such as those occurring from floods and is well-suited to the modelling of the Roma floodplain.

The calibrated, coupled 1D-2D TUFLOW model developed for Stage 1 was adopted as the basis for the Stage 2 analysis of regional mitigation options. However, the Stage 1 model was developed for the purpose of assessing regional flood events. This created certain limitations when applied to the Stage 2 investigation, which also considers smaller scale flood mitigation works and the interaction between local catchment flooding and regional flooding. In order to circumvent these limitations, a number of changes were made in the Stage 1 model to update it to the 'Stage 2 Regional hydraulic model' as utilised and referred to in this study. These changes include the following:

- Refinements to the Manning's n roughness map, particularly within the township area to better represent details of local flooding
- Incorporation of additional survey data and additional drainage structure details (listed in Section 0) received following the Stage 1 investigation for more accurate representation of the terrain and stormwater network
- Refinements to terrain data to improve the representation of channel inverts and road/rail crests
- More detailed breakdown of inflow hydrographs within the township area based on the revised URBS model discussed in Section 4.2

Sources of input data to the Stage 2 Regional hydraulic model such as topography, hydraulic structures and boundary conditions can be found in Section 2 of this report. A summary of key features in the model is provided in Section 5.2.

5.2 Stage 2 Regional TUFLOW Model Details

In order to simulate the movement of free surface flows through a channel and along a floodplain, TUFLOW requires the input of various data including terrain, inflow and outflow boundary flows and water levels, land use or surface roughness, run duration and hydraulic structures within the system. These inputs are described in the following subsections.

5.2.1 Run Parameters

All hydraulic models for the Stage 2 investigation were run using TUFLOW Build 2012-05-AE-iDP-w64. Time steps of 0.5 seconds and 2 seconds were adopted for the 1D and 2D domains respectively, based on the Courant number, stability of 1D structures and the adopted 10 metre grid size.

5.2.2 2D Terrain

The hydraulic model extent from the Stage 1 model was adopted for Stage 2, and is shown in Figure 5-2. The 10 m cell size was also retained from the Stage 1 model.

The 10 m cell size adopted for the Regional hydraulic model was deemed appropriate for the purposes of comparing the benefit of a range of proposed flood mitigation options at a regional scale. However, the 10 m cell size must be considered when looking at levels and flood extents for individual properties; there will be some averaging of ground surface elevations across a 10 m cell.

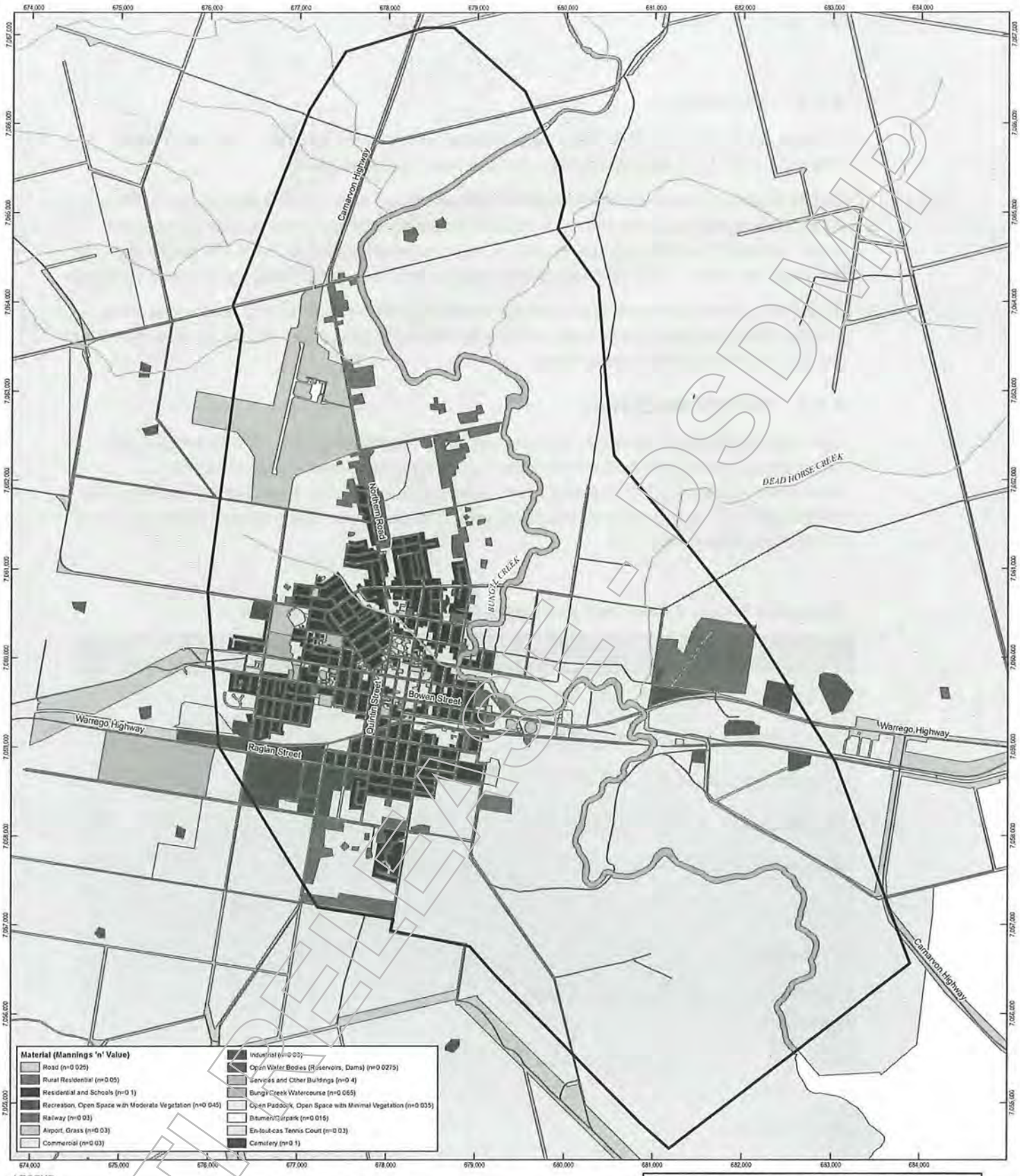
A DEM at 1 m resolution was used to assign elevations within the 2D domain. Key levels along channel inverts and road crests were represented within the model through the use of draped lines (2d_zsh layers) to modify cell elevations.

5.2.3 Surface Roughness

Land use influences the behaviour of flows over the ground surface. In a TUFLOW model, land use is largely represented by the Manning's 'n' roughness coefficient. For this Stage 2 assessment, Manning's 'n' roughness values were adopted from the Stage 1 model and manually refined based on inspection of aerial photography. The roughness categories are shown in Figure 5-1 and tabulated in Table 5-1.

Table 5-1 Stage 2 Regional Hydraulic Model Roughness Values

Category	Manning's 'n' Value
Bungil Creek Watercourse	0.065
Open Water Bodies (Reservoirs, Dams)	0.0275
Bitumen (e.g. car park)	0.015
Road Reserve	0.025
Railway	0.03
Airport	0.03
Short Grass	0.03
Open Paddock, Open Space with Minimal Vegetation	0.035
Recreation, Open Space with Moderate Vegetation	0.045
Rural Residential	0.05
Residential and Schools	0.1
Cemetery	0.1
Commercial and Industrial	0.3
Services and Other Buildings	0.4



LEGEND

- Road
- Watercourse
- Tuflow Regional Hydraulic Model Boundary

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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Stage 2 Regional Hydraulic Model Roughness Categories

Figure 5-1

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5.2.1 Stage 1 Levee

The Stage 2 Regional hydraulic model incorporates the recommendations of the Stage 1 Flood Study (GHD, 2013a) (see Section 1.2) and includes the Stage 1 Levee in the terrain. The March 2013 Stage 1 Levee Reference Design alignment was adopted for initial assessments of the individual options, as this was the current levee design at the commencement of the Stage 2 investigation. However, following community consultation and approval by MRC during the course of the study the final combination runs were performed using the July 2013 Stage 1 Levee alignment.

5.2.2 Hydraulic Structures

Data for the hydraulic structures was obtained from the Stage 1 model and additional information received from Council and captured during site investigations. Bridge structures were represented within the model through the use of layered flow constrictions. Large culverts were represented as 1D link. Minor culvert structures were omitted, given the regional scale of the model and the 10 m cell size. The locations of hydraulic structures included in the model are shown in Figure 5-2. These structures are considered in the Stage 2 Local Mitigation report (GHD, 2013b). It is recommended that the hydraulic effects of culvert and hydraulic structures are considered further during detailed design when configuration and sizing of such structures can be fine-tuned.

LEGEND

- Highway
- Road
- Watercourse
- Stage 1 Levee March 2013 Reference Design
- Stage 1 Levee July 2013 Reference Design
- Culvert
- Bridge
- Tuflow Major Local Hydraulic Model Boundary
- Tuflow Regional Hydraulic Model Boundary
- Cadastre

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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Stage 2 Regional Hydraulic Model Setup

Figure 5-2

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5.2.3 Boundary Conditions

The upstream and downstream boundary conditions within Bungil Creek were adopted from the Stage 1 model. An inflow hydrograph extracted from the calibrated hydrologic model was applied at the upstream boundary of the model, while the downstream boundary condition was based on a rating curve (TUFLOW-generated stage-discharge curve).

Source point inflow hydrographs were applied to simulate the effect of rain falling on the catchment within Roma and running off into local stormwater infrastructure. The placements of these source points were determined according to topography and existing flow paths. This is considered to be appropriate for this comparative analysis of existing hydrology in Roma at a regional scale.

Local catchment inflow hydrographs were applied directly onto the 2D domain at various locations along Bungil Creek, across the floodplain and within the township area, based on the revised URBS model. The hydrographs associated with these inflows were derived from the calibrated URBS model described in Section 4.1.2.

5.2.4 Calibration of Flood Levels

The hydraulic model had been calibrated and verified during Stage 1; therefore, a second calibration process was not considered necessary for Stage 2. However, as a precaution, a verification check was undertaken; results for existing conditions (no Stage 1 Levee) and Stage 1 conditions (with the Stage 1 July 2013 Reference Design Levee, see Section 5.2.1) were double-checked against flood information and data collected after the 2012 flood event and against the results of the Stage 1 hydraulic model. The resulting modelled flood levels were found to be comparable for both verification scenarios.

In addition, the differences between the flood levels and extent predicted within the urban area of Roma between the Stage 1 and 2 models were compared. Differences between the models are attributed primarily to the refinement of inflow locations and the terrain within major flow paths undertaken as a part of Stage 2. Details of this comparison are shown in Appendix B. As additional details have been added to the Stage 2 model, flood levels predicted by the Stage 2 hydraulic model are considered to be a better representation than those from the Stage 1 hydraulic model.

The Stage 2 hydraulic model predicts higher flood levels within the Bungil Creek floodplain under existing conditions than the 2012 flood markers. These differences are within the variances of the model, given the accuracy of a 10 m model and also the potential for error in surveying flood levels after the event. The modelled flood extent shows a close match to that obtained from aerial photography for the 2012 flood event.

The Regional hydraulic model contains more surface flow than what would be conveyed through the stormwater systems in Roma because the underground drainage system has been excluded. The local stormwater drainage system is included in the Major Local hydraulic model which is discussed in the Stage 2 Local Mitigation report (GHD, 2013b).

5.3 Representation of Regional Flood Mitigation Options

A number of regional flood mitigation options were developed based on discussions with Council and a high level assessment of potential opportunities, as discussed in Section 3. The Stage 2 Regional hydraulic model was then further developed to incorporate these regional flood mitigation options. Options were modelled individually based on 2012 flood event inflows, and the resulting flood extent and levels compared against the 'base case' (with March 2013 Stage 1 Reference Design Levee) flood extent and levels, as shown in Figure 6-1.

Details for individual options investigated are discussed in Section 6; however, they can be generally described as levees, diversion channels, retarding basins and earthworks to widen the floodplain, removal of embankments within the floodplain, and replacement or removal of hydraulic structures. The methodology used to incorporate these features into the Stage 2 Regional hydraulic model are discussed in the following sections. Following assessment of the performance of each of these mitigation options individually, a number of 'combination' mitigation options were developed, each comprising of two or more of the individual options. Details for combinations options investigated are discussed in Section 7.

The options proposed within this report are high-level conceptual designs. A number of key considerations, e.g. agreement with property owners, utility impacts, etc. have not been investigated at this stage. These should be considered during the detailed design phase.

5.3.1 Levees

Proposed Stage 1 and Stage 2 levees are designed to be higher than the 2012 design flood event. To represent this, within the hydraulic model levees were assigned an arbitrary height that exceeded the expected flood levels under both 'base case' scenarios (with March 2013 Stage 1 Levee Reference Design alignment) and mitigated conditions. The Stage 1 levee and all proposed Stage 2 levees were represented within the model by raising a line of cells along the proposed levee alignment to this arbitrary height.

Levee heights were adjusted following confirmation of the July 2013 Stage 1 Reference Design Levee alignment and selection of the preferred Stage 2 Regional Combination Mitigation Option. Heights were assigned based on the modelled 2012 flood event water levels. Adjusted levee heights were incorporated into the final Stage 2 Regional hydraulic model prior to running the full suite of flood events, including those in which the levee is expected to be overtopped (refer Section 8.3).

5.3.2 Diversion Channels

Based on community consultation and council input, a number of diversion channels were investigated as a part of Stage 2. Various sizes and alignments were investigated to find the most effective combination. These channels were designed using 12d software such that the proposed channels merged in with the existing terrain. Elevations from the design surface were then read into the TUFLOW model (as a .12da file), replacing the existing conditions terrain. Due to the 10 m grid resolution, low flow channels were not represented within the hydraulic model. This is unlikely to have a significant impact on the model results, due to the relatively small capacity of these low flow channels, particularly during large flood events such as the 2012 event.

5.3.3 Retarding Basins and Widening of Floodplain

Similar to the diversion channels, retarding basins and major earthworks to widen areas of the Bungil Creek floodplain were designed in the 12d software package to merge in with the existing terrain. These design surfaces were then read into the TUFLOW model (as a .12da file), replacing the existing conditions terrain. While in practice retarding basins are likely to have low flow pipes at the outlet, these were not represented in the hydraulic model as they are unlikely to be quickly surcharged during large flood events and do not contribute to the reduction of peak flood levels.

5.3.4 Removal of Embankments

As discussed in Section 3, scenarios involving the removal of Warrego Highway and Railway embankments were modelled. Embankment removal was represented within the hydraulic model

by using elevations on either side of the embankment to interpolate approximate ground elevation (using 2d_zsh layers).

5.3.5 Removal or Replacement of Hydraulic Structures

The removal and/or replacement of existing bridges and culverts was represented within the hydraulic model by modifying either the layered flow constrictions (2d_lfcsh layers), or 1d network attributes (1d_nwk layers) used to represent these structures under existing conditions. In some cases, crossings were removed entirely to represent a "best case" scenario where there is no obstruction to flow (e.g. due to piers or bridge decks). In other scenarios, a proposed crossing was represented based on a possible crossing configuration. Where new bridge structures have been proposed, a standard nominal pier blockage of 5% was adopted across the bridge opening and a bridge deck of 600 mm was applied. Minor road crossings have not been represented in the model at the 10 m grid size. Details of crossings and their representation for each option are discussed in Section 6.

6. Benefits of Individual Regional Flood Mitigation Options

6.1 Regional Base Case Flood Event – Stage 1 Levee

Individual flood mitigation options as identified in Section 3.3 were modelled as described in Section 5.3. In order to analyse the flood mitigation impact of the individual options, changes in water level and property inundation impact were assessed against a regional "base case" scenario. The base case scenario was the end-point of the Stage 1 Flood Study, i.e. flooding of Roma with the Stage 1 Levee in place. The design flood event selected was the 2012 equivalent flood event. This was chosen in line with the project aim to "reduce the risk of above floor flooding in Roma from a storm event equal to the 2012 flood".

The assessment of individual flood mitigation options is performed in terms of their additional mitigation action on the base case. The base case includes the Stage 1 Levee, which already provides a significant baseline reduction in the number of properties experiencing above-floor flooding in the 2012 equivalent event. With the Stage 1 Levee in place (see Figure 6-1), flood waters have a greatly reduced risk of entering the urban areas of Roma to the west of Bungil Creek. Flood water is now constrained by the physical barrier, which restricts the flow to a floodplain of between 600 m to 1.3 km wide. Properties near Lovell Street, Edwardes Street and Kirkbridge Street experience reduced flooding because backwater effects from Bungil Creek up into Shady's Lagoon and the Long Drain region are reduced. While flooding is still experienced in these urban locations, it is reduced compared to what would occur under the existing conditions.

As modelled in the Stage 1 Flood Study, under the 'base case' scenario the number of properties experiencing flooding will be decreased from approximately 590 under existing conditions to about 120 with the Stage 1 Levee in place. The Stage 1 Levee does not, however, remove above-floor flooding in the 2012 equivalent event for all properties in Roma. As mentioned, there are approximately 120 properties that still experience flooding. Stage 2 Regional mitigation options are intended to reduce the number of properties still experiencing flooding. Particular areas of concern identified by the Roma community and MRC are the following:

- Properties located to the east of the Stage 1 Levee
- The Chinatown area
- The industrial precinct to the east of the Bungil Creek bridge
- Properties in the vicinity of Shady's Lagoon
- Commercial properties bordering the Warrego Highway

In addition to these areas, there are a number of urban areas identified by MRC that experience local flooding. These additional areas have been investigated and the findings are included in the Stage 2 Local Drainage Mitigation report (GHD, 2013b).

The following assessment of individual options has been carried out and the results compared to the 'base case' scenario, both in terms of changes in flood level and property inundation impact.

LEGEND

- Highway
- Road
- Watercourse
- Stage 1 Levee March 2013 Reference Design
- Tuflow Regional Hydraulic Model Boundary
- Cadastre

1:30,000 @ A3

0 500 1,000
Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

Maranoa Regional Council
Roma Flood Study

Stage 2 Regional Hydraulic Model
'Base Case' Flood Extent

Job Number	41-25323
Revision	0
Date	14 Oct 2013

Figure 6-1

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\41_25323_003_Rev_0.mxd
Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: ©Commonwealth of Australia (Geoscience Australia) \Watercourses\2007; DNRM, Locality, Roads\2010, Cadastre, Rivers\2012; GHD Flood Surface, Levee\2013. Created By: LB

6.2 Comparison of Flood Mitigation Results

6.2.1 Comparison of Identified Reference Points

Figures showing the afflux (change in peak flood levels) for each flood mitigation scenario compared to the "base case" scenario (with Stage 1 Levee) are in Appendix C. Table 6-1 provides a summary table of afflux values at a number of reference points located across the town (shown in Figure 2-2). Reference points chosen for comparison are at locations of particular interest as identified by Council and as targeted by the mitigation options.

Table 6-1 Individual Regional Mitigation Options – Change in Flood Levels

Option and Change in Flood Level (+ is decrease, - is increase)		Bungil St Bridge (Point 1)	Carnarvon Hwy and Lovell St (Point 4)	Lovell St and Charles St (Point 9)	Station St and Tiffin St (Point 22)	Property within Floodplain (Point 14)
1	***Eastern Levee***	***-2***	***-2***	***-1***	***-3***	***-4***
2	***Western Levee***	***1***	***3***	***82***	***14***	***-1***
3	Alternative Western Levee	-207	-203	-122	-68	-19
4	***Eastern Diversion Channel A***	***52***	***54***	***67***	***30***	***9***
5	***Eastern Diversion Channel B***	***64***	***66***	***64***	***51***	***19***
6	***Eastern Diversion Channel C***	***96***	***98***	***98***	***76***	***27***
7	***Eastern Diversion Channel D***	***138***	***142***	***126***	***101***	***33***
8	***Extended Eastern Diversion Channel A***	***78***	***80***	***76***	***72***	***71***
9	***Extended Eastern Diversion Channel B***	***109***	***110***	***74***	***125***	***124***
10	***Extended Eastern Diversion Channel C***	***166***	***168***	***103***	***205***	***191***
11	***Extended Eastern Diversion Channel D***	***225***	***227***	***126***	***277***	***222***
12	Eastern Diversion Channel B with Levees	-344	-391	-369	85	188
13	***Western Diversion Drain A***	***39***	***39***	***14***	***192***	***39***
14	***Western Diversion Drain B***	***49***	***46***	***17***	***223***	***49***
15	Ashburn Road Retarding Basin	19	19	7	20	-6
16	Explorers Inn Retarding Basin	49	49	17	80	144
17	***Shady's Lagoon Extension***	***0***	***0***	***0***	***0***	***0***

Option and Change in Flood Level (+ is decrease, - is increase)		Bungil St Bridge (Point 1)	Carnarvon Hwy and Lovell St (Point 4)	Lovell St and Charles St (Point 9)	Station St and Tiffin St (Point 22)	Property within Floodplain (Point 14)
18	Bungil Creek Widening near Hay-Roma Dam	0	0	0	0	0
19	***Bungil Creek Widening at Bungil Street Bridge***	***4***	***8***	***3***	***0***	***0***
20	Remove Warrego Highway	13	13	5	-8	32
21	Remove Railway Embankment	24	24	9	231	120
22	Remove Warrego Hwy and Railway Embankment	56	56	18	163	163
23	***Levees around Properties in Floodplain***	***-48***	***-48***	***-23***	***-68***	***0***

NB: **Bolded Italic** values rows indicate those options taken forward for further consideration.

6.2.2 Comparison of Property Inundation Impact

The impact on property above-floor inundation is tabulated in Table 6-2, according to the categories described in Table 2-1 in Section 2.1.5. These results are presented according to a ranking of all the options modelled, based on the number of properties affected under each option. During the 2012 flood event, approximately 593 properties were flooded. Stage 2 Hydraulic modelling shows that for an event similar to the 2012 flood event, approximately 474 properties will be at far less risk of being impacted by the above-floor flooding after the Stage 1 levee is constructed. The impacts collated in Table 6-2 are compared to and in addition to those impacts experienced in the construction of the Stage 1 Levee.

To make these comparisons, a number of assumptions regarding information about properties, within the collated 'property database' were made. The property database is a compilation of data from sources as described in the Stage 1 report, with additional floor level survey by Bennett & Bennett (2013). Assumptions include:

- Compiled data have not been reviewed by GHD but were submitted to MRC for verification of completeness during the Stage 1 study. Data may be lacking where properties lie outside of the mapped 2012 flood extent
- Should further verification of described impacts and corresponding potential benefits be required, door knocking to collect data on inundation from the 2012 event is recommended
- The accuracy of the reported property impacts is limited by the accuracy of the regional hydraulic model and should be taken as an approximate level only. Where modelled flood levels are close to the surveyed floor level, verification of flood impacts from the 2012 historical event is recommended

Table 6-2 Regional Hydraulic Model Results – Impact on Property Flooding Compared to Stage 1 Only

Rating – least to most flooded	Regional Mitigation Option (Option Number and Description)		Properties **At higher risk** of above floor flooding	Properties **Flooded Either Way**	Properties **At less risk** of being flooded*	Properties **At risk of being flooded** Either Way	Total **Properties at risk** of being flooded	Total **Properties at reduced risk** of being flooded
1	*11*	*Extended Eastern Diversion Channel D*	*0*	*88*	*35*	*933*	*86*	*958*
2	*10*	*Extended Eastern Diversion Channel C*	*0*	*97*	*26*	*933*	*97*	*959*
3	*5*	*Eastern Diversion Channel B*	*0*	*101*	*22*	*933*	*101*	*955*
4	*9*	*Extended Eastern Diversion Channel B*	*0*	*101*	*22*	*933*	*101*	*955*
5	*7*	*Eastern Diversion Channel D*	*0*	*101*	*22*	*933*	*101*	*955*
6	*14*	*Western Diversion Drain B*	*0*	*104*	*19*	*933*	*104*	*952*
7	*6*	*Eastern Diversion Channel C*	*0*	*104*	*19*	*933*	*104*	*952*
8	*4*	*Eastern Diversion Channel A*	*0*	*105*	*18*	*933*	*105*	*951*
9	*8*	*Extended Eastern Diversion Channel A*	*0*	*105*	*18*	*933*	*105*	*951*
10	*13*	*Western Diversion Drain A*	*0*	*108*	*15*	*933*	*108*	*948*
11	16	Explorers Inn Retarding Basin	0	108	15	933	108	948
12	*2*	*Western Levee*	*1*	*114*	*9*	*932*	*115*	*941*
13	15	Ashburn Road Retarding Basin	0	119	4	933	119	937

Rating – least to most flooded	Regional Mitigation Option (Option Number and Description)		Properties **At higher risk** of above floor flooding	Properties **Flooded Either Way**	Properties **At less risk** of being flooded*	Properties **At risk of being flooded** Either Way	Total **Properties at risk** of being flooded	Total **Properties at reduced risk** of being flooded
14	***17***	***Shady's Lagoon Extension***	***0***	***123***	***0***	***933***	123	933
15	18	Widening of Bungil Creek at Hay-Roma Dam	0	123	0	933	123	933
16	***19***	***Widening of Bungil Creek at Bungil Street Bridge***	***0***	***123***	***0***	***933***	123	933
17	***1***	***Eastern Levee***	***1***	***123***	***0***	***932***	124	932
18	***23***	***Levees around properties within floodplain***	***17***	***115***	***8***	***916***	132	924
19	3	Alternative Western Levee	29	118	5	904	147	909
20	12	Eastern Diversion Channel B with Levees	53	108	15	880	161	895

NB: ***bold italic*** values rows indicate those options taken forward for further consideration.

A brief description and discussion on the results of each Stage 2 regional mitigation option follows these summary tables.

6.2.3 Option 1: Eastern Levee

- Increase at Bungil Street Bridge: < 5 mm
- Change in flood levels behind levee: decrease of 70 mm – increase of > 250 mm
- Increase in flood levels within floodplain adjacent to levee: 5-50 mm

While the Eastern Levee option creates a barrier between properties behind the levee and flood flows within Bungil Creek, local catchment flood flows are trapped behind the levee and cannot flow into the creek. This results in an additional property becoming inundated as a result of the mitigation option when compared against the "base case" scenario.

Option 1 will need to include additional drainage features to allow for local stormwater flows entering Bungil Creek. Option 1 will also need to restrict backflow behind the levee at Bungil Creek for increased effectiveness in flood mitigation.

The model shows that there was a small increase in flood levels within the floodplain as a result of the Eastern Levee, however this impact was relatively localised, and within the wider floodplain area was generally small, in the order of 5 mm.

6.2.4 Option 2: Western Levee

- Minimal change in flood level at Bungil Street Bridge
- Decrease in flood levels up to 960 mm directly west of the Stage 1 levee
- Decrease in flood levels up to 150 mm behind southern section of Western Levee
- Decrease in flood levels of up to 200 mm along Long Drain between Bassett Lane and Lovell Street

The Western Levee reduces the volume of backflow occurring within Roma, particularly through the overland flow path between Charles and Edwardes Streets. Some flooding still occurs directly to the west of the proposed levee north of Shady's Lagoon, however this is due to runoff from the local catchment, rather than Bungil Creek. Similarly, flood levels behind the proposed levee south of Shady's Lagoon are reduced, although flooding still occurs due to local runoff and some flow entering this area via Bowen Street/Warrego Highway.

There is minimal change in flood levels elsewhere within Roma, with flood levels marginally lower (< 5 mm) south of Lovell Street, and 10 – 20 mm lower south of Bowen Street, near the Western Drain. Flood levels within the floodplain directly east of Roma are increased slightly as a result of the proposed levees; however this is generally less than 5 mm. Where the Western Levee joins the Stage 1 levee, flood levels increase by approximately 60 mm; this increase is fairly localised, with flood levels south of East George Street increasing by less than 10 mm.

As the proposed levee also causes local catchment flows to pond up behind the embankment, additional drainage features will be required to allow local drainage to pass through the levee.

6.2.5 Option 3: Alternative Western Levee

- *Increase* in flood level at Bungil Street Bridge: 205 mm

The results indicated that the final section of the Stage 1 levee (east of the Stage 2 Western Levee) directs flood flows east across the floodplain, away from the critical Bungil Street Bridge location. Removal of this section of levee results in higher flood levels at the Bungil Street Bridge and Shady's Lagoon area (approximately 205 mm increase), increasing flood levels by up to 200 mm through the Long Drain system compared to the "base case" scenario. Flood levels also increased by up to 70 mm adjacent to the Western Drain.

6.2.6 Options 4, 5 and 6: Eastern Diversion Channel Options A, B and C

- Decrease in flood level at Bungil Street Bridge: 50 mm, 65 mm and 95 mm for Option A, B and C respectively
- Decrease in flood level at East Miscamble Street (beginning of diversion): 230 mm, 240 mm and 350 mm for Option A, B and C respectively
- Localised increase in flood level at downstream end of diversion: 45 mm, 65 mm and 85 mm for Option A, B and C respectively

As can be expected, the largest diversion channel (Option C) had the greatest impact on flood levels, and Option A, being wide but relatively shallow, had the smallest impact on flood levels.

The three Eastern Diversion Channel options (without the extended channel to the south) reduce peak flood levels within the floodplain between East Miscamble Street and the southern end of the diversion channel at Bungil Street. The decrease in flood level within the Long Drain system upstream of Shady's Lagoon from Miscamble Street is similar to that achieved by these mitigation options at the Bungil Street Bridge (50, 65 and 95 mm for Options A, B and C respectively).

As the diversion channels convey floodwaters south-east across the floodplain and away from Shady's Lagoon and Western Diversion Drain areas, flood levels adjacent to the Western Diversion Drain decrease by 30, 50 and 75 mm for Option A, B and C respectively.

There is a localised increase in flood levels where the diversion channel re-joins Bungil Creek and a slight increase in flood levels downstream of this junction, however in all three cases, this increase is generally less than 50 mm, and flood levels are similar to the base case levels south of the railway.

6.2.7 Option 7: Eastern Diversion Channel D

- Decrease in flood level at Bungil Street Bridge: 140 mm
- Decrease in flood levels along the Long Drain system and between Charles and Edwardes Streets: 100 – 230 mm
- Decrease in flood level at Tiffin Street adjacent to the Western Diversion Drain: 100 mm
- Localised increase in flood level at the downstream end of diversion: 90 mm

This alternative alignment of the Eastern Diversion Channel aims to capture the flow being directed east across the floodplain by the end of the Stage 1 levee, thereby more effectively conveying floodwater away from the confluence of Bungil Creek and Shady's Lagoon and the Western Diversion Drain. The results indicate that this alignment performs better than the identically sized Eastern Diversion Channel Option C.

There is a decrease in flood levels of 100 – 200 mm between East Miscamble Street and Bungil Street within the floodplain, with greater decreases locally at the beginning of the diversion (up to 600 mm). West of Bungil Creek, flood levels along the Long Drain and overland flow path between Charles and Edwardes Streets decrease by up to 140 mm. Flood levels directly west of the Stage 1 levee decrease by up to 230 mm due to the lower Bungil Creek levels. There is also a 100 mm decrease in peak flood levels between Edwardes Street and Tiffin Street north of the railway.

As with all the diversion channel options, there is a localised increase in flood levels at the downstream end of the diversion. The localised increase for Option D is approximately 90 mm, however this is relatively localised and afflux is generally 10 – 20 mm north of Warrego Highway, and is minimal south of the railway.

6.2.8 Options 8, 9 and 10: Extended Eastern Diversion Channel Options A, B and C

- Decrease in flood level at Bungil Street Bridge: 80 mm, 110 mm and 165 mm for Options A, B and C respectively
- Decrease in flood level at East Miscamble Street (beginning of diversion): 230 mm, 240 mm and 350 mm for Option A, B and C respectively
- Decrease in flood level at Tiffin Street adjacent to the Western Diversion Drain: 70 mm, 125 mm and 205 mm for Options A, B and C respectively
- Localised increase in flood level at the downstream end of diversion: 70 mm, 85 mm and 110 mm for Options A, B and C respectively

The three Extended Eastern Diversion Channel options reduce peak flood levels within the floodplain between East Miscamble Street and the railway, with the largest channel configuration (Option C) having the largest impact. The decrease in flood levels within Roma is similar at Miscamble and Lovell Streets as those reported above at the Bungil Street Bridge.

As expected, extending the diversion channel through the highway and railway embankments results in lower flood levels compared to the diversion channels that end north of the highway. Within town, the additional section of diversion channel result in flood levels 30 – 70 mm lower compared to the non-extended diversion channel options. Within the floodplain between Bungil Street and the railway, the decrease in flood levels is particularly noticeable, particularly at the two key properties along Warrego Highway, where flood levels decrease between 70 and 120 mm under Option A, and 190 to 280 mm under Option C.

Similar to the Eastern Diversion Channel options, there is an increase in flood levels where the diversion channel re-joins Bungil Creek, south of the railway; however these increases are generally less than 50 mm.

Note that the modelling currently does not include a crossing at Warrego Highway and the configuration of the proposed crossing (e.g. pier blockage, deck thickness and level) will impact the performance of these options. Similarly, the configuration of the crossing at the railway (modelled to be similar to the existing crossing) will affect the hydraulic performance of these options).

6.2.9 Option 11: Extended Eastern Diversion Channel D

- Decrease in flood level at Bungil Street Bridge: 225 mm
- Decrease in flood level at Tiffin Street adjacent to the Western Diversion Drain: 280 mm
- Decrease in flood level near Creek Street, upstream of railway: 400 mm
- Increase in flood level at downstream end of diversion: 150 mm

This alternative alignment of the Extended Eastern Diversion Channel aims to capture the flow being directed east across the floodplain by the end of the Stage 1 levee, thereby more effectively conveying floodwater away from the confluence of Bungil Creek and Shady's Lagoon and the Western Diversion Drain. The results indicate the alignment performs better than the identically sized Extended Eastern Diversion Channel Option C, however, it must be noted there is a larger increase in flood levels south of the railway of up to 150 mm (compared to 110 mm for the Extended Eastern Diversion Channel C).

The results indicate that there are significant decreases in flood levels between East Miscamble Street and the railway (generally 150 – 200 mm) as a result of this mitigation option. In particular, flood levels within the Long Drain and between Charles and Edwardes Streets decrease by up to 230 mm. There is also a substantial decrease in flood levels between

Warrego Highway and the railway, between 270 mm near Tiffin Street, and 400 mm near the proposed crossings of the highway and railway.

Note that the modelling does not currently include any obstruction at the Warrego Highway crossing, and that the details, i.e. piers, of both the highway and railway crossings will impact the hydraulic performance of this mitigation option.

6.2.10 Option 12: Eastern Diversion Channel B with Levees

- *Increase* in flood level at Bungil Street Bridge: 345 mm
- *Increase* in flood levels along the Long Drain system and between Charles and Edwardes Streets: 300 – 400 mm
- Removal of flooding in small area between proposed levees
- Decrease in flood level at Bungil Street and Major Street intersection: 375 mm
- Decrease in flood level at Tiffin Street adjacent to the Western Diversion Drain: 85 mm

This combination of diversion channel and levees aims to decrease flood levels within the floodplain between Bungil Creek and the proposed diversion channel. While flood levels within this area do decrease and a small area is no longer flood-affected, flooding across most of this area still occurs due to backflow from Bungil Creek near the downstream end of the diversion channel.

Additionally, the capacity of the proposed diversion channel is not large enough to compensate for the reduction in floodplain flows caused by the levee along Bungil Creek. This results in *increased* flood levels at the Bungil Street Bridge, which in turn results in significantly higher flood levels along the Long Drain system and through the town.

There are also increases in flood levels east of the diversion channel, of up to 250 – 300 mm. There is little change in flood levels south of the railway.

6.2.11 Options 13 and 14: Western Diversion Drain Options A and B

- Decrease in flood level at Bungil Street Bridge: 40 mm for Option A, 50 mm for Option B
- Decrease in flood levels along the Long Drain system and between Charles and Edwardes Streets: 35 - 40 mm for Option A, 45 - 50 mm for Option B
- Decrease in flood level at Tiffin Street adjacent to the Western Diversion Drain: 190 mm and 225 mm for Option A and B respectively

Of the two Western Diversion Drain options assessed, the larger channel (Option B) results in a slightly larger decrease in peak flood levels within Roma, however both options result in a slight (< 5 mm) decrease in flood levels across the entire floodplain, both north and south of the railway.

The greatest benefit was achieved adjacent to the Western Diversion Drain between Warrego Highway and the railway, with decreases of up to 200 and 225 mm for Option A and B respectively.

As with the other diversion channel options, there was a slight increase in flood levels at the downstream end of the proposed diversion. However, in the case of these Western Diversion Drain options, there are few properties located adjacent to the downstream end of the proposed channel where this afflux occurs.

With these options, it was important that flood flows entering Hay-Roma Dam were not significantly impacted. Checks were undertaken to measure the volume of flow entering the dam via the existing inlet channel from both Western Diversion Drain options. Volumes were found to

allow similar or greater volumes of floodwaters to enter the dam as under base case conditions. More detailed checks are recommended during the design phase should one of these options be selected as the preferred option.

Note that the hydraulic model did not include any blockage for the proposed crossing at Warrego Highway. The design of both the highway and railway crossings for these options will impact the hydraulic performance of these diversion channel options.

6.2.12 Option 15: Ashburn Road Retarding Basin

- Decrease in flood level at Bungil Street Bridge: 20 mm
- *Increase* at properties along Warrego Highway between Short Street and Creek Street: 5 – 10 mm

The results showed minor decreases in peak flood level west of the proposed retarding basin and minor increases east of the proposed basin, although the increases are generally less than 10 mm. Within Roma along the Long Drain, and the overland flow path between Charles and Edwardes Streets, flood levels decrease by up to 20 mm. This retarding basin option also results in small decreases of approximately 20 mm adjacent to the Western Diversion Drain.

While this option provided minimal reduction in flood levels during the 2012 flood event, it may provide a more significant level of flood storage during smaller, more frequent events.

6.2.13 Option 16: Explorers Inn Retarding Basin

- Decrease in flood level at Bungil Street Bridge: 50 mm
- Decrease in flood level at Tiffin Street adjacent to the Western Diversion Drain: 80 mm
- Decrease in flood level at Short Street and Warrego Highway: 140 mm
- Decrease in flood level within industrial properties along Clayton Road: 100 mm

The available storage within the Explorers Inn Retarding Basin is significantly larger than the Ashburn Road Retarding Basin, thus the reduction in flood levels achieved by this option are greater. Peak flood levels across the floodplain between East George Street and Warrego Highway decrease by 80 – 90 mm, and the properties along Warrego Highway between Short Street and Creek Street experience decreased flood levels of up to 140 mm as a result of this option. This option also results in an approximately 100 mm decrease in flood levels within the industrial properties east of Clayton Road.

Note that the decreased flood levels shown within the model will be impacted by the design of the crossing of the outlet channel at Warrego Highway.

6.2.14 Option 17: Shady's Lagoon Extension

- No significant change in flood level at Bungil Street Bridge

The results showed no noticeable change in flood levels due to this option. This is potentially due to the large volume of flow during the 2012 event, during which the majority of flood flows occurred across the floodplain. These works may provide a noticeable benefit during smaller flood events. Additionally, this option may be worth considering in conjunction with additional works to be assessed with the Stage 2 Major Local hydraulic model.

6.2.15 Option 18: Bungil Creek Widening near Hay-Roma Dam

- No significant change in flood level at Bungil Street Bridge
- Decrease in flood levels directly upstream of the Hay-Roma Dam: 100 – 200 mm

Increasing the conveyance within the Bungil Creek floodplain near the Hay-Roma dam significantly lowers flood levels upstream of the dam, however the impact does not extend upstream of the railway. Additionally, these works increase flood levels downstream of the dam, and decrease the volume of flood flows being captured by the dam.

6.2.16 Option 19: Bungil Creek Widening at Bungil Street Bridge

- Decrease in flood level at Bungil Street Bridge: < 5 mm
- Decrease in flood levels along the Long Drain and Western Drain systems: 5 – 10 mm

While there was little change in flood levels due to this option, this is probably due to the large volume of flow during the 2012 event, most of which crossed Bungil Street over the floodplain, rather than through the Bungil Street Bridge. This option may provide a more noticeable benefit during smaller flood events, when the impact of the constriction at the confluence of Shady's Lagoon and Bungil Creek, and the pedestrian crossing downstream of the bridge, on upstream flood levels is more significant

6.2.17 Options 20, 21 and 22: Removal of Embankments (Warrego Highway and/or Railway)

- Decrease in flood level at Bungil Street Bridge:
  - remove Warrego Highway embankment only: 15 mm
  - remove railway embankment only: 25 mm
  - remove both embankments: 55 mm

These options were modelled to investigate the level of impact the highway and railway embankments have, both individually and combined, on flood levels during major flood events. Removing the Warrego Highway and railway embankments allows flood flows to pass more easily through the floodplain, resulting in decreases in peak flood levels across the floodplain upstream of these embankments.

The impact of these options on flood levels downstream of the embankments varied, as the distribution of flows across the floodplain was altered. Removal of the highway embankment resulted in slightly higher flood levels to the east and west between the highway and railway (generally < 10 mm increase), but a decrease in flood levels at the centre of the floodplain, suggesting that the highway restricts the passage of flood waters to a larger degree towards the east and west of the floodplain, rather than at the centre.

Removal of the railway embankment resulted in a significant decrease in flood levels between the highway and railway, ranging from 200 – 600 mm; however this was accompanied by an increase in flood levels downstream of the railway over a sizeable area of the floodplain. These results suggest that the railway embankment forms a blockage to floodplain flows towards the centre of the floodplain, more than near the existing crossings at the Western Drain and Bungil Creek.

Removal of both these embankments generally provided a greater benefit than each of the individual embankment removal options, except in the area south of Bowen Street, west of the Western Diversion Drain. However, this option also resulted in the greatest increase in flood levels downstream of the railway, and across the largest area.

6.2.18 Option 23: Levees around Properties within Floodplain

- Properties within levees north and south of Warrego Highway no longer flood-affected.
- *Increase* in flood level at Bungil Street Bridge: 50 mm
- Localised increase in flood level upstream of the levees: 100 – 200 mm

- Smaller (< 10 mm) increase in flood levels extends from railway to Miscamble Street

This option provides a level of protection for the two properties within the levees, identified as being of high importance. There is a small localised area of a relatively high increase (up to 200 mm) in flood levels surrounding and upstream of the levees, as the embankments decrease the flow area across the floodplain. This impact of these levees extends north to Miscamble Street, although the increase in flood levels across this wider area is generally in the order of 5 – 10 mm. Implementation of this option would need to include drainage measures to allow any runoff from the properties to be discharged outside the levees, to prevent flooding occurring behind the levee.

6.3 Conclusion on Individual Flood Mitigation Options

The comparison of flood levels (Table 6-1) and impacts to property above-floor inundation (Table 6-2) were ranked according to their effectiveness in flood mitigation. Particular consideration was given to target areas as identified by the Roma community and MRC, including the following aims:

- Reduce flooding in the Chinatown area
- Reduce flooding near the high-value industrial areas to the east of Roma
- Reduce flooding impact along Warrego Highway, in particular near high-value commercial properties
- Reduce tailwater near Shady's Lagoon/Long Drain outlet to benefit urban drainage
- Maintain flood flow harvesting to Hay Roma Dam

With reference to the above targeted areas individual options were given further consideration or discounted based on its ability to reduce above-floor flooding. For instances where multiple options benefitted the same target area the option providing the largest benefit progressed into further analysis. Detailed explanations of the rationale for each decision are provided in Sections 6.3.1 and 6.3.2.

6.3.1 Options for Further Detailed Analysis

The following options were selected for further detailed analysis:

Option 1: Eastern Levee

Provided local catchment runoff can be conveyed through or around the proposed levee effectively, the Eastern Levee provides significant benefit to the economically valuable industrial properties along Clayton Road. However this option only provides benefit to a small number of properties, and additional mitigation measures are required to address flooding in other areas of the town.

Option 2: Western Levee

The Western Levee, particularly the section north of Shady's Lagoon, resulted in significantly lower flood levels through a considerable area of Roma as it prevents flows within Bungil Creek from entering Roma west of the Stage 1 levee and contributing to flood flows through the town along the Long Drain system. This option could be enhanced through the inclusion of local drainage to prevent local runoff from ponding behind the levee.

