



ATTACHMENTS

UNDER SEPARATE COVER

Ordinary Council Meeting

27 September 2022



NARRABRI SHIRE
DISCOVER THE POTENTIAL

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**Narrabri Shire Council
CODE OF MEETING PRACTICE**

2022

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1 INTRODUCTION

This Model Code of Meeting Practice for Local Councils in NSW (the Model Meeting Code) is prescribed under section 360 of the *Local Government Act 1993* (the Act) and the *Local Government (General) Regulation 2021* (the Regulation).

The Model Meeting Code applies to all meetings of councils and committees of councils of which all the members are councillors (committees of council). Council committees whose members include persons other than councillors may adopt their own rules for meetings unless the council determines otherwise.

Councils must adopt a code of meeting practice that incorporates the mandatory provisions of the Model Meeting Code.

A council's adopted code of meeting practice may also incorporate the non-mandatory provisions of the Model Meeting Code and other supplementary provisions. However, a code of meeting practice adopted by a council must not contain provisions that are inconsistent with the mandatory provisions of this Model Meeting Code.

A council and a committee of the council of which all the members are councillors must conduct its meetings in accordance with the code of meeting practice adopted by the council.

2 MEETING PRINCIPLES

2.1 Council and committee meetings should be:

Transparent: Decisions are made in a way that is open and accountable.

Informed: Decisions are made based on relevant, quality information.

Inclusive: Decisions respect the diverse needs and interests of the local community.

Principled: Decisions are informed by the principles prescribed under Chapter 3 of the Act.

Trusted: The community has confidence that councillors and staff act ethically and make decisions in the interests of the whole community.

Respectful: Councillors, staff and meeting attendees treat each other with respect.

Effective: Meetings are well organised, effectively run and skilfully chaired.

Orderly: Councillors, staff and meeting attendees behave in a way that contributes to the orderly conduct of the meeting.

3 BEFORE THE MEETING

Timing of ordinary council meetings

- 3.1 Ordinary meetings of the council will be held on the following occasions:
Dates: Fourth Tuesday of each month
Time: 1:00pm
Place: Council Chambers, 46-48 Maitland Street Narrabri NSW
- 3.2 [Deleted]

Extraordinary meetings

- 3.3 If the mayor receives a request in writing, signed by at least two (2) councillors, the mayor must call an extraordinary meeting of the council to be held as soon as practicable, but in any event, no more than fourteen (14) days after receipt of the request. The mayor can be one of the two councillors requesting the meeting.

Note: Clause 3.3 reflects section 366 of the Act.

Notice to the public of council meetings

- 3.4 The council must give notice to the public of the time, date and place of each of its meetings, including extraordinary meetings and of each meeting of committees of the council.

Note: Clause 3.4 reflects section 9(1) of the Act.

- 3.5 For the purposes of clause 3.4, notice of a meeting of the council and of a committee of council is to be published before the meeting takes place. The notice must be published on the council's website, and in such other manner that the council is satisfied is likely to bring notice of the meeting to the attention of as many people as possible.
- 3.6 For the purposes of clause 3.4, notice of more than one (1) meeting may be given in the same notice.

Notice to councillors of ordinary council meetings

- 3.7 The general manager must send to each councillor, at least three (3) days before each meeting of the council, a notice specifying the time, date and place at which the meeting is to be held, and the business proposed to be considered at the meeting.

Note: Clause 3.7 reflects section 367(1) of the Act.

- 3.8 The notice and the agenda for, and the business papers relating to, the meeting may be given to councillors in electronic form, but only if all councillors have facilities to access the notice, agenda and business papers in that form.

Note: Clause 3.8 reflects section 367(3) of the Act.

Notice to councillors of extraordinary meetings

- 3.9 Notice of less than three (3) days may be given to councillors of an extraordinary meeting of the council in cases of emergency.

Note: Clause 3.9 reflects section 367(2) of the Act.

Giving notice of business to be considered at council meetings

- 3.10 A councillor may give notice of any business they wish to be considered by the council at its next ordinary meeting by way of a notice of motion. To be included on the agenda of the meeting, the notice of motion must be in writing and must be submitted **not later than 12 noon on Monday in the week preceding the Council Meeting, or the business day before if that Monday falls on a NSW Public Holiday.**
- 3.11 A councillor may, in writing to the general manager, request the withdrawal of a notice of motion submitted by them prior to its inclusion in the agenda and business paper for the meeting at which it is to be considered.
- 3.12 If the general manager considers that a notice of motion submitted by a councillor for consideration at an ordinary meeting of the council has legal, strategic, financial or policy implications which should be taken into consideration by the meeting, the general manager may prepare a report in relation to the notice of motion for inclusion with the business papers for the meeting at which the notice of motion is to be considered by the council.
- 3.13 A notice of motion for the expenditure of funds on works and/or services other than those already provided for in the council's current adopted operational plan must identify the source of funding for the expenditure that is the subject of the notice of motion. If the notice of motion does not identify a funding source, the general manager must either:
- (a) prepare a report on the availability of funds for implementing the motion if adopted for inclusion in the business papers for the meeting at which the notice of motion is to be considered by the council, or
 - (b) by written notice sent to all councillors with the business papers for the meeting for which the notice of motion has been submitted, defer consideration of the matter by the council to such a date specified in the notice, pending the preparation of such a report.
- 3.13A Councillors are limited to submitting up to two (2) notices of motion each per Council meeting.

Questions with notice

- 3.14 A councillor may, by way of a notice submitted under clause 3.10, ask a question for response by the general manager about the performance or operations of the council. Councillors are limited to submitting up to five (5) questions on notice each per Council meeting. Councillors may submit more than five (5) at the discretion of the General Manager.
- 3.15 A councillor is not permitted to ask a question with notice under clause 3.14 that comprises a complaint against the general manager or a member of staff of the council, or a question that implies wrongdoing by the general manager or a member of staff of the council.

- 3.16 The general manager or their nominee may respond to a question with notice submitted under clause 3.14 by way of a report included in the business papers for the relevant meeting of the council or orally at the meeting.

Agenda and business papers for ordinary meetings

- 3.17 The general manager must cause the agenda for a meeting of the council or a committee of the council to be prepared as soon as practicable before the meeting.
- 3.18 The general manager must ensure that the agenda for an ordinary meeting of the council states:
- (a) all matters to be dealt with arising out of the proceedings of previous meetings of the council, and
 - (b) if the mayor is the chairperson – any matter or topic that the chairperson proposes, at the time when the agenda is prepared, to put to the meeting, and
 - (c) all matters, including matters that are the subject of staff reports and reports of committees, to be considered at the meeting, and
 - (d) any business of which due notice has been given under clause 3.10.
- 3.19 Nothing in clause 3.18 limits the powers of the mayor to put a mayoral minute to a meeting under clause 9.6.
- 3.20 The general manager must not include in the agenda for a meeting of the council any business of which due notice has been given if, in the opinion of the general manager, the business is, or the implementation of the business would be, unlawful. The general manager must report, without giving details of the item of business, any such exclusion to the next meeting of the council.
- 3.21 Where the agenda includes the receipt of information or discussion of other matters that, in the opinion of the general manager, is likely to take place when the meeting is closed to the public, the general manager must ensure that the agenda of the meeting:
- (a) identifies the relevant item of business and indicates that it is of such a nature (without disclosing details of the information to be considered when the meeting is closed to the public), and
 - (b) states the grounds under section 10A(2) of the Act relevant to the item of business.