The southern section of the levee has less of an impact, and the cost of the works may not be justified by the comparatively small reduction in flood levels afforded by this option.

Options 4 through 11: Eastern and Extended Eastern Diversion Channel

The Eastern Diversion Channel options redirect a significant volume of the Bungil Creek flood flows through the floodplain, lowering the flood levels at the critical Bungil Street Bridge location. As expected, the largest channel configuration (Options C and D, at 60 m wide, 3.5 m deep) provides the greatest benefit.

Extending the diversion channel through the highway and railway embankments results in even more significant decreases in flood levels within Roma, however this must be weighed against the additional cost of the earthworks and new/upgraded structures required at the highway and railway crossings. The degree of flood benefits achieved by each of the extended diversion channel options will also be dependent on the final design of the crossings; this should be investigated in greater detail during the detailed design phase.

The alternative alignment (Option D) resulted in even greater decreases in flood levels compared to the initial alignment, as it better captures flows directed across the floodplain by the final length of the Stage 1 levee.

As these diversion channels cross through a number of properties, the viability of this option will also depend on consultation and agreement with the relevant landowners.

Options 13 and 14: Western Diversion Channel

Modification of the existing Western Diversion Channel was found to be a worthwhile option, as it reduces flood levels at properties adjacent to the diversion channel (near Tiffin Street, south of Bowen Street), and eases some of the pressure on Bungil Creek as it passes under Warrego Highway and the railway.

Option 17: Shady's Lagoon Extension

Although this option did not yield significant decreases in flood levels during the design 2012 flood event, increasing the storage capacity of Shady's Lagoon may result in better performance of the Long Drain system during smaller, more frequent flood events.

As this option potentially has an impact on flooding at a more local scale, it was included in the options assessment in the "Major Local" phase of this investigation.

Option 19: Bungil Creek Widening at Bungil Street Bridge

This option was selected for further consideration as the narrow channel section in this area and small culvert beneath the pedestrian crossing downstream of the Bungil Street Bridge forms quite a large constriction to flows within the creek. Improving the conveyance through this area is likely to provide benefits during smaller flood events.

Option 23: Levees around Properties Within Floodplain

These properties were identified as being of significant value and as the levees surrounding these properties only results in relatively small increases elsewhere within the floodplain, this option was considered beneficial. However, this option should be considered in conjunction with additional mitigation measures to both mitigate against the impact of these levees, and provide flood mitigation for a larger number of properties within Roma.

6.3.2 Discounted Options

The following options were discounted as not being viable based on the results of the preliminary assessment:

Option 3: Alternative Western Levee

Model results indicated that retaining the final section of the Stage 1 levee is beneficial as this arm of the levee directs flows east across the floodplain, away from the confluence of the Long Drain and Bungil Creek.

Option 9: Eastern Diversion Channel B with Levee

This option was discounted as the proposed diversion channel was insufficient to compensate for the reduced floodplain capacity as a result of the proposed levees, resulting in higher flood levels within Roma west of Bungil Creek, negatively impacting more properties than the number that benefit from this option.

Option 15: Ashburn Road and Explorers Inn Retarding Basins

The retarding basins have little impact on flood levels during large floods such as the 2012 event. While their impact is likely to be greater during more frequent events, these options were discounted due to their ineffectiveness during large events compared to the levee and diversion channel flood mitigation options.

Option 18: Bungil Creek Widening near Hay-Roma Dam

Although this option resulted in substantial decreases in flood levels south of the railway, this option was discounted as it requires significant earthworks and does not impact flooding within the major urban and industrial areas of Roma.

Options 20 through 22: Removal of Warrego Highway and Railway Embankments

These options were tested primarily as a sensitivity analysis to assess the impact of the highway and railway on flood flows and levels upstream of the embankments. While the results indicate that flood levels could be significantly reduced if these embankments did not obstruct flow, lowering the level of the highway and/or railway would significantly reduce their flood immunity and impede traffic and the rail service during smaller flood events.

Although it is highly unlikely that these embankments can be fully removed, future consideration could be given to providing additional conveyance through these embankments as part of future upgrade works to Warrego Highway and/or the railway line.

7. Combination Options for Regional Flood Mitigation

7.1 Design of Combination Options

Individual options were initially progressed to combination phase for the benefit they provided to target areas. These were then combined in multiple combination options to evaluate their cumulative benefit. Aims of the combination design included best flood level reductions in areas of high urban density, potential to reduce Long Drain tailwater and overall flood risk to Roma, and reduction of flood risk to those target areas identified in Section 6.1 and 6.3.

When integrating individual options to create the combination options, some modifications were necessary to streamline the infrastructure or minimise the obstruction to local floodplain flows where passage is required. These changes as modelled comprised of alteration to levee alignments such as near the sporting field bordering Bungil Creek, and at the Western Levee near the Western Diversion Drain. Testing was undertaken to confirm the neutral impact of these changes on potential property inundation.

Note that for Combinations 1 through 5, pipes with downstream floodgate, or pumps, to collect and discharge flows ponded behind the levee were not incorporated into the modelling for the Eastern and Western Levee options. This means that results show local inflows to an identified pond against the levee wall which can result in higher flood levels at a number of properties adjoining the levee. Minor drainage pipes were included in Combinations 6 and 7. This situation will be further assessed in the detail design phase so that an appropriate local drainage solution can be incorporated in the final design.

Each of the seven combination options designed is described in Table 7-1.

Table 7-1 Regional flood mitigation combination options

Combination Option		Description
C1	Combined Levees, Eastern Diversion Channel B	Combination of: Eastern Levee; Western Levee; and Eastern Diversion Channel B (width 40 m, depth 3.5 m).
C2	Combined Levees, Eastern Diversion Channel C	Combination of: Eastern Levee; Western Levee; and Eastern Diversion Channel C (width 60 m, depth 3.5 m).
C3	Combined Levees, Extended Eastern Diversion Channel C	Combination of: Eastern Levee; Western Levee; and Extended Eastern Diversion Channel C (width 60 m, depth 3.5 m, channel extends south through Warrego Highway and railway).
C4	Combined Levees, Western Diversion Drain A	Combination of: Eastern Levee; Western Levee; and Western Diversion Drain A (width 40 m, depth 2 m, off-take to Hay-Roma Dam).

Combination Option		Description
C5	Combined Levees, Western Diversion Drain A, Eastern Diversion Channel C	Combination of: Eastern Levee; Western Levee; Western Diversion Drain A (width 40 m, depth 2 m, off-take to Hay-Roma Dam); and Eastern Diversion Channel C (width 60 m, depth 3.5 m).
C6	Modified Levees, Western Diversion Drain B, Extended Eastern Diversion Channel D, Widening of Bungil Creek at Bungil Street Bridge	Combination of: Eastern Levee (with 2 sets 6 No. 600 mm diameter pipes with flap gate); Western Levee (northern section only, with 1 set 4 No. 600 mm diameter pipes with flap gate); Extended Eastern Diversion Channel D (60 m wide, 3.5 m deep); Western Diversion Drain B; Bungil Creek Widening at Bungil Street Bridge; and Levees around Properties within Floodplain (alternative alignment).
C7	Modified Levees, Extended Eastern Diversion Channel D, Widening of Bungil Creek at Bungil Street Bridge	Combination of: Eastern Levee (with 2 sets 6 No. 600 mm diameter pipes with flap gate); Western Levee (northern section only, with 1 set 4 No. 600 mm diameter pipes with flap gate); Extended Eastern Diversion Channel D (60 m wide, 3.5 m deep); Bungil Creek Widening at Bungil Street Bridge; and Levees around Properties within Floodplain (alternative alignment).

7.2 Flood Mitigation Benefits

7.2.1 Change in Flood Level

Figures showing the afflux (change in flood level) under combined mitigation scenarios were compared against the "base case" scenario (with Stage 1 Levee). Appendix B displays the result for Combinations 1 through to 5, whilst the results of Combinations 6 and 7 are presented in Section 8.3. A summary table of afflux values (shown in Figure 2-2) and impacts of properties are tabulated in Table 7-2 and Table 7-3 respectively for specified reference points. A brief description and discussion on the results follow the summary tables.

It should be noted that changes in flood behaviour based on the combination mitigation options described in this report will only be representative where all proposed works within that option are in place. Staging of implementation has not been considered in this report. Impacts from individual components have been modelled individually and may be referenced for further information.

Table 7-2 Combination regional mitigation options – Change in Flood Level

Option and change in flood level compared to Stage 1 Levee only (+ is reduction, - is increase)		Bungil St Bridge (Point 1)	Carnarvon Hwy and Lovell St (Point 4)	Lovell St and Charles St (Point 9)	Station St and Tiffin St (Point 22)	Property within Floodplain (Point 14)
C1	Combined Levees, Eastern Diversion Channel B	62 mm	63 mm	126 mm	60 mm	14 mm

Option and change in flood level compared to Stage 1 Levee only (+ is reduction, - is increase)		Bungil St Bridge (Point 1)	Carnarvon Hwy and Lovell St (Point 4)	Lovell St and Charles St (Point 9)	Station St and Tiffin St (Point 22)	Property within Floodplain (Point 14)
C2	Combined Levees, Eastern Diversion Channel C	92 mm	92 mm	126 mm	86 mm	20 mm
C3	Combined Levees, Extended Eastern Diversion Channel C	166 mm	166 mm	126 mm	228 mm	187 mm
C4	Combined Levees, Western Diversion Drain A	17 mm	19 mm	98 mm	364 mm	13 mm
C5	Combined Levees, Western Diversion Drain A, Eastern Diversion Channel C	110 mm	111 mm	126 mm	485 mm	38 mm
C6	***Modified Levees, Western Diversion Drain B, Extended Eastern Diversion Channel D, Widening of Bungil Creek at Bungil Street Bridge***	***286 mm***	***290 mm***	***300 mm***	***405 mm***	***Flooding removed***
C7	***Modified Levees, Extended Eastern Diversion Channel D, Widening of Bungil Creek at Bungil Street Bridge***	***231 mm***	***236 mm***	***246 mm***	***246 mm***	***Flooding removed***

NB: **bolded Italic** values rows indicate those options taken forward for further consideration.

When modelled in combination, a number of interactions were observed between the individual flood mitigation options. The Western Levee in particular had benefit to urban areas of Roma but pushed increased flow through the Bungil Creek. This reduced the efficiency of combined options with measures to improve flood levels at the Bungil Street Bridge. In this way, smaller benefit to this area was seen in combination compared to modelling of individual options. However, properties within Roma north of Shady's Lagoon benefit from the inclusion of the Western Levee due to its ability to prevent flows from Bungil Creek entering Roma directly behind the Stage 1 levee and for this reason is was a preferred option for combination.

The larger the diversion channel, the larger the decreases in flood levels achieved across most of the floodplain. This is not surprising and is confirmed by the following observations:

- Combination 6, which includes a Western Diversion Drain option and the better performing alignment of the Extended Eastern Diversion (Option D), produces the largest decreases in flood level across most of the study area
- Combination 3, with the Extended Eastern Diversion Channel C (60 m wide, 3.5 m deep, extended through Warrego Highway and railway embankments), resulted in larger decreases than those combinations without the extended section of the Eastern Diversion Channel (Combinations 1, 2 and 5)
- Combination 7 performs similarly to Combination 6, although the exclusion of the Western Diversion Drain option is reflected in the smaller reduction in flood levels at Station Street and Tiffin Street (adjacent to the Western Drain), and slightly smaller decreases in flood levels (approximately 50 mm) across the floodplain and within the Long Drain system

The Western Diversion Drain is another feature that provides definition between options, as noted in the following observations:

- The Station Street and Tiffin Street location, given its proximity to the Western Diversion Drain, sees the greatest decrease in flood levels when the Western Diversion Drain option is included (Combinations 4 and 6)
- Combination 4 alone, without one of the configurations of the Eastern Diversion Channel (as in Combination 6), results in little change to flooding within the main urbanised area of Roma

7.2.2 Change in Property Inundation Impact

The impact on property above-floor inundation is tabulated in Table 7-3, according to the categories described in Table 2-1 in Section 2.1.5. These results are presented according to a ranking of all the combination options modelled, based on the number of properties affected under each option. During the 2012 flood event, approximately 593 properties were flooded. Stage 2 Hydraulic modelling shows that for an event similar to the 2012 flood event, approximately 474 properties will be saved from flooding after the Stage 1 levee is constructed. The impacts collated in Table 7-3 are in addition to those impacts experienced in the construction of the Stage 1 Levee.

Reductions in above-floor flooding for properties showed that Combination 6 and Combination 7 provide the best flood mitigation benefit. Compared to the base case scenario (Stage 1 Levee) these options, respective to Combination 6 and 7, showed that 55 and 51 properties would no longer experience above-floor flooding with the combination works in place (Properties No Longer Flooded). Neither of them causes inundation of previously 'dry' properties (i.e. Properties Newly Flooded). The total properties that remain flooded with mitigatory works at this scale of assessment are 73 with Combination 6 implemented, and 77 with Combination 7 implemented. These results confirm that the flood level reductions noted previously translate to benefits to properties.

Table 7-3 Changes in Property Inundation Compared to Stage 1 Only

Rating – least to most flooded	Regional Mitigation Option (Option Number and Description)		Properties **At higher risk** of above floor flooding	Properties **Flooded Either Way**	Properties **At less risk** of being flooded*	Properties **At risk of being flooded** Either Way	Total **Properties at risk** of being flooded	Total **Properties at reduced risk** of being flooded
1	C6	Combination 6 – Modified Levees, Western Diversion Drain B, Extended Eastern Diversion Channel D, Widening of Bungil Creek at Bungil Street Bridge	0	73	55	928	73	983
2	C7	Combination 7 - Modified Levees, Extended Eastern Diversion Channel D, Widening of Bungil Creek at Bungil Street Bridge	0	77	51	928	77	979
4	C3	Combination 3 - Combined Levees, Extended Eastern Diversion Channel C	0	94	29	933	94	962
5	C5	Combination 5 - Combined Levees, Western Diversion Drain A, Eastern Diversion Channel C	0	96	27	933	96	960
10	C4	Combination 4 - Combined Levees, Western Diversion Drain A	0	102	21	933	102	954
11	C1	Combination 1 - Combined Levees, Eastern Diversion Channel B	0	103	20	933	103	953
12	C2	Combination 2 - Combined Levees, Eastern Diversion Channel C	0	100	20	933	100	953

8. Assessment of Mitigation Combinations

8.1 Multi-Criteria Analysis

A Multi-Criteria Analysis (MCA) was combined with desktop based Geographic Information System (GIS) technology to undertake the analysis of flood mitigation options. The purpose of this MCA was to provide a systematic tool for evaluating each option considered during the Stage 2 flood mitigation options analysis.

The evaluation results for assessment of the regional flood mitigation combination options are described in detail in Appendix D. The effects of building infrastructure on the natural and built environment (including social and cultural heritage) was evaluated. Placements of flood mitigation infrastructure (levees, diversions, etc.) were evaluated against the following MCA values:

- Social (flood levels, zoning, cultural heritage)
- Environmental (habitats, ecosystems, wildlife, and wetlands)
- Infrastructure (roads, rail, and utilities)

GHD applied a systematic and transparent approach to assess the feasibility of the combined flood mitigation options to assess:

- Impact from foot-print of proposed flood mitigation option infrastructure, i.e. total surface area impacted by construction of levees or diversions
- Impact from changes to the floodplain that would occur based on implementation of the proposed flood mitigation options e.g. decreases in flood level

The results of the MCA assessment provide a ranking for each combination. The combinations are listed from most to least preferred in Table 8-1

Table 8-1 Ranking of Combinations by MCA, Listed by Most to Least Preferred

Ranking	Combination
1	Combination 5
2	Combination 6
3	Combination 7
4	Combination 4
5	Combination 3
6	Combination 1
7	Combination 2

Combination 5 is listed as the most preferred option because the footprint is smaller; however, because the aim of this study is to improve flooding conditions, the weighted totals for the floodplain impacts have been given a higher priority. As such, Combinations 6 and 7 are considered to be the more preferable options.

8.2 Summary of Preferred Option

The results of the flood level benefit assessment, property inundation impact assessment both favoured Combination 6 and then Combination 7. The MCA process resulted in the top three ranked options of Combination 5, 6 and 7. It is therefore evident that, based on the aim of reducing the risk of above-floor flooding in Roma, Combination 6 is the preferred flood mitigation options, followed by Combination 7. Both of these preferred options were carried into feasibility stage, as discussed in Section 9.

Schematics of Combination 6 and 7 are shown in Figure 8-1. Concept drawings are included in Appendix F. Combination 7 is identical to Combination 6, except that Combination 7 does not include Western Diversion Drain B and the two new bridge structures across Warrego Highway and the railway that are associated with this diversion.

It should be noted that this conclusion is based on a comparative assessment of the proposed options. More detailed modelling of the preferred option is recommended during the detailed design phase to confirm hydraulic behaviour and inform design.

LEGEND

- Highway
- Road
- Watercourse
- Cadastre
- Stage 1 Levee July 2013 Reference Design
- Stage 2 Levee
- Extended Eastern Diversion Channel D
- Western Diversion Drain B (Combination 6 Only)
- Remove Bungil Street Bridge and Culvert
- Tuflow Regional Hydraulic Model Boundary

New Bridge Structures

- Not Modelled
- Included in Model

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study

Stage 2 Preferred Regional Combinations 6 & 7
Flood Mitigation Options

Job Number 41-25323
Revision 0
Date 14 Oct 2013

Figure 8-1

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Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

8.3 Modelling of Preferred Options with Updated Stage 1 Levee

To complete this stage of the investigation, the July 2013 Stage 1 Reference Design Levee was incorporated into a final TUFLOW hydraulic model. This revised model was then run for the Combination 6 and 7 scenarios, with Stage 2 levee levels based on 2012 flood event levels plus a 300 mm freeboard. This model was run for a range of ARI events, ranging from 2 years to a PMF event.

The following figures, Figure 8-2 to Figure 8-11, show the results of the Stage 2 Regional hydraulic modelling of the preferred combination options, Options 6 and 7, for the 2012 flood event. These results are also compared against Existing Conditions (Figure 8-5 and Figure 8-10) and with the July 2013 Stage 1 Reference Design Levee in place (Figure 8-6 and Figure 8-11). The impact of these Stage 2 Regional works on flood levels at a number of locations (refer Figure 2-2 for locations) is tabulated in Table 8-2.

Based on these results, both of the preferred Stage 2 Regional Mitigation Combination Options provide additional reductions in flood levels within Roma on top of the reductions achieved by the Stage 1 levee. These reductions in peak flood levels, particularly within the Shady's Lagoon area, are expected to assist the conveyance of local flood flows to provide additional benefit at a more localised scale, as investigated in the Stage 2 Local Mitigation report (GHD, 2013b).

Construction of the Stage 1 levee resulted in higher flood levels within the floodplain directly east of the levee. Stage 2 options, Combinations 6 and 7 resulted in a slight reduction in flood levels east of the Stage 1 levee, compared to the Stage 1 Conditions (50 –100 mm along East Miscamble Road), flood levels within this area of the floodplain are still higher than under Existing Conditions.

Table 8-2 Preferred Regional Combination Mitigation Options – Decrease in Flood Levels

Flood Mitigation Option	Base Case Scenario	Change in Flood Level at Location of Interest (mm, + is reduction, - is increase)					
		Bungil St Bridge (Point 1)	Carnarvon Hwy and Lovell St (Point 4)	Lovell St and Charles St (Point 9)	Station St and Tiffin St (Point 29)	Property within Floodplain (Point 17)	Creek St and Warrego Hwy (Point 33)
Combination 6	Existing Conditions	1198	1726	1579	706	Flooding risk reduced significantly	421
Combination 6	Stage 1 Levee	286	290	300	405	Flooding risk reduced significantly	462
Combination 7	Existing Conditions	1143	1672	1525	547	Flooding risk reduced significantly	381
Combination 7	Stage 1 Levee	231	236	246	246	Flooding risk reduced significantly	422

LEGEND

- Highway
- Road
- Watercourse
- Cadastre
- Tuflow Regional Hydraulic Model Boundary
- Stage 1 Levee July 2013 Reference Design
- Combination 6

New Bridge Structures

- Not Modelled
- Included in Model

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

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Roma Flood Study

Job Number 41-25323
Revision 0
Date 14 Oct 2013

Stage 2 Regional Combination 6 Mitigation Option 2012 Event Peak Flood Depth

Figure 8-2

Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E brmail@ghd.com W www.ghd.com

LEGEND

- Highway
- Road
- Watercourse
- Cadastre
- Tuflow Regional Hydraulic Model Boundary
- Stage 1 Levee July 2013 Reference Design
- Combination 6

New Bridge Structures

- Not Modelled
- Included in Model

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Roma Flood Study

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Stage 2 Regional Combination 6 Mitigation Option
2012 Event Peak Flood Velocity

Figure 8-3

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Data Source: ©Commonwealth of Australia (Geoscience Australia) Watercourses/2007; DNRM, Locality, Roads/2010, Cadastre, River/2012; GHD Flood Surfaces, Sample Points, Levee/2013; DTMR Aerial/2011 Created By: LS

LEGEND

- Highway
- Road
- Watercourse
- Cadastre
- Tuflow Regional Hydraulic Model Boundary
- Stage 1 Levee July 2013 Reference Design
- Combination 6

New Bridge Structures

- Not Modelled
- Included in Model

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study

Stage 2 Regional Combination 6 Mitigation Option
2012 Event Flood Hazard

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Revision	0
Date	14 Oct 2013

Figure 8-4

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Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

LEGEND

- Sample Point
- Highway
- Road
- Watercourse
- Stage 1 Levee July 2013 Reference Design
- Combination 6
- Tuflow Regional Hydraulic Model Boundary
- Existing Conditions Flood Extent

New Bridge Structures

- Not Modelled
- Included in Model

1:30,000 @ A3

0 500 1,000 Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study

Stage 2 Regional Combination 6 Mitigation Option 2012 Event Peak Flood Afflux Against Existing Conditions (No Stage 1 Levee)

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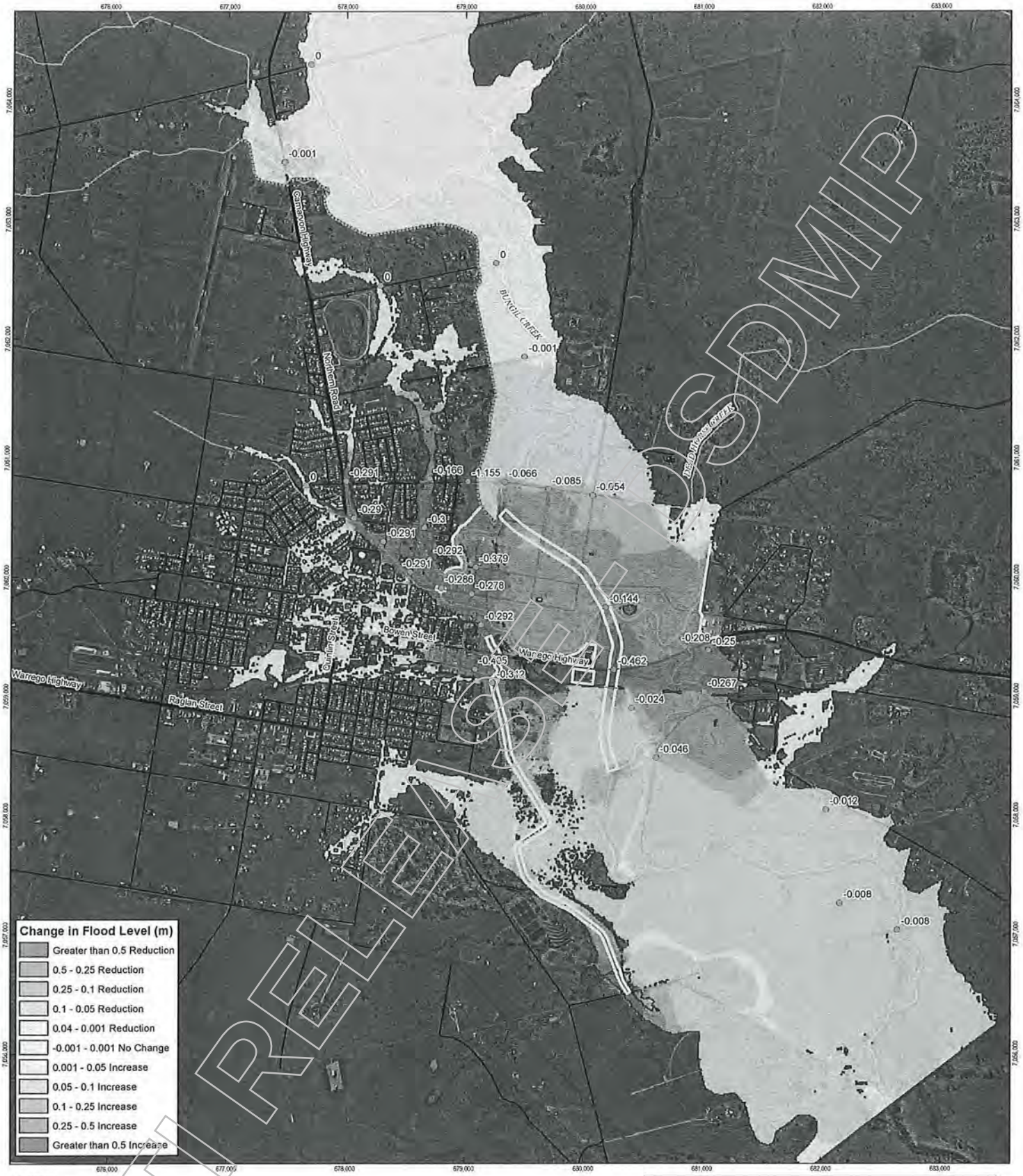
Revision 0
Date 14 Oct 2013

Figure 8-5

Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



LEGEND

- Sample Point
- Highway
- Road
- Watercourse
- Stage 1 Levee July 2013 Reference Design
- Combination 6
- Tuflow Regional Hydraulic Model Boundary
- Stage 1 Flood Extent

New Bridge Structures

- Not Modelled
- Included in Model

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study

Stage 2 Regional Combination 6 Mitigation Option 2012 Event Peak Flood Afflux Against Base Case Conditions (Stage 1 Levee)

Job Number 41-25323
Revision 0
Date 14 Oct 2013

Figure 8-6

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Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

LEGEND

- Highway
- Road
- Watercourse
- Cadastre
- Tuflow Regional Hydraulic Model Boundary
- Stage 1 Levee July 2013 Reference Design
- Combination 7

New Bridge Structures

- Not Modelled
- Included in Model

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study

Job Number 41-25323
Revision 0
Date 14 Oct 2013

Stage 2 Regional Combination 7 Mitigation Option 2012 Event Peak Flood Depth

Figure 8-7

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Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

LEGEND

- Highway
- Road
- Watercourse
- Cadastre
- Tuflow Regional Hydraulic Model Boundary
- Stage 1 Levee July 2013 Reference Design
- Combination 7

New Bridge Structures

- Not Modelled
- Included in Model

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study

Job Number 41-25323
Revision 0
Date 14 Oct 2013

Stage 2 Regional Combination 7 Mitigation Option 2012 Event Peak Flood Velocity

Figure 8-8

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Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: ©Commonwealth of Australia (Geoscience Australia): Watercourses/2007; DNRM, Locality, Roads/2010, Cadastre, River/2012, GHD Flood Surfaces, Sample Points, Levee/2013; DTMR Aerial/2011. Created By: LS

LEGEND

- Highway
- Road
- Watercourse
- Cadastre
- Tuflow Regional Hydraulic Model Boundary
- ******* Stage 1 Levee July 2013 Reference Design Combination 7

New Bridge Structures

- Not Modelled
- Included in Model

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study

Job Number 41-25323
Revision 0
Date 24 Jan 2014

Stage 2 Regional Combination 7 Mitigation Option 2012 Event Flood Hazard

Figure 8-9

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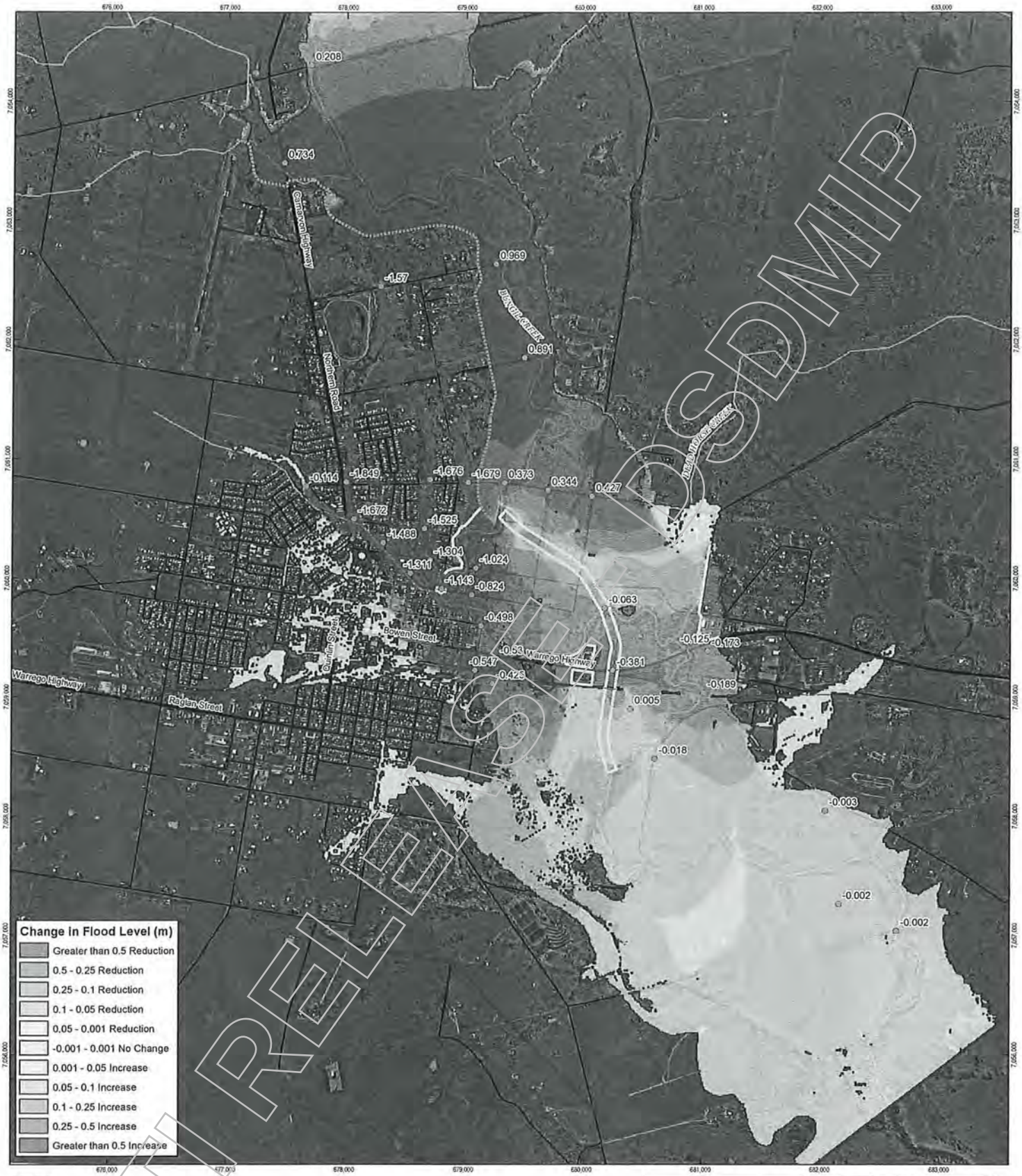

LEGEND

- Sample Point
- Highway
- Road
- Watercourse
- Stage 1 Levee July 2013 Reference Design
- Combination 7
- Tuflow Regional Hydraulic Model Boundary
- Existing Conditions Flood Extent

New Bridge Structures

- Not Modelled
- Included in Model

1:30,000 @ A3
0 500 1,000
Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study

Stage 2 Regional Combination 7 Mitigation Option 2012 Event Peak Flood Afflux Against Existing Conditions (No Stage 1 Levee)

Job Number 41-25323
Revision 0
Date 14 Oct 2013

Figure 8-10

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Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: ©Commonwealth of Australia (Geoscience Australia) Watercourses/2007; DNRM, Locality, Roads/2010, Cadastre, River/2012, GHD, Flood Surfaces, Sample Points, Levee/2013; DTMR Aerial/2011. Created By: LS

LEGEND

Sample Point
Highway
Road
Watercourse
Stage 1 Levee July 2013 Reference Design
Combination 7
Tuflow Regional Hydraulic Model Boundary
Stage 1 Flood Extent

New Bridge Structures

Not Modelled
Included in Model

1:30,000 @ A3
0 500 1,000
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

Maranoa Regional Council
Roma Flood Study
Stage 2 Regional Combination 7 Mitigation Option
2012 Event Peak Flood Afflux
Against Base Case Conditions (Stage 1 Levee)

Job Number 41-25323
Revision 0
Date 14 Oct 2013

Figure 8-11

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Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E brmail@ghd.com W www.ghd.com

9. Option Feasibility

9.1 Cost Benefit Analysis (CBA)

As described in the previous section, two hydraulically preferred options were selected. To assist council with determination of the feasibility of these options, a CBA was undertaken.

To perform a cost benefit analysis, indicative Capital Expenditures (CAPEX) has been prepared for the two preferred combinations; Combination 6 and Combination 7. The CBA Methodology adopted for this Stage 2 analysis is consistent with the methodology used to estimate a preliminary benefit-cost ratio in the Stage 1 analysis. The cost estimates are included in Appendix E.

The calculated CAPEX for each option was compared against the associated cost of flood damages. The comparison was made between the Average Annual Damage (AAD) and the cost of mitigation (Combinations 6 and Combination 7). AAD is the average damage by flooding per year that would occur in a nominated development situation over a very long period of time. In order to maintain consistency with the Stage 1 analysis, the evaluation period of 50 years and discount rate of 7% was again adopted for this analysis. Several discount rates can be applied to perform sensitivity checks as part of a detailed economic analysis. A comparison was also made between the net present value (NPV) of the damage under the existing case and the NPV of the reduced damages predicted to be experienced with Combinations 6 and 7. Net Present Value is the sum of the total value of all money that will be spent across a time frame, discounted back to reflect its current value

The results of the cost-benefit analysis are summarised in Table 9-1.

Table 9-1 Economic Analysis Summary

	Existing (no Stage 1 or 2 works)	Developed (Combination 6)	Developed (Combination 7)
AAD ($M/Annum)	$2.98	$0.49	$0.48
NPV of damage ($M/Annum)	$41.2	$6.8	$6.7
Cost of Mitigation ($M)	N/A	$29.1M*	$25.2M*
Cost Benefit Ratio	N/A	1.18	1.37
Reduction in NPV of damages ($M/Annum)	N/A	$34.4	$34.5

*Inclusive of Stage 1 Levee Cost ($14.8 M)

The values presented in Table 9-1 differ from those given in the *Maranoa Regional Council, Roma Flood Mitigation Project, Stage 1 Hydrology and Hydraulic Assessment Report* (GHD, April 2013). The NPV of damages predicted for the existing condition are shown to be more in the Stage 2 model because of the refinement of the hydraulic model since the time of the Stage 1 Study. The Stage 2 hydraulic model has been updated to include local inflows at various locations.

As expected, the cost benefit ratios for the Stage 2 flood mitigation options (Combination 6 and 7) are somewhat less than that seen for the Stage 1 Levee.

To calculate the AAD for Stage 2, methodology (and stage-damage curve) adopted during Stage 1 has been used for consistency. Note that the Hawkesbury-Nepean Floodplain Management Steering Committee document titled "Managing Flood Risk through Planning Opportunities" (2006) has been referenced in this process. The AAD is reflective of structural, contents and other external damages to single storey residential properties. The Hawkesbury-Nepean document contains data valid in 2006. Therefore inflation adjustment has been applied to the data to estimate their current value. An inflation rate of 1.2% has been adopted for the Stage 2 analysis, calculated using an online tool provided by the Australian Bureau of Statistics (ABS, October 2013).

Robust property data (such as number of storeys and property type) should be collected to support a more detailed economic analysis. At this preliminary stage, all properties have been analysed as single storey residential category, to maintain consistency with the Stage 1 analysis and reporting. Soft costs for shutting the highway for days when the road is cut by flooding have not been included; these costs could be quite substantial given the agricultural, livestock, and coal seam gas industry activities in the region. In addition, the costs associated with loss of life have not been included as a part of this analysis. A detailed economic analysis for the area would be required to fully evaluate the soft costs associated with each option for Stage 2; performing such an analysis is outside the scope of this project This analysis does not consider the structural damage & reinstatement losses resulting from total destruction of buildings. Consideration of these costs should be made in a detailed economic analysis

9.2 Potential Scheduling

The benefit-cost ratio for the Regional Combination works is a preliminary estimate only. Furthermore it is recommended that the construction of the preferred combination components should be undertaken using a staged approach to provide incremental benefit as funding and infrastructure renewal opportunities arise. An additional economic analysis of these works, incorporating 'soft costs' associated with the flood damage experienced, should be undertaken in future stages of consideration. The suggested order of implementation, and approximate associated cost, is as given in Table 9-2.

It is recommended that the levees are installed first, because they will provide an immediate level of protection for the industrial and hotel properties. In addition, the western levee will help to reduce risk of flooding caused by backwater from the Bungil Creek. Construction of the Eastern Diversion, north of the Warrego Highway, is recommended to be construction second because it allows a direct flow path for flows in the floodplain to be conveyed quickly downstream; additionally, the Eastern Diversion helps to reduce risk of flooding in the Chinatown area, especially during smaller flood events.

The Eastern Diversion Extension is recommended third, only because the cost is substantial due to the crossings with the Warrego Highway and Rail. As funding is available, the extension should be constructed to provide additional benefit regionally.

The Western Diversion is recommended fourth for construction because it provides the least regional benefit of each of the individual options. However, the Western Diversion is integral to

the holistic approach of the project; Major Local mitigation options at Station Street are dependent on construction of the Western Diversion.

Table 9-2 Staging of Combination 6

Sequencing	Description	Approximate Capital Cost Estimate*
1	Install Western, Eastern, and Hotel Levees	$999,000
2	Construct Eastern Diversion (section north of Warrego Highway)	$1,555,000
3	Construct Eastern Diversion Extension including crossings at Warrego Highway and Rail	$4,325,000
4	Construct Western Diversion including crossings at Warrego Highway and Rail	$2,866,000

*Note: indicative cost estimate based on information included in Appendix E.

10. Conclusion

10.1 Preferred regional flood mitigation combination

This Stage 2 Regional Flood Mitigation Investigation found that a combination of levees and diversion channel(s) provided significant reductions in flood levels in Roma. In particular, options that increased the ability of flood flows to pass under the highway and railway embankments provided the most benefit.

The two preferred Stage 2 Regional Combination Mitigation Options which were found to be the most beneficial are Combinations 6 and 7:

- Combination 6 is the hydraulically preferred option.
- Combination 7 is the secondary preferred option.

The two options are similar, comprising the following components:

- Eastern Levee
- Northern section of Western Levee
- Levees around two properties within the floodplain
- Extended Eastern Diversion Channel D
- Widening of Bungil Creek at Bungil Street Bridge and removal of downstream culvert

Combination 6 also included works done to the existing Western Drain (Western Diversion Drain Option B) (Refer to Figure 8-1). Section 7 presents the model results showing the provided decrease in flood levels compared to firstly the existing scenario and secondly with the Stage 1 levee constructed.

10.2 Reduction in flooding risk

During the 2012 flood event, approximately 593 properties were flooded. Hydraulic modelling undertaken as part of this study shows that for an event similar to the 2012 flood event, approximately 474 properties will be saved from above-floor flooding after the Stage 1 Levee is constructed. The Stage 2 regional flood mitigation Combination 6 and Combination 7 each provide additional benefit in reducing flood levels and the risk of above-floor flooding. It was shown that compared to a base case scenario with the Stage 1 Levee in place, Combination 6 would provide benefit to an additional 55 properties, while Combination 7 would provide slightly less flood mitigation, benefitting 51 properties. Checks for adverse effects in other areas of the floodplain shows that neither option causes above-floor inundation to properties previously not flooded. Following implementation of Combination 6 or Combination 7, it is expected that the number of properties experiencing above-floor flooding will be reduced to approximately 73 or 77 properties respectively.

10.3 Benefits of individual components

Each component of the regional preferred combination options provides a level of flood risk reduction. The benefits observed from modelling of the options are described as follows:

- The diversion channels increase the conveyance through the floodplain during large events
- The levees provided additional protection on top of the reduced flood levels achieved by the diversion channels

- The greatest benefit of the Western Diversion Channel was observed adjacent to the Western Diversion Drain between Warrego Highway and the railway
- The Eastern Diversion Channel provided more widespread benefits, particularly when aligned with the end of the Stage 1 levee and extended through Warrego Highway and the railway
- The Eastern Levee and levees around two particular properties within the floodplain were proposed and selected for inclusion as they protect commercially valuable properties from regional flooding
- The northern section of the Western Levee was found to be beneficial in preventing backflow from Bungil Creek from worsening local flooding through Roma, as it blocks off a low-lying section of terrain near the end of the Stage 1 levee
- The option to replace the Bungil Street Bridge and culvert downstream of this bridge was included in both preferred combination options as this location is identified as a constriction point for flows within Bungil Creek.

11. Recommendations

Recommendations are listed below, based on the findings discussed within this study.

- Combination 6 is the recommended option based on hydraulic performance. However, it is our understanding, that funding from grant sources may be limited for implementation of this combination. As such, it is our recommendation that a staged approach be taken to implement aspects of Combination 6. Staging should be done in the order listed in Table 9-2
- Alternatively, Combination 7 has been presented as a slightly more affordable option; however, this option excludes upgrades to the western diversion drain. The Major Local drainage assessment results are dependent on improvements to the western diversion drain. This is especially true for the improvements proposed along Station Street, as discussed in the *Maranoa Regional Council, Roma Flood Mitigation Project, Stage 2 Local Flood Mitigation Assessment* (GHD, August 2013)
- It is recommended that a detailed economic analysis be undertaken to fully evaluate soft costs associated with each option for Stage 2. A detailed economic analysis should be done to consider the costs associated with loss of life, closing the Warrego highway for periods when the roadway is cut by flooding, and to evaluate impacts of flooding on the coal seam gas industry
- Considerations such as agreement with property owners, utility impacts, etc. have not been included as a part of the assessment because of the high-level nature of this study and conceptual designs. For detail design, it is recommended that these are considered
- These options were modelled as high level conceptual designs only, for the purpose of comparison against a range of alternatives, and more detailed modelling is recommended at detailed design stage to check the performance of the selected option. In particular, the hydraulic performance of the preferred options is dependent upon details of the design, such as local drainage to prevent ponding of local runoff behind the proposed levees, the final alignment and capacity of the proposed diversion channels, inlet design for diversions, and the design of the proposed bridge or culvert crossings
- The railway and highway embankments were also shown to restrict flows across the floodplain. While it is unlikely that these embankments can be lowered due to the need to maintain a level of flood immunity for both the railway and highway, construction of additional culvert and/or bridge crossings coinciding with future upgrade works to the highway or railway may be worth further consideration
- In conjunction with any flood mitigation measures, it is recommended that MRC consider requiring future developments to the west of Roma near the Railway Dam to provide on-site detention of stormwater flows to achieve pre-development flow rates. This would assist in alleviating current pressures on the local drainage network during small flood events
- It is recommended that a floodplain management plan be developed for Roma that incorporates Stage 1 and 2 flood mitigation options, which will allow for reduced risk evacuation routes and planning for future development

12. Glossary

A number of flood related terms are used in this report. Definitions for some of the more frequently used terms are provided below. In addition, to assist in the understanding of the terminology used in this document, an "introduction to flood risk" is provided in Appendix G.

Average Recurrence Interval (ARI): The long-term average number of years between the occurrences of a flood as big as or larger than, the selected event. For example, floods with a discharge as great as, or greater than, the 20 year ARI flood event will occur on average once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event.

Annual Exceedance Probability (AEP): The chance of a given or larger size occurring in any one year, usually expressed as a percentage, For example, if a peak flood discharge of 500 m^3/s has an AEP of 5%, it means that there is a 5% chance (that is 1 in 20 chance) of a peak flood discharge of 500 m^3/s or larger occurring in any one year.

Average Annual Damage (AAD): Depending on its size (or severity), each flood will cause a different amount of flood damage to a flood prone area. AAD is the average damage per year that would occur in a nominated development situation from flooding over a very long period of time.

Calibration: Is the comparison between numerical model results and recorded values.

Critical Duration: The storm duration that provides the highest flood discharges and flood levels for the flooding source.

Design Flood: A design flood is a hypothetical flood that has been determined for the purpose of floodplain management and planning, e.g. a flood study. Design floods are typically assigned to a probability of occurrence that is specified as an Average Recurrence Interval (ARI) or as an Annual Exceedence Probability (AEP). A summary of the chance of flooding in a lifetime for a range of ARIs is provided in Table A.

Table A Chance of experiencing flooding in a lifetime

Size of Flood (Annual Reccurence Interval)	Chance of occurrence in any year (AEP)	Probability of experiencing the given flood in a lifetime (70 years)	
		At least Once	At least twice
10 year ARI	10%	99.9%	99.3%
20 year ARI	5%	97.0%	86.4%
50 year ARI	2%	75.3%	40.8%
100 year ARI	1%	50.3%	15.6%
200 year ARI	0.5%	29.5%	4.9%

Direct Tangible Flood Damages: The loss of assets with an easily quantifiable value such as buildings, contents, vehicles, stock and crops.

Flood Frequency Analysis (FAA): Provides an estimate of the magnitude of a flood of a selected probability, from a statistical analysis of recorded flood data.

Hydraulics: Term given to the study of water flow in waterways; in particular the evaluation of flow parameters such as water level and velocity.

Hydrograph: A graph which shows how the discharge or level of a flood at any particular location varies with time during a flood.

Hydrology: Term given to the study of the rainfall and runoff process; in particular the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.

Major Local Mitigation: Considers mid-scale mitigation options within the town of Roma to mitigate flooding that occurs due to a combination of local runoff and regional tailwater effects, such as occurs through the Long Drain system and in the vicinity of the Railway Dam.

Minor Local Mitigation: Considers local stormwater drainage issues that occur on a regular basis due to local runoff, including road cross-drainage.

Net Present Value: The sum of the value of all money that will be spent across a given time frame, discounted back to reflect its current value.

Regional Mitigation: Considers flooding from runoff generated in the Bungil Creek catchment.

Time of Concentration: Used to characterise the response of a watershed to a rain event, and is defined as the time taken for a droplet of water to flow from the furthest point in a watershed to the outlet downstream.

13. References

Managing Flood Risk Through Planning Opportunities: Guidance on Land Use Planning in Flood Prone Areas (Hawkesbury-Nepean Management Steering Committee, June 2005)

The Bungil Creek Flood Study – Hydrology Report (EGIS, 2002)

Roma Flood Mitigation Project, Flood Study and Report, Stage 1 (Engeny, May 2012)

Drainage Master Plan for Roma, Final Report (Engeny, December 2012)

Queensland Floods Commission of Inquiry – Final Report (March 2012)

Roma Flood Mitigation Project Stage 1 Hydrology and Hydraulic Assessment Report (GHD, April 2013)

Queensland State Planning Policy 1/03 Guideline, (Government of Queensland, June, 2033)

WBM-BMT, 2010 *TUFLOW User Manual*

The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method (BOM, June 2003)

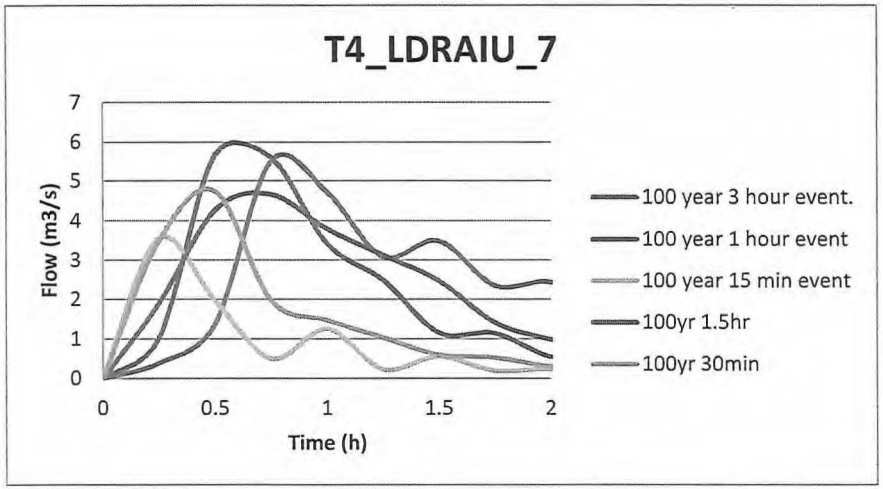
Australian Bureau of Statistics. Inflation Calculation Tool, available at: http://www.abs.gov.au/websitedbs/d3310114.nsf/home/consumer+price+index+inflation+calculator (ABS, October 2013)

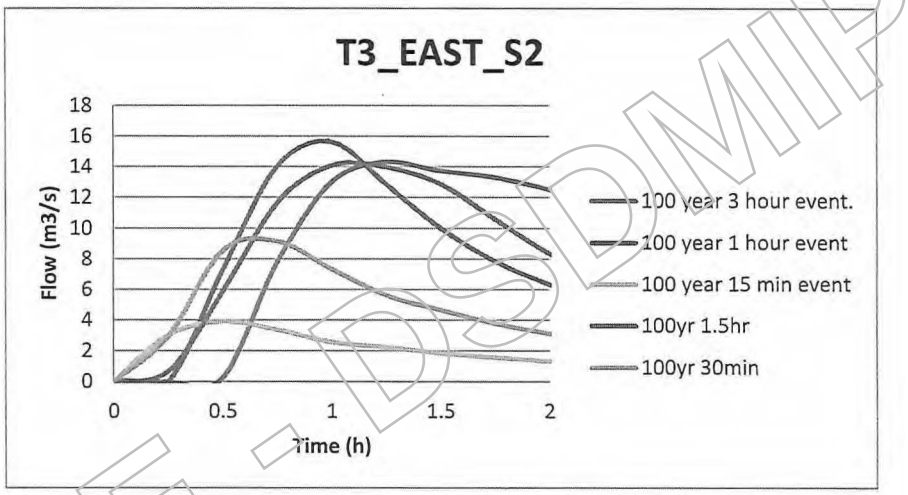
Appendices

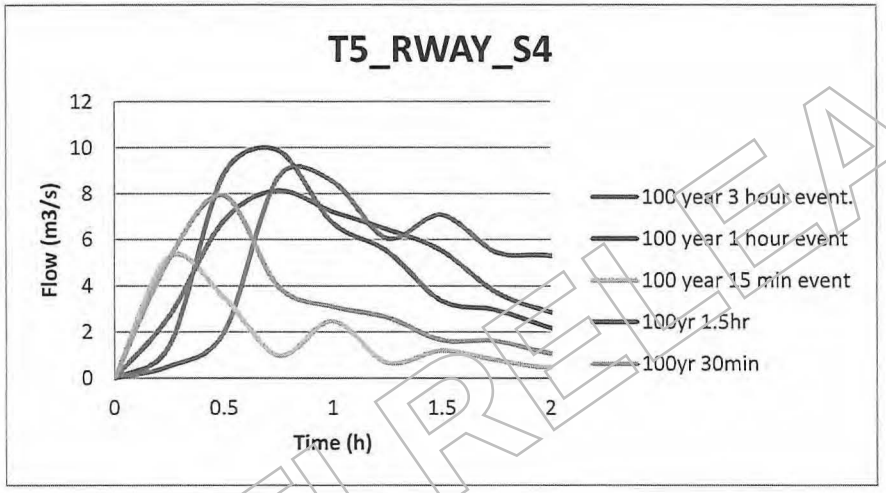
Appendix A – Hydrology

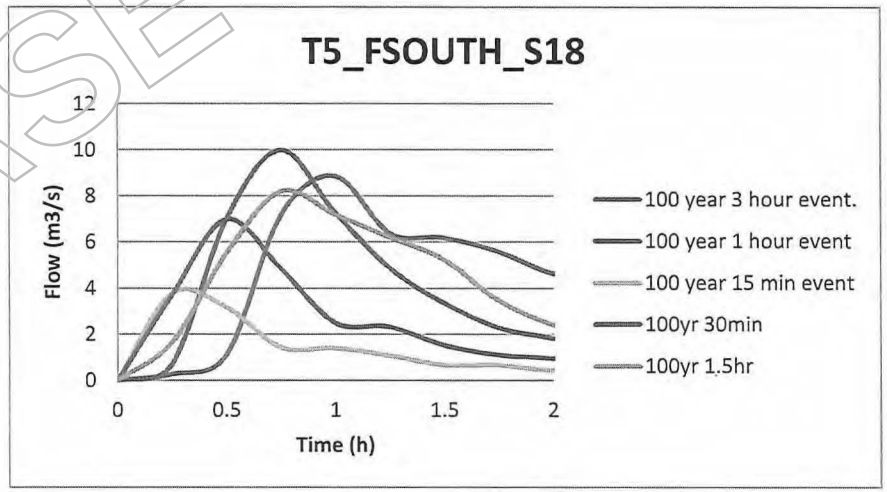
A1 URBS Hydrology Critical Duration Check

A2 Rational Method









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RATIONAL METHOD CALCULATIONS

URBS Peak Flow (m3/s)	Catchment	Total Catchment Area (km^2)	Flowpath Length (m)	Average Slope (%)	Equal Area Slope (%)	Four Factors For C50 Calculation: Rainfall Intensity factor for C50 (<=40)	Catchment Relief for C50	Catchment Storage for C50		Ground Characteristics for C50	Time of Concentration: Bransby-Williams (min)	Adopted tc (min)	Coefficient of Runoff: C1	C2	C5	C10	C20	C50	C100	C2000	Rainfall Intensities (mm/hr): I1	I2	I5	I10	I20	I50	I100	ARF	Design Flow Rates - New Rational Method: $Q1_{year}$ (m^3/s)	$Q2_{year}$ (m^3/s)	$Q5_{year}$ (m^3/s)	$Q10_{year}$ (m^3/s)	$Q_{20-year}$ (m^3/s)	$Q_{50-year}$ (m^3/s)	$Q_{100-year}$ (m^3/s)	Difference Between URBS and Rational
	FSOUTH_S13	0.09	494.4	0.72	0.78	38.72	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	24.4	24.4	0.65	0.63	0.63	0.63	0.71	0.78	0.83	0.87	44.2	57.2	72.8	85.7	97.3	115.7	130.2	1.00	0.7	0.9	1.2	1.3	1.7	2.3	2.7	
	FSOUTH_S15	0.05	903.0	1.93	1.80	30.63	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	39.6	39.6	0.57	0.57	0.57	0.57	0.64	0.71	0.74	0.78	34.4	44.6	57.1	64.8	75.2	89.4	100.6	1.00	0.3	0.4	0.5	0.6	0.7	1.0	1.1	
	FSOUTH_S16	0.14	586.4	1.44	1.42	35.28	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	25.0	25.0	0.65	0.63	0.63	0.63	0.70	0.78	0.82	0.86	43.7	56.6	72.7	85.6	96.1	114.3	128.6	1.00	1.1	1.4	1.8	2.0	2.6	3.4	4.1	
	FSOUTH_S17	0.35	904.0	0.99	0.89	31.49	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	37.9	37.9	0.57	0.57	0.57	0.57	0.64	0.71	0.75	0.79	36.2	46.5	58.5	69.4	77.1	91.6	103.0	1.00	2.0	2.6	3.3	3.7	4.9	6.5	7.6	
	FSOUTH_S18	0.12	591.1	1.01	0.89	35.52	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	27.7	27.7	0.61	0.61	0.61	0.61	0.69	0.77	0.80	0.84	41.5	53.7	69.0	79.4	91.1	108.4	122.0	1.00	0.8	1.1	1.4	1.6	2.0	2.7	3.2	
10.800	T5_FSOUTH_S18	0.75	1852.0	0.97	0.79	22.31	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	73.7	73.7	0.50	0.50	0.50	0.50	0.56	0.62	0.65	0.69	23.8	30.8	39.0	44.3	51.4	61.0	68.6	1.00	2.5	3.2	4.1	4.6	6.0	8.0	9.4	14.84%
	LDRAIU_6	0.08	449.9	0.29	0.93	45.00	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	21.8	21.8	0.64	0.64	0.64	0.64	0.72	0.80	0.84	0.88	48.7	60.5	77.6	89.6	103.0	122.5	138.0	1.00	0.6	0.8	1.1	1.2	1.6	2.1	2.5	
	LDRAIU_7	0.07	906.0	1.29	1.36	30.30	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	41.0	41.0	0.56	0.56	0.56	0.56	0.63	0.70	0.74	0.78	33.7	43.6	56.0	63.6	73.6	87.7	99.0	1.00	0.4	0.5	0.6	0.7	0.9	1.2	1.4	
	LDRAIU_4	0.15	657.1	1.26	1.22	35.16	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	28.2	28.2	0.61	0.61	0.61	0.61	0.69	0.76	0.80	0.84	41.1	53.1	68.3	77.6	90.2	107.3	120.7	1.00	1.0	1.3	1.7	1.9	2.5	3.3	3.9	
	LDRAIU_5	0.07	907.0	1.93	1.68	30.93	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	39.3	39.3	0.57	0.57	0.57	0.57	0.64	0.71	0.74	0.78	34.5	44.7	57.5	65.1	75.6	89.8	101.0	1.00	0.4	0.5	0.6	0.7	1.0	1.3	1.5	
6.690	T4_LDRAIU_7	0.36	1279.5	1.19	1.15	27.35	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	50.8	50.8	0.54	0.54	0.54	0.54	0.61	0.67	0.71	0.74	30.1	38.8	49.5	56.5	65.5	78.5	88.5	1.00	1.6	2.1	2.7	3.1	4.0	5.3	6.3	6.98%
	East_S4	1.20	908.0	4.35	4.45	39.71	5	Poorly defined watercourses	0.00	Grazing land and open forest	40	24.4	24.4	0.67	0.67	0.67	0.67	0.75	0.84	0.88	0.92	44.2	57.2	73.8	90.7	97.3	115.7	130.2	1.00	9.9	12.8	16.5	18.7	24.5	32.4	38.3	
	East_S3	0.36	1084.0	2.64	2.70	35.12	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	36.3	36.3	0.58	0.58	0.58	0.58	0.65	0.72	0.76	0.80	36.0	46.6	60.5	68.0	78.0	93.7	105.4	1.00	2.1	2.7	3.4	3.9	5.1	6.8	8.0	
	East_S2	0.49	909.0	1.02	1.07	32.47	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	35.5	35.5	0.56	0.56	0.56	0.56	0.65	0.72	0.76	0.80	36.4	47.1	60.5	68.5	78.9	94.6	106.7	1.00	2.9	3.7	4.6	5.4	7.1	9.4	11.1	
18.28	T3_East_S2	2.06	2505.0	2.48	2.02	25.11	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	74.7	74.7	0.50	0.50	0.50	0.50	0.56	0.62	0.65	0.69	23.3	30.1	38.8	43.6	50.8	60.4	67.9	1.00	6.6	8.5	11.0	12.4	16.2	21.4	25.3	-27.70%
	RWAY_S103	0.09	910.0	1.20	1.51	30.95	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	39.3	39.3	0.57	0.57	0.57	0.57	0.64	0.71	0.75	0.79	34.6	44.7	57.5	65.1	75.0	89.6	101.0	1.00	0.5	0.6	0.8	0.9	1.2	1.6	1.9	
	RWAY_S1	0.06	283.2	1.20	1.51	40.00	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	12.8	12.8	0.64	0.64	0.64	0.64	0.72	0.80	0.84	0.88	50.7	77.4	99.5	113.7	130.3	157.7	177.7	1.00	0.6	0.8	1.0	1.2	1.5	2.0	2.4	
	RWAY_S2	0.03	911.0	1.10	1.01	28.26	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	47.4	47.4	0.55	0.55	0.55	0.55	0.61	0.68	0.72	0.75	31.2	40.3	51.7	58.7	68.1	80.9	90.9	1.00	0.1	0.2	0.2	0.3	0.4	0.5	0.6	
	RWAY_S3	0.08	503.0	0.66	0.59	37.25	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	26.5	26.5	0.62	0.62	0.62	0.62	0.70	0.77	0.81	0.85	42.4	54.9	70.5	80.2	93.2	110.8	124.7	1.00	0.6	0.8	1.0	1.1	1.5	2.0	2.3	
	RWAY_S4	0.04	912.0	1.55	1.45	29.70	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	42.8	42.8	0.56	0.56	0.56	0.56	0.63	0.70	0.73	0.77	33.0	42.7	54.9	62.1	72.1	85.7	96.3	1.00	0.2	0.3	0.4	0.4	0.5	0.7	0.8	
8.33	T5_RWAY_S4	0.31	711.8	0.75	0.86	34.69	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	30.5	30.5	0.60	0.60	0.60	0.60	0.67	0.75	0.80	0.83	39.5	51.0	65.6	74.5	86.6	103.0	115.9	1.00	2.0	2.6	3.3	3.8	5.0	6.6	7.7	7.58%
	East_S19	0.21	913.0	1.93	2.36	33.54	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	33.2	33.2	0.59	0.59	0.59	0.59	0.66	0.74	0.77	0.81	37.9	48.9	62.7	71.2	82.8	98.5	110.6	1.00	1.3	1.7	2.1	2.4	3.2	4.2	5.0	
	East_S20	0.19	1155.0	0.75	0.67	26.40	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	54.6	54.6	0.53	0.53	0.53	0.53	0.60	0.66	0.70	0.73	28.9	37.3	47.8	54.2	62.9	74.7	83.9	1.00	0.8	1.0	1.3	1.5	1.9	2.6	3.0	
	East_S20a	0.50	914.0	2.12	1.84	34.13	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	32.0	32.0	0.59	0.59	0.59	0.59	0.67	0.74	0.78	0.82	38.5	49.8	64.0	72.7	84.5	100.4	113.0	1.00	3.2	4.1	5.3	6.0	7.9	10.4	12.3	
9.880	T3_East_S20	0.90	2308.5	1.54	1.46	21.26	0	Poorly defined watercourses	0.00	Grazing land and open forest	40	79.9	79.9	0.49	0.49	0.49	0.49	0.55	0.61	0.64	0.68	22.3	28.7	36.8	41.7	48.4	57.5	64.7	1.00	2.7	3.5	4.5	5.1	6.7	8.8	10.4	-4.90%

Appendix B – Regional Hydraulic Model Results Comparison Against 2012 Flood Event and Stage 1 Model Results

LEGEND

- 2012 Calibration Point (Modelled Level – Recorded Level)
- Highway
- Road
- Watercourse
- 2012 Recorded Flood Extent
- Tuflow Regional Hydraulic Model Boundary
- Cadastre

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

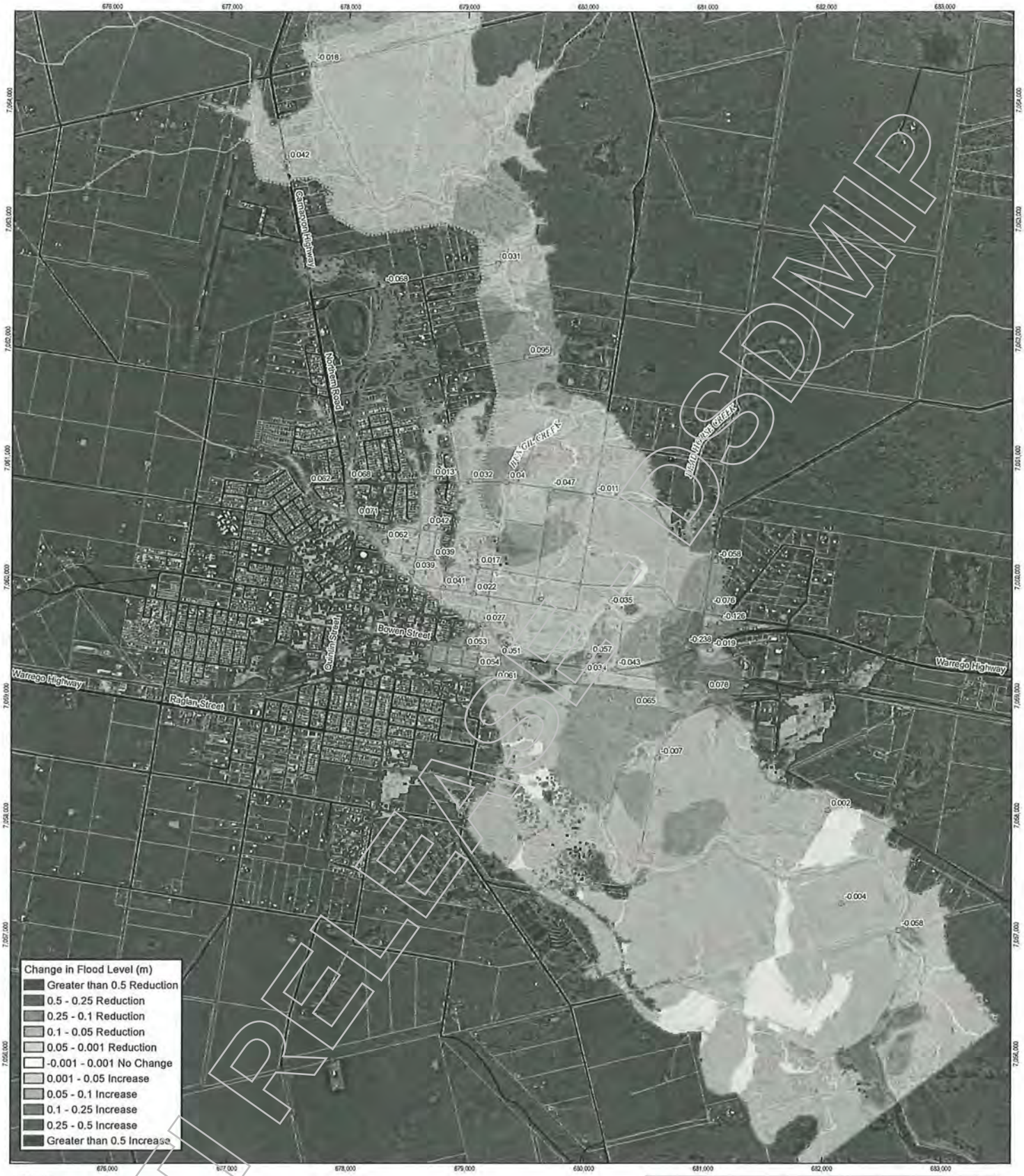
Maranoa Regional Council
Roma Flood Study

Job Number 41-25323
Revision 0
Date 11 Oct 2013

2012 Flood Extent Comparison

Figure B1

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\41_25323_012_Rev_0.mxd
Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



LEGEND

- Sample Point
- Highway
- Road
- Watercourse
- Stage 1 Levee July 2013 Reference Design
- Stage 1 2012 Flood Extent
- Stage 2 2012 Flood Extent
- Cadastre

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

Maranoa Regional Council
Roma Flood Study

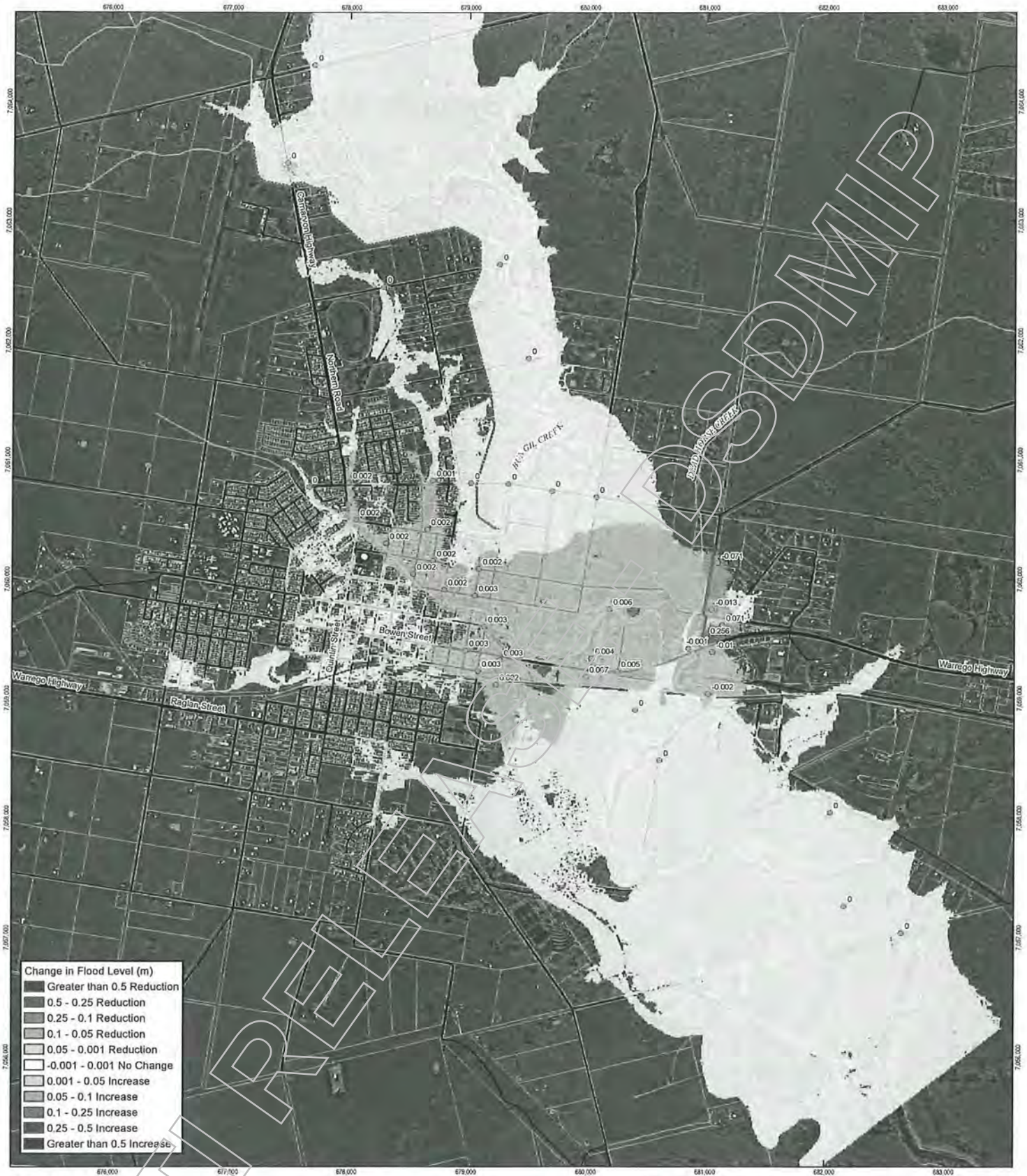
Job Number	41-25323
Revision	0
Date	11 Oct 2013

Stage 1 Levee Comparison

Figure B2

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\41_25323_013_Rev_0.mxd
Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Appendix C – Regional Hydraulic Model Afflux Results



LEGEND

Sample Point | Highway | Stage 1 Levee Reference Alignment | Cadastre

Road | Eastern Levee

Watercourse

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study
Stage 1 & Stage 2 Option
Eastern Levee
2012 Flood Event Peak Afflux

Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C1

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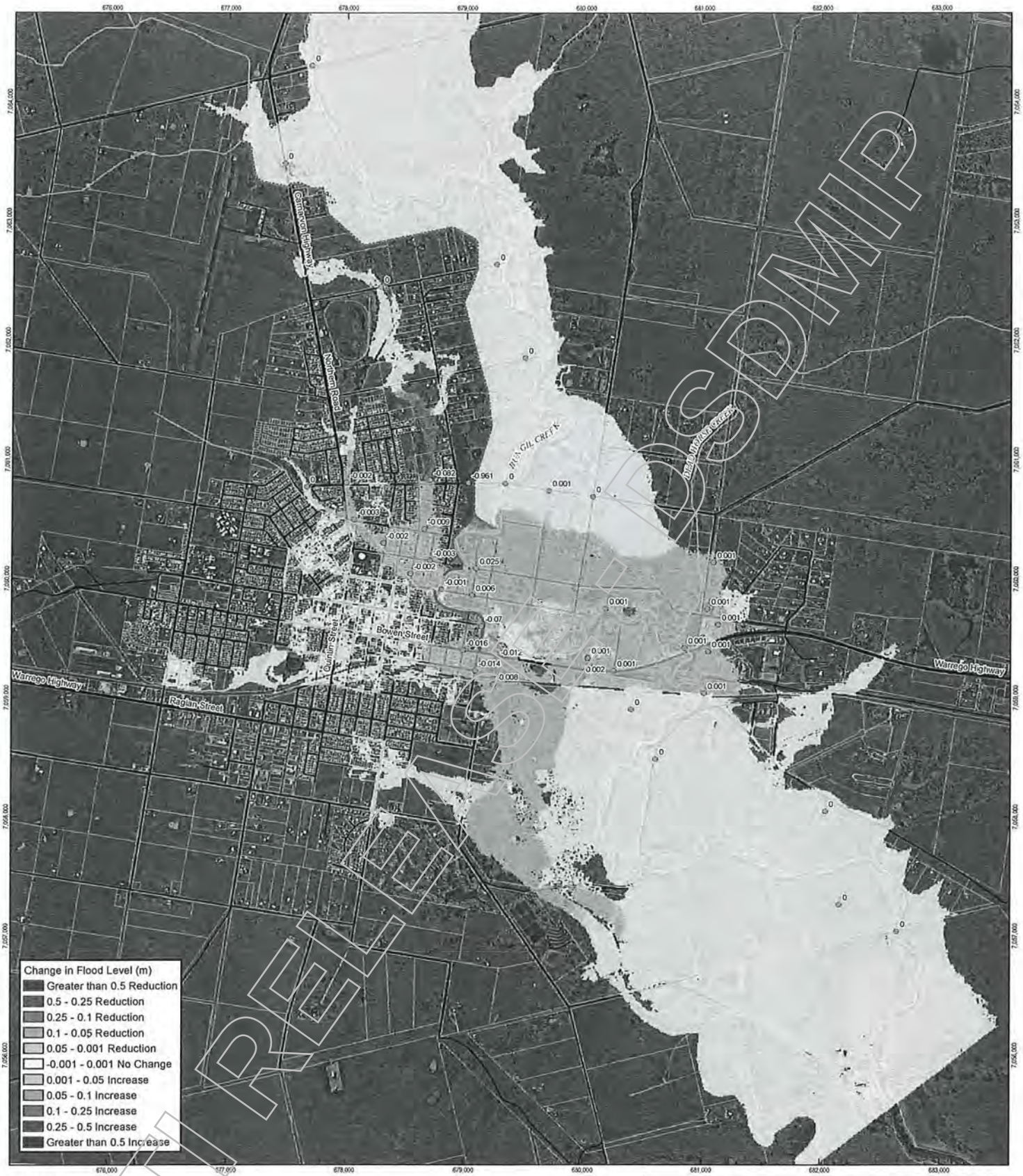
Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E brmail@ghd.com W www.ghd.com

Data Source: ©Commonwealth of Australia (Geoscience Australia) Watercourses/2007, DNRM Locality, Roads/2010, Cadastre, River/2012, GHD Flood Surfaces, Sample Points, Levee/2013; DTMR Aerial/2011 Created By: LS



LEGEND

Sample Point | Highway | Stage 1 Levee Reference Alignment | Cadastre

Road | Western Levee

Watercourse

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study

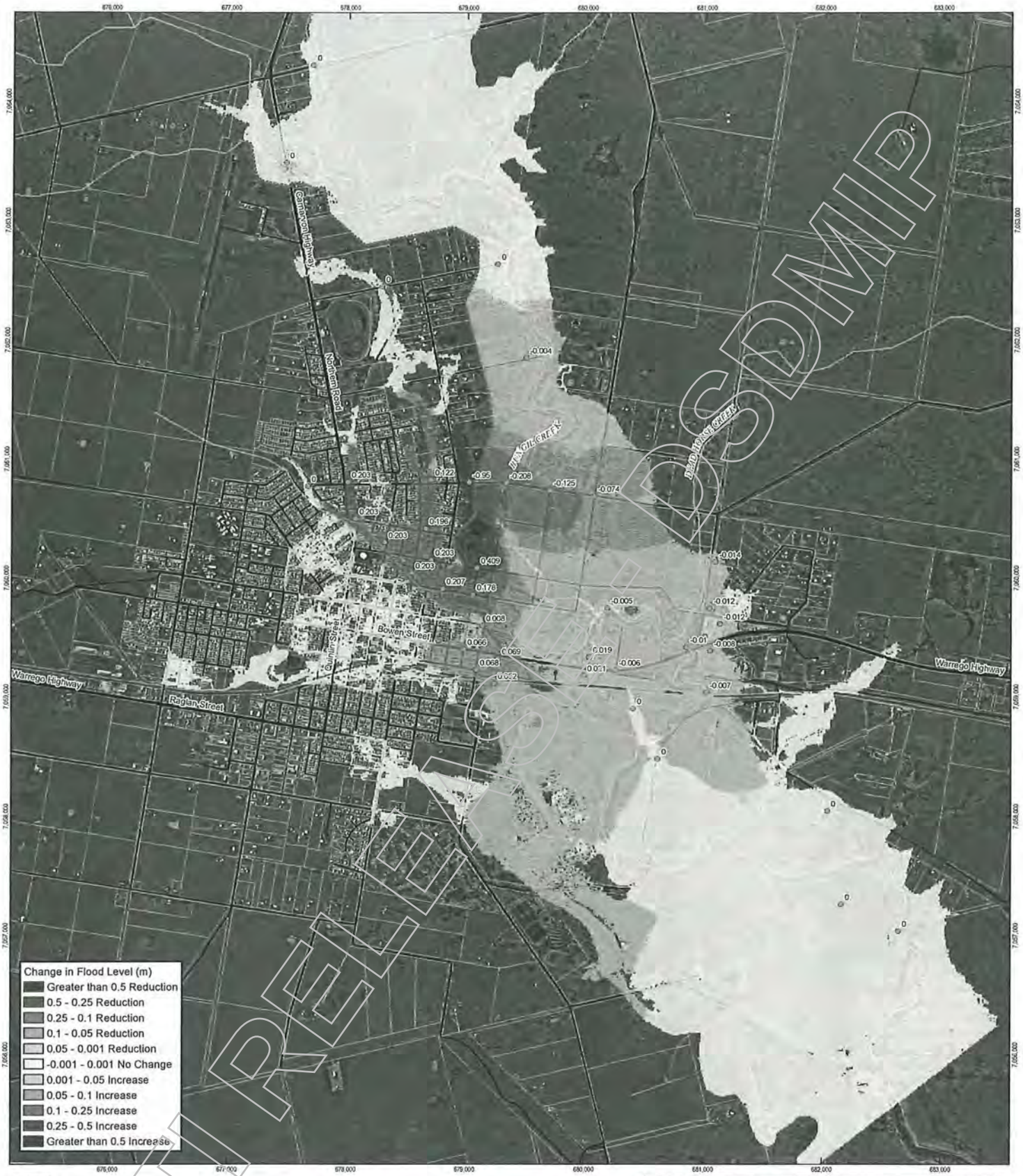
Stage 1 & Stage 2 Option Western Levee 2012 Flood Event Peak Afflux

Job Number	41-25323
Revision	0
Date	11 Oct 2013

Figure C2

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\Fig_C2_Stage 2_2012 Flood Eventyr_Aff_Roma_Rev_0.mxd

Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E brmail@ghd.com W www.ghd.com



LEGEND

Sample Point — Highway — Stage 1 Levee Reference Alignment — Cadastre

Road — Remove section of Stage 1 Levee

Watercourse — Alternative Western Levee

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study

Stage 1 & Stage 2 Option Alternative Western Levee 2012 Flood Event Peak Afflux

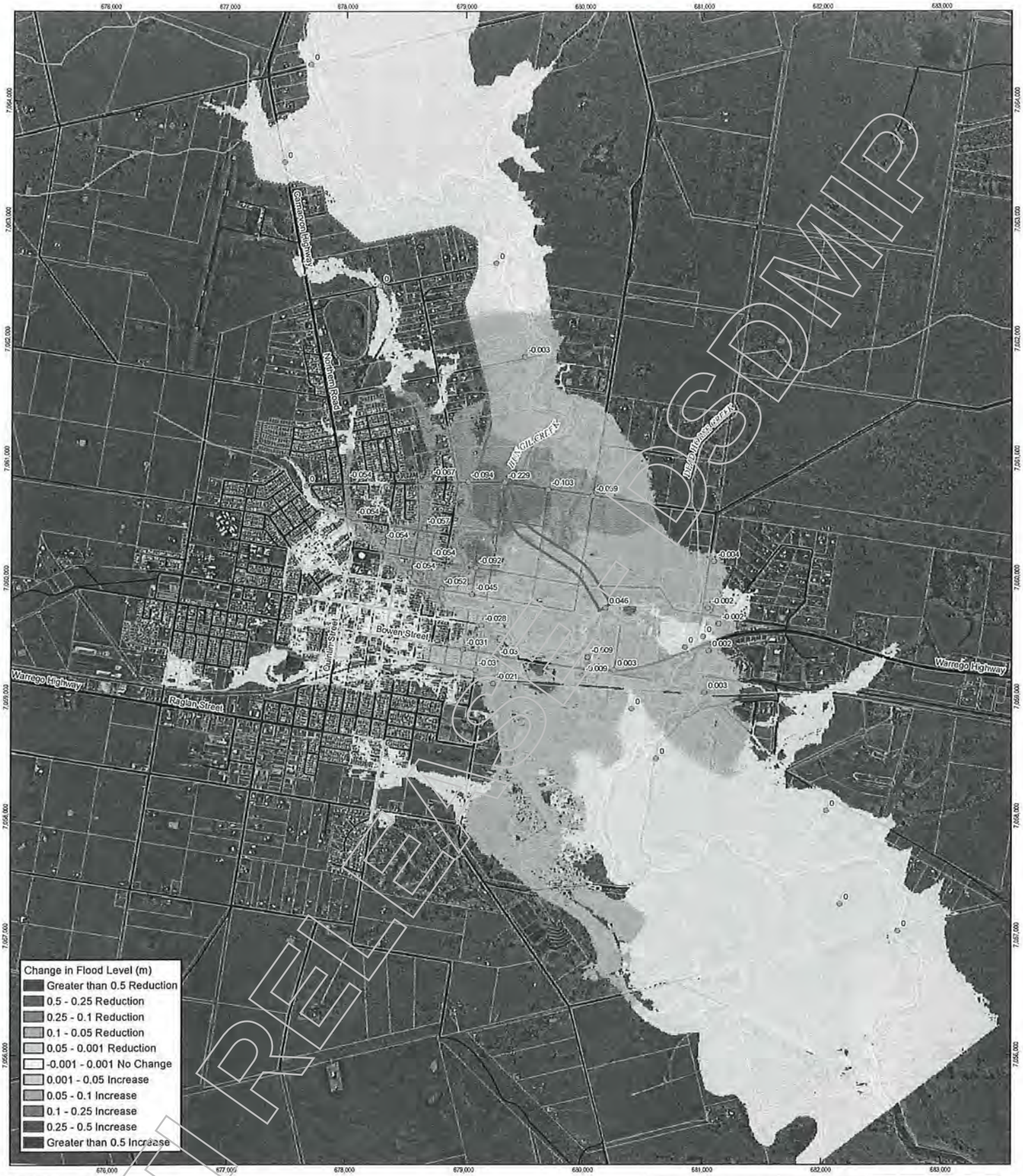
Job Number	41-25323
Revision	0
Date	11 Oct 2013

Figure C3

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\Fig_C3_Stage 2_2012 Flood Eventyr_Aff_Roma_Rev_0.mxd

Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: ©Commonwealth of Australia (Geoscience Australia): Watercourses/2007; DNRM: Locality; Roads/2010, Cadastre, River/2012, GHD: Flood Surfaces, Sample Points, Levee/2013; DTMR: Aerial/2011. Created By: LS



LEGEND

Sample Point | Highway | Stage 1 Levee Reference Alignment | Cadastre
Road | Eastern Diversion Channel A
Watercourse

1:30,000 @ A3
0 500 1,000
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study
Stage 1 & Stage 2 Option
Eastern Diversion Channel A
2012 Flood Event Peak Afflux

Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C4

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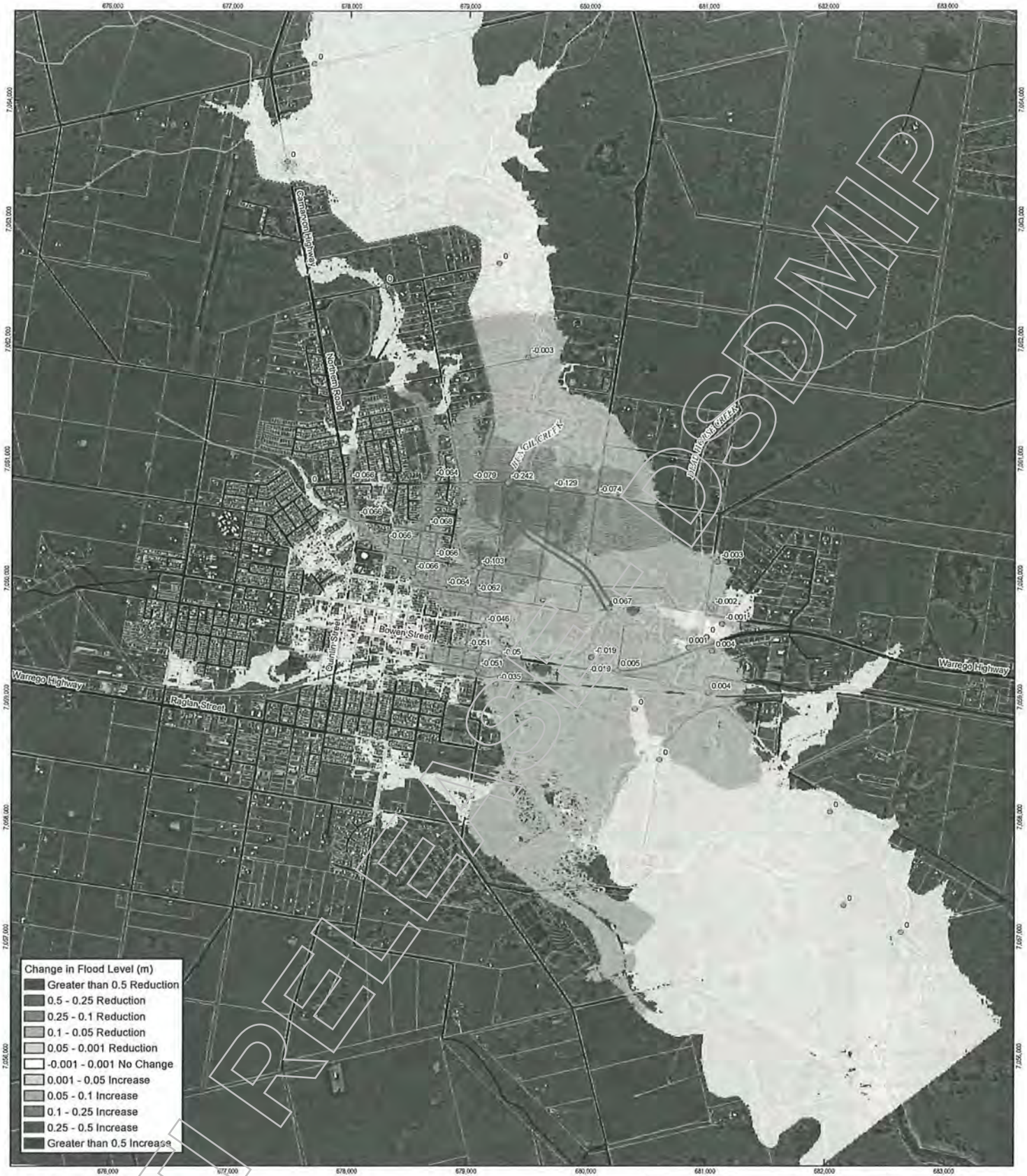
Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