Note: Clause 3.21 reflects section 9(2A)(a) of the Act.

- 3.22 The general manager must ensure that the details of any item of business which, in the opinion of the general manager, is likely to be considered when the meeting is closed to the public, are included in a business paper provided to councillors for the meeting concerned. Such details must not be included in the business papers made available to the public and must not be disclosed by a councillor or by any other person to another person who is not authorised to have that information.

Statement of ethical obligations

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- 3.23 Business papers for all ordinary and extraordinary meetings of the council and committees of the council must contain a statement reminding councillors of their oath or affirmation of office made under section 233A of the Act and their obligations under the council's code of conduct to disclose and appropriately manage conflicts of interest.

Availability of the agenda and business papers to the public

- 3.24 Copies of the agenda and the associated business papers, such as correspondence and reports for meetings of the council and committees of council, are to be published on the council's website, and must be made available to the public for inspection, or for taking away by any person free of charge at the offices of the council, at the relevant meeting and at such other venues determined by the council.

Note: Clause 3.24 reflects section 9(2) and (4) of the Act.

- 3.25 Clause 3.24 does not apply to the business papers for items of business that the general manager has identified under clause 3.21 as being likely to be considered when the meeting is closed to the public.

Note: Clause 3.25 reflects section 9(2A)(b) of the Act.

- 3.26 For the purposes of clause 3.24, copies of agendas and business papers must be published on the council's website and made available to the public at a time that is as close as possible to the time they are available to councillors.

Note: Clause 3.26 reflects section 9(3) of the Act.

- 3.27 A copy of an agenda, or of an associated business paper made available under clause 3.24, may in addition be given or made available in electronic form.

Note: Clause 3.27 reflects section 9(5) of the Act.

Agenda and business papers for extraordinary meetings

- 3.28 The general manager must ensure that the agenda for an extraordinary meeting of the council deals only with the matters stated in the notice of the meeting.
- 3.29 Despite clause 3.28, business may be considered at an extraordinary meeting of the council, even though due notice of the business has not been given, if:
- (a) a motion is passed to have the business considered at the meeting, and
 - (b) the business to be considered is ruled by the chairperson to be of great urgency on the grounds that it requires a decision by the council before the next scheduled ordinary meeting of the council.
- 3.30 A motion moved under clause 3.29(a) can be moved without notice but only after the business notified in the agenda for the extraordinary meeting has been dealt with.

- 3.31 Despite clauses 10.20–10.30, only the mover of a motion moved under clause 3.29(a) can speak to the motion before it is put.
- 3.32 A motion of dissent cannot be moved against a ruling of the chairperson under clause 3.29(b) on whether a matter is of great urgency.

Pre-meeting briefing sessions and councillor workshops

- 3.33 Prior to each ordinary meeting of the council, the general manager may arrange a pre-meeting briefing session to brief councillors on business to be considered at the meeting. Pre-meeting briefing sessions may also be held for extraordinary meetings of the council and meetings of committees of the council.
- 3.34 Pre-meeting briefing sessions are to be held in the absence of the public.
- 3.35 Pre-meeting briefing sessions may be held by audio-visual link.
- 3.36 The general manager or a member of staff nominated by the general manager is to preside at pre-meeting briefing sessions.
- 3.37 Councillors must not use pre-meeting briefing sessions to debate or make preliminary decisions on items of business they are being briefed on, and any debate and decision-making must be left to the formal council or committee meeting at which the item of business is to be considered.
- 3.38 Councillors (including the mayor) must declare and manage any conflicts of interest they may have in relation to any item of business that is the subject of a briefing at a pre-meeting briefing session, in the same way that they are required to do so at a council or committee meeting. The council is to maintain a written record of all conflict of interest declarations made at pre-meeting briefing sessions and how the conflict of interest was managed by the councillor who made the declaration.
- 3.39 Council may hold monthly workshops with Councillors. Excepting the below, Council Workshops will operate according to 3.33 to 3.38 above as though they were pre-meeting briefing sessions.
- 3.40 Council Workshops may be held on the first Tuesday of each month, or on such other occasions as determined by the General Manager.
- 3.41 At workshops, the General Manager and staff will brief councillors on business to be considered at upcoming council meetings, but not necessarily the next council meeting.
- 3.42 Councillors may ask questions of the General Manager or other staff (with the General Manager's permission) at workshops. Questions may be answered at the time or taken on notice by the General Manager and/or staff.

4 PUBLIC FORUMS

- 4.1 The council may hold a public forum prior to each ordinary meeting of the council for the purpose of hearing oral submissions from members of the public on items of business or those within the scope of council's functions. Public forums may also be held prior to extraordinary council meetings and meetings of committees of the council. Public forums do not form part of the meeting.
- 4.2 Public forums may be held by audio-visual link.
- 4.3 Public forums are to be chaired by the mayor or their nominee.
- 4.4 To speak at a public forum, a person must first make an application to the council in the approved form. Applications to speak at the public forum must be received by **5pm on the working day** before the date on which the public forum is to be held, and must identify the item of business (that is on the agenda of the meeting or otherwise within the scope of council's functions) the person wishes to speak on, and whether they wish to speak 'for' or 'against' the item.
- 4.5 A person may apply to speak on no more than **2** items of business on the agenda of the council meeting.
- 4.6 Legal representatives acting on behalf of others are not to be permitted to speak at a public forum unless they identify their status as a legal representative when applying to speak at the public forum.
- 4.7 The general manager or their delegate may refuse an application to speak at a public forum. The general manager or their delegate must give reasons in writing for a decision to refuse an application.
- 4.8 No more than **three (3) speakers** are to be permitted to speak on each item of business (that is on the agenda of the meeting or otherwise within the scope of council's functions), or 'for' or 'against' each item of business (that is on the agenda of the meeting or otherwise within the scope of council's functions).
- 4.9 If more than the permitted number of speakers apply to speak 'for' or 'against' any item of business or otherwise within the scope of council's functions, the general manager or their delegate may request the speakers to nominate from among themselves the persons who are to address the council on the item of business. If the speakers are not able to agree on whom to nominate to address the council, the general manager or their delegate is to determine who will address the council at the public forum.
- 4.10 If more than the permitted number of speakers apply to speak 'for' or 'against' any item of business or otherwise within the scope of council's functions, the general manager or their delegate may, in consultation with the mayor or the mayor's nominated chairperson, increase the number of speakers permitted to speak on an item of business, where they are satisfied that it is necessary to do so to allow the council to hear a fuller range of views on the relevant item of business or council function.