LEGEND

Sample Point | Highway | Stage 1 Levee Reference Alignment | Cadastre
Road | Eastern Diversion Channel B
Watercourse

1:30,000 @ A3
0 500 1,000
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

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Roma Flood Study
Stage 1 & Stage 2 Option
Eastern Diversion Channel B
2012 Flood Event Peak Afflux

Job Number | 41-25323
Revision | 0
Date | 11 Oct 2013

Figure C5

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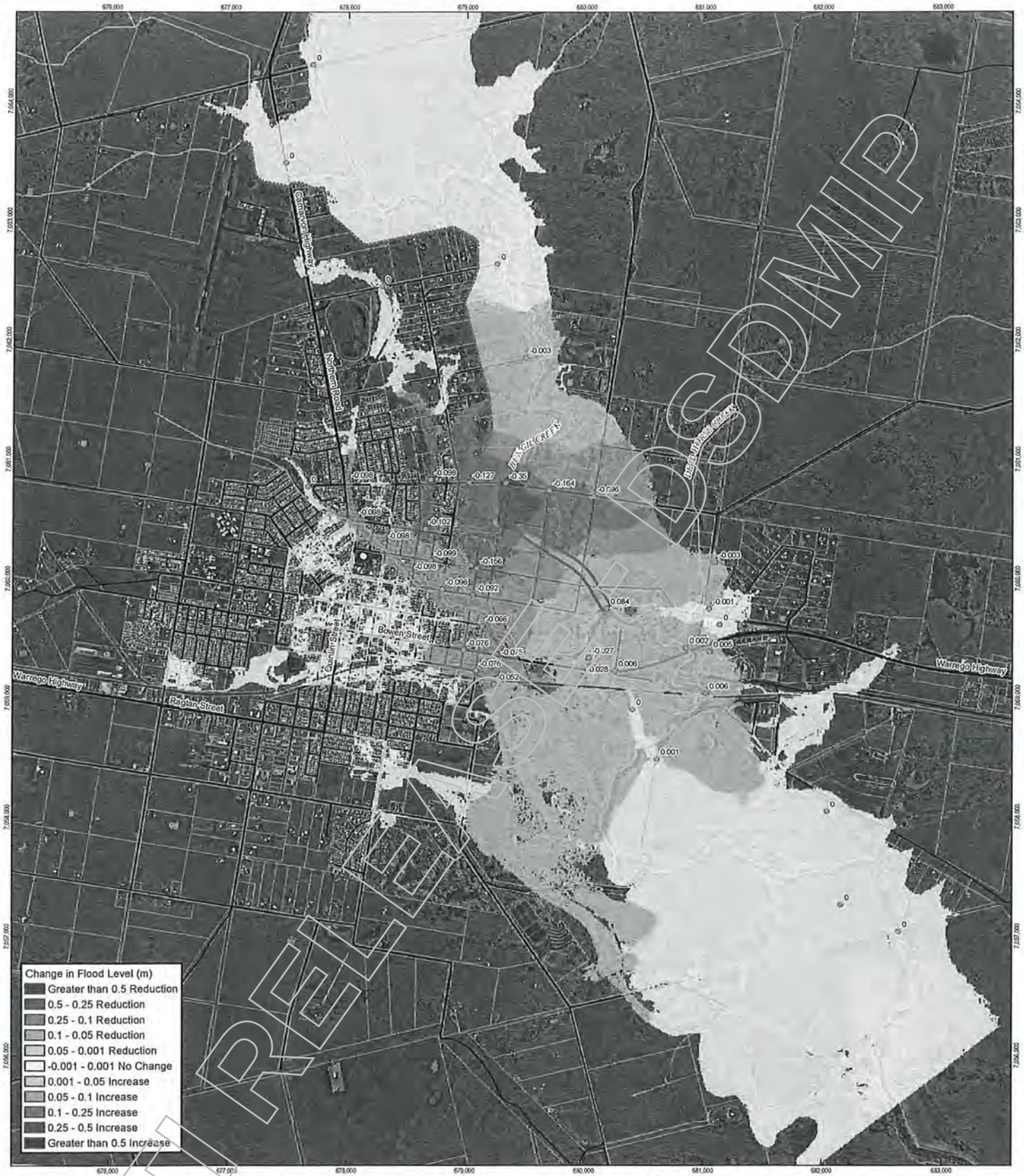
Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



LEGEND

Sample Point | Highway | Stage 1 Levee Reference Alignment | Cadastre

Road | Eastern Diversion Channel C

Watercourse

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

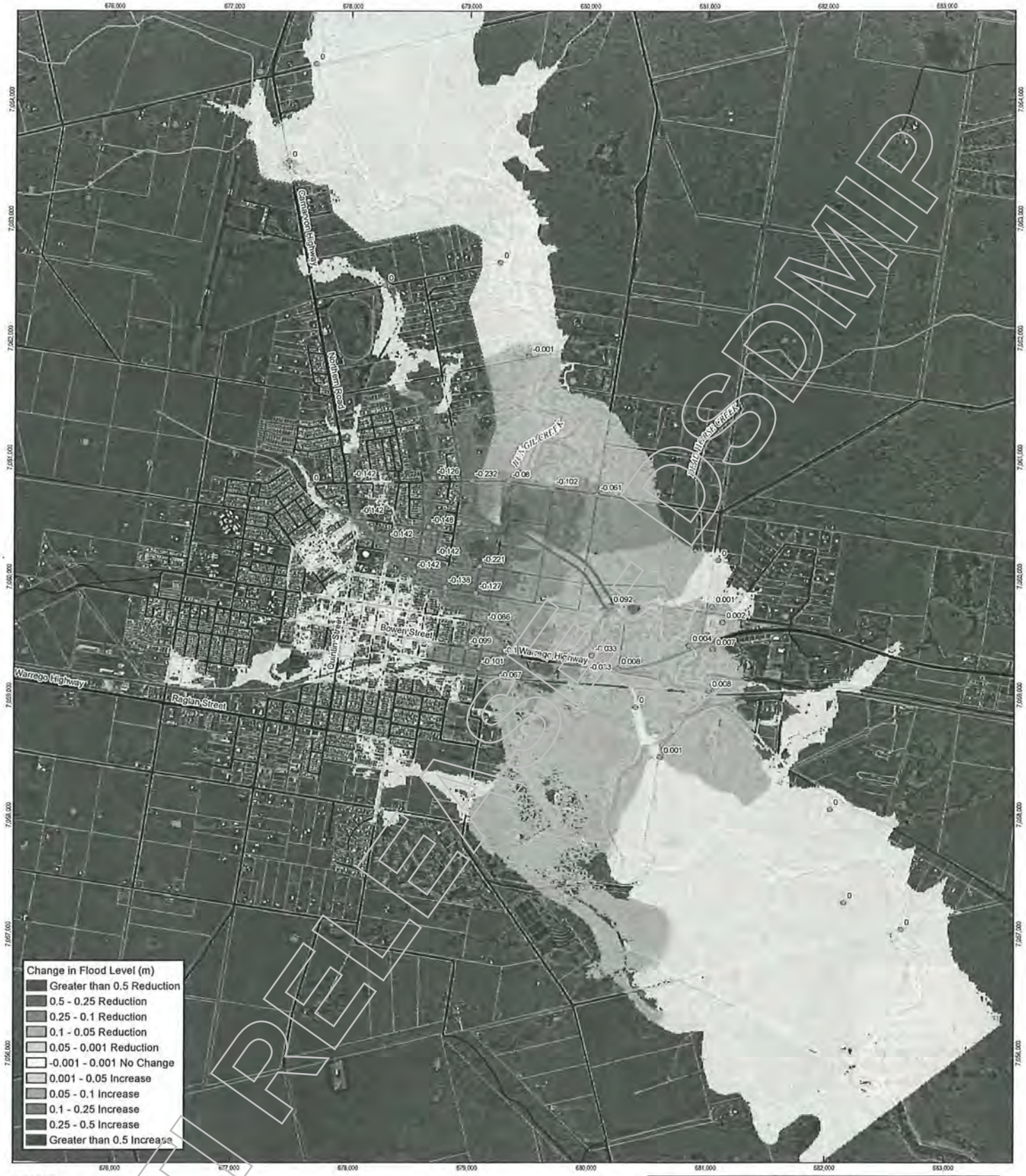
Maranoa Regional Council
Roma Flood Study

Stage 1 & Stage 2 Option Eastern Diversion Channel C 2012 Flood Event Peak Afflux

Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C6

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\Fig_C6_Stage 2_2012 Flood Event\r_Aff_Roma_Rev_0.mxd
Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



LEGEND

Sample Point | Highway | Stage 1 Levee Reference Alignment | Cadastre
Road | Eastern Diversion Channel D
Watercourse

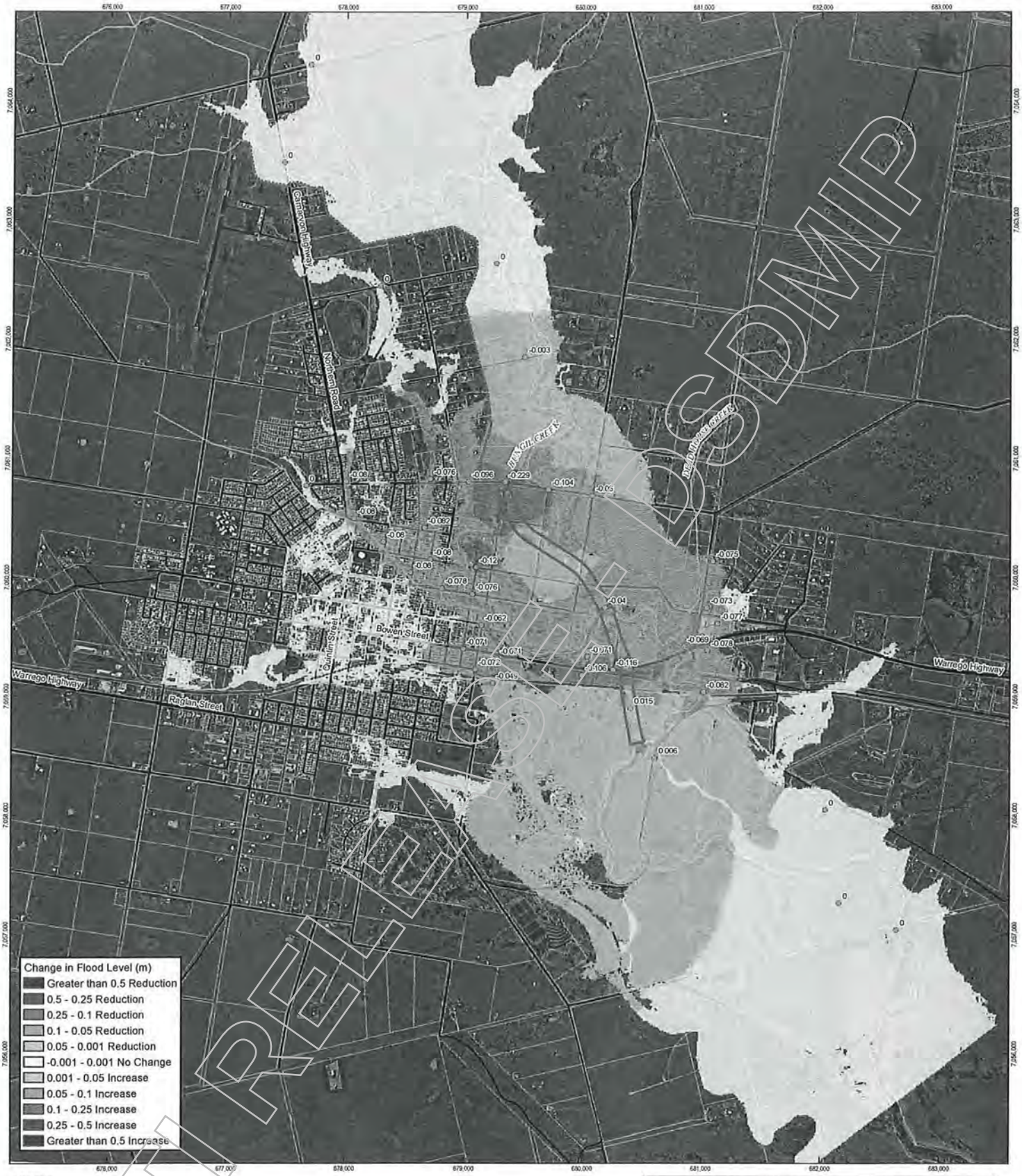
1:30,000 @ A3
0 500 1,000
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

Maranoa Regional Council
Roma Flood Study
Stage 1 & Stage 2 Option
Eastern Diversion Channel D
2012 Flood Event Peak Afflux

Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C7

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\Fig_C7_Stage 2_2012 Flood Eventpr_Aff_Roma_Rev_0.mxd
Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



LEGEND

Sample Point | Highway | Stage 1 Levee Reference Alignment | Cadastre | Road | Extended Eastern Diversion Channel A | Watercourse

1:30,000 @ A3
0 500 1,000
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study
Stage 1 & Stage 2 Option
Extended Eastern Diversion Channel A
2012 Flood Event Peak Afflux

Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C8

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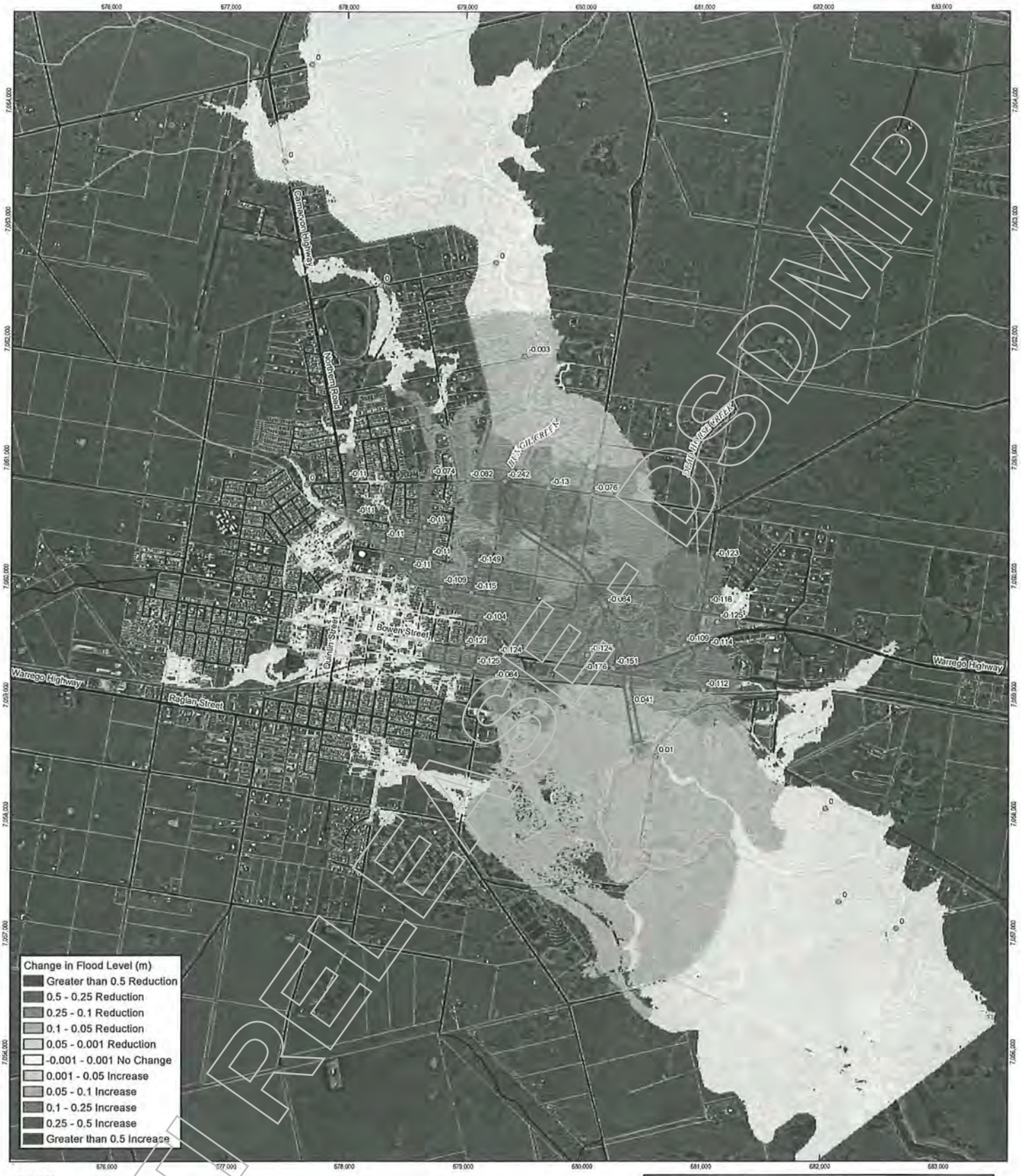
Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



LEGEND

Sample Point | Highway | Stage 1 Levee Reference Alignment | Cadastre

Road | Extended Eastern Diversion Channel B

Watercourse

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study

Stage 1 & Stage 2 Option
Extended Eastern Diversion Channel B
2012 Flood Event Peak Afflux

Job Number | 41-25323
Revision | 0
Date | 11 Oct 2013

Figure C9

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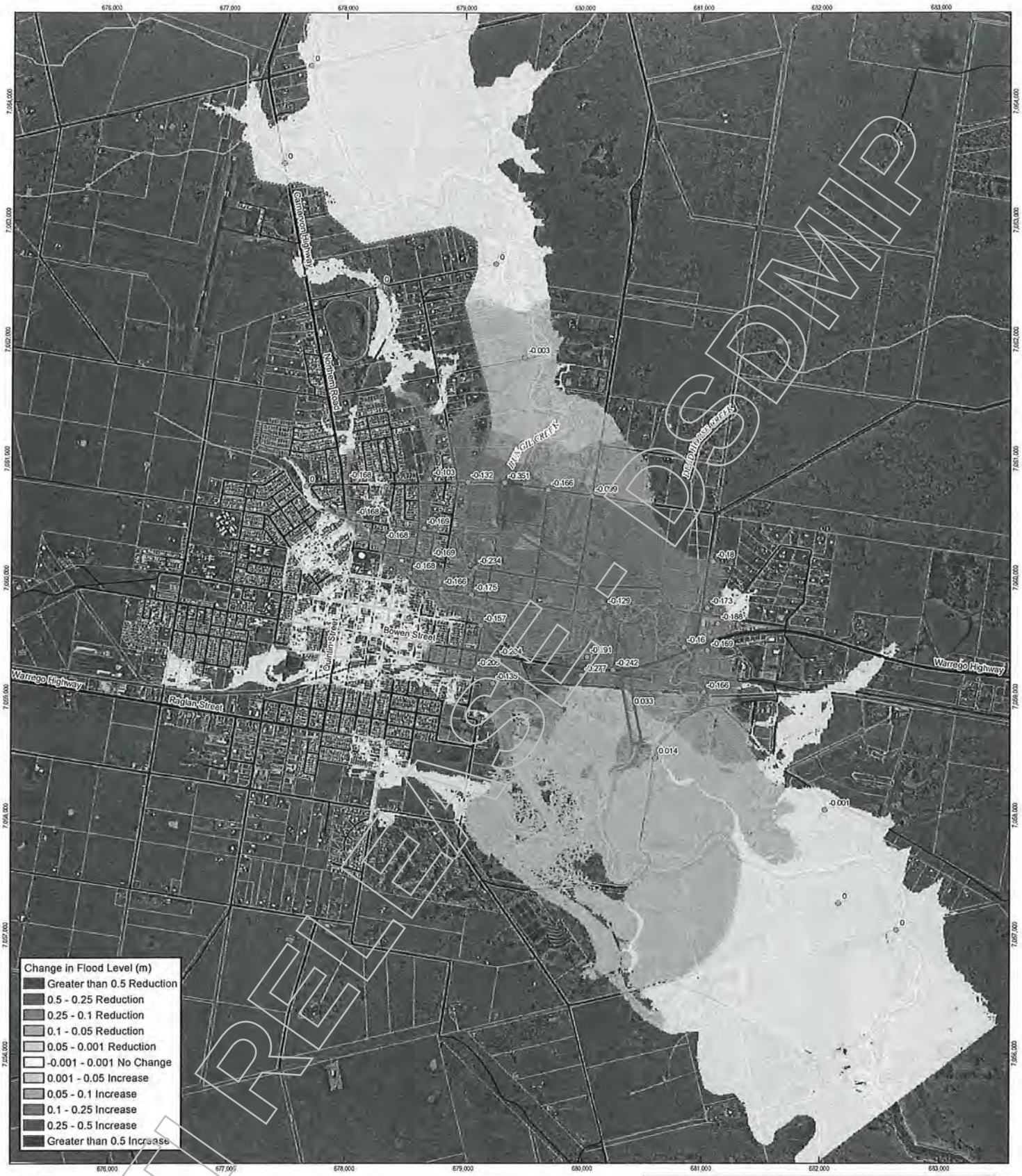
Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



LEGEND

Sample Point | Highway | Stage 1 Levee Reference Alignment | Cadastre

Road | Extended Eastern Diversion Channel C

Watercourse

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study

Stage 1 & Stage 2 Option
Extended Eastern Diversion Channel C
2012 Flood Event Peak Afflux

Job Number 41-25323
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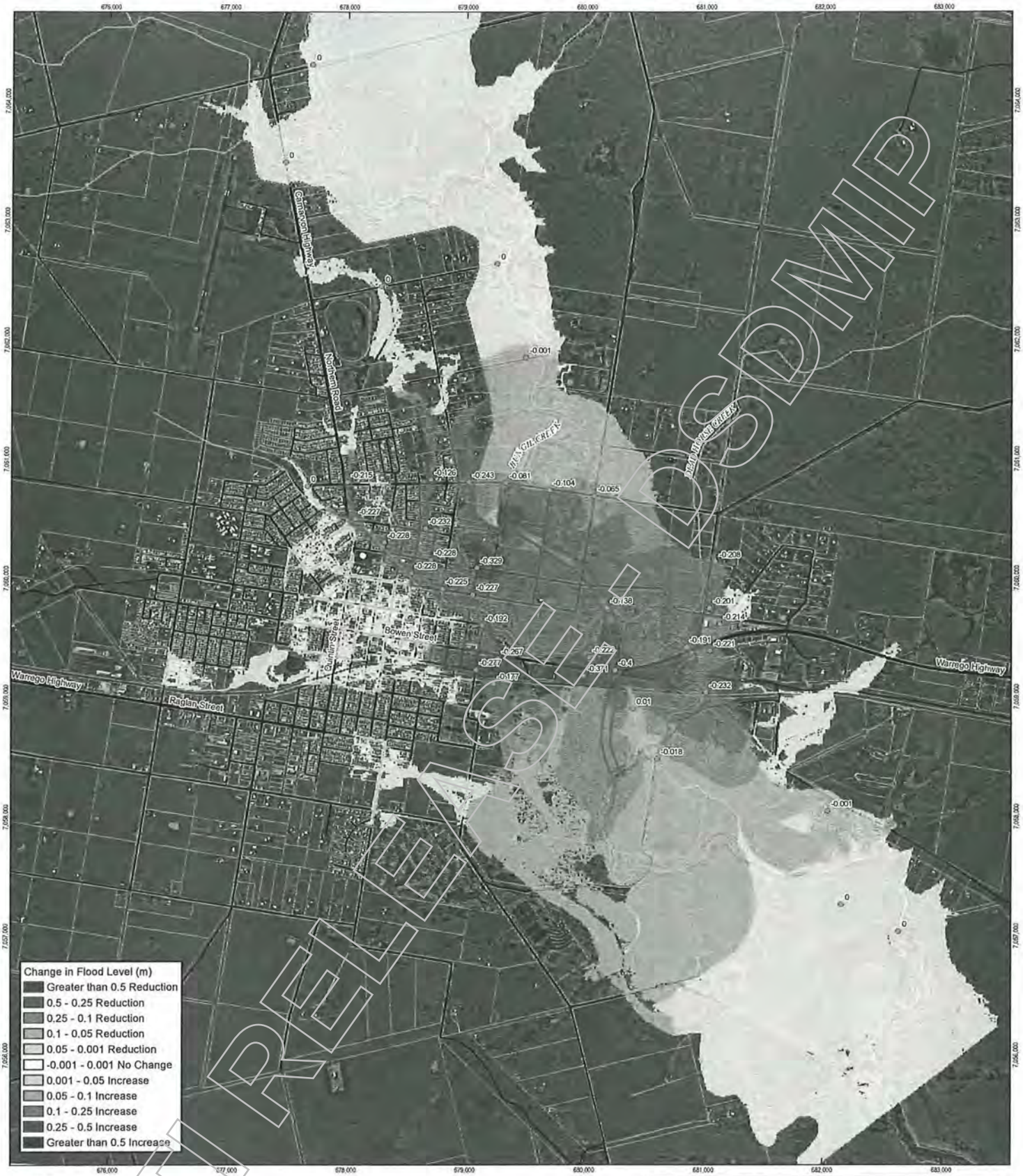
Date 11 Oct 2013

Figure C10

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\Fig_C10_Stage 2_2012 Flood Event\r_Aff_Roma_Rev_0.mxd

Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



LEGEND

Sample Point | Highway | Stage 1 Levee Reference Alignment | Cadastre

Road | Extended Eastern Diversion Channel D

Watercourse

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

Maranoa Regional Council
Roma Flood Study
Stage 1 & Stage 2 Option
Extended Eastern Diversion Channel D
2012 Flood Event Peak Afflux

Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C11

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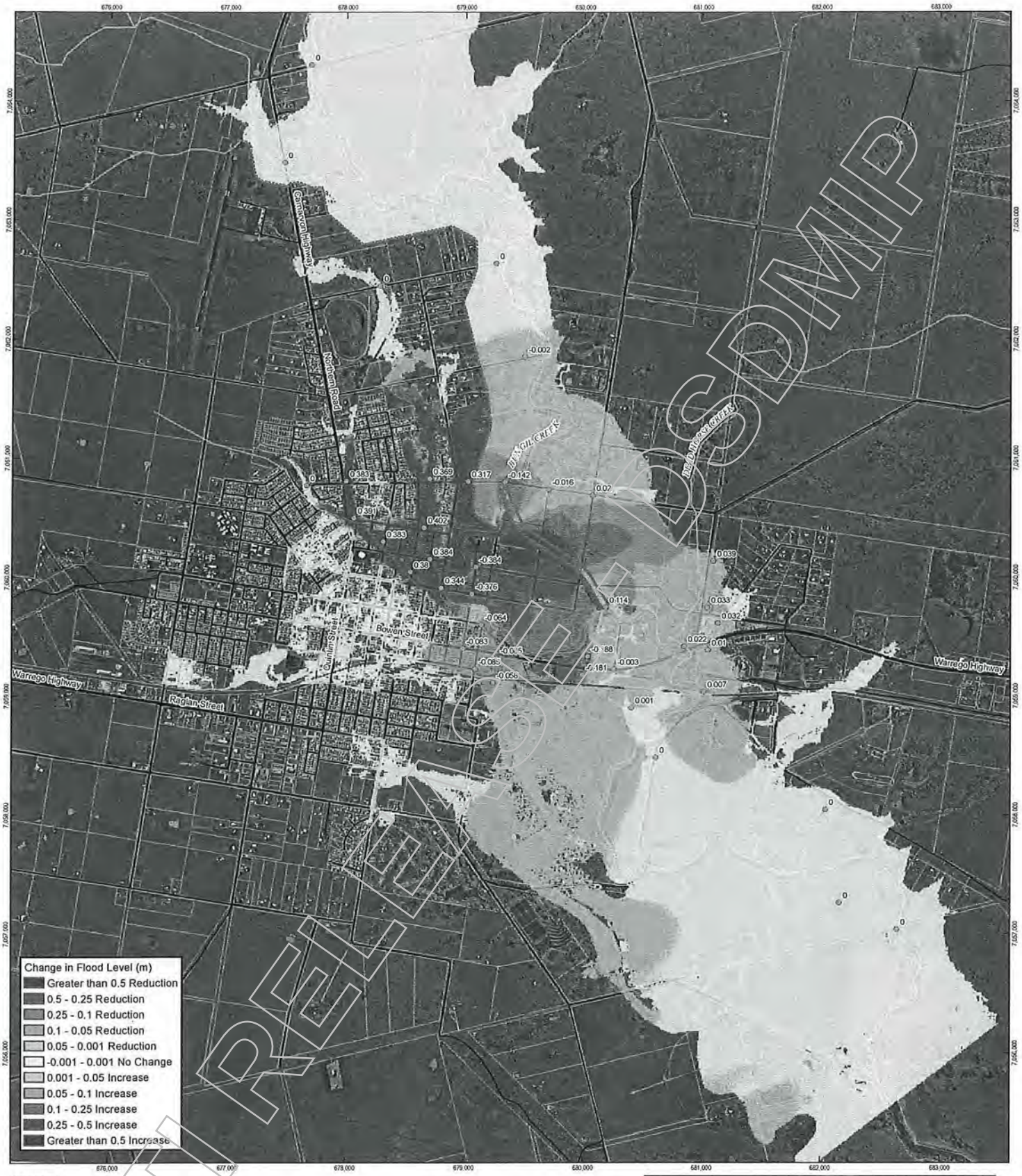
Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



LEGEND

Sample Point · Highway · Stage 1 Levee Reference Alignment · Cadastre

Road · Eastern Diversion Channel B

Watercourse · Levee

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

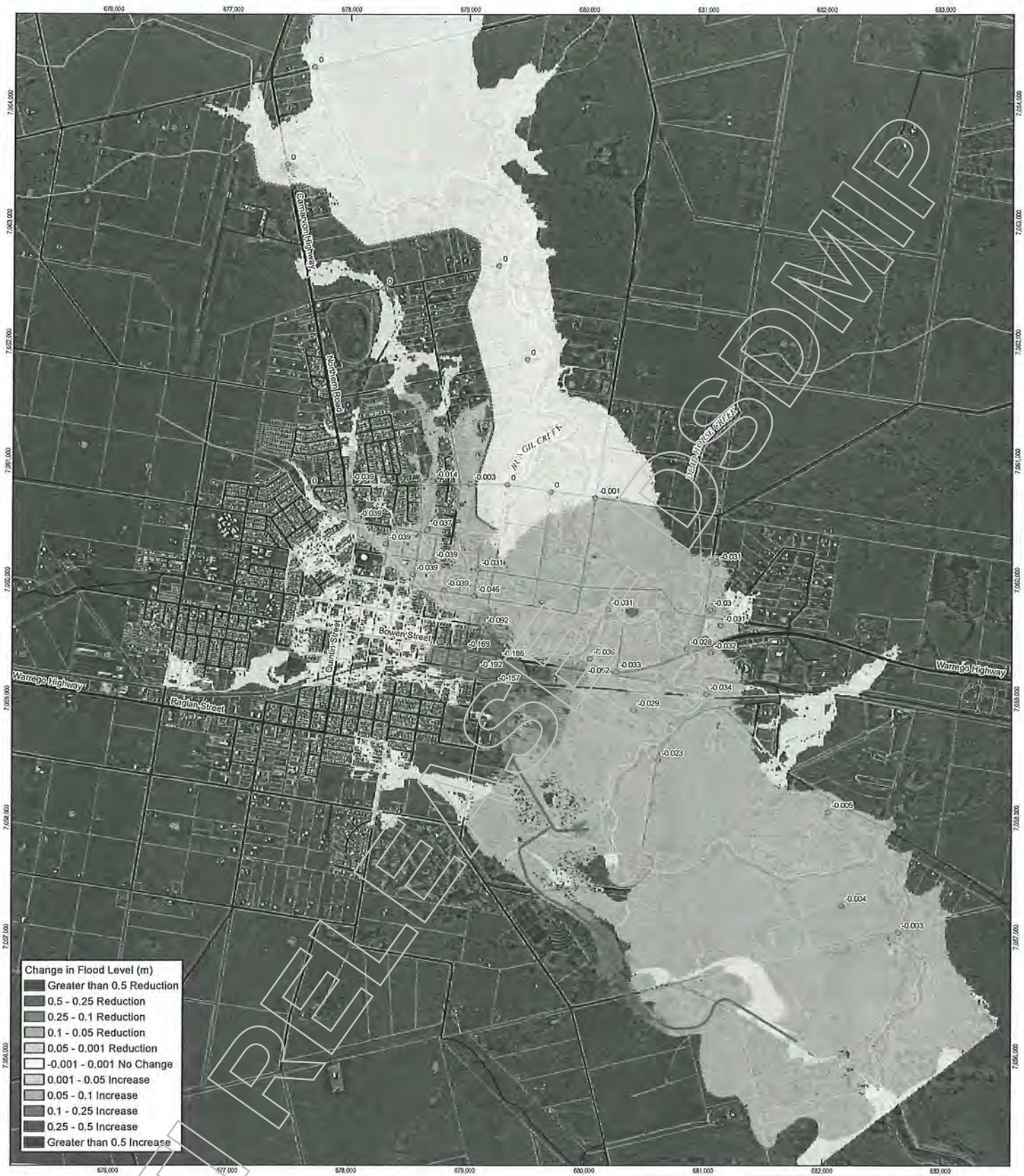
N

Maranoa Regional Council
Roma Flood Study
Stage 1 & Stage 2 Option
Eastern Diversion Channel B with Levee
2012 Flood Event Peak Afflux

Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C12

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\Fig_C12_Stage 2_2012 Flood Event\yr_Aff_Roma_Rev_0.mxd
Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



LEGEND

Sample Point | Highway | Stage 1 Levee Reference Alignment | Cadastre

Road | Western Diversion Drain A

Watercourse

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

Maranoa Regional Council
Roma Flood Study

Stage 1 & Stage 2 Option
Western Diversion Drain A
2012 Flood Event Peak Afflux

Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C13

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Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E brmail@ghd.com W www.ghd.com

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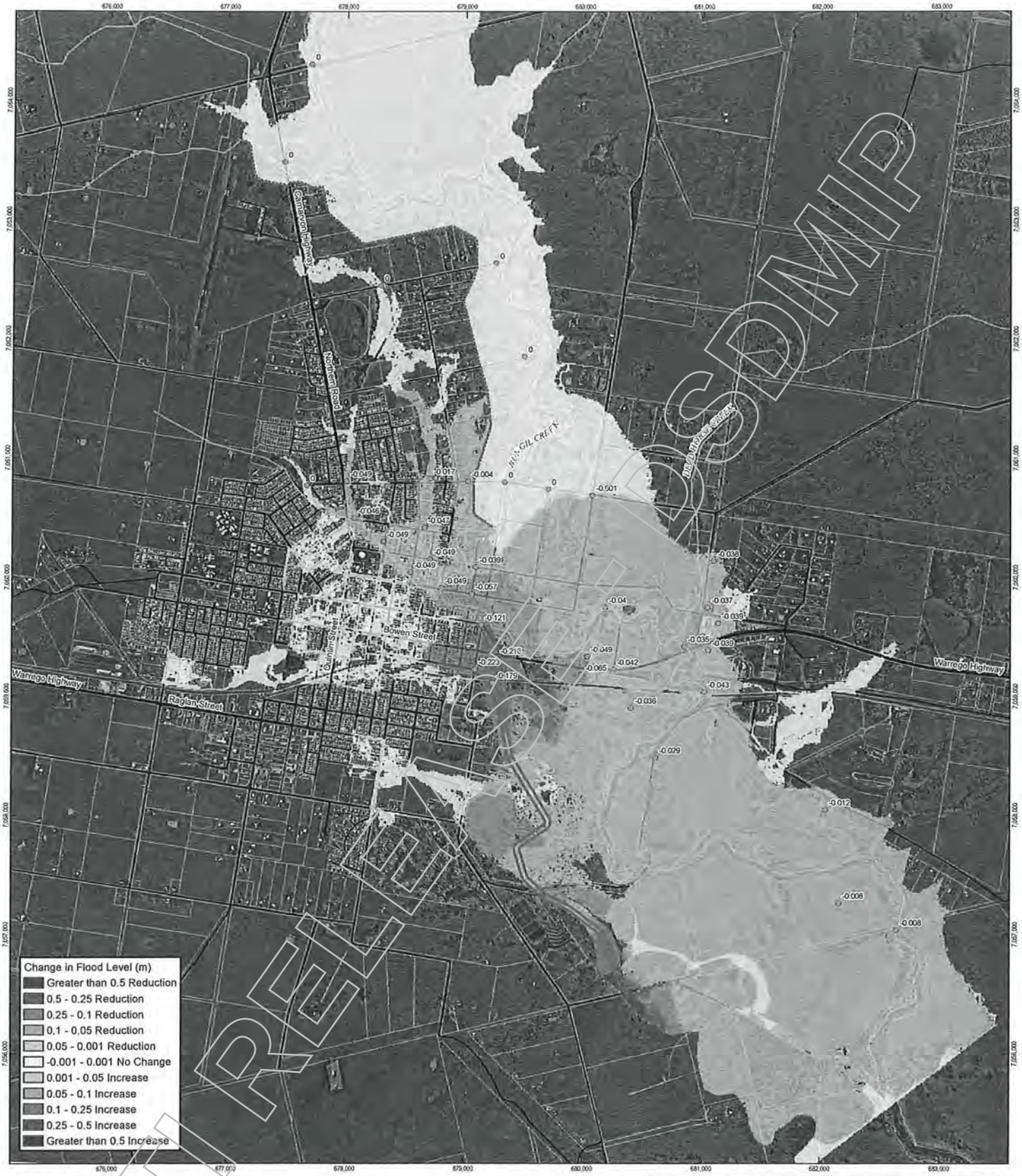

LEGEND

Sample Point | Highway | Stage 1 Levee Reference Alignment | Cadastre
Road | Western Diversion Drain B
Watercourse

1:30,000 @ A3
0 500 1,000
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

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Maranoa Regional Council
Roma Flood Study
Stage 1 & Stage 2 Option
Western Diversion Drain B
2012 Flood Event Peak Afflux

Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C14

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\Fig_C14_Stage 2_2012 Flood Event_Aff_Roma_Rev_0.mxd

Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

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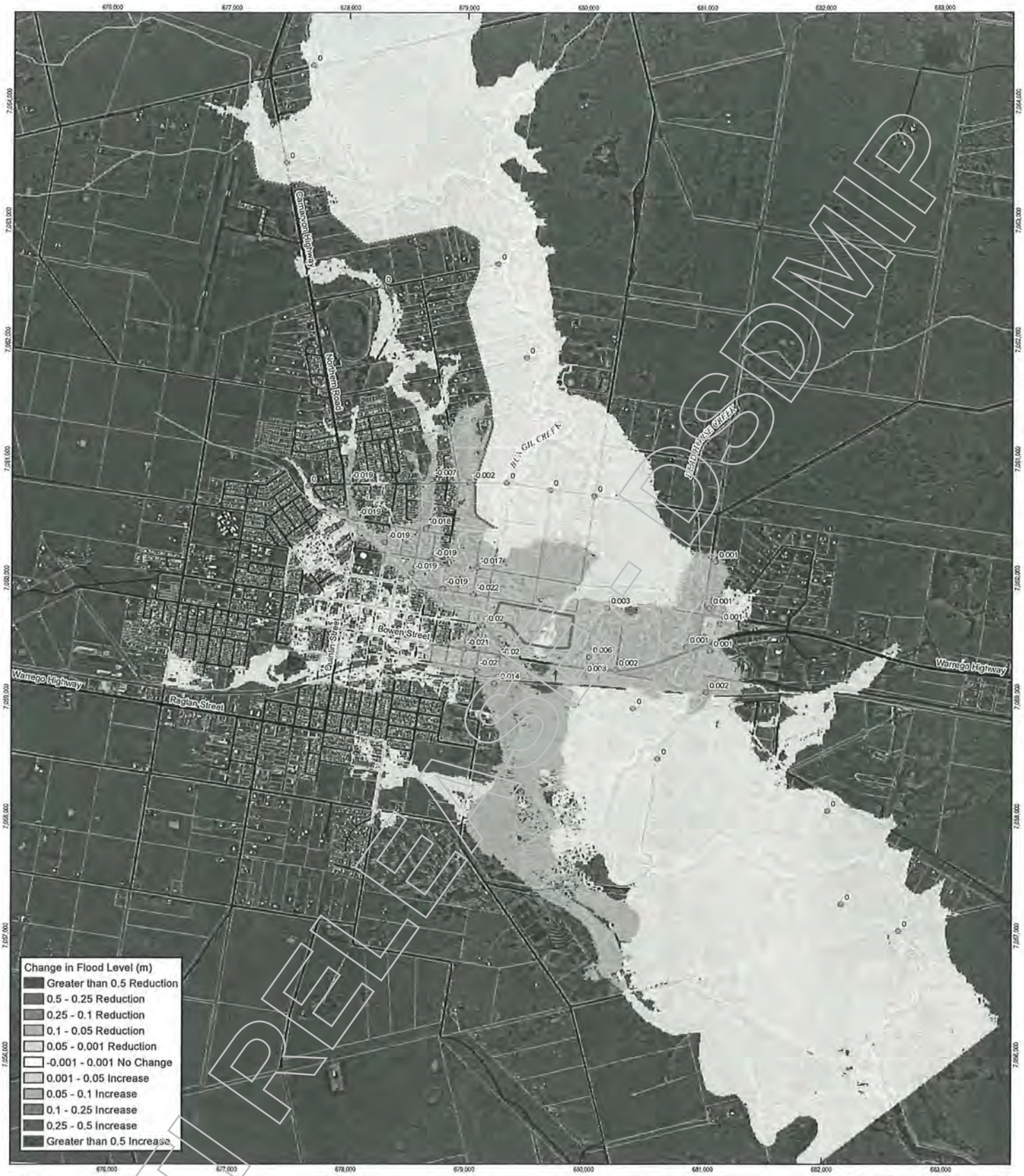


LEGEND

Sample Point | Highway | Stage 1 Levee Reference Alignment | Cadastre | Road | Ashburn Road Retarding Basin | Watercourse

1:30,000 @ A3

0 500 1,000 Metres

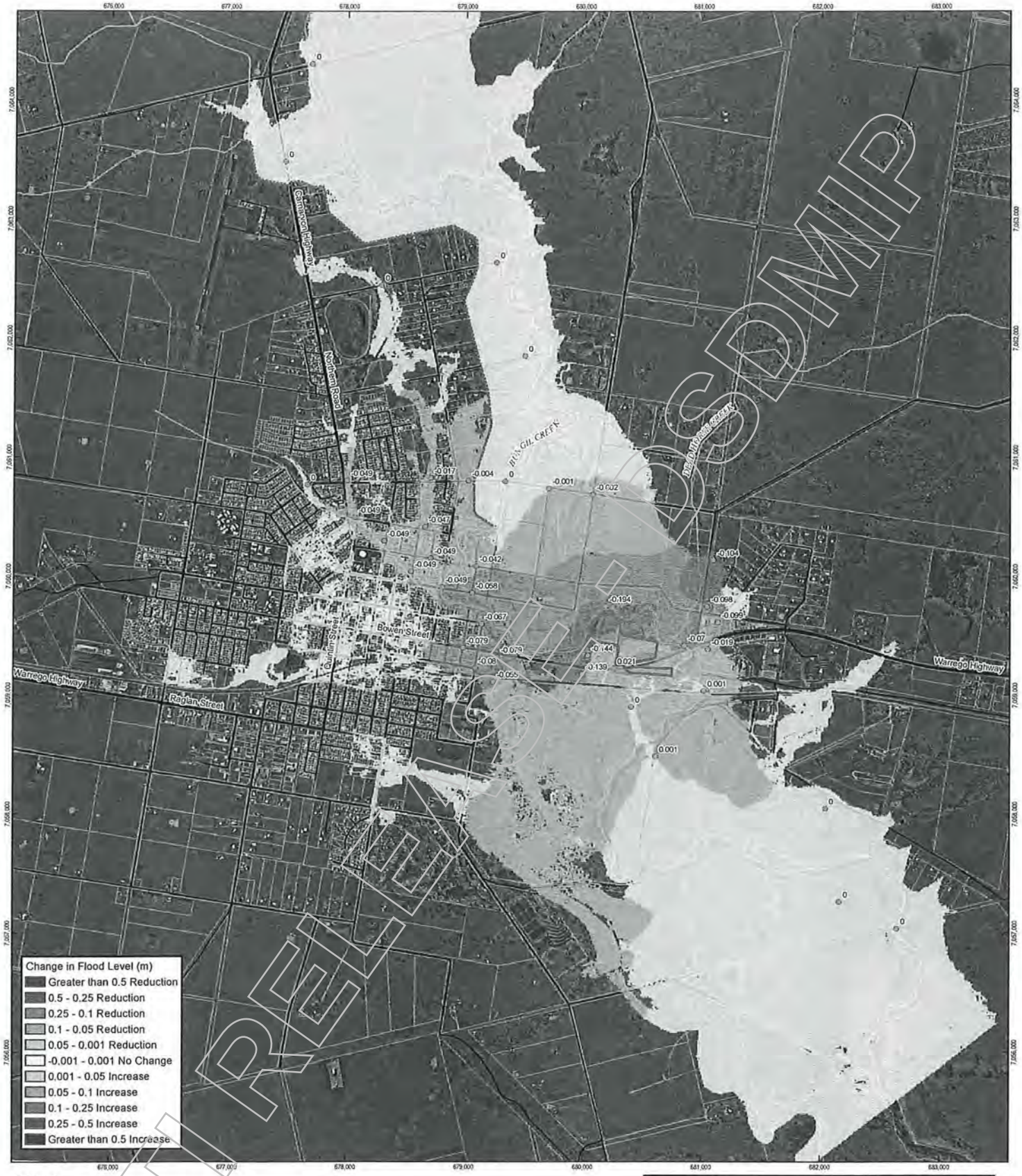
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

Maranoa Regional Council
Roma Flood Study
Stage 1 & Stage 2 Option
Ashburn Road Retarding Basin
2012 Flood Event Peak Afflux

Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C15

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\Fig_C15_Stage 2_2012 Flood Eventyr_Aff_Roma_Rev_0.mxd
Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



LEGEND

Sample Point — Highway — Stage 1 Levee Reference Alignment — Cadastre

Road — Explorers Inn RB

Watercourse

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study

Stage 1 & Stage 2 Option Explorers Inn Retarding Basin 2012 Flood Event Peak Afflux

Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C16

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\Fig_C16_Stage 2_2012 Flood Eventyr_Aff_Roma_Rev_0.mxd

Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E brmail@ghd.com W www.ghd.com

Data Source: ©Commonwealth of Australia (Geoscience Australia) Watercourses/2007; DNRM: Locality, Roads/2010, Cadastre, River/2012; GHD: Flood Surfaces, Sample Points, Levee/2013; DTMR: Aerial/2011. Created By: LS

LEGEND

Sample Point | Highway | Stage 1 Levee Reference Alignment | Cadastre
Road | Shady's Lagoon Extension
Watercourse

1:30,000 @ A3
0 500 1,000
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study
Stage 1 & Stage 2 Option
Shady's Lagoon Extension
2012 Flood Event Peak Afflux

Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C17

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Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

LEGEND

Sample Point | Highway | Stage 1 Levee Reference Alignment | Cadastre
Road | Bungil Creek Floodplain Widening
Watercourse

1:30,000 @ A3
0 500 1,000
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study
Stage 1 & Stage 2 Option
Bungil Creek Widening near Hay-Roma Dam
2012 Flood Event Peak Afflux

Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C18

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\Fig_C18_Stage 2_2012 Flood Event\r_Aff_Roma_Rev_0.mxd
Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

LEGEND

Sample Point | Highway | Stage 1 Levee Reference Alignment | Cadastre

Road | Remove Bungil Street Bridge and Culvert

Watercourse

1:30,000 @ A3

0 500 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

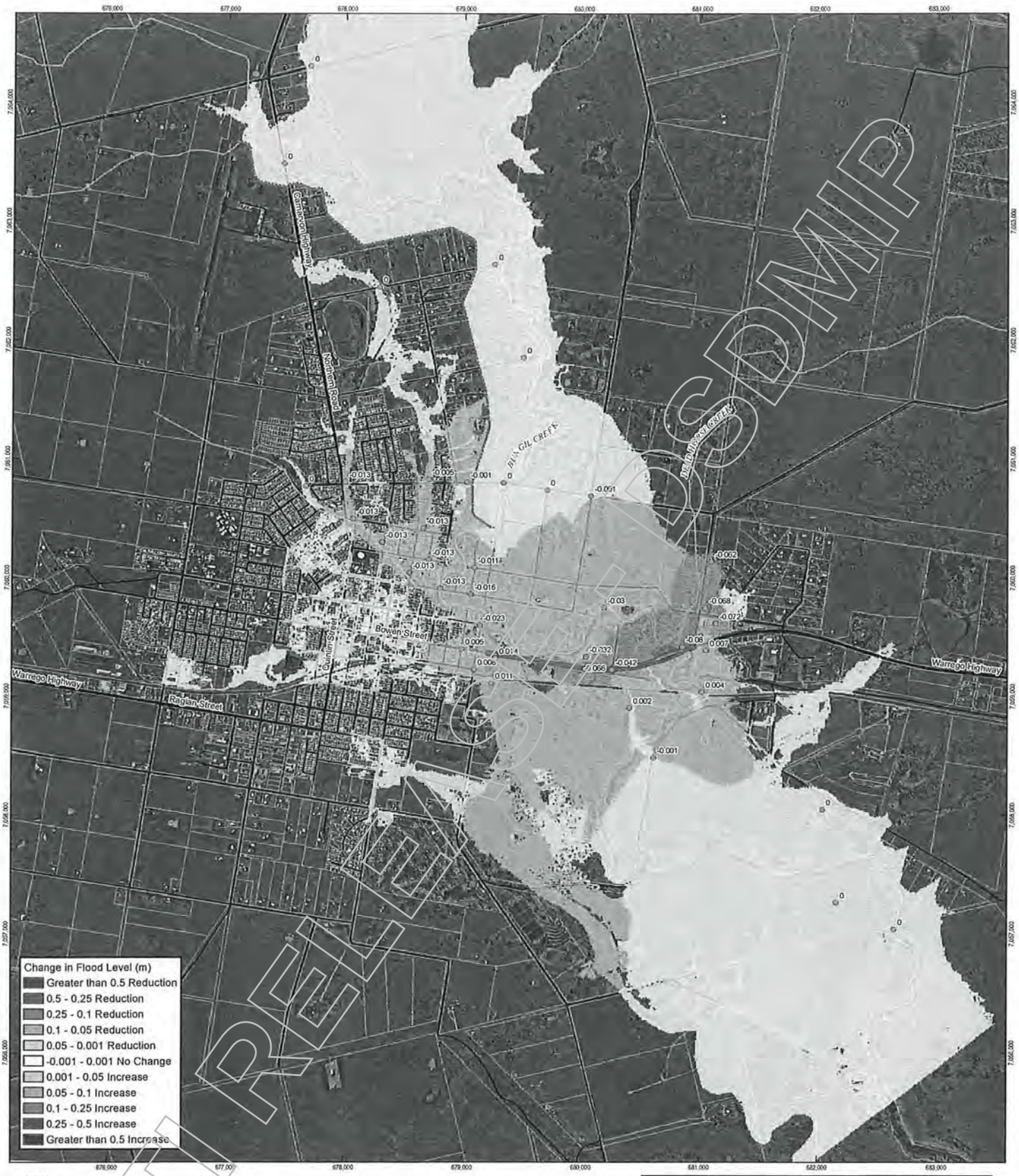
Maranoa Regional Council
Roma Flood Study
Stage 1 & Stage 2 Option
Bungil Creek Widening at Bungil Street Bridge
2012 Flood Event Peak Afflux

Job Number | 41-25323
Revision | 0
Date | 11 Oct 2013

Figure C19

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\Fig_C19_Stage 2_2012 Flood Eventyr_Aff_Roma_Rev_0.mxd

Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



LEGEND

Sample Point
Highway
Road
Watercourse
Stage 1 Levee Reference Alignment
Remove Warrego Highway Embankment
Cadastre

1:30,000 @ A3

0 500 1,000
Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

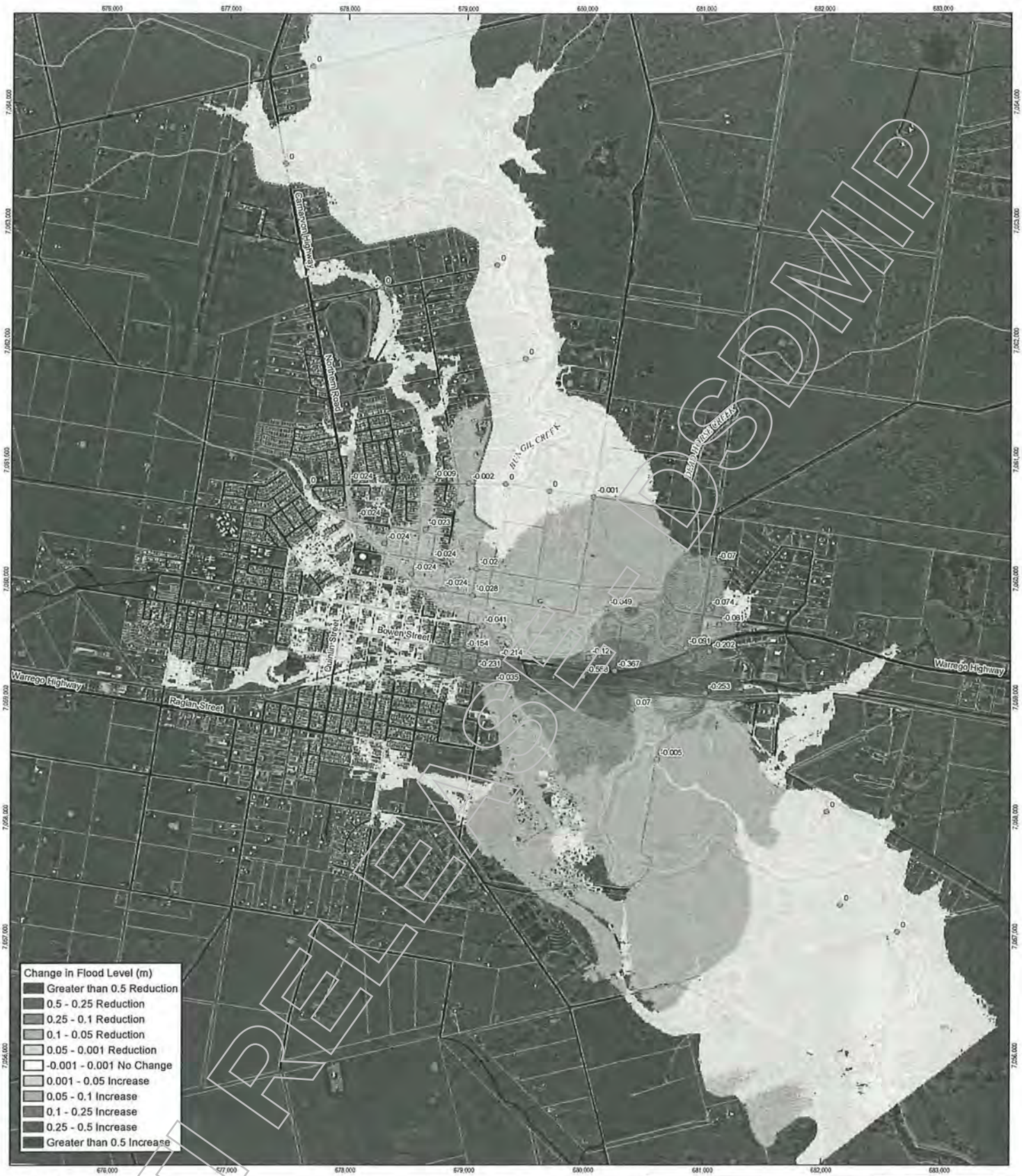
Maranoa Regional Council
Roma Flood Study
Stage 1 & Stage 2 Option
Remove Warrego Highway
2012 Flood Event Peak Afflux

Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C20

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\Fig_C20_Stage 2_2012 Flood Eventyr_Aff_Roma_Rev_0.mxd

Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



LEGEND

Sample Point | Highway | Stage 1 Levee Reference Alignment | Cadastre
Road | Remove Railway Embankment
Watercourse

1:30,000 @ A3
0 500 1,000
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

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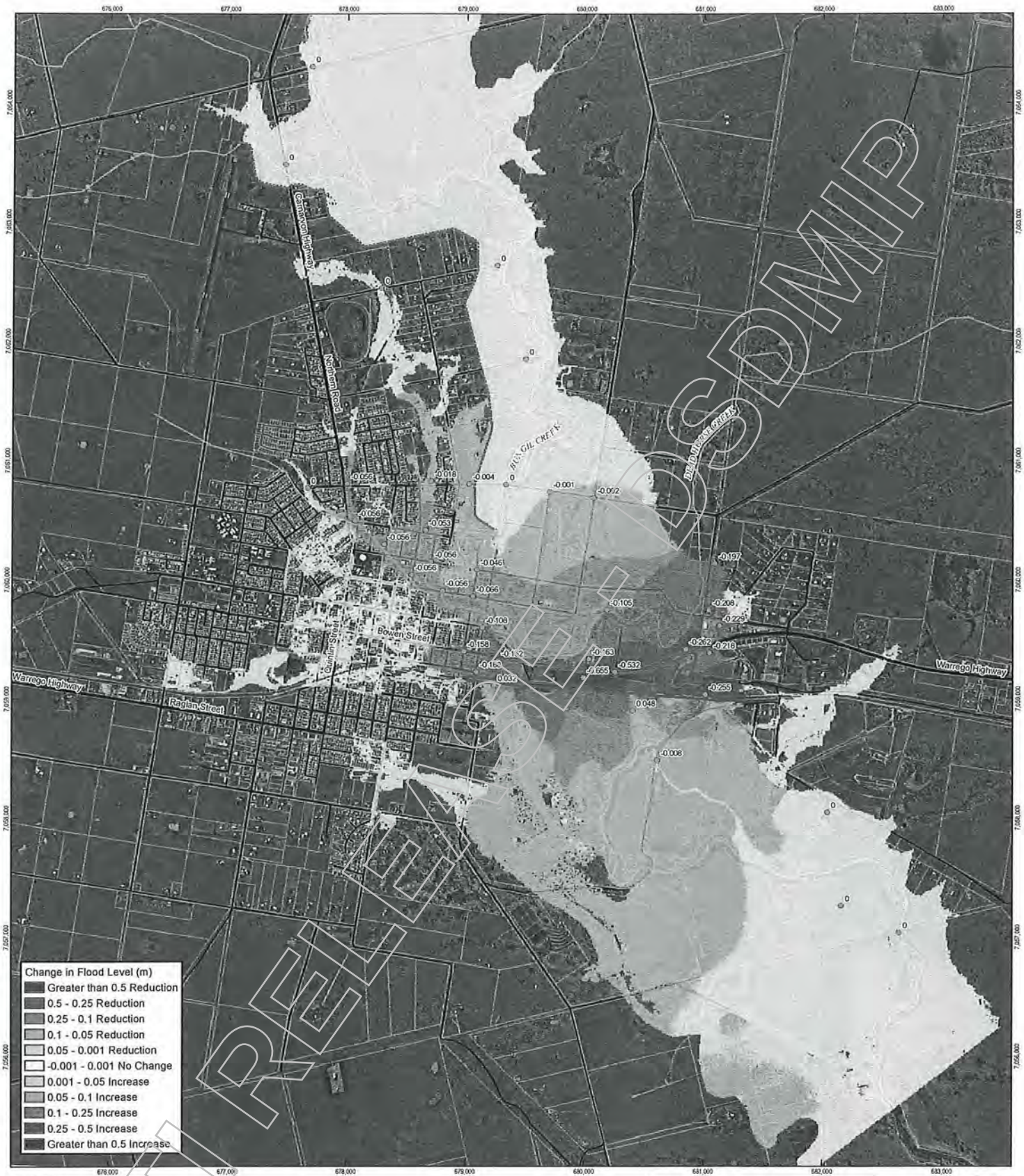
Maranoa Regional Council
Roma Flood Study
Stage 1 & Stage 2 Option
Remove Railway Embankment
2012 Flood Event Peak Afflux

Job Number | 41-25323
Revision | 0
Date | 11 Oct 2013

Figure C21

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\Fig_C21_Stage 2_2012 Flood Eventyr_Aff_Roma_Rev_0.mxd

Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E brmail@ghd.com W www.ghd.com



LEGEND

Sample Point
Highway
Road
Watercourse
Stage 1 Levee Reference Alignment
Remove Warrego Highway Embankment
Remove Railway Embankment
Cadastre

1:30,000 @ A3
0 500 1,000
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

Maranoa Regional Council
Roma Flood Study
Stage 1 & Stage 2 Option
Remove Warrego Highway and Railway Embankments
2012 Flood Event Peak Afflux

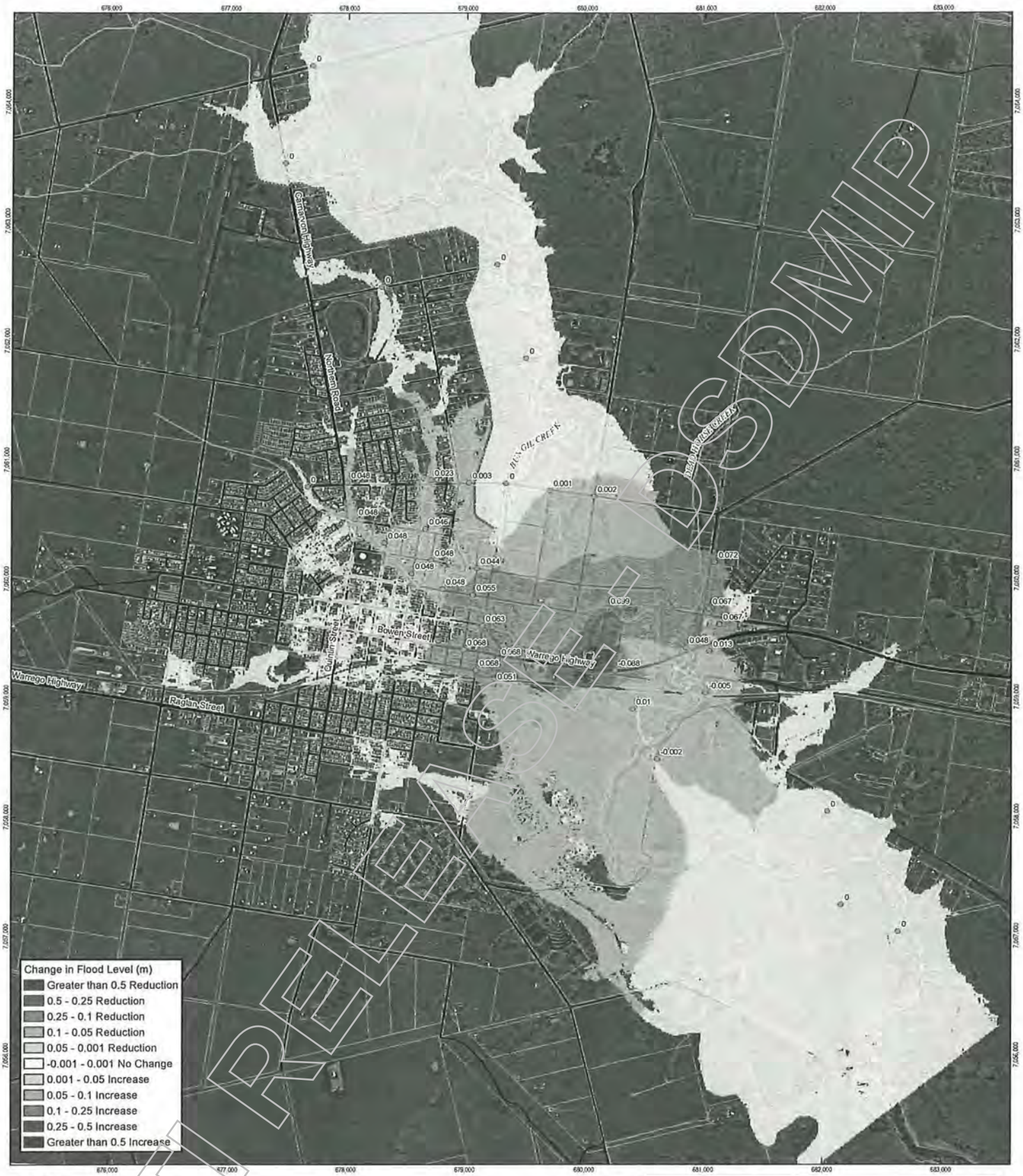
Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C22

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\Fig_C22_Stage 2_2012 Flood Event\r_Aff_Roma_Rev_0.mxd

Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E brisemail@ghd.com W www.ghd.com

Data Source: ©Commonwealth of Australia (Geoscience Australia) Watercourses/2007; DNRM, Locality, Roads/2010, Cadastre, River/2012, GHD Flood Surfaces, Sample Points, Levee/2013; DTMR Aerial/2011 Created By: LS



LEGEND

Sample Point | Highway | Stage 1 Levee Reference Alignment | Cadastre
Road | Levee Around Properties in Floodplain
Watercourse

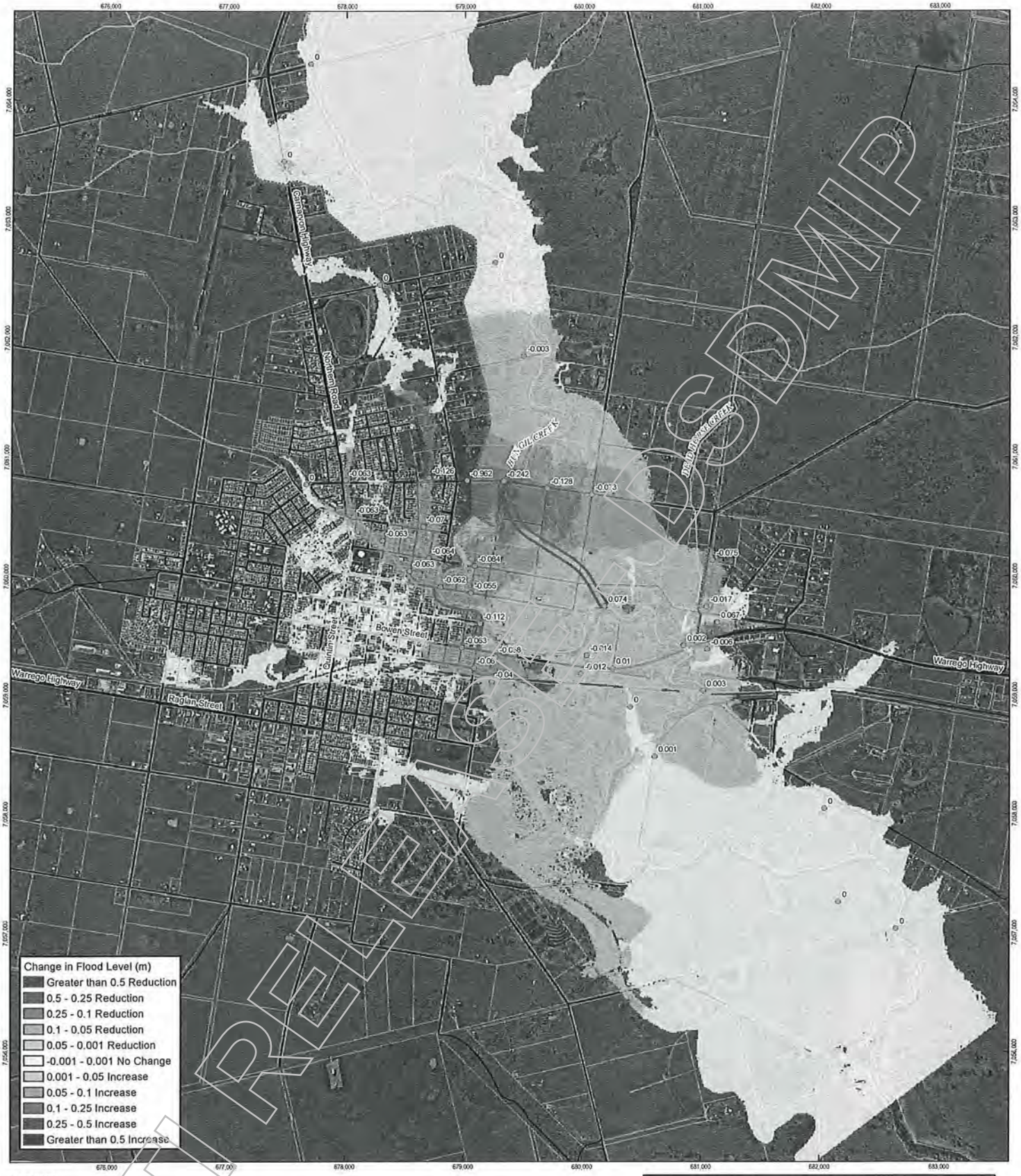
1:30,000 @ A3
0 500 1,000
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

Maranoa Regional Council
Roma Flood Study
Stage 1 & Stage 2 Option
Levees Around Properties Within Floodplain
2012 Flood Event Peak Afflux

Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C23

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\Fig_C23_Stage 2_2012 Flood Eventyr_Aft_Roma_Rev_0.mxd
Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



LEGEND

Sample Point
Highway
Road
Watercourse
Stage 1 Levee Reference Alignment
Combination 1
Eastern Levee
Western Levee
Eastern Diversion Channel B
Cadastre

1:30,000 @ A3
0 500 1,000
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study
Stage 1 & Stage 2 Option Combination 1
2012 Flood Event Peak Afflux

Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C24

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\Fig_C24_Stage 2_2012 Flood Eventyr_Aff_Roma_Rev_0.mxd

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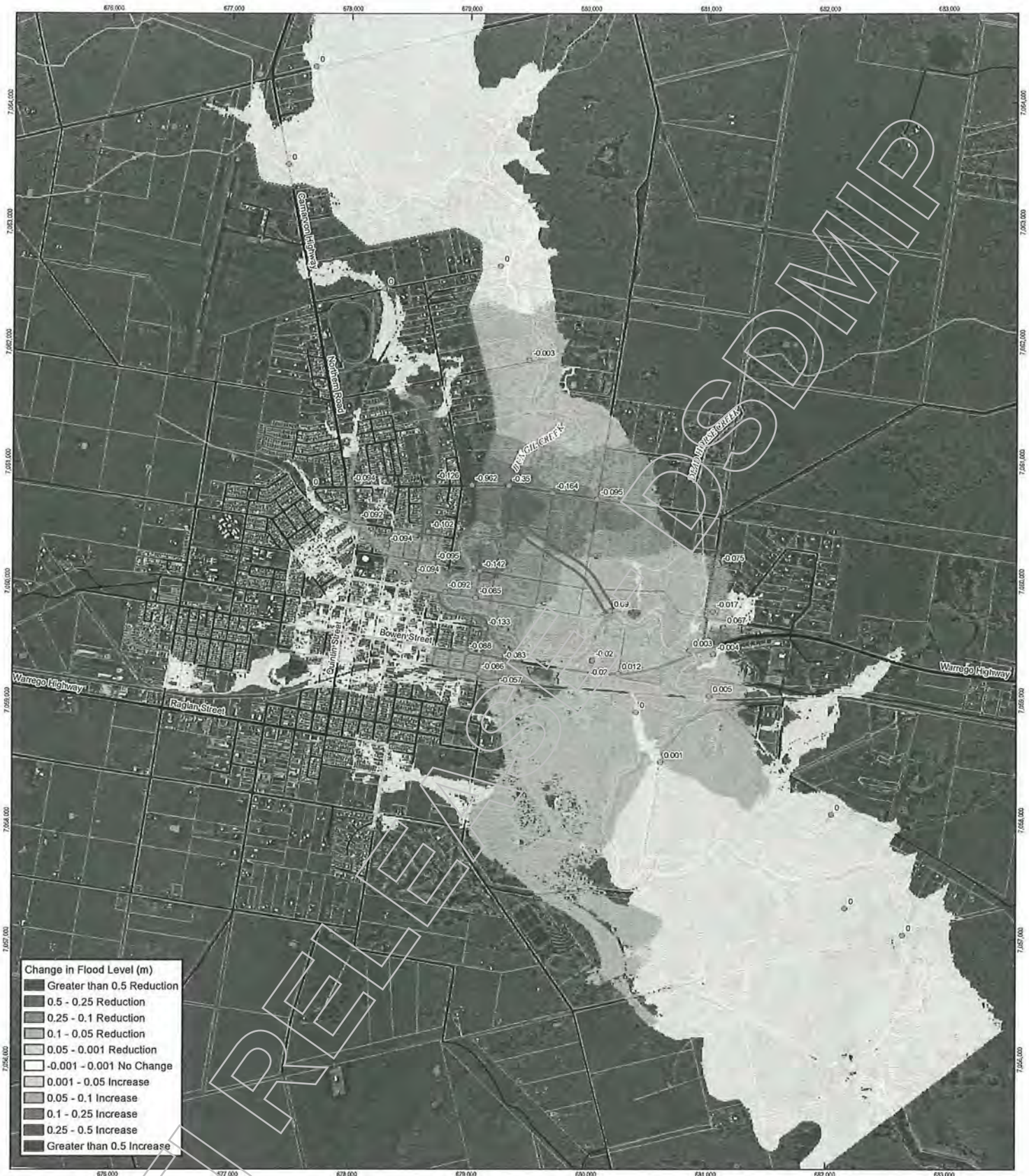

LEGEND

Sample Point
Highway
Road
Watercourse
Stage 1 Levee Reference Alignment
Combination 2
Eastern Levee
Western Levee
Eastern Diversion Channel C
Cadastre

1:30,000 @ A3
0 500 1,000
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

Maranoa Regional Council
Roma Flood Study
Stage 1 & Stage 2 Option Combination 2
2012 Flood Event Peak Afflux

Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C25

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\Fig_C25_Stage 2_2012 Flood Event\r_Aff_Roma_Rev_0.mxd

Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

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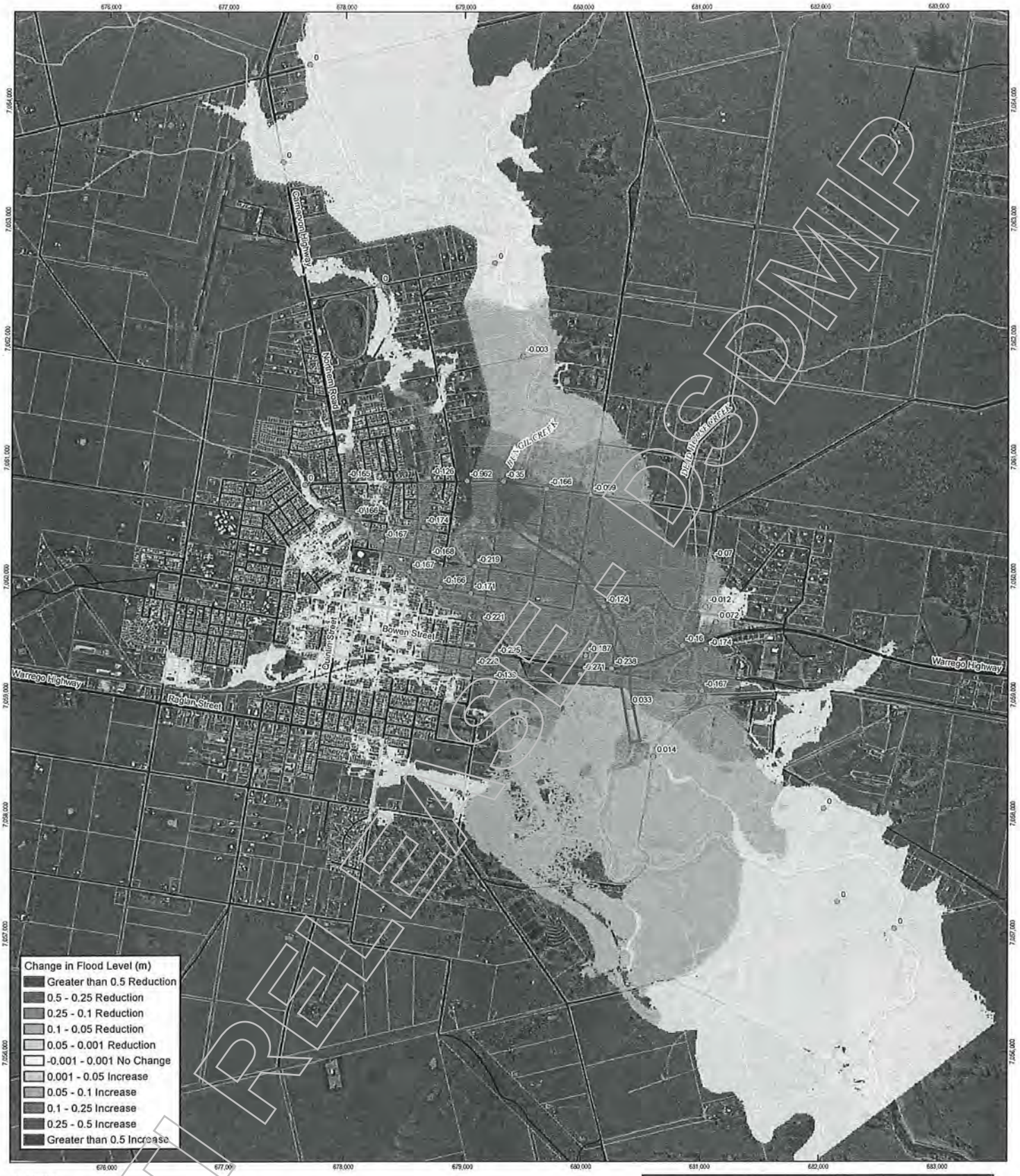

LEGEND

Sample Point
Highway
Road
Watercourse
Stage 1 Levee Reference Alignment
Combination 3
Eastern Levee
Western Levee
Extended Eastern Diversion Channel C
Extended Section of Eastern Diversion Channel C
Cadastre

1:30,000 @ A3
0 500 1,000
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

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Maranoa Regional Council
Roma Flood Study
Stage 1 & Stage 2 Option
Combination 3
2012 Flood Event Peak Afflux

Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C26

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\Fig_C26_Stage 2_2012 Flood Eventyr_Aft_Roma_Rev_0.mxd
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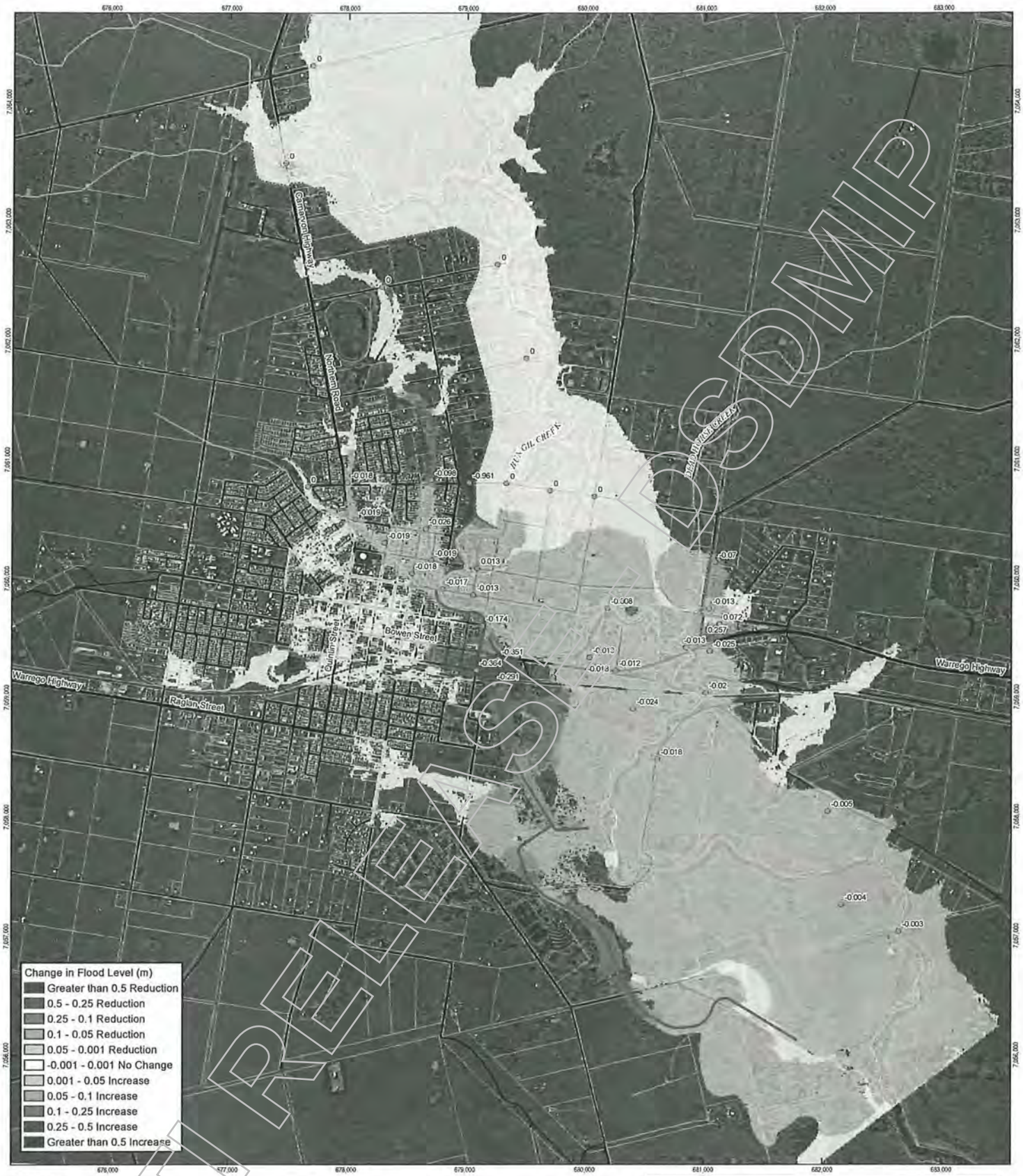

LEGEND

Sample Point
Highway
Road
Watercourse
Stage 1 Levee Reference Alignment
Combination 4
Eastern Levee
Western Levee
Western Diversion Drain A
Cadastre

1:30,000 @ A3
0 500 1,000
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

Maranoa Regional Council
Roma Flood Study
Stage 1 & Stage 2 Option Combination 4
2012 Flood Event Peak Afflux

Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C27

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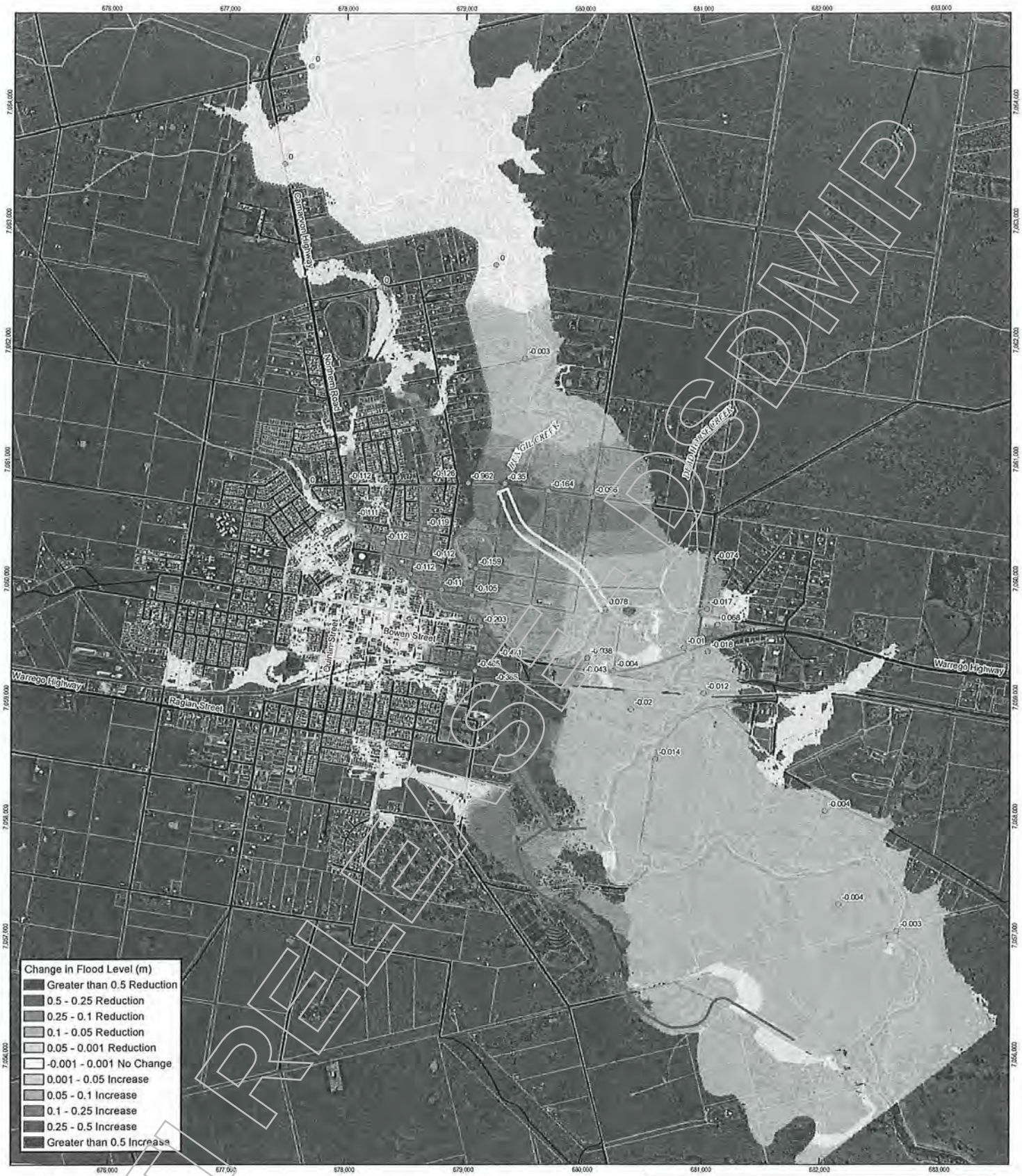
Level 9, 145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



LEGEND

Sample Point
Highway
Road
Watercourse
Stage 1 Levee Reference Alignment
Combination 5
Eastern Levee
Western Levee
Western Diversion Drain A
Eastern Diversion Channel C
Cadastre

1:30,000 @ A3
0 500 1,000
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Maranoa Regional Council
Roma Flood Study
Stage 1 & Stage 2 Option Combination 5
2012 Flood Event Peak Afflux

Job Number 41-25323
Revision 0
Date 11 Oct 2013

Figure C28

G:\41\25323\GIS\Maps\Stage_2\MXD\Regional_Report_Rev_0\Fig_C28_Stage 2_2012 Flood Event\yr_Aff_Roma_Rev_0.mxd

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Data Source: ©Commonwealth of Australia (Geoscience Australia), Watercourses/2007; DNRM, Locality, Roads/2010, Cadastre, River/2012, GHD Flood Surfaces, Sample Points, Levee/2013; DTMR Aerial/2011. Created By: LS

Appendix D - Multi Criteria Analysis Documentation

Memorandum

19 August 2013

To	Maranoa Regional Council		
Copy to	Michael Parker, Ross Drabble,		
From	Megan Holcomb, Daniel Boitshoko	Tel	(07) 3316 3000
Subject	Roma Flood Study - Stage 2 Multi-Criteria Analysis	Job no.	41/25323/00

1 Introduction

GHD has used a Multi-Criteria Analysis (MCA) combined with desktop based Geographic Information System (GIS) technology to undertake the analysis of flood mitigation options. The purpose of this MCA is to provide a systematic tool for evaluating each option considered during the Stage 2 flood mitigation options analysis.

This document gives the evaluation results for assessment of the regional flood mitigation combination options. A full description for each option and combination of options are given in Maranoa Regional Council, Romal Flood Mitigation Study, Hydrology and Hydraulics for Stage 2, Regional Mitigation Options (GHD, August 2013). This document is meant to be read in conjunction with the Stage 2, Regional Mitigation Options report.

2 Multi-Criteria Analysis

The effect of building infrastructure on the natural and built environment (including social and cultural heritage) largely depends on the type of infrastructure and site selected. Consequently, careful selection of the flood mitigation infrastructure and placement has significant importance in minimising a range of impacts in the study area.