- 4.11 Approved speakers at the public forum are to register with the council any written, visual or audio material to be presented in support of their address to the council at the public forum, and to identify any equipment needs no more **three (3) days** before the public forum. The general manager or their delegate may refuse to allow such material to be presented.
- 4.12 The general manager or their delegate is to determine the order of speakers at the public forum.
- 4.13 Each speaker will be allowed **three (3) minutes** to address the council. This time is to be strictly enforced by the chairperson. The chairperson may, at their sole unfettered discretion, grant one extension up to a maximum of **two (2) minutes**.
- 4.14 Speakers at public forums must not digress from the item on the agenda of the council meeting or otherwise within the scope of council's functions, they have applied to address the council on. If a speaker digresses to irrelevant matters, the chairperson is to direct the speaker not to do so. If a speaker fails to observe a direction from the chairperson, the speaker will not be further heard.
- 4.15 A councillor (including the chairperson) may, through the chairperson, ask questions of a speaker following their address at a public forum. Questions put to a speaker must be direct, succinct and without argument.
- 4.16 Speakers are under no obligation to answer a question put under clause 4.15. Answers by the speaker, to each question are to be limited to **three (3) minutes**.
- 4.17 Speakers at public forums **cannot** ask questions of the council, councillors, or council staff.
- 4.18 The general manager or their nominee may, with the concurrence of the chairperson, address the council for up to **five (5) minutes** in response to an address to the council at a public forum after the address and any subsequent questions and answers have been finalised.
- 4.19 Where an address made at a public forum raises matters that require further consideration by council staff, the general manager may recommend that the council defer consideration of the matter pending the preparation of a further report on the matters.
- 4.20 When addressing the council, speakers at public forums must comply with this code and all other relevant council codes, policies, and procedures. Speakers must refrain from engaging in disorderly conduct, publicly alleging breaches of the council's code of conduct, or making other potentially defamatory statements.
- 4.21 If the chairperson considers that a speaker at a public forum has engaged in conduct of the type referred to in clause 4.20, the chairperson may request the person to refrain from the inappropriate behaviour and to withdraw and unreservedly apologise for any inappropriate comments. Where the speaker fails to comply with the chairperson's request, the chairperson may immediately require the person to stop speaking.

- 4.22 Clause 4.21 does not limit the ability of the chairperson to deal with disorderly conduct by speakers at public forums in accordance with the provisions of Part 15 of this code.
- 4.23 Where a speaker engages in conduct of the type referred to in clause 4.20, the general manager or their delegate may refuse further applications from that person to speak at public forums for such a period as the general manager or their delegate considers appropriate.
- 4.24 Councillors (including the mayor) must declare and manage any conflicts of interest they may have in relation to any item of business that is the subject of an address at a public forum, in the same way that they are required to do so at a council or committee meeting. The council is to maintain a written record of all conflict of interest declarations made at public forums and how the conflict of interest was managed by the councillor who made the declaration.

5 COMING TOGETHER

Attendance by councillors at meetings

- 5.1 All councillors must make reasonable efforts to attend meetings of the council and of committees of the council of which they are members.

Note: A councillor may not attend a meeting as a councillor (other than the first meeting of the council after the councillor is elected or a meeting at which the councillor takes an oath or makes an affirmation of office) until they have taken an oath or made an affirmation of office in the form prescribed under section 233A of the Act.

- 5.2 A councillor cannot participate in a meeting of the council or of a committee of the council unless personally present at the meeting, unless permitted to attend the meeting by audio-visual link under this code.
- 5.4 Where a councillor is unable to attend one or more ordinary meetings of the council, the councillor should request that the council grant them a leave of absence from those meetings. This clause does not prevent a councillor from making an apology if they are unable to attend a meeting. However, the acceptance of such an apology does not constitute the granting of a leave of absence for the purposes of this code and the Act.
- 5.5 A councillor's request for leave of absence from council meetings should, if practicable, identify (by date) the meetings from which the councillor intends to be absent and the grounds upon which the leave of absence is being sought.
- 5.6 The council must act reasonably when considering whether to grant a councillor's request for a leave of absence.
- 5.7 A councillor's civic office will become vacant if the councillor is absent from three (3) consecutive ordinary meetings of the council without prior leave of the council, or leave granted by the council at any of the meetings concerned, unless the holder is absent because they have been suspended from office

under the Act, or because the council has been suspended under the Act, or as a consequence of a compliance order under section 438HA.

Note: Clause 5.7 reflects section 234(1)(d) of the Act.

- 5.8 A councillor who intends to attend a meeting of the council despite having been granted a leave of absence should, if practicable, give the general manager at least two (2) days' notice of their intention to attend.

The quorum for a meeting

- 5.9 The quorum for a meeting of the council is a majority of the councillors of the council who hold office at that time and are not suspended from office.

Note: Clause 5.9 reflects section 368(1) of the Act.

- 5.10 Clause 5.9 does not apply if the quorum is required to be determined in accordance with directions of the Minister in a performance improvement order issued in respect of the council.

Note: Clause 5.10 reflects section 368(2) of the Act.

- 5.11 A meeting of the council must be adjourned if a quorum is not present:
- (a) at the commencement of the meeting where the number of apologies received for the meeting indicates that there will not be a quorum for the meeting, or
 - (b) within half an hour after the time designated for the holding of the meeting, or
 - (c) at any time during the meeting.
- 5.12 In either case, the meeting must be adjourned to a time, date, and place fixed:
- (a) by the chairperson, or
 - (b) in the chairperson's absence, by the majority of the councillors present, or
 - (c) failing that, by the general manager.
- 5.13 The general manager must record in the council's minutes the circumstances relating to the absence of a quorum (including the reasons for the absence of a quorum) at or arising during a meeting of the council, together with the names of the councillors present.

- 5.14 Where, prior to the commencement of a meeting, it becomes apparent that a quorum may not be present at the meeting, or that the health, safety or welfare of councillors, council staff and members of the public may be put at risk by attending the meeting because of a natural disaster or a public health emergency, the mayor may, in consultation with the general manager and, as far as is practicable, with each councillor, cancel the meeting. Where a meeting is cancelled, notice of the cancellation must be published on the council's website and in such other manner that the council is satisfied is likely to bring notice of the cancellation to the attention of as many people as possible.

- 5.15 Where a meeting is cancelled under clause 5.14, the business to be considered at the meeting may instead be considered, where practicable, at the next ordinary meeting of the council or at an extraordinary meeting called under clause 3.3.

Meetings held by audio-visual link

- 5.16 A meeting of the council or a committee of the council may be held by audio-visual link where the mayor determines that the meeting should be held by audio-visual link because of a natural disaster or a public health emergency. The mayor may only make a determination under this clause where they are satisfied that attendance at the meeting may put the health and safety of councillors and staff at risk. The mayor must make a determination under this clause in consultation with the general manager and, as far as is practicable, with each councillor.
- 5.17 Where the mayor determines under clause 5.16 that a meeting is to be held by audio-visual link, the general manager must:
- (a) give written notice to all councillors that the meeting is to be held by audio-visual link, and
 - (b) take all reasonable steps to ensure that all councillors can participate in the meeting by audio-visual link, and
 - (c) cause a notice to be published on the council's website and in such other manner the general manager is satisfied will bring it to the attention of as many people as possible, advising that the meeting is to be held by audio-visual link and providing information about where members of the public may view the meeting.
- 5.18 This code applies to a meeting held by audio-visual link under clause 5.16 in the same way it would if the meeting was held in person.

Note: Where a council holds a meeting by audio-visual link under clause 5.16, it is still required under section 10 of the Act to provide a physical venue for members of the public to attend in person and observe the meeting.

Attendance by councillors at meetings by audio-visual link

- 5.19 Councillors may attend and participate in meetings of the council and committees of the council by audio-visual link with the approval of the council or the relevant committee.
- 5.20 A request by a councillor for approval to attend a meeting by audio-visual link must be made in writing to the general manager prior to the meeting in question and must provide reasons why the councillor will be prevented from attending the meeting in person.
- 5.21 Councillors may request approval to attend more than one meeting by audio-visual link. Where a councillor requests approval to attend more than one meeting by audio-visual link, the request must specify the meetings the request relates to in addition to the information required under clause 5.20.

- 5.22 The council must comply with the Health Privacy Principles prescribed under the *Health Records and Information Privacy Act 2002* when collecting, holding, using, and disclosing health information in connection with a request by a councillor to attend a meeting by audio-visual link.
- 5.23 A councillor who has requested approval to attend a meeting of the council or a committee of the council by audio-visual link may participate in the meeting by audio-visual link until the council or committee determines whether to approve their request and is to be taken as present at the meeting. The councillor may participate in a decision in relation to their request to attend the meeting by audio-visual link.
- 5.24 A decision whether to approve a request by a councillor to attend a meeting of the council or a committee of the council by audio-visual link must be made by a resolution of the council or the committee concerned. The resolution must state:
- (a) the meetings the resolution applies to, and
 - (b) the reason why the councillor is being permitted to attend the meetings by audio-visual link where it is on grounds other than illness, disability, or caring responsibilities.
- 5.25 If the council or committee refuses a councillor's request to attend a meeting by audio-visual link, their link to the meeting is to be terminated.
- 5.26 A decision whether to approve a councillor's request to attend a meeting by audio-visual link is at the council's or the relevant committee's discretion. The council and committees of the council must act reasonably when considering requests by councillors to attend meetings by audio-visual link. However, the council and committees of the council are under no obligation to approve a councillor's request to attend a meeting by audio-visual link where the technical capacity does not exist to allow the councillor to attend the meeting by these means.
- 5.27 The council and committees of the council may refuse a councillor's request to attend a meeting by audio-visual link where the council or committee is satisfied that the councillor has failed to appropriately declare and manage conflicts of interest, observe confidentiality or to comply with this code on one or more previous occasions they have attended a meeting of the council or a committee of the council by audio-visual link.
- 5.28 This code applies to a councillor attending a meeting by audio-visual link in the same way it would if the councillor was attending the meeting in person. Where a councillor is permitted to attend a meeting by audio-visual link under this code, they are to be taken as attending the meeting in person for the purposes of the code and will have the same voting rights as if they were attending the meeting in person.
- 5.29 A councillor must give their full attention to the business and proceedings of the meeting when attending a meeting by audio-visual link. The councillor's camera must be on at all times during the meeting except as may be otherwise provided for under this code.

- 5.30 A councillor must be appropriately dressed when attending a meeting by audio-visual link and must ensure that no items are within sight of the meeting that are inconsistent with the maintenance of order at the meeting or that are likely to bring the council or the committee into disrepute.

Entitlement of the public to attend council meetings

- 5.31 Everyone is entitled to attend a meeting of the council and committees of the council. The council must ensure that all meetings of the council and committees of the council are open to the public.

Note: Clause 5.31 reflects section 10(1) of the Act.

- 5.32 Clause 5.31 does not apply to parts of meetings that have been closed to the public under section 10A of the Act.

- 5.33 A person (whether a councillor or another person) is not entitled to be present at a meeting of the council or a committee of the council if expelled from the meeting:

- (a) by a resolution of the meeting, or
- (b) by the person presiding at the meeting if the council has, by resolution, authorised the person presiding to exercise the power of expulsion.

Note: Clause 5.33 reflects section 10(2) of the Act.

Webcasting of meetings

- 5.34 Each meeting of the council or a committee of the council is to be recorded by means of an audio or audio-visual device.

- 5.35 At the start of each meeting of the council or a committee of the council, the chairperson must inform the persons attending the meeting that:

- (a) the meeting is being recorded and made publicly available on the council's website, and
- (b) persons attending the meeting should refrain from making any defamatory statements.

- 5.36 The recording of a meeting is to be made publicly available on the council's website:

- (a) at the same time as the meeting is taking place, or
- (b) as soon as practicable after the meeting.

- 5.37 The recording of a meeting is to be made publicly available on the council's website for at least 12 months after the meeting.

- 5.38 Clauses 5.36 and 5.37 do not apply to any part of a meeting that has been closed to the public in accordance with section 10A of the Act.

Note: Clauses 5.34 – 5.38 reflect *Local Government (General) Regulation 2021 (NSW)* reg 236.

- 5.39 Recordings of meetings may be disposed of in accordance with the *State Records Act 1998*.

Attendance of the general manager and other staff at meetings

- 5.40 The general manager is entitled to attend, but not to vote at, a meeting of the council or a meeting of a committee of the council of which all of the members are councillors.

Note: Clause 5.40 reflects section 376(1) of the Act.

- 5.41 The general manager is entitled to attend a meeting of any other committee of the council and may, if a member of the committee, exercise a vote.

Note: Clause 5.41 reflects section 376(2) of the Act.

- 5.42 The general manager may be excluded from a meeting of the council or a committee while the council or committee deals with a matter relating to the standard of performance of the general manager or the terms of employment of the general manager.

Note: Clause 5.42 reflects section 376(3) of the Act.

- 5.43 The attendance of other council staff at a meeting, (other than as members of the public) shall be with the approval of the general manager.

- 5.44 The general manager and other council staff may attend meetings of the council and committees of the council by audio-visual-link. Attendance by council staff at meetings by audio-visual link (other than as members of the public) shall be with the approval of the general manager.

6 THE CHAIRPERSON

The chairperson at meetings

- 6.1 The mayor, or at the request of or in the absence of the mayor, the deputy mayor (if any) presides at meetings of the council.

Note: Clause 6.1 reflects section 369(1) of the Act.

- 6.2 If the mayor and the deputy mayor (if any) are absent, a councillor elected to chair the meeting by the councillors present presides at a meeting of the council.

Note: Clause 6.2 reflects section 369(2) of the Act.

Election of the chairperson in the absence of the mayor and deputy mayor

- 6.3 If no chairperson is present at a meeting of the council at the time designated for the holding of the meeting, the first business of the meeting must be the election of a chairperson to preside at the meeting.
- 6.4 The election of a chairperson must be conducted:
- (a) by the general manager or, in their absence, an employee of the council designated by the general manager to conduct the election, or
 - (b) by the person who called the meeting or a person acting on their behalf if neither the general manager nor a designated employee is present at the meeting, or if there is no general manager or designated employee.
- 6.5 If, at an election of a chairperson, two (2) or more candidates receive the same number of votes and no other candidate receives a greater number of votes, the chairperson is to be the candidate whose name is chosen by lot.
- 6.6 For the purposes of clause 6.5, the person conducting the election must:
- (a) arrange for the names of the candidates who have equal numbers of votes to be written on similar slips, and
 - (b) then fold the slips so as to prevent the names from being seen, mix the slips and draw one of the slips at random.
- 6.7 The candidate whose name is on the drawn slip is the candidate who is to be the chairperson.
- 6.8 Any election conducted under clause 6.3, and the outcome of the vote, are to be recorded in the minutes of the meeting.