Recognising this, GHD has applied a systematic and transparent approach to assess the feasibility of the Stage 2 – Roma Flood Study using a Multi-Criteria Analysis (MCA) methodology. Each of the options has been evaluated to assess:

- Impact from foot-print of proposed flood mitigation option infrastructure, i.e. levees or diversions.
- Impact from changes to the floodplain that would occur based on implementation of the proposed flood mitigation options.

2.1 Overview

The methodology used by GHD is a combined MCA with desktop based Geographic Information System (GIS) analysis to evaluate potential flood mitigation options using a range of selected criteria. An overview of the process is given in Table 1.

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Table 1 MCA Process

Process	Description
Decision Criteria	Develop a set of social, environmental, and economic criteria to score potential adaptions options
Scoring	Assess the value associated with the consequences of each option for each criterion
Weighting	Assign weights for each of the criterion to reflect their relative importance to the decision
Weighted Scoring	Combine the weights and scores for each option to derive an overall value

- MCA techniques were used to identify, rank and weight the performance criteria guiding the options suitability modelling process. The adoption of the MCA enabled the option selection process to take a balanced, transparent and traceable approach that considered environmental, social, physical, infrastructure and hydraulic related evaluation criteria while supporting a range of inputs from stakeholders.
- To meet the requirements of the options study, an initial set of suitability criteria were developed by the GHD study team. These criteria were reviewed in a client stakeholder meeting, which also rated and weighted the criteria. These ratings and weightings were then reviewed by the GHD project team for consistency and adjusted as per the advice of GHD's interdisciplinary team.
- The MCA approach allowed differing types of criteria to be considered in relation to each other, using the same assessment framework, based on the ability to map the suitability criteria to available spatial data sources.

2.2 Data Review and Selection

The spatial datasets utilised for the suitability assessment were sourced from Maranoa Regional Council or from those currently licensed to or acquired by GHD. The datasets were limited to local, State and Federal Government geospatial datasets. While this scale of information is acceptable for high-level options assessment, it is recognised that detailed, large scale datasets available through specific discipline studies would provide an improved set of information for the detailed options assessments.

2.2.1 Data Selection Criteria

Selection of geospatial datasets for use in the modelling process was determined by a number of factors, including:

- Representation of the Stage 2 study area flood mitigation options assessment criteria, in terms of both constraints and opportunities;
- A consistent level of coverage across the study area;

- Availability of data from local, State and Federal Government sources; and
- Accuracy and currency.

2.2.2 *Scale of Inputs and Modelling Resolution*

The scales for inputs from regional and local hydraulic models are discussed within the modelling reports.

2.3 Performance Rating

Rating and weighting of the input criteria are the main judgement phases of the MCA process, which have a direct and significant bearing on the output of the options suitability modelling process. Both ratings and weightings reflect the preferences of the decision makers and theoretically should be the only subjective elements of the assessment process. A matrix-based approach was used to facilitate a group of discipline specific stakeholders to work towards agreement on the relative influence that each of the inputs should have on the model.

Performance ratings for each of the suitability criterion were identified as follows:

- Fatal flaw (100)
- Highly constrained (40)
- Moderately constrained (20)
- Absence of constraints (Neutral, 10)
- Highly suitable (1)
- In determining the performance ratings, the following issues were considered:
- Legislative requirements, for example, requirements to obtain permits to clear vegetation.
- Construction related physical limitations of rail alignment corridor infrastructure.
- Environmental values and sensitivities and the need to protect ecosystems, species and wetlands.
- Social values and sensitivities in relation to existing residential areas and landownership; and
- Planned and existing transportation corridors for co-location, safety and access considerations.

2.4 Criteria Weighting

Upon allocation of the ratings, each criterion was considered in relation to each other criteria in a pair-wise comparison. This enabled the relative importance of each criterion to be allocated and used in the generation of the constraints and opportunities mapping outcome.

In the modelling process, the relative influence of the criteria's performance rating was modified by the weight. As a result, the application of each criterion weight allows the differentiation between similar performance ratings across themes.

For example, if only two inputs were considered and these had the same ratings and all other factors were equal, the model would favour an area that was contained within the lower weighting rather than an

area with a higher weighting. This example reflects the underlying logic that is applied simultaneously across all inputs when determining the suitability of a mitigation measure.

2.5 MCA Limitations

It should be noted that while the MCA is a powerful desktop tool for screening study options and generating suitability surfaces, there are a number of specific limitations to this approach including:

- Inability to represent all of the aspects that determine suitability for a flood mitigation option in a geographic format (i.e. cost/benefit analysis).
- Lack of data at a suitable scale relating to site specific considerations.
- Accuracy and currency of the data.

3 Roma Flood Mitigation Stage 2 Suitability

Using the methodology outlined in Section 2, a suitability surface for assessing the Roma Flood Mitigation Stage 2 options was developed. The criteria selection, ratings and weightings used to create the suitability surface were determined in workshops by project stakeholders and reviewed by GHD's nominated discipline professionals.

3.1 Flood Mitigation Option Assessment

The primary source of data was gathered through a review of local, State and Federal Government datasets over the study area. The key issues able to be collated with any accuracy and utilised in the constraints and opportunity mapping are discussed below. It must be noted that only data which can be represented spatially can be assessed during the MCA process. 'Soft' data (i.e. social value, public opinion, etc.) have been excluded because of difficulty in representing this data spatially. These types of 'soft' data can be considered outside of the formal MCA process (i.e. during the final option selection).

3.1.1 Social Values

S1 – Flood Levels

S2 – Zoning

S3 – Cultural heritage (Indigenous and non-indigenous)

3.1.2 Environmental Values

E1 – Essential habitat

E2 – Regional ecosystems

E3 – High value regrowth

E4 – Wildlife corridor

E5 – Wetlands

E6 – Matters of National Environmental Significance (MNES)

E6 – Areas on the Environmental Management / Contaminated Land Registers (EMR/CLR)

3.1.3 Infrastructure Values

I1 – Local Government road network (existing and planned) hazard

I2 – State Government road network (existing and planned) hazard

I3 – State Rail Network

I4 – Utilities, Powelines, gas pipeline, water pipeline, telecommunications

3.2 Constraint Weighting

Constraint weights reflect the importance of each constraint and were determined in conjunction with relevant stakeholders. To complete the paired comparison approach, constraints are compared against every other constraint, and most important constraint is identified for assessing the preference of mitigation options.

Table 2 below lists the preference for each pair of constraints.

For each constraint, the number of preferred comparisons is totalled. The weighting is derived from this score, divided by the total number of (ie. Weighting for S1 is 14/105 = 0.1333, expressed as a percentage is 13.33%).

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Table 2 Constant Weighting Determination

	Criteria	S1. Flood Levels	S2. Tenure	S3. Cultural Heritage (ind. and non-ind.)	S4. Native Title	E1. Essential Habitat	E2. Regional Ecosystem	E3. High Value Regrowth	E4. Wildlife Corridor	E5. Wetlands	E6. Areas on the EMR/CLR	E7. MNES	I1. Local Gov. Road Network	I2. State Gov Road Network	I3. Rail Easement	I4. Utilities	Count	Weight	%
Social	S1. Flood Levels		1	1	1	1	1	1	1	1	1	1	1	1	1	1	14	0.13	13.33%
	S2. Zoning	0		0	1	0	0	0	0	0	0	0	0	0	0	0	1	0.01	0.95%
	S3. Cultural Heritage (indigenous and non-indigenous)	0	1		1	0	0	1	1	1	1	0	0	0	0	0	6	0.06	5.71%
	S4. Native Title	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00%
Environmental	E1. Essential Habitat	0	1	1	1		1	1	1	1	1	0	1	0	0	0	9	0.09	8.57%
	E2. Regional Ecosystem	0	1	1	1	0		1	1	1	1	0	1	0	0	0	8	0.08	7.62%
	E3. High Value Regrowth	0	1	0	1	0	0		0	0	1	0	1	0	0	0	4	0.04	3.81%
	E4. Wildlife Corridor	0	1	0	1	0	0	1		0	1	0	1	0	0	0	5	0.05	4.76%
	E5. Wetlands	0	1	0	1	0	0	1	1		1	0	1	0	0	0	6	0.06	5.71%
	E6. Areas on the EMR/CLR	0	1	0	1	0	0	0	0	0		0	0	0	0	0	2	0.02	1.90%
	E7. MNES	0	1	1	1	1	1	1	1	1	1		1	1	1	1	13	0.12	12.38%
Infrastructure	I1. Local Government Road Network (existing and planned)	0	1	1	1	0	0	0	0	0	1	0		0	1	0	5	0.05	4.76%
	I2. State Government Road Network (existing and planned)	0	1	1	1	1	1	1	1	1	1	0	1		1	0	11	0.10	10.48%
	I3. Rail Easement	0	1	1	1	1	1	1	1	1	1	0	0	0		0	9	0.09	8.57%
	I4. Utilities	0	1	1	1	1	1	1	1	1	1	0	1	1	1		12	0.11	11.43%
	Total	0	13	8	14	5	6	10	9	8	12	1	9	3	5	2	105	1.00	100%

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3.3 Performance Ratings and Weightings

The Table 3, Table 4, and Table 5 contain the weightings and ratings for each criteria used in the MCA process. Weightings listed for each theme are directly related to the weight calculated in the constraint weighting determination,

Table 2. E.g., for S1, Flood levels, the weight is 0.13 in

Table 2, the project rating (10) given in Table 3 is multiplied by the weight, to produce a weighting (10 x 0.13 = 1.33) for the outcome for the criteria given.

Table 3 Social Values

Theme	Justification for Inclusion/Exclusion	Notes	Criteria	Weighting	Project Rating*
S1. Flood levels	Will flooding impact above floor flooding of dwellings	Comparing number of dwellings impacted by revised flood levels against base scenario.	Not flooded Either way	1.33	10
			Saved	0.13	1
			Newly Flooded	5.33	40
			Flooded Either way	1.33	10
S2. Zoning	What type of tenure will be impacted by flooding		Recreation Zone	0.01	1
			Rural Residential Zone, Rural Zone	0.10	10
			Residential, Industry	0.19	20
			Commercial, Special Purpose	0.38	40
S3. Cultural Heritage (indigenours and non-indigenous)	Will flooding impact on areas identified as posessing cultural heritage (indigenous and non-indigenous)		Nil items of cultural heritage expected to occur	0.06	1
			Items of cultural heritage expected to be disturbed and/or destroyed	2.29	40

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Table 4 Environmental Values

Theme	Justification for Inclusion/Exclusion	Criteria	Weighting	Project Rating*
E1. Essential habitat	Does flooding / infrastructure impact essential habitat	Nil essential habitat impacted	0.09	1
		EHAB Impacted	3.43	40
E2. Regional Ecosystem	Does flooding impact on types of regional ecosystems	Cleared area	0.08	1
		Non-remnant	0.76	10
		Not of concern	1.52	20
		Of Concern	3.05	40
		Endangered	7.62	100
E3. HVR	flooding/infrastructure impacts HVR	Not of concern regrowth impacted	0.76	20
		Of concern regrowth impacted	1.52	40
		Endangered regrowth impacted	3.81	100
E4. Wildlife Corridor	Does flooding impact on areas mapped as wildlife corridor	Not mapped as wildlife corridor	0.05	1
		Mapped as wildlife corridor	0.95	20
E5. Wetlands	Does flodding impact on areas mapped as wetlands	Wetland management trigger not activated	0.06	1
		Wetland management trigger activated	2.29	40
E6. MNES		MNES will potentially be impacted	0.12	1
		Will have significant detrimental impacts on MNES	4.95	40
E7. Areas on the EMR/CLR	Does flooding impact areas registered on the EMR and/or CLR	Site is not registered on the EMR/CLR	0.02	1
		Site is registered on the EMR/CLR	0.76	40

Table 5 Infrastructure Values

Subcategory	*Theme*	Justification for Inclusion/Exclusion	Criteria	Weighting	Project Rating*
Road Infrastructure	*I1. Local Government Road Network (existing and planned)*	Whether or not flooding has an impact on Local Government Road network infrastructure	Low Hazard	0.95	20
			Significant Hazard	1.90	40
			High Hazard	4.76	100
			Extreme Hazard	4.76	100
	I2. State Government Road Network (existing and planned)	Whether or not flooding has an impact on State Government Road network infrastructure	Low Hazard	2.10	20
			Significant Hazard	4.19	40
			High Hazard	10.48	100
			Extreme Hazard	10.48	100
Rail Infrastructure	*I3. State Rail Network*	Whether or not flooding has an impact on the state rail easement network	Nil impact on rail easement network	0.09	1
			Impacts rail easement network	3.43	40
Utilities	*I4. Powerlines, gas pipeline, water pipeline, telecommunications*	Whether or not flood mitigation infrastructure coincides with utility locations	Nil impact on utilities	0.11	1
			Impacts on utilities	4.57	40

4 Roma Flood Mitigation Stage 2 Performance Evaluation

Each of the combinations of flood mitigation options was assessed for their potential to improve flooding conditions within Roma. The combinations were assessed by using 2D hydraulic modelling, as described in Maranoa Regional Council, Romal Flood Mitigation Study, Hydrology and Hydraulics for Stage 2, Regional Mitigation Options (GHD, August 2013). The results from the hydraulic modelling for each option was used to develop a score for each of the themes identified for the MCA. The scoring is based on:

- Floodplain and infrastructure footprint extents
- Flood hazard

To score each option, the results were assessed geographically against the criteria, i.e. the data sets were clipped to the floodplain and infrastructure footprint extents. Property counts, utility counts, linear infrastructure lengths, and areas were then extracted as appropriate for each criterion. Weightings were then applied to these values, and a weighted score was for each option. The options were then ranked, based upon their score. Tables 6 through 8 list the combination options in order of most to least preferred.

Some of the environmental criterions have highly constrained weightings, which may affect the ultimate decision to move forward with any of these options, even though the options could have a better ranking than others that were considered. For example combination 6 is shown to impact E6 (MNES), however, it is the best ranked option. Criterion should be individually examined for the preferred option before moving forward, so that the implications are fully understood

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Table 6 Floodplain impact weighted scores, listed by rank (most to least preferred)

Ranked Combinations*	S1	S2	S3	E1	E2	E3	E4	E5	E6	E7	I1	I2	I3	I4	SUM
Combination 6	1342.00	280.18	16.00	20.24	2358.41	155.33	314.04	217.70	68.97	31.24	81.16	18.45	7.09	672.86	5583.65
Combination 5	1375.60	298.36	16.00	20.24	2347.96	143.65	314.76	184.60	68.97	30.48	81.46	21.89	7.00	694.13	5605.10
Combination 7	1346.80	282.18	16.00	20.24	2372.70	157.72	314.56	228.96	68.97	31.24	81.21	19.97	7.09	682.01	5629.64
Combination 4	1382.80	299.69	16.00	20.24	2370.38	152.20	314.82	201.67	68.97	30.48	84.49	21.80	7.21	701.60	5672.35
Combination 3	1373.20	297.41	16.00	20.24	2376.32	158.13	314.62	217.37	68.97	30.48	80.87	21.05	6.78	695.80	5677.22
Combination 2	1380.40	298.93	16.00	20.24	2385.38	159.75	314.81	220.03	68.97	30.48	81.69	22.16	7.52	705.06	5711.42
Combination 1	1384.00	299.12	16.00	20.24	2387.65	159.92	314.80	220.71	68.97	30.48	82.70	22.30	7.62	707.00	5721.50

*Note: Combinations are ranked based on the sum total of the weighted scores

Table 7 Footprint impact weighted scores, listed by rank (most to least preferred)

combination	S1**	S2	S3**	E1**	E2	E3	E4	E5	E6	E7	I1	I2	I3	I4	SUM
Combination 1	-	3.352	-	-	16.35	0.74	3.307	0	0.762	-	0.297	0	0	2.888	27.7
Combination 5	-	3.352	-	-	20.44	0.79	4.267	0	0.762	-	0.367	0	0	3.224	33.2
Combination 3	-	4.305	-	-	28.36	0.79	5.798	0	1.524	-	0.52	0.009	0.297	5.678	47.28
Combination 6	-	3.276	-	-	39.77	9.099	5.351	20.89	2.286	-	0.74	0.014	0.526	9.628	91.58
Combination 4	-	4.019	-	-	13.2	5.978	0.7	17.15	1.524	-	0.156	0.005	0.165	3.627	46.53
Combination 2	-	4.505	-	-	29.34	6.06	4.278	17.15	2.286	-	0.411	0.005	0.165	4.828	69.03
Combination 7	-	2.876	-	-	27.94	0.727	5.309	0	1.524	-	0.656	0.009	0.323	7.537	46.9

*Note: Combinations are ranked based on the sum total of the weighted scores.

**Note: These values not applicable for footprint impact assessment.

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Table 8 Weighted scores (Floodplain and Footprint), Listed by Rank (most to least preferred)

Combination	Floodplain Total	Footprint Total	SUM
combination 5	5605.10	33.20	5638.30
combination 6	5583.65	91.58	5675.22
combination 7	5629.64	46.90	5676.54
combination 4	5672.35	46.53	5718.88
combination 3	5677.22	47.28	5724.50
combination 1	5721.50	27.70	5749.20
combination 2	5711.42	69.03	5780.45

5 Summary

Based on the MCA Analysis for Floodplain and Footprint impacts, the combination options with the best performance are:

1. Combination 5
2. Combination 6
3. Combination 7

Combination 5 is ranked higher than combinations 6 and 7 because it has a smaller footprint. Because the purpose of the study is to find a flood mitigation option, the results for floodplain impacts were given a higher emphasis when choosing the preferred option. If the floodplain impacts alone are considered, the options with the best performance combinations 6 and 7.

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Appendix E - Indicative Cost Estimates

ROMA FLOOD MITIGATION STUDY
STAGE 2 OPTIONS

PRELIMINARY DETAILED COST ESTIMATE - REGIONAL COMBINATION 6

Item	Description	Unit	Quantity	Rate	Amount	Remarks
1	**Preliminary Items**					40% of total stage 1 smec costs
1	Survey setout	Item	1	8,000	8,000	
2	Mobilisation to Site (labour, plant and equipment) & site facilities	Item	1	60,000	60,000	additional due to multiple locations/distance between them
3	Construction Management & Supervision	Item	1	716,000	716,000	
4	Site Support Services (testing, training, HSEQ, etc.)	Item	1	94,000	94,000	
5	Project management plans plus other plans	Item	1	12,000	12,000	
6	Erosion management plan	Item	1	28,000	28,000	
7	De-mobilisation	Item	1	18,000	18,000	
				Sub Total	936,000	
2	**Western Levee - Northern Section (0.80km)**					*6 properties affected*
1	Clearing and grubbing of levee footprint including fence removal	m2	8,640	0.80	6,912	used stage 1 smec costs
2	Earthworks - remove unsuitable material (including topsoil) to stockpile	m3	1,728	3.10	5,357	used stage 1 smec costs
3	Earthworks - clay core on leads from local source including excavation, carting, placement and compaction	m3	2,858	18.00	51,444	
4	Earthworks - sand filter including excavation, carting, placement and compaction	m3	1,600	6.50	10,400	
5	Earthworks - spread topsoil to 200 mm depth	m3	1,762	5.40	9,515	used stage 1 smec costs
6	Hydromulch	m2	8,810	1.30	11,453	used stage 1 smec costs
				Sub Total	95,081	
3	**Eastern Levee (1.01km long)**					*1 property affected*
1	Clearing and grubbing of levee footprint including fence removal	m2	18,250	0.80	14,600	
2	Earthworks - remove unsuitable material (including topsoil) to stockpile	m3	3,650	3.10	11,315	
3	Earthworks - clay core on leads from local source including excavation, carting, placement and compaction	m3	20,248	18.00	364,464	
4	Earthworks - sand filter including excavation, carting, placement and compaction	m3	1,400	6.50	9,100	
5	Earthworks - spread topsoil to 200 mm depth	m3	3,702	5.40	19,991	
6	Hydromulch	m2	18,510	1.30	24,063	
7	Beaumont Drive reconstruction (base course and spray seal pavement)	Item	1	50,000	50,000	
8	Erosion protection	m2	5,700	40	228,000	
				Sub Total	721,533	

4	**Levees around properties in Flood Plain - Explorer Inn Motel (0.71km long)**					*2 properties affected*
1	Clearing and grubbing of levee footprint including fence removal	m2	8,150	0.80	6,520	
2	Earthworks - remove unsuitable material (including topsoil) to stockpile	m3	1,630	3.10	5,053	
3	Earthworks - clay core on leads from local source including excavation, carting, placement and compaction	m3	2,598	18.00	46,764	
4	Earthworks - sand filter including excavation, carting, placement and compaction	m3	1,420	6.50	9,230	
5	Earthworks - spread topsoil to 200 mm depth	m3	1,662	5.40	8,975	
6	Hydromulch	m2	8,310	1.30	10,803	
7	Driveway reconstruction (base course and spray seal pavement)	Item	1	5,000	5,000	
8	Erosion protection	m2	750	40	30,000	
				Sub Total	122,345	
5	**Levees around properties in Flood Plain - Quality Inn Motel (0.47km long)**					*2 properties affected*
1	Clearing and grubbing of levee footprint including fence removal	m2	5,300	0.80	4,240	
2	Earthworks - remove unsuitable material (including topsoil) to stockpile	m3	1,060	3.10	3,286	
3	Earthworks - clay core on leads from local source including excavation, carting, placement and compaction	m3	1,598	18.00	28,764	
4	Earthworks - sand filter including excavation, carting, placement and compaction	m3	940	6.50	6,110	
5	Earthworks - spread topsoil to 200 mm depth	m2	1,082	5.40	5,843	
6	Hydromulch	m2	5,410	1.30	7,033	
7	Driveway reconstruction (base course and spray seal pavement)	Item	1	5,000	5,000	
				Sub Total	60,276	
6	**Eastern Diversion Channel D (1.19km long)**					*6 properties affected*
1	Clearing and grubbing including fence removal	m2	93,050	0.80	74,440	
2	Earthworks - cut to fill (stockpile within 1km)	m3	161,370	6.50	1,048,905	90% of total volume
3	Earthworks - cut to spoil	m3	17,930	5.00	89,650	10% of total volume
4	Earthworks - spread topsoil to 200 mm depth	m3	18,806	5.40	101,552	
5	Hydromulch	m2	94,030	1.30	122,239	
6	Ashburn Road reconstruction (base course & spray sealed pavement)	Item	1	50,000	50,000	
7	Short St & Beaumont Dr reconstruction (unsealed)	Item	2	10,000	20,000	
8	Erosion Protection at Bungil Creek	m2	1,200	40	48,000	10m wide at Creek
				Sub Total	1,554,786	

7	**Extended Eastern Diversion Channel D (1.40km long)**					*7 properties affected*
1	Clearing and grubbing including fence removal	m2	107,700	0.80	86,160	
2	Earthworks - cut to fill (stockpile within 1km)	m3	171,810	6.50	1,116,765	90% of total volume
3	Earthworks - cut to spoil	m3	19,090	5.00	95,450	10% of total volume
4	Earthworks - spread topsoil to 200 mm depth	m2	21,748	5.40	117,439	
5	Hydromulch	m2	108,740	1.30	141,362	
6	Driveway reconstruction (unsealed)	Item	2	10,000	20,000	
7	Warrego Highway RCBC construction	Item	1	1,710,000	1,710,000	70m long 12m wide
8	Rail RCBC construction	Item	1	990,000	990,000	
9	Erosion Protection at Bungil Creek	m2	1,200	40	48,000	10m wide at Creek
				Sub Total	4,325,176	
9	**Western Diversion Drain B (3.66km long)**					*7 properties affected*
1	Clearing and grubbing including fence removal	m2	152,610	0.80	122,088	
2	Earthworks - cut to fill (stockpile within 1km)	m3	165,144	6.50	1,073,436	70% of total volume
3	Earthworks - cut to spoil	m3	70,776	5.00	353,880	30% of total volume
4	Earthworks - spread topsoil to 200 mm depth	m2	30,820	5.40	166,428	
5	Hydromulch	m2	154,100	1.30	200,330	
6	Warrego Highway RCBC construction	Item	1	590,000	590,000	40m long 12m wide
7	Rail RCBC construction	Item	1	350,000	350,000	
8	Two Mile Road reconstruction (unsealed)	Item	1	10,000	10,000	
				Sub Total	2,866,162	
10	**Miscellaneous**					
1	Fencing - Including access gate at each property boundary	Item	31	1,000	31,000	Allow $1,000 for each property
2	Establishment of easements over affected properties including easement documents and plan lodging.	Item	31	1,000	31,000	Provisional sum
3	Survey - as constructed	Item	1	50,000	50,000	Provisional sum
				Sub Total	112,000	
11	**Additional Oncost**					
1	Detailed design	LS	6%		584,722	6% on Direct Job Costs
2	Contingencies	LS	30%		2,923,608	30% on Direct Job Costs & Preliminary based on class 4 estimate
				Sub Total	3,508,329	
				GRAND TOTAL	**14,301,688**	

Notes

- Earthwork quantities are assumed from 12D calculations. These are approximate, but are assumed to be accurate for this concept level.
- The amount of soil that will be to spoil or to fill, has been assumed based on available ground surface data and 12D concept design.
- Unit prices were based on Stage 1 cost estimates. Unit prices for bridges were based on previous projects and checked against Rawlinsons (2013).
- Easement costs have been assumed based on Stage 1 preliminary cost estimates. Property acquisition costs have been excluded.
- Owner costs and project management fees have been excluded.
- Preliminary items, i.e. survey, mobilisation, construction management, site support, erosion and sediment control, de-mobilisation, have been included and are based on a percentage of the total estimate for Stage 2.

ROMA FLOOD MITIGATION STUDY
STAGE 2 OPTIONS

PRELIMINARY DETAILED COST ESTIMATE - REGIONAL COMBINATION 7

Item	Description	Unit	Quantity	Rate	Amount	Remarks
1	**Preliminary Items**					40% of total stage 1 smec costs
1	Survey setout	Item	1	8,000	8,000	
2	Mobilisation to Site (labour, plant and equipment) & site facilities	Item	1	60,000	60,000	additional due to multiple locations/distance between them
3	Construction Management & Supervision	Item	1	716,000	716,000	
4	Site Support Services (testing, training, HSEQ, etc.)	Item	1	94,000	94,000	
5	Project management plans plus other plans	Item	1	12,000	12,000	
6	Erosion management plan	Item	1	28,000	28,000	
7	De-mobilisation	Item	1	18,000	18,000	
				Sub Total	936,000	
2	**Western Levee - Northern Section (0.80km)**					*6 properties affected*
1	Clearing and grubbing of levee footprint including fence removal	m2	8,640	0.80	6,912	used stage 1 smec costs
2	Earthworks - remove unsuitable material (including topsoil) to stockpile	m3	1,728	3.10	5,357	used stage 1 smec costs
3	Earthworks - clay core on leads from local source including excavation, carting, placement and compaction	m3	2,858	18.00	51,444	
4	Earthworks - sand filter including excavation, carting, placement and compaction	m3	1,600	6.50	10,400	
5	Earthworks - spread topsoil to 200 mm depth	m3	1,762	5.40	9,515	used stage 1 smec costs
6	Hydromulch	m2	8,810	1.30	11,453	used stage 1 smec costs
				Sub Total	95,081	
3	**Eastern Levee (1.01km long)**					*1 property affected*
1	Clearing and grubbing of levee footprint including fence removal	m2	18,250	0.80	14,600	
2	Earthworks - remove unsuitable material (including topsoil) to stockpile	m3	3,650	3.10	11,315	
3	Earthworks - clay core on leads from local source including excavation, carting, placement and compaction	m3	20,248	18.00	364,464	
4	Earthworks - sand filter including excavation, carting, placement and compaction	m3	1,400	6.50	9,100	
5	Earthworks - spread topsoil to 200 mm depth	m3	3,702	5.40	19,991	
6	Hydromulch	m2	18,510	1.30	24,063	
7	Beaumont Drive reconstruction (base course and spray seal pavement)	Item	1	50,000	50,000	
8	Erosion protection	m2	5,700	40	228,000	
				Sub Total	721,533	

4	**Levees around properties in Flood Plain - Explorer Inn Motel (0.71km long)**					*2 properties affected*
1	Clearing and grubbing of levee footprint including fence removal	m2	8,150	0.80	6,520	
2	Earthworks - remove unsuitable material (including topsoil) to stockpile	m3	1,630	3.10	5,053	
3	Earthworks - clay core on leads from local source including excavation, carting, placement and compaction	m3	2,598	18.00	46,764	
4	Earthworks - sand filter including excavation, carting, placement and compaction	m3	1,420	6.50	9,230	
5	Earthworks - spread topsoil to 200 mm depth	m3	1,662	5.40	8,975	
6	Hydromulch	m2	8,310	1.30	10,803	
7	Driveway reconstruction (base course and spray seal pavement)	Item	1	5,000	5,000	
8	Erosion protection	m2	750	40	30,000	
				Sub Total	122,345	
5	**Levees around properties in Flood Plain - Quality Inn Motel (0.47km long)**					*2 properties affected*
1	Clearing and grubbing of levee footprint including fence removal	m2	5,300	0.80	4,240	
2	Earthworks - remove unsuitable material (including topsoil) to stockpile	m3	1,060	3.10	3,286	
3	Earthworks - clay core on leads from local source including excavation, carting, placement and compaction	m3	1,598	18.00	28,764	
4	Earthworks - sand filter including excavation, carting, placement and compaction	m3	940	6.50	6,110	
5	Earthworks - spread topsoil to 200 mm depth	m2	1,082	5.40	5,843	
6	Hydromulch	m2	5,410	1.30	7,033	
7	Driveway reconstruction (base course and spray seal pavement)	Item	1	5,000	5,000	
				Sub Total	60,276	
6	**Eastern Diversion Channel D (1.19km long)**					*6 properties affected*
1	Clearing and grubbing including fence removal	m2	93,050	0.80	74,440	
2	Earthworks - cut to fill (stockpile within 1km)	m3	161,370	6.50	1,048,905	90% of total volume
3	Earthworks - cut to spoil	m3	17,930	5.00	89,650	10% of total volume
4	Earthworks - spread topsoil to 200 mm depth	m3	18,806	5.40	101,552	
5	Hydromulch	m2	94,030	1.30	122,239	
6	Ashburn Road reconstruction (base course & spray sealed pavement)	Item	1	50,000	50,000	
7	Short St & Beaumont Dr reconstruction (unsealed)	Item	2	10,000	20,000	
8	Erosion Protection at Bungil Creek	m2	1,200	40	48,000	10m wide at Creek
				Sub Total	1,554,786	

7	**Extended Eastern Diversion Channel D (1.40km long)**					*7 properties affected*
1	Clearing and grubbing including fence removal	m2	107,700	0.80	86,160	
2	Earthworks - cut to fill (stockpile within 1km)	m3	171,810	6.50	1,116,765	90% of total volume
3	Earthworks - cut to spoil	m3	19,090	5.00	95,450	10% of total volume
4	Earthworks - spread topsoil to 200 mm depth	m2	21,748	5.40	117,439	
5	Hydromulch	m2	108,740	1.30	141,362	
6	Driveway reconstruction (unsealed)	Item	2	10,000	20,000	
7	Warrego Highway RCBC construction	Item	1	1,710,000	1,710,000	70m long 12m wide
8	Rail RCBC construction	Item	1	990,000	990,000	
9	Erosion Protection at Bungil Creek	m2	1,200	40	48,000	10m wide at Creek
				Sub Total	4,325,176	
9	**Western Diversion Drain B (3.66km long)**					*OMITTED FROM COMBINATION 7*
1	Clearing and grubbing including fence removal	m2	152,610	0.80		
2	Earthworks - cut to fill (stockpile within 1km)	m3	165,144	6.50		
3	Earthworks - cut to spoil	m3	70,776	5.00		
4	Earthworks - spread topsoil to 200 mm depth	m2	30,820	5.40		
5	Hydromulch	m2	154,100	1.30		
6	Warrego Highway RCBC construction	Item	1	590,000		
7	Rail RCBC construction	Item	1	350,000		
8	Two Mile Road reconstruction (unsealed)	Item	1	10,000		
				Sub Total		
10	**Miscellaneous**					
1	Fencing - Including access gate at each property boundary	Item	31	1,000	31,000	Allow $1,000 for each property
2	Establishment of easements over affected properties including easement documents and plan lodging.	Item	31	1,000	31,000	Provisional sum
3	Survey - as constructed	Item	1	50,000	50,000	Provisional sum
				Sub Total	112,000	
11	**Additional Oncost**					
1	Detailed design	LS	6%		412,752	6% on Direct Job Costs
2	Contingencies	LS	30%		2,063,759	30% on Direct Job Costs & Preliminary based on class 4 estimate
				Sub Total	2,476,511	
				GRAND TOTAL	**10,403,707**	

Notes

- Earthwork quantities are assumed from 12D calculations. These are approximate, but are assumed to be accurate for this concept level.
- The amount of soil that will be to spoil or to fill, has been assumed based on available ground surface data and 12D concept design.
- Unit prices were based on Stage 1 cost estimates. Unit prices for bridges were based on previous projects and checked against Rawlinsons (2013).
- Easement costs have been assumed based on Stage 1 preliminary cost estimates. Property acquisition costs have been excluded.
- Owner costs and project management fees have been excluded.
- Preliminary items, i.e. survey, mobilisation, construction management, site support, erosion and sediment control, de-mobilisation, have been included and are based on a percentage of the total estimate for Stage 2.

Appendix F – Conceptual Drawings

PLAN
SCALE 1:10,000

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0 100 200 300 400 500m
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Client MARANOA REGIONAL COUNCIL
Project ROMA FLOOD STUDY
Title PROPOSED STAGE 2 REGIONAL OPTIONS OVERALL PLAN

Original Size A1
Drawing No: 41-25323-SK101
Rev: A

Plot Date: 2 December 2013 - 3:05 PM Plotted by: Jeremy Wilmot
Cad File No: G:\41\25323\CAD\Drawings\41-25323-SK101-SK107.dwg

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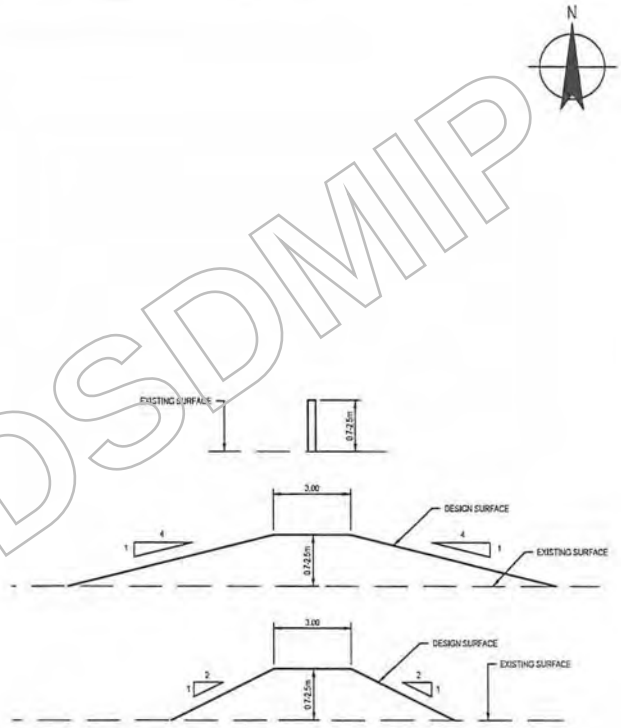

LEVEE TYPICAL SECTION - ALTERNATIVE OPTIONS
SCALE 1:100

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A	PRELIMINARY		LSM	MH*	JP*	02.12.13

Plot Date: 2 December 2013 - 2:58 PM Plotted by: Jeremy Wilmot Cad File No. G:\41\25323\CADD\Drawings\41-25323-SK101-SK107.dwg

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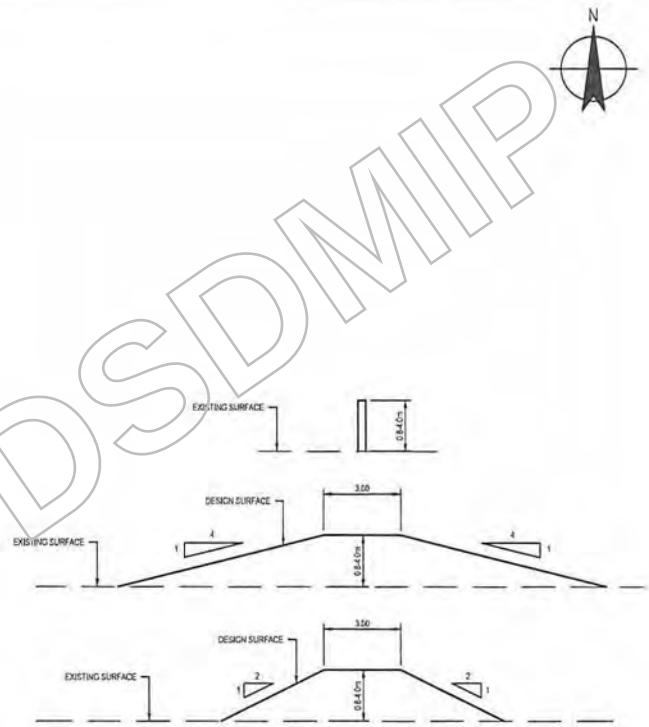
Title PROPOSED STAGE 2 REGIONAL OPTIONS WESTERN LEVEE (NORTHERN SECTION) - DETAILS

Original Size A1 Drawing No: 41-25323-SK102 Rev: A

PLAN
SCALE 1:2000



LEVEE TYPICAL SECTION - ALTERNATIVE OPTIONS
SCALE 1:100

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SCALE 1:100 AT ORIGINAL SIZE
0 20 40 60 80 100m
SCALE 1:2000 AT ORIGINAL SIZE

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EASTERN LEVEE - DETAILS

Original Size: A1 Drawing No: 41-25323-SK103 Rev: A

Plot Date: 2 December 2013 - 3:07 PM Plotted by: Jeremy Wilmet Cad File No: G:\41\25323\CADD\Drawings\41-25323-SK101-SK107.dwg

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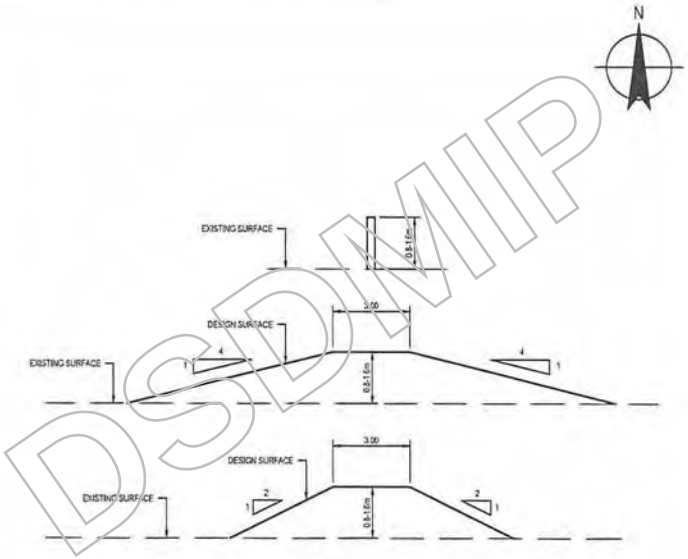

EXPLORER INN
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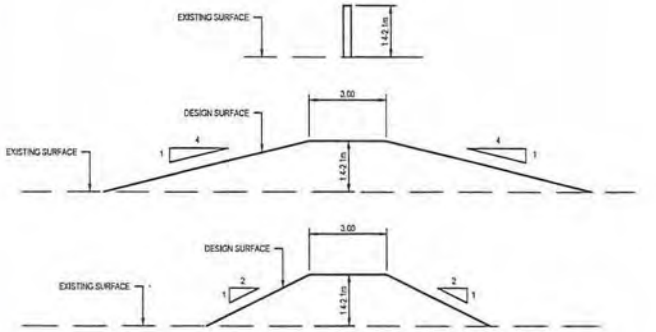
SCALE 1:100



QUALITY INN
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0 1 2 3 4 5m
SCALE 1:100 AT ORIGINAL SIZE
0 10 20 30 40 50m
SCALE 1:1000 AT ORIGINAL SIZE

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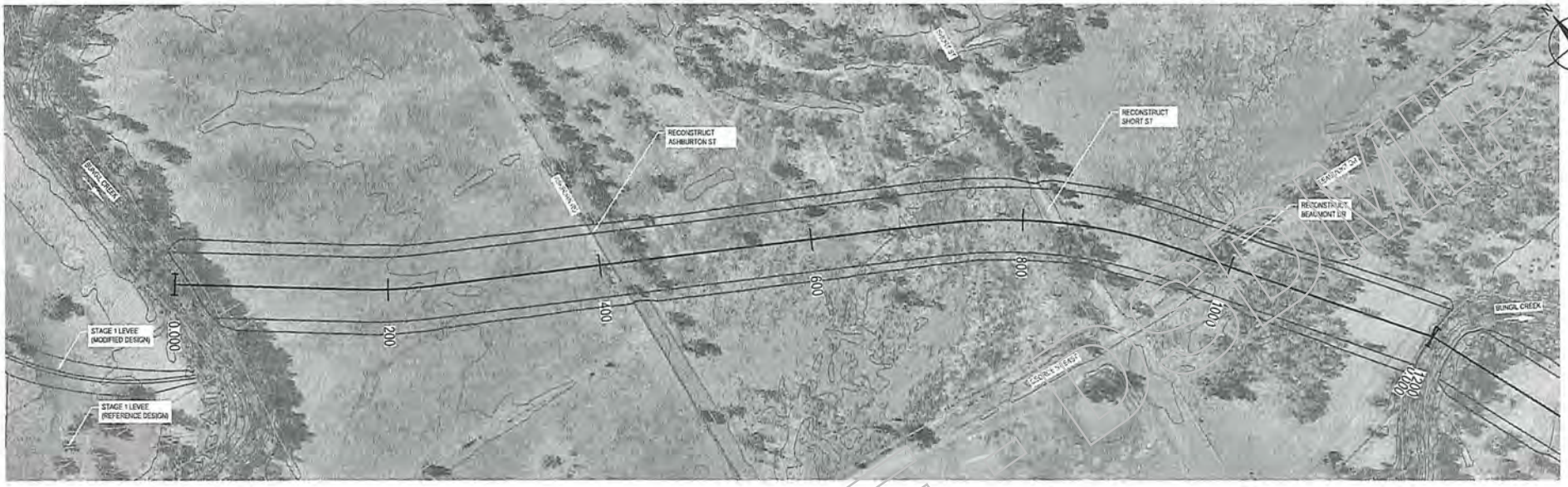
Title	PROPOSED STAGE 2 REGIONAL OPTIONS PROPERTIES IN FLOOD PLAIN LEVEES - DETAILS
Original Size	A1
Drawing No:	41-25323-SK104
Rev:	A

Plot Date: 2 December 2013 - 3:08 PM Plotted by: Jeremy Wilmot Civil File No: G:\41\25323\CADD\Drawings\41-25323-SK101-SK107.dwg



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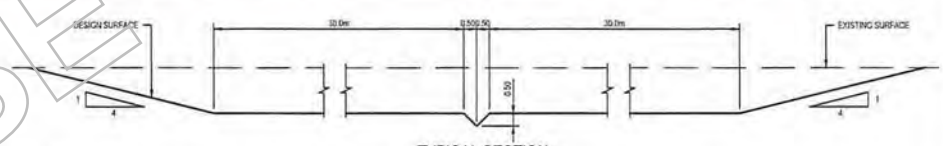