Chairperson to have precedence

- 6.9 When the chairperson rises or speaks during a meeting of the council:
- (a) any councillor then speaking or seeking to speak must cease speaking and, if standing, immediately resume their seat, and
 - (b) every councillor present must be silent to enable the chairperson to be heard without interruption.

7 MODES OF ADDRESS

- 7.1 If the chairperson is the mayor, they are to be addressed as 'Mr Mayor' or 'Madam Mayor'.
- 7.2 Where the chairperson is not the mayor, they are to be addressed as either 'Mr Chairperson' or 'Madam Chairperson'.
- 7.3 A councillor is to be addressed as 'Councillor [surname]'.
- 7.4 A council officer is to be addressed by their official designation or as Mr/Ms [surname] or other salutation as applicable (ie Dr.).

8 ORDER OF BUSINESS FOR ORDINARY COUNCIL MEETINGS

8.1 The general order of business for an ordinary meeting of the council shall be:

- 01 Opening meeting
- 02 Opening Affirmation
- 03 Acknowledgement of country
- 04 Acknowledgement of Australian Servicepeople
- 05 Apologies and applications for a leave of absence or attendance by audio-visual link by councillors
- 06 Confirmation of minutes
- 07 Disclosures of interests
- 08 Mayoral minute(s)
- 09 Matters of great urgency
- 10 Reports of committees
- 11 Reports to council
- 12 Notices of motions
- 13 Questions with notice
- 14 Confidential matters
- 15 Conclusion of the meeting

8.2 [Deleted]

8.3 The order of business as fixed under clause 8.1 may be altered for a particular meeting of the council if a motion to that effect is passed at that meeting. Such a motion can be moved without notice.

8.4 Despite clauses 10.20–10.30, only the mover of a motion referred to in clause 8.3 may speak to the motion before it is put.

9 CONSIDERATION OF BUSINESS AT COUNCIL MEETINGS

Business that can be dealt with at a council meeting

9.1 The council must not consider business at a meeting of the council:

- (a) unless a councillor has given notice of the business, as required by clause 3.10, and
- (b) unless notice of the business has been sent to the councillors in accordance with clause 3.7 in the case of an ordinary meeting or clause 3.9 in the case of an extraordinary meeting called in an emergency.

9.2 Clause 9.1 does not apply to the consideration of business at a meeting, if the business:

- (a) is already before, or directly relates to, a matter that is already before the council, or
- (b) is the election of a chairperson to preside at the meeting, or
- (c) subject to clause 9.9, is a matter or topic put to the meeting by way of a mayoral minute, or
- (d) is a motion for the adoption of recommendations of a committee, including, but not limited to, a committee of the council.

- 9.3 Despite clause 9.1, business may be considered at a meeting of the council even though due notice of the business has not been given to the councillors if:
- (a) a motion is passed to have the business considered at the meeting, and
 - (b) the business to be considered is ruled by the chairperson to be of great urgency on the grounds that it requires a decision by the council before the next scheduled ordinary meeting of the council.
- 9.4 A motion moved under clause 9.3(a) can be moved without notice. Despite clauses 10.20–10.30, only the mover of a motion referred to in clause 9.3(a) can speak to the motion before it is put.
- 9.5 A motion of dissent cannot be moved against a ruling by the chairperson under clause 9.3(b).

Mayoral minutes

- 9.6 Subject to clause 9.9, if the mayor is the chairperson at a meeting of the council, the mayor may, by minute signed by the mayor, put to the meeting without notice any matter or topic that is within the jurisdiction of the council, or of which the council has official knowledge.
- 9.7 A mayoral minute, when put to a meeting, takes precedence over all business on the council's agenda for the meeting. The chairperson (but only if the chairperson is the mayor) may move the adoption of a mayoral minute without the motion being seconded.
- 9.8 A recommendation made in a mayoral minute put by the mayor is, so far as it is adopted by the council, a resolution of the council.
- 9.9 A mayoral minute must not be used to put without notice matters that are routine and not urgent or matters for which proper notice should be given because of their complexity. For the purpose of this clause, a matter will be urgent where it requires a decision by the council before the next scheduled ordinary meeting of the council.
- 9.10 Where a mayoral minute makes a recommendation which, if adopted, would require the expenditure of funds on works and/or services other than those already provided for in the council's current adopted operational plan, it must identify the source of funding for the expenditure that is the subject of the recommendation. If the mayoral minute does not identify a funding source, the council must defer consideration of the matter, pending a report from the general manager on the availability of funds for implementing the recommendation if adopted.

Staff reports

- 9.11 A recommendation made in a staff report is, so far as it is adopted by the council, a resolution of the council.

Reports of committees of council

- 9.12 The recommendations of a committee of the council are, so far as they are adopted by the council, resolutions of the council.
- 9.13 If in a report of a committee of the council distinct recommendations are made, the council may make separate decisions on each recommendation.

Questions

- 9.14 A question must not be asked at a meeting of the council unless it concerns a matter on the agenda of the meeting or notice has been given of the question in accordance with clauses 3.10 and 3.14.
- 9.15 A councillor may, through the chairperson, put a question to another councillor about a matter on the agenda.
- 9.16 A councillor may, through the general manager, put a question to a council employee about a matter on the agenda. Council employees are only obliged to answer a question put to them through the general manager at the direction of the general manager.
- 9.17 A councillor or council employee to whom a question is put is entitled to be given reasonable notice of the question and, in particular, sufficient notice to enable reference to be made to other persons or to information. Where a councillor or council employee to whom a question is put is unable to respond to the question at the meeting at which it is put, they may take it on notice and report the response to the next meeting of the council.
- 9.18 Councillors must put questions directly, succinctly, respectfully and without argument.
- 9.19 The chairperson must not permit discussion on any reply to, or refusal to reply to, a question put to a councillor or council employee.

10 RULES OF DEBATE

Motions to be seconded

- 10.1 Unless otherwise specified in this code, a motion or an amendment cannot be debated unless or until it has been seconded.

Notices of motion

- 10.2 A councillor who has submitted a notice of motion under clause 3.10 is to move the motion the subject of the notice of motion at the meeting at which it is to be considered.
- 10.3 If a councillor who has submitted a notice of motion under clause 3.10 wishes to withdraw it after the agenda and business paper for the meeting at which it is to be considered have been sent to councillors, the councillor may request the withdrawal of the motion when it is before the council.
- 10.4 In the absence of a councillor who has placed a notice of motion on the agenda for a meeting of the council:

- (a) any other councillor may, with the leave of the chairperson, move the motion at the meeting, or
- (b) the chairperson may defer consideration of the motion until the next meeting of the council.

Chairperson's duties with respect to motions

- 10.5 It is the duty of the chairperson at a meeting of the council to receive and put to the meeting any lawful motion that is brought before the meeting.
- 10.6 The chairperson must rule out of order any motion or amendment to a motion that is unlawful or the implementation of which would be unlawful.
- 10.7 Before ruling out of order a motion or an amendment to a motion under clause 10.6, the chairperson is to give the mover an opportunity to clarify or amend the motion or amendment.
- 10.8 Any motion, amendment, or other matter that the chairperson has ruled out of order is taken to have been lost.

Motions requiring the expenditure of funds

- 10.9 A motion or an amendment to a motion which if passed would require the expenditure of funds on works and/or services other than those already provided for in the council's current adopted operational plan must identify the source of funding for the expenditure that is the subject of the motion. If the motion does not identify a funding source, the council must defer consideration of the matter, pending a report from the general manager on the availability of funds for implementing the motion if adopted.

Amendments to motions

- 10.10 An amendment to a motion must be moved and seconded before it can be debated.
- 10.11 An amendment to a motion must relate to the matter being dealt with in the original motion before the council and must not be a direct negative of the original motion. An amendment to a motion which does not relate to the matter being dealt with in the original motion, or which is a direct negative of the original motion, must be ruled out of order by the chairperson.
- 10.12 The mover of an amendment is to be given the opportunity to explain any uncertainties in the proposed amendment before a seconder is called for.
- 10.13 If an amendment has been lost, a further amendment can be moved to the motion to which the lost amendment was moved, and so on, but no more than one (1) motion and one (1) proposed amendment can be before council at any one time.
- 10.14 While an amendment is being considered, debate must only occur in relation to the amendment and not the original motion. Debate on the original motion

is to be suspended while the amendment to the original motion is being debated.

- 10.15 If the amendment is carried, it becomes the motion and is to be debated. If the amendment is lost, debate is to resume on the original motion.
- 10.16 An amendment may become the motion without debate or a vote where it is accepted by the councillor who moved the original motion.

Foreshadowed motions

- 10.17 A councillor may propose a foreshadowed motion in relation to the matter the subject of the original motion before the council, without a seconder during debate on the original motion. The foreshadowed motion is only to be considered if the original motion is lost or withdrawn and the foreshadowed motion is then moved and seconded. If the original motion is carried, the foreshadowed motion lapses.
- 10.18 Where an amendment has been moved and seconded, a councillor may, without a seconder, foreshadow a further amendment that they propose to move after the first amendment has been dealt with. There is no limit to the number of foreshadowed amendments that may be put before the council at any time. However, no discussion can take place on foreshadowed amendments until the previous amendment has been dealt with and the foreshadowed amendment has been moved and seconded.
- 10.19 Foreshadowed motions and foreshadowed amendments are to be considered in the order in which they are proposed. However, foreshadowed motions cannot be considered until all foreshadowed amendments have been dealt with.

Limitations on the number and duration of speeches

- 10.20 A councillor who, during a debate at a meeting of the council, moves an original motion, has the right to speak on each amendment to the motion and a right of general reply to all observations that are made during the debate in relation to the motion, and any amendment to it at the conclusion of the debate before the motion (whether amended or not) is finally put.
- 10.21 A councillor, other than the mover of an original motion, has the right to speak once on the motion and once on each amendment to it.
- 10.22 A councillor must not, without the consent of the council, speak more than once on a motion or an amendment, or for longer than **five (5) minutes** at any one time.
- 10.23 Despite clause 10.22, the chairperson may permit a councillor who claims to have been misrepresented or misunderstood to speak more than once on a motion or an amendment, and for longer than **five (5) minutes** on that motion or amendment to enable the councillor to make a statement limited to explaining the misrepresentation or misunderstanding.

- 10.24 Despite clause 10.22, the council may resolve to shorten the duration of speeches to expedite the consideration of business at a meeting.
- 10.25 Despite clauses 10.20 and 10.21, a councillor may move that a motion or an amendment be now put:
- (a) if the mover of the motion or amendment has spoken in favour of it and no councillor expresses an intention to speak against it, or
 - (b) if at least two (2) councillors have spoken in favour of the motion or amendment and at least two (2) councillors have spoken against it.
- 10.26 The chairperson must immediately put to the vote, without debate, a motion moved under clause 10.25. A seconder is not required for such a motion.
- 10.27 If a motion that the original motion or an amendment be now put is passed, the chairperson must, without further debate, put the original motion or amendment to the vote immediately after the mover of the original motion has exercised their right of reply under clause 10.20.
- 10.28 If a motion that the original motion or an amendment be now put is lost, the chairperson must allow the debate on the original motion or the amendment to be resumed.
- 10.29 All councillors must be heard without interruption and all other councillors must, unless otherwise permitted under this code, remain silent while another councillor is speaking.
- 10.30 Once the debate on a matter has concluded and a matter has been dealt with, the chairperson must not allow further debate on the matter.

11 VOTING

Voting entitlements of councillors

- 11.1 Each councillor is entitled to one (1) vote.

Note: Clause 11.1 reflects section 370(1) of the Act.

- 11.2 The person presiding at a meeting of the council has, in the event of an equality of votes, a second or casting vote.

Note: Clause 11.2 reflects section 370(2) of the Act.

- 11.3 Where the chairperson declines to exercise, or fails to exercise, their second or casting vote, in the event of an equality of votes, the motion being voted upon is lost.

11.4 **[Deleted]**

Voting at council meetings

- 11.5 A councillor who is present at a meeting of the council but who fails to vote on a motion put to the meeting is taken to have voted against the motion.

- 11.6 [Deleted]
- 11.7 [Deleted]
- 11.8 [Deleted]
- 11.9 [Deleted]
- 11.10 [Deleted]
- 11.11 All voting at council meetings, (including meetings that are closed to the public), must be recorded in the minutes of meetings with the names of councillors who voted for and against each motion or amendment, (including the use of the casting vote), being recorded.

Voting on planning decisions

- 11.12 The general manager must keep a register containing, for each planning decision made at a meeting of the council or a council committee (including, but not limited to a committee of the council), the names of the councillors who supported the decision and the names of any councillors who opposed (or are taken to have opposed) the decision.
- 11.13 For the purpose of maintaining the register, a division is taken to have been called whenever a motion for a planning decision is put at a meeting of the council or a council committee.
- 11.14 Each decision recorded in the register is to be described in the register or identified in a manner that enables the description to be obtained from another publicly available document.
- 11.15 Clauses 11.12–11.14 apply also to meetings that are closed to the public.

Note: Clauses 11.12–11.15 reflect section 375A of the Act.

Note: The requirements of clause 11.12 may be satisfied by maintaining a register of the minutes of each planning decision.

12 COMMITTEE OF THE WHOLE

- 12.1 The council may resolve itself into a committee to consider any matter before the council.

Note: Clause 12.1 reflects section 373 of the Act.

- 12.2 All the provisions of this code relating to meetings of the council, so far as they are applicable, extend to and govern the proceedings of the council when in committee of the whole, except the provisions limiting the number and duration of speeches.

Note: Clauses 10.20–10.30 limit the number and duration of speeches.