TYPICAL SECTION
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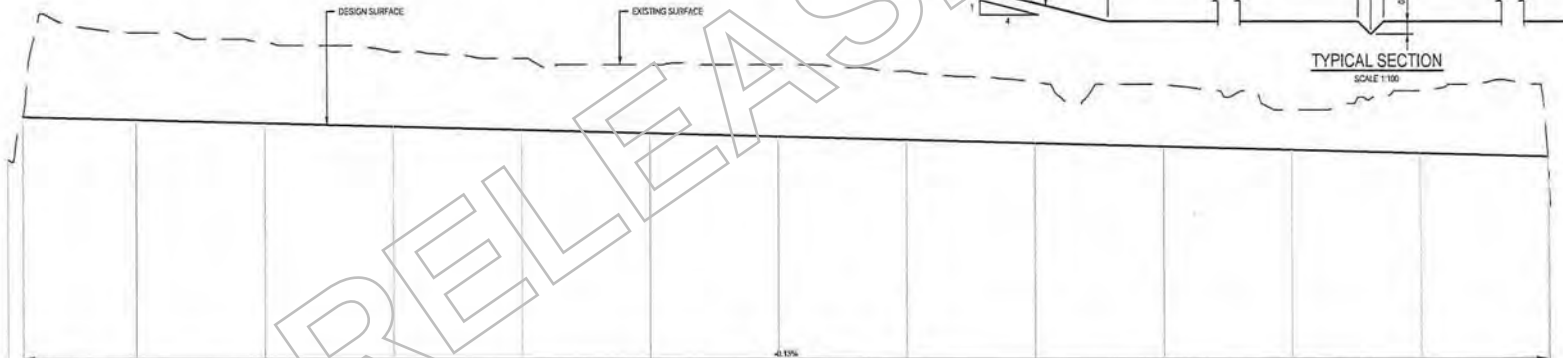

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EXISTING SURFACE LEVEL	293.933	293.233	294.5	294.143	297.75	297.5	297.25	297.25	297	296.658	296.454	296.5	296.25	293.605 293.615
CHAINAGE	0 11.754	100	200	300	400	500	600	700	800	900	1000	1100	1200	1119.115 1200

LONGITUDINAL SECTION - EASTERN DIVERSION CHANNEL D
HORIZONTAL SCALE 1:2000 VERTICAL SCALE 1:100

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EASTERN DIVERSION CHANNEL D - DETAILS

Original Size A1 Drawing No: 41-25323-SK105 Rev: A

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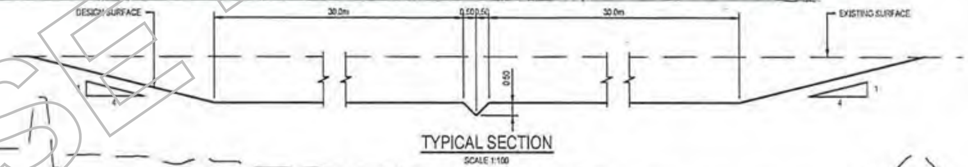
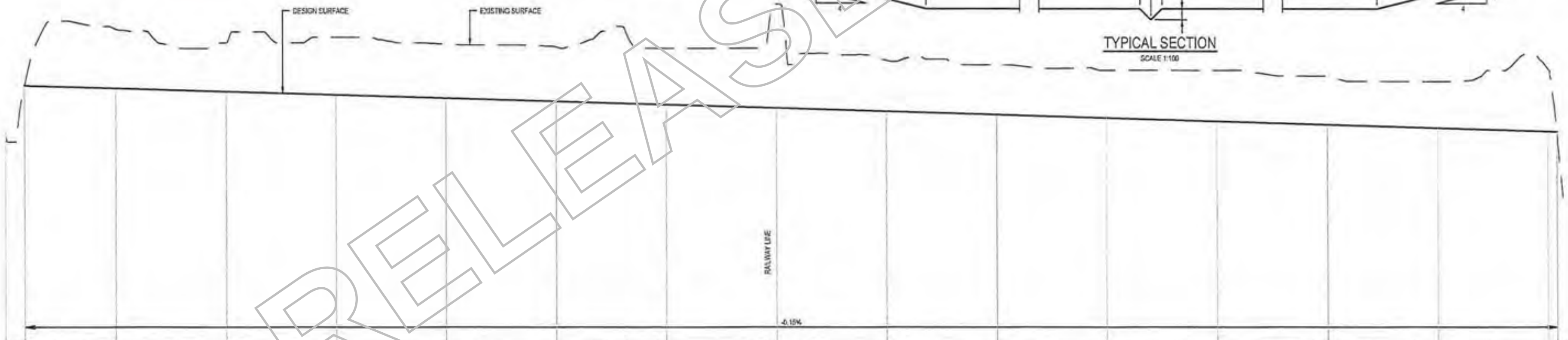


TYPICAL SECTION
SCALE 1:100



VERTICAL ALIGNMENT
DATUM RL 282.0

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DESIGN LEVEL		293.799	293.676	293.526	293.376	293.226	293.076	292.927	292.777	292.627	292.477	292.327	292.178	292.028	291.878	291.728	291.716
EXISTING SURFACE LEVEL	291.758	293.799	296.304	295.75	296	295.674	295.552	295.5	297.5	294.942	294.738	294.5	294.5	294.219	294	294.59	291.716
CHAINAGE	0	17.330	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1408.181

LONGITUDINAL SECTION - EXTENDED EASTERN DIVERSION CHANNEL D
HORIZONTAL SCALE 1:2000 VERTICAL SCALE 1:100

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No	Revision	Drawn	Job Manager	Project Director	Date
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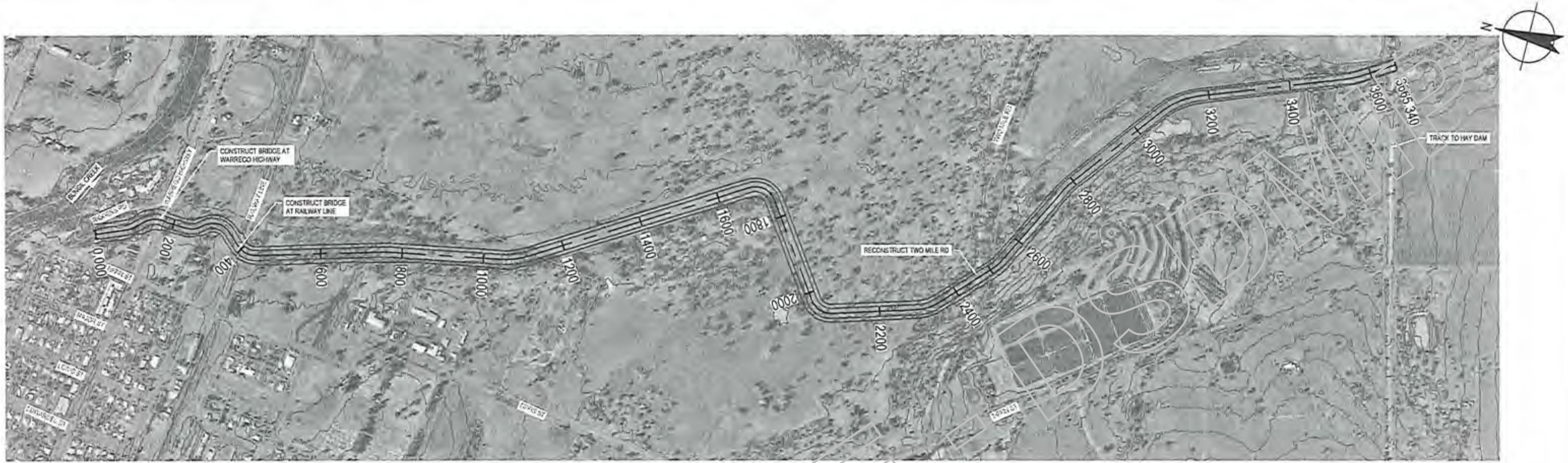
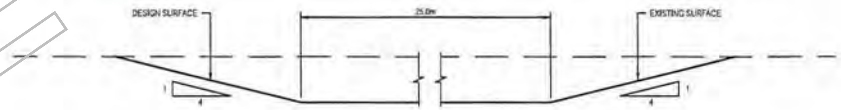
Project ROMA FLOOD STUDY
Title PROPOSED STAGE 2 REGIONAL OPTIONS EXTENDED EASTERN DIVERSION CHANNEL D - DETAILS

Original Size A1
Drawing No: 41-25323-SK106
Rev: A

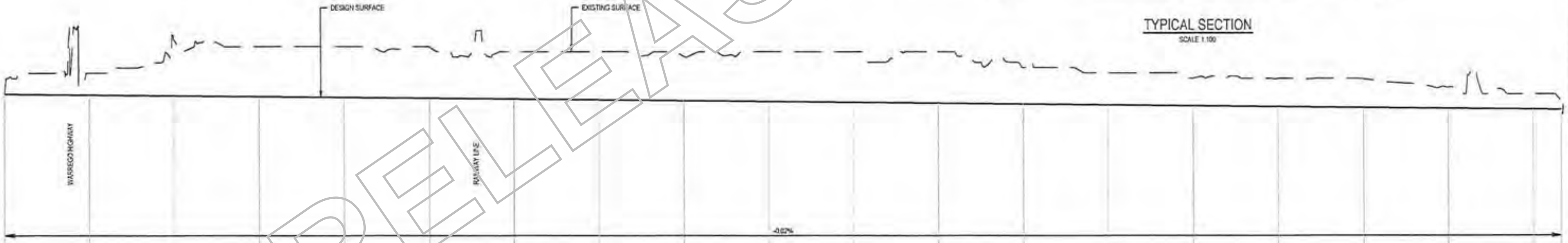
Plot Date: 2 December 2013 - 3:11 PM Plotted by: Jeremy Wilmot Cad File No: G:\41\25323\CADD\Drawings\41-25323-SK101-SK107.dwg



PLAN
SCALE 1:5000



TYPICAL SECTION
SCALE 1:100



LEVEL DIFFERENCE CUT - / FILL +	0	-1.04	-2.616	-2.37	-2.41	-2.445	-2.24	-2.28	-2.087	-2.36	-2.4	-2.438	-1.73	-1.52	-1.31	-1.333	-1.357	-0.968	-0.72	0
INVERT LEVEL	294.50	294.45	294.42	294.38	294.34	294.3	294.26	294.22	294.13	294.14	294.1	294.06	294.02	293.98	293.94	293.9	293.86	293.82	293.78	293.767
EXISTING SURFACE LEVEL	294.5 294.5	295.5	297.036	296.75	296.75	296.745	296.5	296.5	296.267	296.5	296.5	296.498	295.75	295.5	295.25	295.233	295.217	294.819	294.5	293.77
CHAINAGE	0 0.65	210	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400	3600	3605.45

LONGITUDINAL SECTION - WESTERN DIVERSION DRAIN B
HORIZONTAL SCALE 1:5000 VERTICAL SCALE 1:100

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SCALE 1:5000 AT ORIGINAL SIZE (0 50 100 150 200 250m)

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Project ROMA FLOOD STUDY
Title PROPOSED STAGE 2 REGIONAL OPTIONS
WESTERN DIVERSION DRAIN B - DETAILS

Original Size A1 Drawing No: 41-25323-SK107 Rev: A

Plot Date: 2 December 2013 - 3:12 PM Plotted by: Jeremy Wilmot Cad File No: G:\41\25323\CADD\Drawings\41-25323-SK101-SK107.dwg

Appendix G – Introduction to Flood Risk

Design flood events description

A design flood is a hypothetical flood that has been determined for the purpose of floodplain management and planning. Design floods are typically assigned a probability of occurrence that is specified as an Average Recurrence Interval (ARI) or as an Annual Exceedence Probability (AEP). Average recurrence interval events (ARI's) are expressed in years whilst Annual Exceedence Probability events are expressed as a percentage.

The return period or average recurrence interval (ARI) is the 'average' number of years between successive events of the same or greater magnitude. For example, if the 100-year return period flood level is 8.9 m AHD at a certain location then on average, a 8.9 m AHD flood level or greater can be expected to occur once every 100 years. In reality, this level is likely to be reached by flooding in periods more and less frequently than 100 years. This statistical definition of ARI also means that the example 8.9 m AHD flood level has a better-than-even chance of being exceeded by the end of any 100-year period. If the 100-year event were to occur, then there is still a finite possibility that it could occur again soon, even in the same year, or that the 1000 year event could occur, for example, next year. Clearly if such multiple events continue unchecked then the basis for the estimate of say the 100 year event might then need to be questioned, but statistically this type of behaviour can be expected.

Table 13-1 provides a description of some of the design floods assessed in this study.

Table 13 1 AEP and ARI description

AEP	ARI	Description
0.2%	500 Year	The best estimate of a flood which has 1 chance in 500 of occurring in any one year. This flood is likely to occur on average once every 500 years.
0.5%	200 Year	The best estimate of a flood which has 1 chance in 200 of occurring in any one year. This flood is likely to occur on average once every 200 years.
1%	100 Year	The best estimate of a flood which has 1 chance in 100 of occurring in any one year. This flood is likely to occur on average once every 100 years.
2%	50 Year	The best estimate of a flood which has 1 chance in 50 of occurring in any one year. This flood is likely to occur on average once every 50 years.

Consideration of risk

It is important to note that (for example) the 100 year ARI (1% AEP) design event occurs once on average in 100 years and therefore may occur more than once in a 100 year period. In fact, the probability of a 1% AEP event occurring in any 100 year period is approximately 64%.

A consistent way of considering flood risk (NCCOE 2004) is to include the concepts of "design life" and "encounter probability" which, when linked with the return period, provide better insight into the problem and can better assist risk management decision making. These various elements are linked by the following formula (Borgman 1963):

$$T = -N/\ln[1-p]$$

Where P = encounter probability 0 to 1, N = the design life (years), T = the return period (years)

This equation describes the complete continuum of risk when considering the prospect of at least one event of interest occurring. More complex equations describe other possibilities such as the risk of only two events in a given period or only one event occurring. Figure 13-1 illustrates the above equation graphically. It presents the variation in probability of at least one event occurring (the encounter probability) versus the period of time considered (the design life). The intersection of any of these chosen variables leads to a particular return period and a selection of common return periods is indicated. For example, this shows that the 200-year return period has a 40 per cent chance of being equalled or exceeded in any 100-year period.

The level of risk acceptable is a policy decision. Figure 13-1 is provided to assist in this decision making process by showing a selection of risk options. For example, accepting only a 5 per cent chance of flood inundation occurrence in a design life of 50 years means that planning needs to be undertaken and/or infrastructure needs to be designed for a 1 in 1000-year return period event. A similar design criteria (1 in 1000-year ARI) is required if a 1 per cent probability of exceedence is acceptable during a period of 10 years. By comparison, a 1 in 100 year return period event has a 10 per cent chance of occurrence in a 10 year period. Concepts relating to annual average damages can be introduced to help determine appropriate design criteria for key infrastructure that balances the cost of construction against the potential risks and costs of inundation or failure.

It is suggested that this framework is used in any further decision-making regarding flooding and drainage related risks in the Maranoa region. Effective risk management acknowledges that there is always some level of residual risk when developing within or adjacent to a floodplain or drainage corridor, and that flood events larger than the selected design events can occur at any time and will occur given enough time.

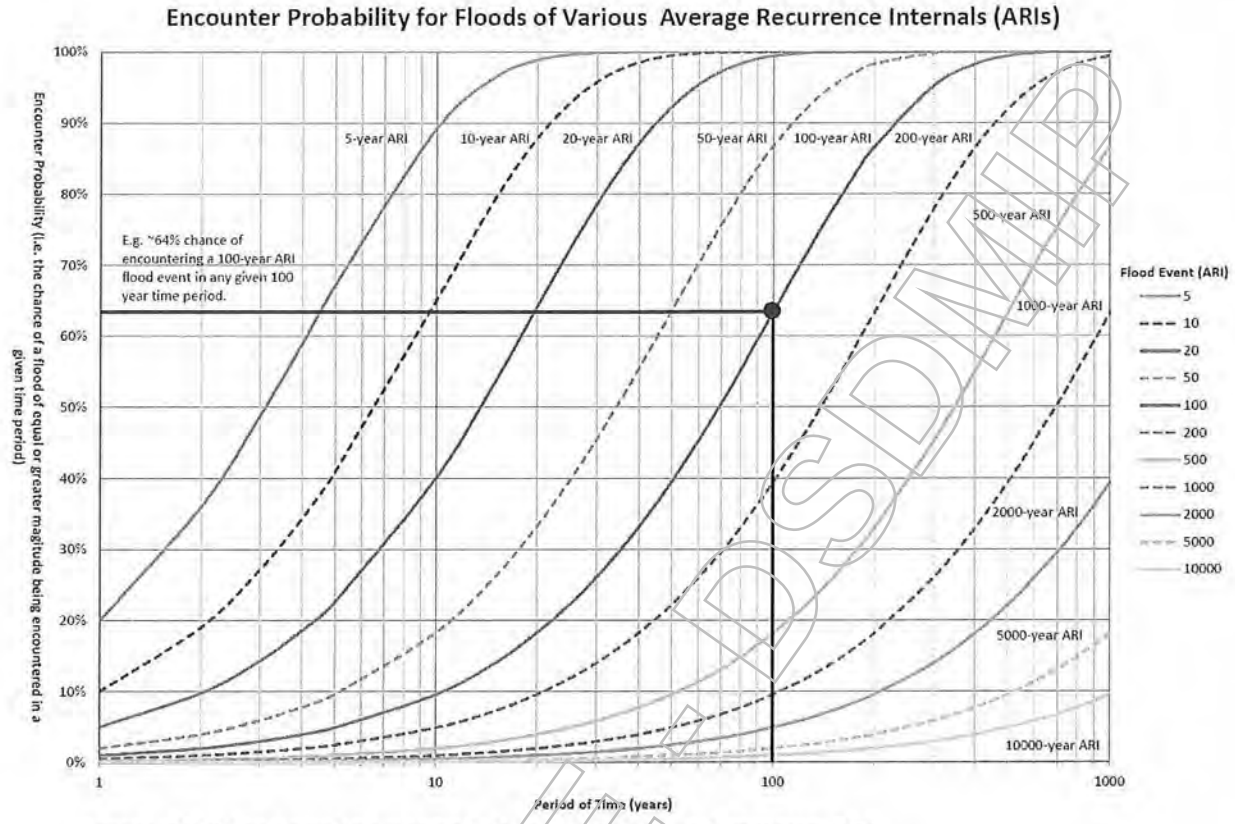

Figure 13 1 Encounter probability for floods of various ARI

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Maranoa Regional Council

Report on Communication and Engagement for Roma Flood Mitigation Project Stage 2

October 2014

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1. Executive summary

To seek stakeholder and community feedback to inform the concept designs for the second stage of the Roma Flood Mitigation project to further reduce the risk of above floor flooding in Roma, GHD's stakeholder engagement team worked with Maranoa Regional Council (MRC) to plan, implement and record a communication and engagement strategy.

The first phase from December 2013 to Janaury 2014, was to seek agreement on the consultation approach and timing of activities from the the MRC Project Manager, Mayor, Councillors. This was followed by the roll-out of targeted engagement in December 2013 with landholders whose properties came into contact with, or was in some way potentially affected by, the proposed concepts. MRC felt it was important to proactively engage with landholders prior to Christmas, given there was some concern about the imending threat of storm season.

This first landholder session was immediately followed by a community-wide release of information and map to illustrate the location of the different elements of stage 2. MRC was keen to improve upon the first stage of information release regarding the stage 1 mitigations, by focussing on the way it informed the wider community of the proposed designs. In response, MRC placed a full-page advert in the Western Star in December 2013, uploaded the Factsheet to its website and Facebook page, and participated in radio interviews. These tools pointed community to the dedicated project 1800-number and email address which sparked a number of community enquiries and requests for information about the stage 2 concepts.

Following the public release of the concepts, throughout January and February, the team held one-on-one meetings with affected landholders to identify potential property-related issues and to collect specific ideas to tweak and improve the designs. This has led to important local knowledge and design suggestions, some of which are being considered by the team.

In early March 2014, GHD and MRC undertook a strong push to advertise community-wide information sessions in a community-wide Roma flood mitigation newsletter, advertisments, media releases and social media content.

Two well-attended community information sessions were held on 19 March at Roma cultural centre. On 20 and 21 March, a GHD technical officer and stakeholder engagement officer facilitated a 'drop-in' style of forum in the Cultural Centre. The team spoke to 19 local residents to help provide property-specfic information such as the predicted changes in flood extents and levels at their property once both stage 1 and 2 are in place.

In late March, a community-wide survey was launched and promoted to provide people who could not attend an information session with another opportunity to share feedback on the concepts. There was low take-up of this survey which could be attributed to a lack of community-wide interest in the stage 2 concepts, given MRC had been very proactive with its information distribution.

One on one landholder briefings and requests for information have been ongoing since February until submission of this report in June 2014.

All community and landholder interactions and feedback has been recorded in Consultation Manager and has been summarised in this Report.

Please find below a summary of the key successes, key lessons learnt, and insights and recommendations which are provided in more detail through this Report.

Key successes

- Continue to adopt a direct mail approach for the community wide updates
- Continue to communicate with potentially impacted landholders to inform and engage them early, but avoid any over-segmentation of the landholder audience to avoid confusion
- Continue to adopt a wide range of traditional and digital communication tools – people liked the face-to-face option, traditional collateral items such as the factsheet and maps, and they also liked engaging in a conversation via the Western Star Facebook page
- People liked they could call the 1800 or email the team directly – allowed for fast contact
- People were particularly interested in the impacts on their own property/ies. Feedback at the Phase 2 information sessions was that they liked the property information handout as it provided tangible information.
- Continue to brief the editor of the Western Star to ensure the facts are correct
- Continue to brief the Local MP
- Information Session attendees like the fact we had a detailed and independent presentation (delivered by GHD's [redacted]) about the flood study, the process of how GHD and Council decided on the range of Stage 2 mitigations etc.
- People appreciated the factsheets and the highly detailed large scale A0 sized concept maps on offer – it demonstrated transparency of information, and allowed people to identify specific and real concerns on a micro level
- People like the one-on-one drop in sessions available for their specific questions which followed the wider community information sessions – it allowed for a personal approach, with a high level of independence given GHD was leading this activity.

Key lessons learnt

- While the survey uptake was not particularly high, it did record that people are broadly supportive of Council's prioritisation and this can be referred to in future communication.
- Despite a heavy awareness push, only 34 surveys were completed. This indicates that the Roma community may prefer a face to face format for providing their feedback, rather than a survey format. It could also indicate that the wider community did not feel compelled or motivated to have their say via this online survey mechanism as people are generally happy with Council's progress and plans.

Key recommendations

1. Close the consultation loop to thank those who participated in the landholder briefings or information sessions and communicate next steps

Since finalisation of the community survey in April 2014, there has been no further update to thank people for their input and explain what the future path of progress is likely to be.

Therefore, we recommend:

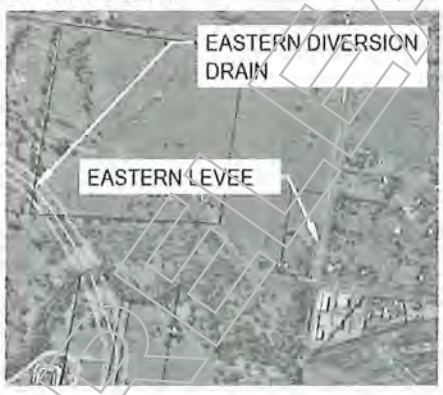
A short email and letter (depending on what contact details they have provided) is sent to individuals who actively participated in the sessions – this letter should:

- Update on Stage 1 progress
- Outline what changes are being considered for Stage 2 as a result of the community input
- What the next steps are regarding funding or timing
- Who they can contact for further information moving forward i.e. email address, phone number etc.

2. Consider running the following items through the flood model

In direct response to the community and landholder feedback received, GHD proposes to update concept designs relating to various mitigations.

More specific details of the concept 'tweaks' will be available following further hydraulic and engineering investigations. The GHD team will provide Council with a detailed recommendations report, separate to this summary provided below.

Mitigation	GHD proposed action
Eastern Levee 	Identify and consider impact of flows *Roma One* flows Realign levee Upstream diversions Improved local drainage Clear Dead Horse Creek outlet to Bungil Creek
Western Levee 	Option to realign levee at intersection with Stage 1 levee to minimise impact on properties Consider alternative levee type construction in specific locations to reduce impact on properties

Mitigation	GHD proposed action
Motel Levees 	Incorporate Explorer's levee with football club where possible - viewing embankment Overlander Motel – assess enclosing adjoining block with levee Assess local drainage options
Long drain improvements 	Local refinement of concept alignment to minimise impact on properties Major drainage works Consult with Council's engineering department to integrate with future operational works
Western diversion and eastern diversion extension 	Incorporate high flow bypass drain and Western Diversion with flood gate Extend Eastern Diversion further south

3. Messages to inform the wider community periodically (quarterly)

A clear message from the community was that they appreciated the proactive approach to the communication of Stage 1 and Stage 2 mitigation projects.

We recommend that periodic website, Facebook, email and Community Newsletter updates, should be made to keep people informed, even where it may appear there has been little material progress.

When updating the community, consider making reference to some of the top suggestions from the community regarding the proposed Stage 2 concept and suggested alterations to concept design:

1. Tweaks to the levee design where feasible to allow for specific requests for minor realignment or changes such as the use of fences rather than an engineered levee in specific locations.

2. Suggestions to make alterations to the alignment of the eastern diversion, eastern levee, western levee, and long drain, to reduce impacts to property owners.

3. Check if any new or proposed developments like the Roma One development would have any impact on the efficacy of the proposed Stage 2 mitigations.

Also, a number of residents expressed concern about water pooling on the town side of the current levee. Council could take the opportunity to discuss and remedy these issues before people say the levee has made the situation worse for some residents. This could be addressed proactively in the next Community Newsletter.

4. Maintain Consultation Manager

The Consultation Manager database provides a useful record of stakeholders and their interactions on the Stage 2 project to date. This information can continue to be used and updated throughout the lifecycle of the project through to completion of construction. We recommend Council familiarise themselves with Consultation Manager and how to operate it.

2. Purpose

The purpose of this document is to report on the communication and engagement strategy for the Roma Stage 2 flood mitigation project, present the results and an analysis of feedback from the community and provide recommendations based on this analysis.

This report: has been prepared by GHD for Moranoa Regional Council (Council) and may only be used and relied on by Council for the purpose agreed between GHD and Council.

GHD otherwise disclaims responsibility to any person other than Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

3. Background

Roma has a long history of flooding. During 2010 and 2011, there were significant floods experienced in Roma. In 2012, an unprecedented storm event occurred with the following consequences to the Roma community:

- One fatality resulted from the event
- Approximately 580 properties experienced above floor flooding, with approximately 1,028 properties within the flood extent
- Significant damage costs resulting from the flood events.

As a result of these floods, Maranoa Regional Council commissioned GHD to undertake a two staged flood study of the Bungil Creek floodplain in Roma to align with funding timeframes and Council's aspiration to commence construction of mitigation works as soon as practical. The assessment stages comprised:

- Stage 1 to investigate mitigation options that would reduce risk from regional flooding
- Stage 2 to investigate mitigation options that would further reduce risk from regional flooding and local flooding.

In both Stage 1 and 2, the project aim was to "reduce the risk of above floor flooding in Roma from a storm event equal to the 2012 flood."

Stage 1 of these investigations resulted in the recommendation for the construction of a levee, referred to as the 'Stage 1 Levee.'

Stage 2 investigations identified other mitigation options that further reduce flood risk for the community and focussed on those areas of the township that would still be at risk of above flood flooding following the construction of the Stage 1 levee.

As part of Stage 2 GHD's stakeholder engagement team worked with Maranoa Regional Council to plan, implement and record a communication and engagement strategy.

4. Communication and engagement strategy

A communication and engagement strategy was prepared to support the Stage 2 project goal of supplementing the stage 1 flood levee and further reducing the risk of above floor flooding in Roma.

The strategy was presented to Council on 4 December and included the one-page strategy map (included overleaf). We agreed to use a two phase process as outlined below:

Phase 1: December 2013 – January 2014

Phase 1 included:

- Councillor and Mayor briefing and local MP briefings.
- Two Stage 1 and 2 affected landholder information briefing sessions on Tuesday 17 December at Roma cultural centre.
- A community-wide launch, including:
  - Communication material produced to publicise the Stage 2 concept designs to the wider public, including posters, adverts in newspaper, factsheets and content added to Maranoa Regional Council's website.
  - 1800 phone number and email address to facilitate communication.

Phase 2: January – June 2014

Phase 2 included:

- One-on-one meetings with affected landholders to identify potential impacts and property-related issues.
- Publication and delivery of community-wide Roma flood mitigation newsletter including Stage 2 content.
- Updated communication material, advertising, media release and social media content to engage community in advance of March community information sessions.
- Two community information sessions on 19 March at Roma cultural centre.
- Two days of one-on-one briefing sessions at Roma cultural centre.
- Launch of community-wide Stage 2 survey.
- Briefing to Council to present findings and community feedback to inform Stage 2 design.
- Collation of final report.
- Handover of communication.

STAGE 2 ROMA FLOOD MITIGATION PROJECT – COMMUNICATION AND ENGAGEMENT STRATEGY MAP

OVERALL PROJECT GOAL

To supplement the stage 1 flood levee and further reduce the risk of above floor flooding in Roma from a storm event equal to the 2012 flood

KEY OBJECTIVES
What do we need to achieve through communication to fulfil our goal?

- Engage with directly impacted individuals early, through face to face briefings and info sessions, to build trust in the process and create potential third party advocates
- Motivate residents to actively seek factual information and participate in providing ideas through the established feedback mechanisms
- Provide clear, coordinated, consistent and transparent information throughout the life of the project
- Ensure wide understanding of how Stages 1 and 2 work together to reduce flood risks in Roma
- Raise awareness that flood risk management measures aim to *reduce* risks but will not entirely remove risks.

Measures of success:

- Minimal community and landholder dissatisfaction through comm's channels
- Positive media comment and coverage
- Third party advocacy
- Website hits
- Community and Council employee participation

KEY PARTNERS / STAKEHOLDERS
Who do we need to engage and communicate with to achieve our objectives?

Project team
- Michael Parker
- Ross Drabble
- GHD waterways team
- GHD stakeholder engagement team

MRC
- Mayor
- Councillors
- CEO
- Council staff

Federal and state government
- Elected members
- QRA
- DEHP
- DTMR
- DSDIP

Utility and Infrastructure providers
- Queensland Rail
- Ergon Energy
- SunWater

Directly affected residents and businesses
- Landholders
- Local businesses

Wider Roma community
- Local residents
- Community / environment groups
- Business and industry groups

STRATEGIC APPROACH
What approach will we use to achieve project objectives?

Get the house in order

Get prepared early to communicate factual, detailed and accurate information about stage 2, ahead of details being released to the public, seek the inputs of Councillors and build into the approach

Inform landholder early before communicating to the wider community

Provide ongoing timely and accurate information using a range of communication tools to clearly disseminate project information to key stakeholders appropriate to their needs.

Plan for business continuity

Work with industry and business owners to help ensure business continuity and reduce impacts of the stage 2 project design and construction

Track community feedback and take the 'temperature' to manage issues before they occur

Counter negative community feedback through smart communication and open information sharing and consultation.

Leverage the support of Council staff and other key stakeholders such as Local MPs

To build strong awareness of the process Council is going through to build flood resilience for Roma

Community-wide communication of the facts to inform them of the progress of stage 1 and 2

To ensure wide understanding of how Stages 1 and 2 work together to reduce flood risks in Roma; and to raise awareness that flood risk management measures aim to *reduce* risks but will not entirely remove risks.

IMPLEMENTATION
The tools we will use to implement the strategy?

- Communication plan
- Agree on the Key Messages
- Agree on the key stakeholder groups, and how to inform and engage
- Seek input from Councillors in a workshop (4 Dec)
- Present final plan to Councillors following workshop

Draft communication materials:
- Briefing to council staff
- Community newsletter
- Website update
- Key stakeholder presentations
- Media releases
- Static displays materials

Early December 2013

- One on one briefings for identified individual property owners
- Information Sessions for all other directly impacted Landholders
- Q&A document to guide discussions with stakeholders
- 1300 phone
- Website feedback form
- Project email address.

From mid-December 2013

- Face to face or telephone briefings
- Land access agreements to ensure business continuity
- Factsheets, Q&As/FAQs, website, powerpoint for briefings

From mid-January 2014

- Record stakeholder interactions - set up a *Consultation Manager* database to record all interactions, submissions and generate reports
- Provide regular updates from database to project team to inform progress against objective
- Review Consultation Manager input
- Provide media briefing/s to Project Team.

From mid-December 2013

- Regular Councillor briefings and feedback sessions (two-way)
- MP briefings
- Other opinion leader briefings?
- Q&As/FAQs, website, powerpoint for briefings
- Council Staff Info Sessions Sausage Sizzles at the central office and depots
- Internal survey to help us learn more about any specific knowledge about the stage 2 to help us tweak the design
- Toolbox talks with contractors
- Project information cards (business card size)

From mid-January 2014

- Community-wide distribution of clear, consistent information using a variety of tools and forums
- Strong awareness of the 1800 and email address
- Monthly Community Newsletter (letterbox drop to 4000)
- Factsheets, Q&As/FAQs, website, powerpoint for briefings
- Public consultation information sessions from February 2014
- Professional, visually appealing maps and charts that clearly paint the picture, tell the story

From mid-February 2014

5. Communication tools

We used a range of tools to communicate the Stage 2 flood mitigation project with stakeholders. The tools used varied between each group, and based on feedback from Council's experience during Stage 1 of the project we intentionally communicated with potentially impacted landholders to inform and engage them early, but without segmenting the landholder audience to the extent where it became confusing.

We adopted community-wide information releases to provide project updates across the whole community, to ensure that everyone had a chance to learn about Stage 2 mitigations.

Table 1 Communication tools used with stakeholders

Stakeholder group	Tools used
Council and other external key stakeholders	Briefings/workshops Email status updates
Directly impacted landholders	Phone, letter and email invitations to information sessions Advertising (via posters, newspapers, advertisements etc) Website content Factsheet and FAQs 1800 Phone number Email address for incoming contact Information Sessions x 2 informative flood maps and concept drawings One-on-one meetings and landholder specific maps Community survey – online and hard copies in Council
Wider community	Advertising Social media Website content Factsheet and FAQs 1800 Phone number Email address for incoming contact Information Sessions x 1 Informative flood maps and concept drawings Community survey – online and hard copies in Council

6. Awareness raising

To generate community awareness and provide points of contact for community interest, the following mechanisms were used:

- Paid advertisements in Western Star to promote Info Sessions and online survey
- Media relations and briefings with the Editor to generate editorial stories in the Western Star and Surat Basin News (online edition)
- MRC and Western Star Facebook posts
- Direct invitation phone calls / letters / emails to potentially impacted landholders
- E-update to all stakeholders to encourage participation
- Posters across community touch-points.

These materials were updated for Phase 2 of the project to reflect the progress and modifications to the Stage 2 concept that occurred after Phase 1 consultation.

Figure 1 Communication material

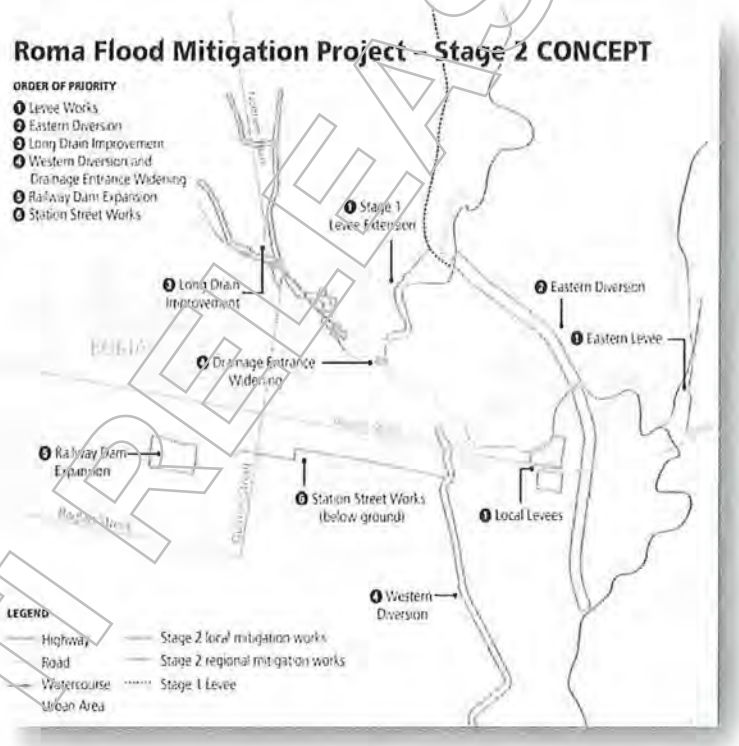


Figure 2 Concept map for communication materials

7. Information sessions

Phase 1 – Landholders – December 2013

Information sessions were held at Roma on 17 December 2013 from 2-4 pm and again at 6-8 pm to give as many people as possible the opportunity to attend. The sessions were originally designed and intended for Stage 1 and 2 affected landholders only, however when it became clear other interested members of the community were likely to attend we made adjustments to the schedule to provide a greater level of general information.

At these sessions and through other contact via the project email address and 1800 number, numerous landholders requested briefings and further information.

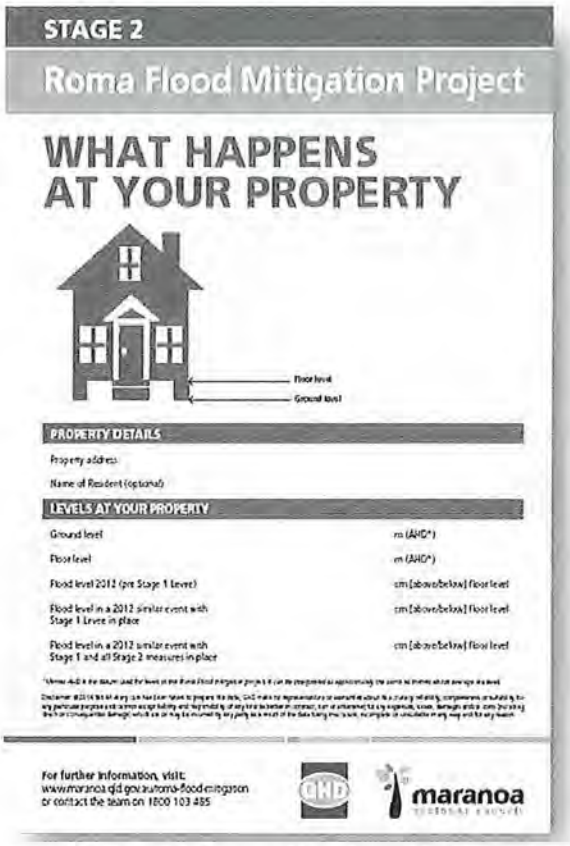
Meetings were organised for GHD engineers to brief landholders and where the nature of a stakeholder's request required, details were forwarded to a Council representative.

Phase 2 – Community wide and one-on-one drop ins – March 2014

A second round of information briefing sessions was held at Roma on **19 March 2014** to update the wider community, provide information on flood levels at specific properties, and to collect specific feedback and ideas from them on the proposed mitigations using large scale concept maps.

The information session format included:

- Mayor's introduction
- GHD's presentation of the flood study
- Large scale concept maps for people to see the concept in detail in relation to the town – people were encouraged to write their ideas or concerns on post-it notes which were collated and noted against each stakeholder in Consultation Manager
- Information on how to get further involved


STAGE 2

Roma Flood Mitigation Project

WHAT HAPPENS AT YOUR PROPERTY

PROPERTY DETAILS

Property address

Name of Resident (optional)

LEVELS AT YOUR PROPERTY

Ground level — m (AHD*)

Floor level — m (AHD*)

Flood level 2012 (pre Stage 1 Levee) — cm [above/below] floor level

Flood level in a 2012 similar event with Stage 1 Levee in place — cm [above/below] floor level

Flood level in a 2012 similar event with Stage 1 and all Stage 2 measures in place — cm [above/below] floor level

For further information, visit:
www.maranoa.qld.gov.au/roma-flood-mitigation
or contact the team on 1800 103 485

maranoa

Figure 3 Flood information handout used at Phase 2 information session

and provide feedback

- Opportunity for detailed one-on-one chats with Council and GHD technical leads
- Handouts with property flood level information.

Following the community wide sessions on 19 March, on **20 March and 21 March**, two GHD team members facilitated one-on-one drop-in sessions with landholders and community members who wanted to discuss the flood modelling results and/or stage 2 concepts further.

This was a highly successful approach and we received very positive feedback from people who were pleased to be given such personal attention. There were approximately 20 additional landholder briefings held.

About 130 people attended across four sessions at Roma cultural centre and one-on-one drop-ins (see Figure 5 for a breakdown of attendance numbers).

8. Community survey

To gather further feedback from the community, particularly from those who may not have been able to attend the information sessions, an online community survey was organised for late March to April 2014.

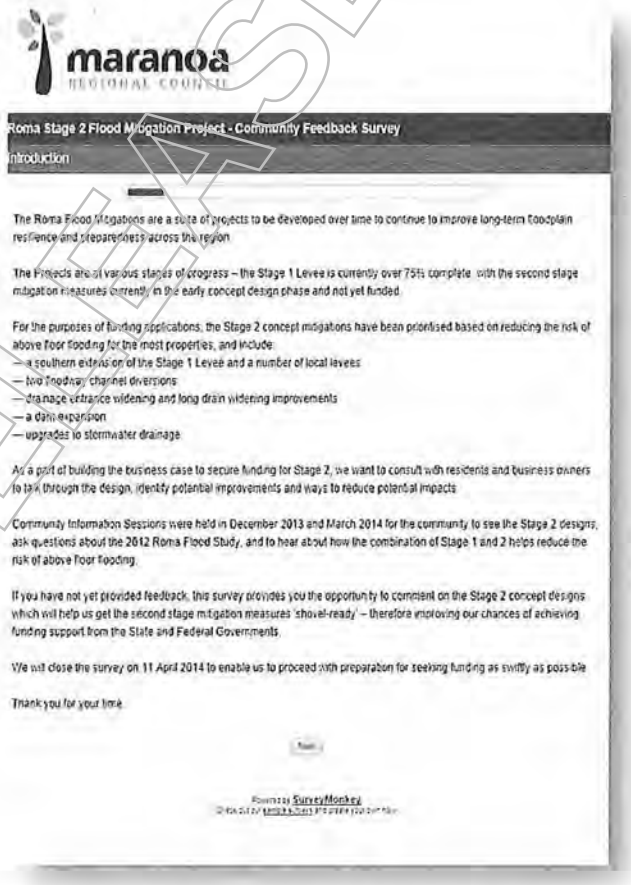
The survey was released shortly after the second information sessions and was printable, with hardcopy versions available from Council offices to ensure maximum accessibility for the community.

The survey ran from Monday 31 March until Friday 17 April. To publicise the survey, advertisements were placed in the Western Star, reminders were posted on the Maranoa Regional Council facebook page (Maranoa make it yours) and Western Star facebook page. An email was also sent to all Maranoa Regional Council staff (approx. 400 people).

Despite a heavy awareness push, only 34 surveys were completed.

This indicates that the Roma community may prefer a face to face format for providing their feedback, rather than a survey format.

It could also indicate that the wider community were happy to receive Stage 2 updates through the Community Newsletter in their letterbox, but that it did not feel compelled or motivated to have their say via this online survey mechanism – this could indicate that people are generally happy with Council's progress and plans.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REGIONAL COUNCIL

Roma Stage 2 Flood Mitigation Project - Community Feedback Survey

Introduction

The Roma Flood Mitigations are a suite of projects to be developed over time to continue to improve long-term floodplain resilience and preparedness across the region.

The Projects are at various stages of progress – the Stage 1 Levee is currently over 75% complete, with the second stage mitigation measures currently in the early concept design phase and not yet funded.

For the purposes of funding applications, the Stage 2 concept mitigations have been prioritised based on reducing the risk of above floor flooding for the most properties, and include:
— a southern extension of the Stage 1 Levee and a number of local levees
— two floodway channel diversions
— drainage entrance widening and long drain widening improvements
— a dam expansion
— upgrades to stormwater drainage.

As a part of building the business case to secure funding for Stage 2, we want to consult with residents and business owners to talk through the design, identify potential improvements and ways to reduce potential impacts.

Community Information Sessions were held in December 2013 and March 2014 for the community to see the Stage 2 designs, ask questions about the 2012 Roma Flood Study, and to hear about how the combination of Stage 1 and 2 helps reduce the risk of above floor flooding.

If you have not yet provided feedback, this survey provides you the opportunity to comment on the Stage 2 concept designs which will help us get the second stage mitigation measures 'shovel-ready' – therefore improving our chances of achieving funding support from the State and Federal Governments.