- 12.3 The general manager or, in the absence of the general manager, an employee of the council designated by the general manager, is responsible for reporting to the council the proceedings of the committee of the whole. It is not necessary to report the proceedings in full, but any recommendations of the committee must be reported.
- 12.4 The council must ensure that a report of the proceedings (including any recommendations of the committee) is recorded in the council's minutes. However, the council is not taken to have adopted the report until a motion for adoption has been made and passed.

13 DEALING WITH ITEMS BY EXCEPTION

- 13.1 The council or a committee of council may, at any time, resolve to adopt multiple items of business on the agenda together by way of a single resolution.
- 13.2 Before the council or committee resolves to adopt multiple items of business on the agenda together under clause 13.1, the chairperson must list the items of business to be adopted and ask councillors to identify any individual items of business listed by the chairperson that they intend to vote against the recommendation made in the business paper or that they wish to speak on.
- 13.3 The council or committee must not resolve to adopt any item of business under clause 13.1 that a councillor has identified as being one they intend to vote against the recommendation made in the business paper or to speak on.
- 13.4 Where the consideration of multiple items of business together under clause 13.1 involves a variation to the order of business for the meeting, the council or committee must resolve to alter the order of business in accordance with clause 8.3.
- 13.5 A motion to adopt multiple items of business together under clause 13.1 must identify each of the items of business to be adopted and state that they are to be adopted as recommended in the business paper.
- 13.6 Items of business adopted under clause 13.1 are to be taken to have been adopted unanimously.
- 13.7 Councillors must ensure that they declare and manage any conflicts of interest they may have in relation to items of business considered together under clause 13.1 in accordance with the requirements of the council's code of conduct.

14 CLOSURE OF COUNCIL MEETINGS TO THE PUBLIC

Grounds on which meetings can be closed to the public

- 14.1 The council or a committee of the council may close to the public so much of its meeting as comprises the discussion or the receipt of any of the following types of matters:
- (a) personnel matters concerning particular individuals (other than

- councillors),
- (b) the personal hardship of any resident or ratepayer,
- (c) information that would, if disclosed, confer a commercial advantage on a person with whom the council is conducting (or proposes to conduct) business,
- (d) commercial information of a confidential nature that would, if disclosed:
 - (i) prejudice the commercial position of the person who supplied it, or
 - (ii) confer a commercial advantage on a competitor of the council, or
 - (iii) reveal a trade secret,
- (e) information that would, if disclosed, prejudice the maintenance of law,
- (f) matters affecting the security of the council, councillors, council staff or council property,
- (g) advice concerning litigation, or advice that would otherwise be privileged from production in legal proceedings on the ground of legal professional privilege,
- (h) information concerning the nature and location of a place or an item of Aboriginal significance on community land,
- (i) alleged contraventions of the council's code of conduct.

Note: Clause 14.1 reflects section 10A(1) and (2) of the Act.

- 14.2 The council or a committee of the council may also close to the public so much of its meeting as comprises a motion to close another part of the meeting to the public.

Note: Clause 14.2 reflects section 10A(3) of the Act.

Matters to be considered when closing meetings to the public

- 14.3 A meeting is not to remain closed during the discussion of anything referred to in clause 14.1:
- (a) except for so much of the discussion as is necessary to preserve the relevant confidentiality, privilege or security, and
 - (b) if the matter concerned is a matter other than a personnel matter concerning particular individuals, the personal hardship of a resident or ratepayer or a trade secret – unless the council or committee concerned is satisfied that discussion of the matter in an open meeting would, on balance, be contrary to the public interest.

Note: Clause 14.3 reflects section 10B(1) of the Act.

- 14.4 A meeting is not to be closed during the receipt and consideration of information or advice referred to in clause 14.1(g) unless the advice concerns legal matters that:
- (a) are substantial issues relating to a matter in which the council or committee is involved, and
 - (b) are clearly identified in the advice, and
 - (c) are fully discussed in that advice.

Note: Clause 14.4 reflects section 10B(2) of the Act.

- 14.5 If a meeting is closed during the discussion of a motion to close another part of the meeting to the public (as referred to in clause 14.2), the consideration of the motion must not include any consideration of the matter or information to be discussed in that other part of the meeting other than consideration of whether the matter concerned is a matter referred to in clause 14.1.

Note: Clause 14.5 reflects section 10B(3) of the Act.

- 14.6 For the purpose of determining whether the discussion of a matter in an open meeting would be contrary to the public interest, it is irrelevant that:
- (a) a person may misinterpret or misunderstand the discussion, or
 - (b) the discussion of the matter may:
 - (i) cause embarrassment to the council or committee concerned, or to councillors or to employees of the council, or
 - (ii) cause a loss of confidence in the council or committee.

Note: Clause 14.6 reflects section 10B(4) of the Act.

- 14.7 In deciding whether part of a meeting is to be closed to the public, the council or committee concerned must consider any relevant guidelines issued by the Departmental Chief Executive of the Office of Local Government.

Note: Clause 14.7 reflects section 10B(5) of the Act.

Notice of likelihood of closure not required in urgent cases

- 14.8 Part of a meeting of the council, or of a committee of the council, may be closed to the public while the council or committee considers a matter that has not been identified in the agenda for the meeting under clause 3.21 as a matter that is likely to be considered when the meeting is closed, but only if:
- (a) it becomes apparent during the discussion of a particular matter that the matter is a matter referred to in clause 14.1, and
 - (b) the council or committee, after considering any representations made under clause 14.9, resolves that further discussion of the matter:
 - (i) should not be deferred (because of the urgency of the matter), and
 - (ii) should take place in a part of the meeting that is closed to the public.

Note: Clause 14.8 reflects section 10C of the Act.

Representations by members of the public

- 14.9 The council, or a committee of the council, may allow members of the public to make representations to or at a meeting, before any part of the meeting is closed to the public, as to whether that part of the meeting should be closed.

Note: Clause 14.9 reflects section 10A(4) of the Act.

- 14.10 A representation under clause 14.9 is to be made after the motion to close the part of the meeting is moved and seconded.

- 14.11 Where the matter has been identified in the agenda of the meeting under clause 3.21 as a matter that is likely to be considered when the meeting is closed to the public, in order to make representations under clause 14.9, members of the public must first make an application to the council in the approved form. Applications must be received by **Noon on the working day** before the meeting at which the matter is to be considered.
- 14.12 The general manager (or their delegate) may refuse an application made under clause 14.11. The general manager or their delegate must give reasons in writing for a decision to refuse an application.
- 14.13 No more than **3** speakers are to be permitted to make representations under clause 14.9.
- 14.14 If more than the permitted number of speakers apply to make representations under clause 14.9, the general manager or their delegate may request the speakers to nominate from among themselves the persons who are to make representations to the council. If the speakers are not able to agree on whom to nominate to make representations under clause 14.9, the general manager or their delegate is to determine who will make representations to the council.
- 14.15 The general manager (or their delegate) is to determine the order of speakers.
- 14.16 Where the council or a committee of the council proposes to close a meeting or part of a meeting to the public in circumstances where the matter has not been identified in the agenda for the meeting under clause 3.21 as a matter that is likely to be considered when the meeting is closed to the public, the chairperson is to invite representations from the public under clause 14.9 after the motion to close the part of the meeting is moved and seconded. The chairperson is to permit no more than **three (3) speakers** to make representations in such order as determined by the chairperson.
- 14.17 Each speaker will be allowed **three (3) minutes** to make representations, and this time limit is to be strictly enforced by the chairperson. Speakers must confine their representations to whether the meeting should be closed to the public. If a speaker digresses to irrelevant matters, the chairperson is to direct the speaker not to do so. If a speaker fails to observe a direction from the chairperson, the speaker will not be further heard.