We will close the survey on 11 April 2014 to enable us to proceed with preparation for seeking funding as swiftly as possible.

Thank you for your time.

Next

Powered by SurveyMonkey

Figure 4 Survey introduction page

9. Feedback and analysis from information sessions, feedback mechanisms and community survey

Information sessions / feedback mechanisms

Many individuals at information sessions and one-on-ones expressed that they appreciated receiving information from an independent source. People who made contact via 1800 phone were pleased to be able to easily contact a team member.

There were approximately 60 requests for information received via 1800 phone, project email, or at the information sessions. In response, GHD provided detailed maps of flood levels, depths, velocities, and concept design, or visited properties to discuss issues with landholders. Further detail on requests for information and the responses are included in **Appendix A**.

The **top four suggestions** from the community regarding the proposed Stage 2 concept and suggested alterations to concept design were:

1. Alternative routes for eastern diversion, eastern levee, western levee, motel levees, and long drain.
2. Concern that the *Roma One* development will compromise the eastern levee design.
3. Concern that public funding should not be used for the eastern levee and motel levees.
4. Property-based requests for minor realignment or changes such as the use of fences rather than an engineered levee in specific locations.

Additionally, a relatively small number of stakeholders questioned survey floor information. This issue has been noted and is being addressed by GHD.

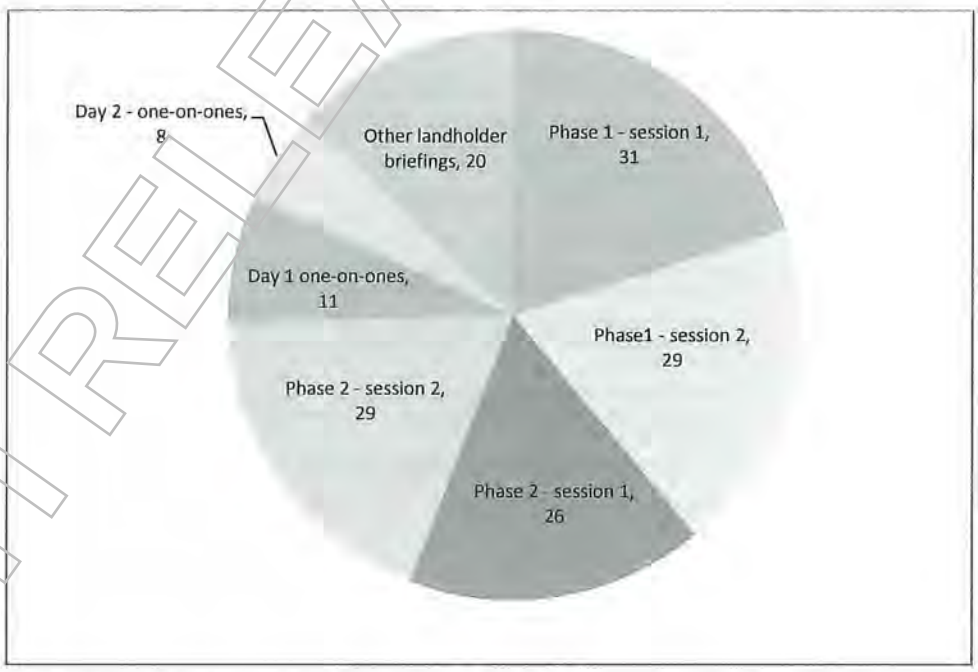


Figure 5 Approximate attendance levels at information sessions, one-on-one drop in days and landholder briefings

Community survey results – online/hard copy

Priorities

The key finding from the community survey was that **respondents broadly agreed with Council's prioritisation of mitigation measures.**

Table 2 shows the alignment between Council's and the community's order of priority in response to a question asking respondents to rank the order of priority they felt each Stage 2 option should be given.

Table 2 Alignment between Council and the community's priorities

Council's order of priority	The community's order of priority	% of community
1. The southern extension of the Stage 1 Levee	✓ 1	41%
2. Three local levees	=2 and 7	32%
3. The Eastern floodway channel diversion	✓ 3	35%
4. Long drain improvement	✓ 4	35%
5. The Western floodway channel diversion and drainage entrance widening at Bungil Creek	=4	32%
6. Expansion of Railway Dam	=7	29%
7. Upgrades to stormwater drainage.	=1 and 6	24%

Specific ideas provided by survey respondents

The following ideas were raised by respondents for flood mitigation:

- Improving support to residents south of the Warrego Highway
- Clear and widen Bungil Creek where required
- "Get the dump off the creek"
- Avoid building in flood prone areas
- Raise houses still at risk.

Concerns raised about Stage 2

Survey respondents raised a number of concerns about the Stage 2 concept as presented in the survey. Concerns included:

- Concerns about levee or diversions being placed on property
- Cencern about changes in flood levels on existing properties brought about by the proposed levee and diversions
- Uncertainty about timing of stage 2 affects impacted landholders decisions for their properties

- Will levee exacerbate flash/stormwater flooding?
- Concern about construction impact of levee extension
- Believe it will increase insurance premiums
- "All residents should be protected"
- "What about the residences on the east of town. Still have no answers."

Perceived importance of measures

The survey included questions about the importance of:

- Reviewing building and planning codes
- Early flood warning initiatives
- Evacuation maps and plans.

Figure 6 shows survey respondents strongly indicated they believe these measures are important.

People particularly believe that reviewing building and planning codes is 'very important'. Early flood warning is also considered important.

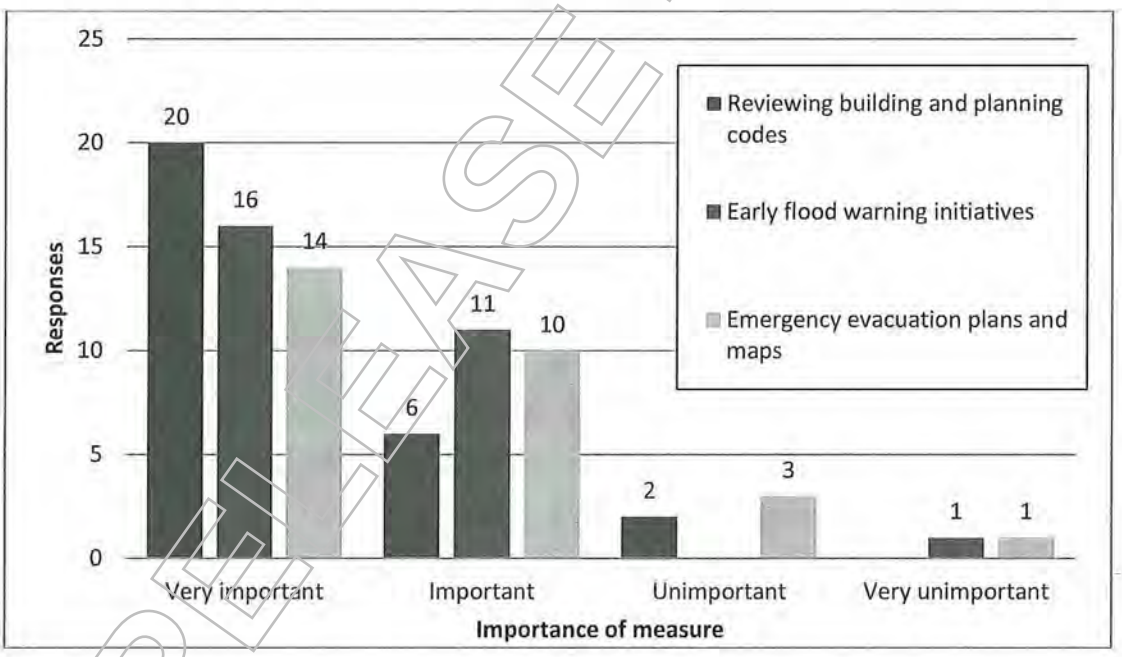


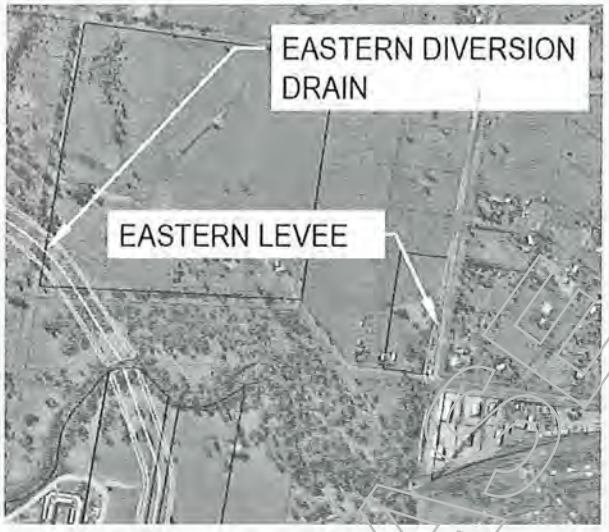
Figure 6 Community opinion of the importance of flood mitigation measures

Design implications - response to feedback

In direct response to the community and landholder feedback received, GHD proposes to update concept designs relating to various mitigations.

Table 3 shows the different mitigations and GHD's proposed actions following landholder and community engagement. More specific details of the concept 'tweaks' will be available following further hydraulic and engineering investigations. The GHD team will provide Council with a detailed recommendations report, separate to this summary provided below.

Table 3 Proposed updates to concept design after community feedback

Mitigation	GHD proposed action
Eastern Levee 	Identify and consider impact of flows *Roma One* flows Realign levee Upstream diversions Improved local drainage Clear Dead Horse Creek outlet to Bungil Creek
Western Levee 	Option to realign levee at intersection with Stage 1 levee to minimise impact on properties Consider alternative levee type construction in specific locations to reduce impact on properties

Mitigation	GHD proposed action
Motel Levees 	Incorporate Explorer's levee with football club where possible - viewing embankment Overlander Motel – assess enclosing adjoining block with levee Assess local drainage options
Long drain improvements 	Local refinement of concept alignment to minimise impact on properties Major drainage works Consult with Council's engineering department to integrate with future operational works
Western diversion and eastern diversion extension 	Incorporate high flow bypass drain and Western Diversion with flood gate Extend Eastern Diversion further south

10. Consultation manager log

At the commencement of the Stage 2 consultation, a *Consultation Manager* account was established as an online database to record all interaction and correspondence received or transmitted by the project team.

GHD established and temporarily managed the Consultation Manager account on behalf of Council. All ingoing and outgoing correspondence was logged in the database, including 1800 phone calls, emails, briefings with stakeholders and feedback. **Appendix B** includes a report of all interactions.

Table 4 summarises the type of incoming and outgoing interaction recorded in Consultation Manager, the number of times these interactions occurred, and the number of people (excluding the project team) we communicated with.

Table 4 Summary of Consultation Manager log

Interactions	Occurrences	No. of people
Incoming communication		
Email – Incoming	32	19
1800 number – Incoming	20	10
Feedback form	18	18
One-on-one meetings	19	19
Phone / face to face or other - Incoming	6	5
Letter - Incoming	1	1
Outgoing communication		
Email – Outgoing	39	138
Phone calls – Outgoing	21	15
Landholder briefing*	7	10
Letter – Outgoing	4	60
Community Information Session (December)	2	55
Community Information Session (March)	2	60
Total event	**171**	**n/a**

*This includes landholder briefings by GHD, additional briefings that were not reported to GHD have not been recorded

All interactions logged in Consultation Manager are assigned an issue to describe the subject of the interaction. Figure 7 contains a summary of these issues.

Almost 40 per cent of interactions related to requests for information about the different Stage 2 mitigations – landholders wanted to know more about the modelling information or requested a briefing.

Twelve per cent of interactions related to design considerations – this included discussions about modifying the concept design to take into account property boundaries, for example.

Other issues included general enquires, such as messages asking for a project team member to make contact, providing information to the project team, or making meeting arrangements. This accounted for 9 per cent of interactions. There were a relatively small number of interactions where people expressed concern about local mitigation options, generally relating to their property.

The 6 per cent of interactions where there were complaints about the consultation process included where people wished for faster responses to their requests for information, where people were unable to attend information sessions and where people disagreed with the information that was provided to them. This also included people stating they did not believe that Council had been keeping people fully informed about the progress of the project.

The same proportion of interactions featured people disagreeing with the flood modelling outcomes for their property. This relates to issues around the accuracy of the property survey information and the resolution of the flood model, and is being investigated further by GHD.

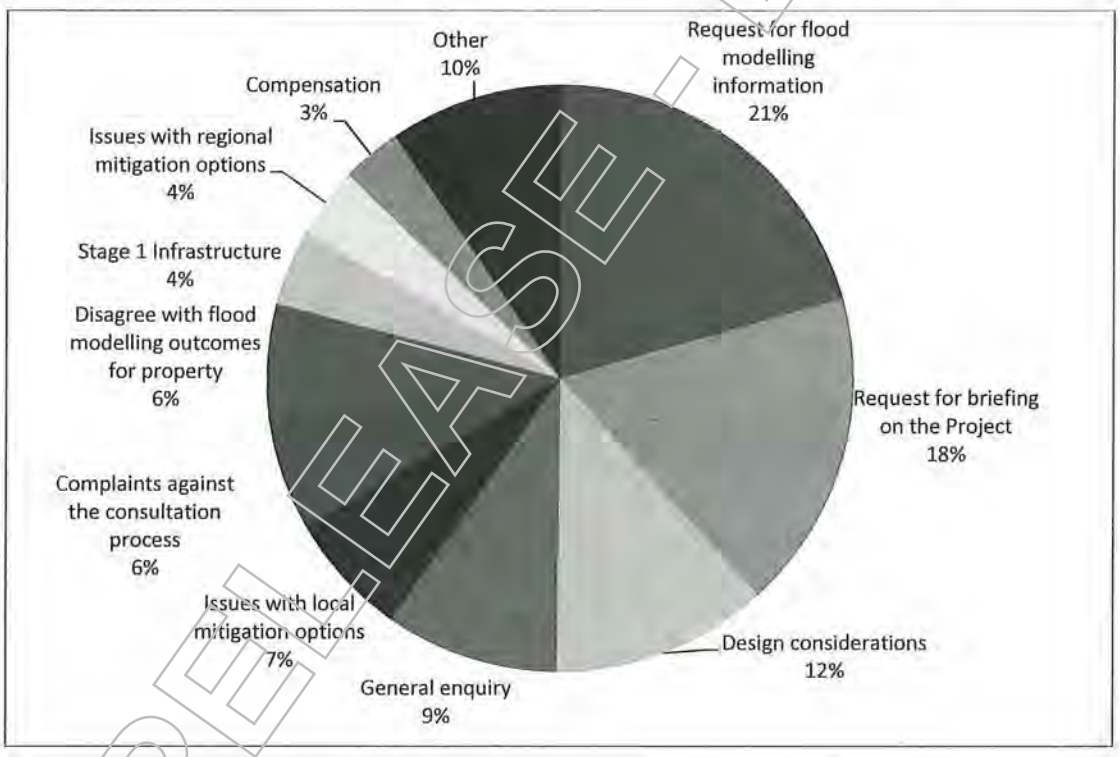


Figure 7 Summary of interaction issues

From various interactions with stakeholders a record of those who specified that they wish to be kept up to date with the progress of Stage 2 has been maintained, including in many instances, the means by which they would prefer to receive updates. **Appendix C presents this information, which will be useful to help direct project updates as the project progresses.**

11. Insights and recommendations

Based on the outcomes of Stage 2 engagement to date we recommend the following actions:

Close the loop and thank those who participated in the landholder briefings or information sessions and communicate next steps

Since finalisation of the community survey in April 2014, there has been no further update to thank people for their input and explain what the future path of progress is likely to be.

Therefore, we recommend:

A short email and letter (depending on what contact details they have provided) is sent to individuals who actively participated in the sessions – this letter should:

- Update on Stage 1 progress
- Outline what changes are being considered for Stage 2 as a result of the community input
- What the next steps are regarding funding or timing
- Who they can contact for further information moving forward i.e. email address, phone number etc.

Messages to inform the wider community periodically (quarterly)

A clear message from the community was that they appreciated the proactive approach to the communication of Stage 1 and Stage 2 mitigation projects.

We recommend that periodic website, Facebook, email and Community Newsletter updates, should be made to keep people informed, even where it may appear there has been little material progress.

When updating the community, consider making reference to some of the top suggestions from the community regarding the proposed Stage 2 concept and suggested alterations to concept design:

4. Tweaks to the levee design where feasible to allow for specific requests for minor realignment or changes such as the use of fences rather than an engineered levee in specific locations.
5. Suggestions to make alterations to the alignment of the eastern diversion, eastern levee, western levee, and long drain, to reduce impacts to property owners.
6. Check if any new or proposed developments like the Roma One development would have any impact on the efficacy of the proposed Stage 2 mitigations.

Also, a number of residents expressed concern about water pooling on the town side of the current levee. Council could take the opportunity to discuss and remedy these issues before people say the levee has made the situation worse for some residents. This could be addressed proactively in the next Community Newsletter.

Maintain Consultation Manager

The Consultation Manager database provides a useful record of stakeholders and their interactions on the Stage 2 project to date. This information can continue to be used and updated throughout the lifecycle of the project through to completion of construction. We recommend Council familiarise themselves with Consultation Manager and how to operate it.

Other insights to consider for future consultation programs:

- Continue to adopt a direct mail approach for the community wide updates
- Continue to communicate with potentially impacted landholders to inform and engage them early, but avoid any over-segmentation of the landholder audience to avoid confusion
- Continue to adopt a wide range of traditional and digital communication tools – people liked the face-to-face option, traditional collateral items such as the factsheet and maps, and they also liked engaging in a conversation via the Western Star Facebook page
- People liked they could call the 1800 or email the team directly – allowed for fast contact
- People were particularly interested in the impacts on their own property/ies. Feedback at the Phase 2 information sessions was that they liked the property information handout as it provided tangible information.
- While the survey uptake was not particularly high, it did record that people are broadly supportive of Council's prioritisation and this can be referred to in future communication. Ie
- Despite a heavy awareness push, only 34 surveys were completed. This indicates that the Roma community may prefer a face to face format for providing their feedback, rather than a survey format. It could also indicate that the wider community did not feel compelled or motivated to have their say via this online survey mechanism as people are generally happy with Council's progress and plans
- Continue to brief the editor of the Western Star to ensure the facts are correct
- Continue to brief the Local MP
- Information Session attendees like the fact we had a detailed and independent presentation (delivered by GHD's [Sch. 4(1)(b) - Disclosing personal information] about the flood study, the process of how GHD and Council decided on the range of Stage 2 mitigations etc.
- People appreciated the factsheets and the highly detailed large scale A0 sized concept maps on offer – it demonstrated transparency of information, and allowed people to identify specific and real concerns on a micro level
- People like the one-on-one drop in sessions available for their specific questions which followed the wider community information sessions – it allowed for a personal approach, with a high level of independence given GHD was leading this activity.

Appendix A
Request for information log

Item No.	Status	Property Owner	Property Address	Request	Notes
1	Complete	Sch. 4(4)(6) - Disclosing personal information		Flood maps with Levels	
2	Complete			Flood maps with Levels	
3	Complete			Hazard and Flood maps with levels	
4	Complete			Flood maps with Levels	
5	Complete			Flood maps with Levels	
6	Complete			Flood maps with Levels	
7	Complete			Flood maps with levels	
8	Complete			Flood maps with Levels	
9	Complete			Flood maps with Levels	5 sample points
10	Complete			Flood maps with Levels	
11	Complete			Flood maps with Levels	
12	Complete			Flood maps with Levels	
13	Complete			Hazard and Flood maps with levels	
14	Complete			Flood maps with Levels	
15	Complete			Drawings with cross sections	
16	Complete			Flood maps with Levels	
17	Complete			Flood maps with Levels	Sch. 4(4)(6) - Disclosing personal information
18	Complete			Sch. 4(4)(6) - Disclosing personal information	

Item No.	Status	Property Owner	Property Address	Request	Notes
19	Complete	Sch. 4(4)(6) - Disclosing personal information		Check flood levels against those experienced in 2012.	Sch. 4(4)(6) - Disclosing personal information
20	Complete			Obtain property development plans for area east of Clayton Road	Sch. 4(4)(6) - Disclosing personal information
21	Complete			Create drawing with sections of height for levee on property. Modify levee to wrap around dam near Bungil Creek.	
22	In progress			Check to see if levee can be shifted behind dam. Is there conflict with species? Send results of detailed ecological survey to the Sch. 4(4)(6) - Disclosing personal information	Sch. 4(4)(6) - Disclosing personal information to verify species during detailed eco survey.
23	Complete			Provide Hazard maps around Hay Roma Dam	
24	Complete			Send Concept Drawings and Stage 2 Report.	Sch. 4(4)(6) - Disclosing personal information
25	Complete			Provide information regarding levels in Bungil creek vs. Western Diversion drain.	
26	Complete			Provide Depth and Velocity maps for property	
27	Complete		Sch. 4(4)(6) - Disclosing personal information		
28	Complete				
29	Complete				
30	Complete			Gregory Street Flood maps with Levels	1 Gregory St maps made with surrounding properties info in table

Item No.	Status	Property Owner	Property Address	Request	Notes
		Sch. 4(4)(6) - Disclosing personal information			
31	Complete			Send concept drawings (100, 103, 107, 108, 113, 114)	
32	Complete			Update Afflux Map	
33	Complete			Channel modifications to allow for potential development on property.	
34	Complete			Provide Depth and Velocity maps for property	
35	Complete			Prepare flood maps showing existing, post stage 1, and post stage 2 depths at property.	
36	Complete			Sch. 4(4)(6) - Disclosing personal information	
37	Complete			Request for flood level information.	Some ambiguity regarding property and owner, called to clarify and found out that she had what she needed already and did not need levels from us any longer.
38	Complete			Request for flood level information.	sent table via email to Sch. 4(4)(6) - Disclosing personal information 18/03/2014.
39	Complete			Request for flood level information.	sent table via email to Sch. 4(4)(6) - Disclosing personal information 18/03/2014.
40	Complete			Produce map with 2012 flood levels across property post stage 1 conditions. Intent is to provide information that can be used by Sch. 4(4)(6) - Disclosing personal information for sub-dividing the lot. Send him maps showing flood levels during 2012, post stage 1, and post stage 2 for various points agross his property	sent by email.

Item No.	Status	Property Owner	Property Address	Request	Notes
		Sch. 4(4)(6) - Disclosing personal information		Sch. 4(4)(6) - Disclosing personal information	
41	Complete				Found the right person at Council for [redacted] to speak with regarding installation of a sewer shut off valve [redacted] She spoke with him and was able to work out how to get the work completed. Modifications to concept drawings have been completed.
42	Complete				Sch. 4(4)(6) - Disclosing personal information
43	Complete				

Item No.	Status	Property Owner	Property Address	Request	Notes
44	Complete	Sch. 4(4)(6) - Disclosing personal information		Sch. 4(4)(6) - Disclosing personal information	Sch. 4(4)(6) - Disclosing personal information
45	Complete				Adjustments made to the levee along his property.
46	Passed to Council			Wants a "peg" installed on the site with the predicted 2012 flood event water level.	Sch. 4(4)(6) - Disclosing personal information
47	Passed to Council			Sch. 4(4)(6) - Disclosing personal information	
48	Passed to Council				
49	Complete				

Item No.	Status	Property Owner	Property Address	Request	Notes
		Sch. 4(4)(6) - Disclosing personal information			
50	Passed to Council				
51	Complete				
52	Complete				
53	Complete				
54	Complete				
55	Complete				

Item No.	Status	Property Owner	Property Address	Request	Notes
56	Complete	Sch. 4(4)(6) - Disclosing personal information		Would like concept maps that show the western diversion drain. Also would like flood level maps that show existing, stage 1, and stage 2 conditions.	Sch. 4(4)(6) - Disclosing personal information
57	Complete			Would like the drainage to be further investigated at their property. Talk to Sch. 4(4)(6) - Disclosing personal information about what exactly it is that we need to do at their property.	Sch. 4(4)(6) - Disclosing personal information added survey request to list of locations for survey to be validated.
58	Complete			Provide figures that show proposed levee location near the St Vincent De Paul village.	Sch. 4(4)(6) - Disclosing personal information
59	Complete			Provide map showing home is outside flood extents during existing and post stage 1 conditions. Send PDFs to Aiva at MRC - customer.service@maranoa.qld.gov.au	Sch. 4(4)(6) - Disclosing personal information emailed maps to Aiva at customer.service@maranoa.qld.gov.au

Appendix B
Consultation Manager report of all external transactions

Report Parameters:
All Stakeholder(s)

Sch. 4(4)(6) - Disclosing personal information

Letter - Outgoing 19 Dec 2013	**Summary:** Letter sent to landholders affected by the Stage 2 infrastructure informing them of the Roma Flood Mitigation Stage 2 concept options. **Team Response:** Letter sent to landholders affected by the Stage 2 infrastructure informing them of the Roma Flood Mitigation Stage 2 concept options. The letter advised that the project team sought to telephone residents in close proximity to the proposed Stage 2 infrastructure to invite them to the community information sessions but that they were unable contact everyone in person. The team advised that they would be happy to visit the landholders to talk you through the concept designs in the new year. Community-wide Information Sessions will also be held in February.
Email - Outgoing 13 Mar 2014	**Summary:** Email to all stakeholders regarding the Stage 2 Flood Mitigation Community Information Sessions- 19 March. **Team Response:** Dear Stakeholder, With the Stage 1 flood levee well underway, Council is now seeking your feedback on the proposed concept designs for the second stage of the Roma Flood Mitigation Proejct to be rolled out over time as funding becomes available. Come along to see the concept designs, ask questions, and hear about how Stage 1 and 2 aims to reduce flood levels at your property. We are keen to discuss potential improvements before taking the projects forward for funding. Stage 2 Community Information Sessions Where: Cultural Centre - Roma When: Wednesday 19 March, 2–4pm and 6–8pm. There is no need to RSVP. Just come along on the day. Drop in to see the GHD Engineers on 20 to 21 March Where: Cultural Centre - Roma When: Drop in any time between 9am-12pm and 1–3pm on 20 and 21 March For further information, reply to this email, visit www.maranoa.qld.gov.au/roma-flood-mitigation or contact the team on 1800 103 485. Kind regards, The Roma Flood Mitigation Team

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Sch. 4(4)(6) - Disclosing personal information

	proximity to the proposed Stage 2 infrastructure to invite them to the community information sessions but that they were unable contact everyone in person. The team advised that they would be happy to visit the landholders to talk you through the concept designs in the new year. Community-wide Information Sessions will also be held in February.
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Community Information Session (March) 19 Mar 2014	**Summary:** Community Information Seession- Stage 2 on Wednesday 19 March 2014, 6-8pm. **Stakeholder Comments:** Information session was attended by 29 people. Feedback from attendees provided in attached document.

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Letter - Outgoing 19 Dec 2013	**Summary:** Letter sent to landholders affected by the Stage 2 infrastructure informing them of the Roma Flood Mitigation Stage 2 concept options. **Team Response:** Letter sent to landholders affected by the Stage 2 infrastructure informing them of the Roma Flood Mitigation Stage 2 concept options. The letter advised that the project team sought to telephone residents in close proximity to the proposed Stage 2 infrastructure to invite them to the community information sessions but that they were unable contact everyone in person. The team advised that they would be happy to visit the landholders to talk you through the concept designs in the new year. Community-wide Information Sessions will also be held in February.
Email - Outgoing 13 Mar 2014	**Summary:** Email to all stakeholders regarding the Stage 2 Flood Mitigation Community Information Sessions- 19 March. **Team Response:** Dear Stakeholder, With the Stage 1 flood levee well underway, Council is now seeking your feedback on

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[redacted]

Email - Outgoing 16 Apr 2014	**Summary:** Email to all stakeholders from Roma Flood Mitigation regarding the Community Survey. **Team Response:** Notifying stakeholders that the Community Survey closes Thursday 17 April. Access survey online, attached pdf to fill out and email back or print out and deliver to a Council Customer Service Centre, or via hard copy at the Customer Service Centres. Community encouraged to fill out survey.

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[redacted]

Community Information Session (March) 19 Mar 2014	**Summary:** Community Information Session- Stage 2 on Wednesday 19 March 2014, 2-4pm. **Stakeholder Comments:** Information session was attended by 31 people. Feedback from attendees provided in attached document.

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[redacted]

Community Information Session (December) 17 Dec 2013	**Summary:** Community information session held on 17 December 2013 from 2pm to 4pm. **Stakeholder Comments:** Information session was attended by 31 people.

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	Feedback from attendees provided in attached document.
Email - Outgoing 13 Mar 2014	**Summary:** Email to all stakeholders regarding the Stage 2 Flood Mitigation Community Information Sessions- 19 March. **Team Response:** Dear Stakeholder, With the Stage 1 flood levee well underway, Council is now seeking your feedback on the proposed concept designs for the second stage of the Roma Flood Mitigation Proejct to be rolled out over time as funding becomes available. Come along to see the concept designs, ask questions, and hear about how Stage 1 and 2 aims to reduce flood levels at your property. We are keen to discuss potential improvements before taking the projects forward for funding. Stage 2 Community Information Sessions Where: Cultural Centre - Roma When: Wednesday 19 March, 2–4pm and 6–8pm. There is no need to RSVP. Just come along on the day. Drop in to see the GHD Engineers on 20 to 21 March Where: Cultural Centre - Roma When: Drop in any time between 9am-12pm and 1–3pm on 20 and 21 March For further information, reply to this email, visit www.maranoa.qld.gov.au/roma-flood-mitigation or contact the team on 1800 103 485. Kind regards, The Roma Flood Mitigation Team

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Community Information Session (March) 19 Mar 2014	**Summary:** Community Information Seession- Stage 2 on Wednesday 19 March 2014, , 6-8pm. **Stakeholder Comments:** Information session was attended by 29 people. Feedback from attendees provided in attached document.
Email - Outgoing 16 Apr 2014	**Summary:** Email to all stakeholders from Roma Flood Mitigation regarding the Community Survey. **Team Response:** Notifying stakeholders that the Community Survey closes Thursday 17 April. Access survey online, attached pdf to fill out and email back or print out and deliver to a Council Customer Service Centre, or via hard copy at the Customer Service Centres. Community encouraged to fill out survey.

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Community Information Session (December) 17 Dec 2013	**Summary:** Community information session held on 17 December 2013 from 6pm to 8pm. **Stakeholder Comments:** Information session was attended by 29 people. Feedback from attendees provided in attached document.
Email - Outgoing 13 Mar 2014	**Summary:** Email to all stakeholders regarding the Stage 2 Flood Mitigation Community Information Sessions- 19 March. **Team Response:** Dear Stakeholder, With the Stage 1 flood levee well underway, Council is now seeking your feedback on the proposed concept designs for the second stage of the Roma Flood Mitigation Proejct to be rolled out over time as funding becomes available. Come along to see the concept designs, ask questions, and hear about how Stage 1 and 2 aims to reduce flood levels at your property. We are keen to discuss potential improvements before taking the projects forward for funding. Stage 2 Community Information Sessions Where: Cultural Centre - Roma When: Wednesday 19 March, 2–4pm and 6–8pm. There is no need to RSVP. Just

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	come along on the day. Drop in to see the GHD Engineers on 20 to 21 March Where: Cultural Centre - Roma When: Drop in any time between 9am-12pm and 1–3pm on 20 and 21 March For further information, reply to this email, visit www.maranoa.qld.gov.au/roma-flood-mitigation or contact the team on 1800 103 485. Kind regards, The Roma Flood Mitigation Team

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[redacted]

Letter - Outgoing 19 Dec 2013	**Summary:** Letter sent to landholders affected by the Stage 2 infrastructure informing them of the Roma Flood Mitigation Stage 2 concept options. **Team Response:** Letter sent to landholders affected by the Stage 2 infrastructure informing them of the Roma Flood Mitigation Stage 2 concept options. The letter advised that the project team sought to telephone residents in close proximity to the proposed Stage 2 infrastructure to invite them to the community information sessions but that they were unable contact everyone in person. The team advised that they would be happy to visit the landholders to talk you through the concept designs in the new year. Community-wide Information Sessions will also be held in February.

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[redacted]

Email - Outgoing 13 Mar 2014	**Summary:** Email to all stakeholders regarding the Stage 2 Flood Mitigation Community Information Sessions- 19 March.

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[redacted]

Team Response: Dear Stakeholder,

With the Stage 1 flood levee well underway, Council is now seeking your feedback on the proposed concept designs for the second stage of the Roma Flood Mitigation Proejct to be rolled out over time as funding becomes available.

Come along to see the concept designs, ask questions, and hear about how Stage 1 and 2 aims to reduce flood levels at your property.
We are keen to discuss potential improvements before taking the projects forward for funding.

Stage 2 Community Information Sessions
Where: Cultural Centre - Roma
When: Wednesday 19 March, 2–4pm and 6–8pm. There is no need to RSVP. Just come along on the day.

Drop in to see the GHD Engineers on 20 to 21 March
Where: Cultural Centre - Roma
When: Drop in any time between 9am-12pm and 1--3pm on 20 and 21 March

For further information, reply to this email, visit www.maranoa.qld.gov.au/roma-flood-mitigation or contact the team on 1800 103 485.

Kind regards,
The Roma Flood Mitigation Team

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Email - Outgoing 13 Mar 2014	**Summary:** Email to all stakeholders regarding the Stage 2 Flood Mitigation Community Information Sessions- 19 March. **Team Response:** Dear Stakeholder, With the Stage 1 flood levee well underway, Council is now seeking your feedback on the proposed concept designs for the second stage of the Roma Flood Mitigation Proejct to be rolled out over time as funding becomes available. Come along to see the concept designs, ask questions, and hear about how Stage 1 and 2 aims to reduce flood levels at your property. We are keen to discuss potential improvements before taking the projects forward for funding. Stage 2 Community Information Sessions Where: Cultural Centre - Roma When: Wednesday 19 March, 2–4pm and 6–8pm. There is no need to RSVP. Just come along on the day. Drop in to see the GHD Engineers on 20 to 21 March Where: Cultural Centre - Roma When: Drop in any time between 9am-12pm and 1–3pm on 20 and 21 March For further information, reply to this email, visit www.maranoa.qld.gov.au/roma-flood-mitigation or contact the team on 1800 103 485. Kind regards, The Roma Flood Mitigation Team
Community Information Session (March) 19 Mar 2014	**Summary:** Community Information Session- Stage 2 on Wednesday 19 March 2014, 2-4pm. **Stakeholder Comments:** Information session was attended by 31 people. Feedback from attendees provided in attached document.

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Community Information Session (December) 17 Dec 2013	**Summary:** Community information session held on 17 December 2013 from 2pm to 4pm. **Stakeholder Comments:** Information session was attended by 31 people. Feedback from attendees provided in attached document.
Email - Outgoing 13 Mar 2014	**Summary:** Email to all stakeholders regarding the Stage 2 Flood Mitigation Community Information Sessions- 19 March. **Team Response:** Dear Stakeholder, With the Stage 1 flood levee well underway, Council is now seeking your feedback on the proposed concept designs for the second stage of the Roma Flood Mitigation Project to be rolled out over time as funding becomes available. Come along to see the concept designs, ask questions, and hear about how Stage 1 and 2 aims to reduce flood levels at your property. We are keen to discuss potential improvements before taking the projects forward for funding. Stage 2 Community Information Sessions Where: Cultural Centre - Roma When: Wednesday 19 March, 2–4pm and 6–8pm. There is no need to RSVP. Just come along on the day. Drop in to see the GHD Engineers on 20 to 21 March Where: Cultural Centre - Roma When: Drop in any time between 9am-12pm and 1–3pm on 20 and 21 March For further information, reply to this email, visit www.maranoa.qld.gov.au/roma-flood-mitigation or contact the team on 1800 103 485. Kind regards, The Roma Flood Mitigation Team

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Letter - Outgoing 19 Dec 2013	**Summary:** Letter sent to landholders affected by the Stage 2 infrastructure informing them of the Roma Flood Mitigation Stage 2 concept options. **Team Response:** Letter sent to landholders affected by the Stage 2 infrastructure informing them of the Roma Flood Mitigation Stage 2 concept options. The letter advised that the project team sought to telephone residents in close

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	proximity to the proposed Stage 2 infrastructure to invite them to the community information sessions but that they were unable contact everyone in person. The team advised that they would be happy to visit the landholders to talk you through the concept designs in the new year. Community-wide Information Sessions will also be held in February.
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Community Information Session (March) 19 Mar 2014	**Summary:** Community Information Seession- Stage 2 on Wednesday 19 March 2014, 6-8pm. **Stakeholder Comments:** Information session was attended by 29 people. Feedback from attendees provided in attached document.

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Community Information Session (December) 17 Dec 2013	**Summary:** Community information session held on 17 December 2013 from 2pm to 4pm. **Stakeholder Comments:** Information session was attended by 31 people. Feedback from attendees provided in attached document.

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Email - Outgoing 13 Mar 2014	**Summary:** Email to all stakeholders regarding the Stage 2 Flood Mitigation Community Information Sessions- 19 March. **Team Response:** Dear Stakeholder, With the Stage 1 flood levee well underway, Council is now seeking your feedback on the proposed concept designs for the second stage of the Roma Flood Mitigation Proejct to be rolled out over time as funding becomes available. Come along to see the concept designs, ask questions, and hear about how Stage 1 and 2 aims to reduce flood levels at your property. We are keen to discuss potential improvements before taking the projects forward for funding. Stage 2 Community Information Sessions Where: Cultural Centre - Roma When: Wednesday 19 March, 2–4pm and 6–8pm. There is no need to RSVP, Just come along on the day. Drop in to see the GHD Engineers on 20 to 21 March Where: Cultural Centre - Roma When: Drop in any time between 9am-12pm and 1–3pm on 20 and 21 March For further information, reply to this email, visit www.maranoa.qld.gov.au/roma-flood-mitigation or contact the team on 1800 103 485. Kind regards, The Roma Flood Mitigation Team

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Community Information Session (December) 17 Dec 2013	**Summary:** Community information session held on 17 December 2013 from 2pm to 4pm. **Stakeholder Comments:** Information session was attended by 31 people. Feedback from attendees provided in attached document.

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[redacted]

Email - Outgoing 13 Mar 2014	**Summary:** Email to all stakeholders regarding the Stage 2 Flood Mitigation Community Information Sessions- 19 March.

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	Team Response: Dear Stakeholder, With the Stage 1 flood levee well underway, Council is now seeking your feedback on the proposed concept designs for the second stage of the Roma Flood Mitigation Proejct to be rolled out over time as funding becomes available. Come along to see the concept designs, ask questions, and hear about how Stage 1 and 2 aims to reduce flood levels at your property. We are keen to discuss potential improvements before taking the projects forward for funding. Stage 2 Community Information Sessions Where: Cultural Centre - Roma When: Wednesday 19 March, 2–4pm and 6–8pm. There is no need to RSVP. Just come along on the day. Drop in to see the GHD Engineers on 20 to 21 March Where: Cultural Centre - Roma When: Drop in any time between 9am-12pm and 1–3pm on 20 and 21 March For further information, reply to this email, visit www.maranoa.qld.gov.au/roma-flood-mitigation or contact the team on 1800 103 485. Kind regards, The Roma Flood Mitigation Team
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Community Information	**Summary:** Community information session held on 17 December 2013 from 2pm to

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Session (December) 17 Dec 2013	4pm. **Stakeholder Comments:** Information session was attended by 31 people. Feedback from attendees provided in attached document.

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	Community encouraged to fill out survey.

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Community Information Session (March) 19 Mar 2014	**Summary:** Community Information Session- Stage 2 on Wednesday 19 March 2014, 2-4pm. **Stakeholder Comments:** Information session was attended by 31 people. Feedback from attendees provided in attached document.

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Feedback form 20 Mar 2014	**Summary:** Completed feedback form - Donna Brown and Rod Caton. **Stakeholder Comments:** Donna and Rod are local residents and their property was affected by the 2012 flood event. The Stage 2 works are located within close proximity to their property (Eastern Division). They have concerns in relation to the Stage 2 mitigation options as the flood modelling shows that flood levels on their property won't change. They feel the proposed Stage 2 mitigation works will not benefit their property. They believe the levee should be around the town in a ring, but the long drains in the centre of the town are the problem. Preference to receive project updates via Council's monthly newsletter. They would like to be told more information and the truth of what has happened past and present.

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Email - Outgoing 13 Mar 2014	**Summary:** Email to all stakeholders regarding the Stage 2 Flood Mitigation Community Information Sessions- 19 March. **Team Response:** Dear Stakeholder, With the Stage 1 flood levee well underway, Council is now seeking your feedback on the proposed concept designs for the second stage of the Roma Flood Mitigation Proejct to be rolled out over time as funding becomes available. Come along to see the concept designs, ask questions, and hear about how Stage 1 and 2 aims to reduce flood levels at your property. We are keen to discuss potential improvements before taking the projects forward for funding. Stage 2 Community Information Sessions Where: Cultural Centre - Roma When: Wednesday 19 March, 2–4pm and 6–8pm. There is no need to RSVP. Just come along on the day. Drop in to see the GHD Engineers on 20 to 21 March Where: Cultural Centre - Roma When: Drop in any time between 9am-12pm and 1–3pm on 20 and 21 March For further information, reply to this email, visit www.maranoa.qld.gov.au/roma-flood-mitigation or contact the team on 1800 103 485. Kind regards, The Roma Flood Mitigation Team

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Letter - Outgoing 19 Dec 2013	**Summary:** Letter sent to landholders affected by the Stage 2 infrastructure informing them of the Roma Flood Mitigation Stage 2 concept options. **Team Response:** Letter sent to landholders affected by the Stage 2 infrastructure informing them of the Roma Flood Mitigation Stage 2 concept options. The letter advised that the project team sought to telephone residents in close proximity to the proposed Stage 2 infrastructure to invite them to the community information sessions but that they were unable contact everyone in person. The team advised that they would be happy to visit the landholders to talk you through

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	She has concerns in relation to the Stage 2 mitigation options - I cannot see why there is a need for the levee on Clayton Road. My property will lose value. Feels that the proposed Stage 2 mitigation works will not benefit her property. Would like to receive project updates via email, Council's monthly newsletter and the website. Not happy about getting a response after calls and visits, never get back to me.
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Email - Outgoing 16 Apr 2014	**Summary:** Email to all stakeholders from Roma Flood Mitigation regarding the Community Survey. **Team Response:** Notifying stakeholders that the Community Survey closes Thursday 17 April. Access survey online, attached pdf to fill out and email back or print out and deliver to a Council Customer Service Centre, or via hard copy at the Customer Service Centres. Community encouraged to fill out survey.

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Community Information Session (December) 17 Dec 2013	**Summary:** Community information session held on 17 December 2013 from 6pm to 8pm. **Stakeholder Comments:** Information session was attended by 29 people. Feedback from attendees provided in attached document.
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[redacted]

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Letter - Outgoing 19 Dec 2013	**Summary:** Letter sent to landholders affected by the Stage 2 infrastructure informing them of the Roma Flood Mitigation Stage 2 concept options. **Team Response:** Letter sent to landholders affected by the Stage 2 infrastructure informing them of the Roma Flood Mitigation Stage 2 concept options. The letter advised that the project team sought to telephone residents in close proximity to the proposed Stage 2 infrastructure to invite them to the community information sessions but that they were unable contact everyone in person. The team advised that they would be happy to visit the landholders to talk you through

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Kind regards,
The Roma Flood Mitigation Team

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Julie Reitano BH Phone: 1300 007 662
CEO, Maranoa Regional Council
PO Box 42
MITCHELL QLD 4465
AUSTRALIA

Email - Incoming 20 Mar 2014	**Summary:** Notification from Maranoa Regional Council of email sent to all Council staff. **Stakeholder Comments:** The email to all Council staff from the CEO was notifying staff of the Community Information Sessions on Wednesday 19 March and also provided a bit of a background on Stage 2.

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	The Roma Flood Mitigation Team
One-on-ones (March 20-21 2014) 21 Mar 2014	**Summary:** Mike and Jill said there was no benefit to them from Stages 1 or 2. They said level for 2012 flood was actually 120cm below floor not 90 cm. Their concern is that their shed floods and it has expensive equipment in it which had to be replaced previously.
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Community Information	**Summary:** Community information session held on 17 December 2013 from 6pm to

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