Expulsion of non-councillors from meetings closed to the public

- 14.18 If a meeting or part of a meeting of the council or a committee of the council is closed to the public in accordance with section 10A of the Act and this code, any person who is not a councillor and who fails to leave the meeting when requested, may be expelled from the meeting as provided by section 10(2)(a) or (b) of the Act.
- 14.19 If any such person, after being notified of a resolution or direction expelling them from the meeting, fails to leave the place where the meeting is being held, a police officer, or any person authorised for the purpose by the council or person presiding, may, by using only such force as is necessary, remove the first-mentioned person from that place and, if necessary restrain that person from re-entering that place for the remainder of the meeting.

Obligations of councillors attending meetings by audio-visual link

- 14.20 Councillors attending a meeting by audio-visual link must ensure that no other person is within sight or hearing of the meeting at any time that the meeting is closed to the public under section 10A of the Act.

Information to be disclosed in resolutions closing meetings to the public

- 14.21 The grounds on which part of a meeting is closed must be stated in the decision to close that part of the meeting and must be recorded in the minutes of the meeting. The grounds must specify the following:
- (a) the relevant provision of section 10A(2) of the Act,
 - (b) the matter that is to be discussed during the closed part of the meeting,
 - (c) the reasons why the part of the meeting is being closed, including (if the matter concerned is a matter other than a personnel matter concerning particular individuals, the personal hardship of a resident or ratepayer or a trade secret) an explanation of the way in which discussion of the matter in an open meeting would be, on balance, contrary to the public interest.

Note: Clause 14.21 reflects section 10D of the Act.

Resolutions passed at closed meetings to be made public

- 14.22 If the council passes a resolution during a meeting, or a part of a meeting, that is closed to the public, the chairperson must make the resolution public as soon as practicable after the meeting, or the relevant part of the meeting, has ended, and the resolution must be recorded in the publicly available minutes of the meeting.
- 14.23 Resolutions passed during a meeting, or a part of a meeting, that is closed to the public must be made public by the chairperson under clause 14.22 during a part of the meeting that is webcast.

15 KEEPING ORDER AT MEETINGS

Points of order

- 15.1 A councillor may draw the attention of the chairperson to an alleged breach of this code by raising a point of order. A point of order does not require a seconder.
- 15.2 A point of order cannot be made with respect to adherence to the principles contained in clause 2.1.
- 15.3 A point of order must be taken immediately it is raised. The chairperson must suspend the business before the meeting and permit the councillor raising the point of order to state the provision of this code they believe has been breached. The chairperson must then rule on the point of order – either by upholding it or by overruling it.

Questions of order

- 15.4 The chairperson, without the intervention of any other councillor, may call any councillor to order whenever, in the opinion of the chairperson, it is necessary to do so.
- 15.5 A councillor who claims that another councillor has committed an act of disorder, or is out of order, may call the attention of the chairperson to the matter.
- 15.6 The chairperson must rule on a question of order immediately after it is raised but, before doing so, may invite the opinion of the council.
- 15.7 The chairperson's ruling must be obeyed unless a motion dissenting from the ruling is passed.

Motions of dissent

- 15.8 A councillor can, without notice, move to dissent from a ruling of the chairperson on a point of order or a question of order. If that happens, the chairperson must suspend the business before the meeting until a decision is made on the motion of dissent.
- 15.9 If a motion of dissent is passed, the chairperson must proceed with the suspended business as though the ruling dissented from had not been given. If, as a result of the ruling, any motion or business has been rejected as out of order, the chairperson must restore the motion or business to the agenda and proceed with it in due course.
- 15.10 Despite any other provision of this code, only the mover of a motion of dissent and the chairperson can speak to the motion before it is put. The mover of the motion does not have a right of general reply.

Acts of disorder

- 15.11 A councillor commits an act of disorder if the councillor, at a meeting of the council or a committee of the council:
- (a) contravenes the Act, the Regulation or this code, or
 - (b) assaults or threatens to assault another councillor or person present at the meeting, or
 - (c) moves or attempts to move a motion or an amendment that has an unlawful purpose or that deals with a matter that is outside the jurisdiction of the council or the committee, or addresses or attempts to address the council or the committee on such a motion, amendment or matter, or
 - (d) insults, makes unfavourable personal remarks about, or imputes improper motives to any other council official, or alleges a breach of the council's code of conduct, or
 - (e) says or does anything that is inconsistent with maintaining order at the meeting or is likely to bring the council or the committee into disrepute.

Note: Clause 15.11 reflects *Local Government (General) Regulation 2021 (NSW)* reg 182.

15.12 The chairperson may require a councillor:

- (a) to apologise without reservation for an act of disorder referred to in clauses 15.11(a), (b), or (e), or
- (b) to withdraw a motion or an amendment referred to in clause 15.11(c) and, where appropriate, to apologise without reservation, or
- (c) to retract and apologise without reservation for any statement that constitutes an act of disorder referred to in clauses 15.11(d) and (e).

Note: Clause 15.12 reflects *Local Government (General) Regulation 2021 (NSW)* reg 233.

How disorder at a meeting may be dealt with

15.13 If disorder occurs at a meeting of the council, the chairperson may adjourn the meeting for a period of not more than fifteen (15) minutes and leave the chair. The council, on reassembling, must, on a question put from the chairperson, decide without debate whether the business is to be proceeded with or not. This clause applies to disorder arising from the conduct of members of the public as well as disorder arising from the conduct of councillors.

Expulsion from meetings

15.14 [Deleted]

15.15 All chairpersons of meetings of the council and committees of the council are authorised under this code to expel any person other than a councillor, from a council or committee meeting, for the purposes of section 10(2)(b) of the Act. Councillors may only be expelled by resolution of the council or the committee of the council.

15.16 Clause 15.15, does not limit the ability of the council or a committee of the council to resolve to expel a person, including a councillor, from a council or committee meeting, under section 10(2)(a) of the Act.

15.17 A councillor may, as provided by section 10(2)(a) or (b) of the Act, be expelled from a meeting of the council for having failed to comply with a requirement under clause 15.12. The expulsion of a councillor from the meeting for that reason does not prevent any other action from being taken against the councillor for the act of disorder concerned.

Note: Clause 15.17 reflects *Local Government (General) Regulation 2021 (NSW)* reg 233(2).

15.18 A member of the public may, as provided by section 10(2)(a) or (b) of the Act, be expelled from a meeting of the council for engaging in or having engaged in disorderly conduct at the meeting.

15.19 Where a councillor or a member of the public is expelled from a meeting, the expulsion and the name of the person expelled, if known, are to be recorded in the minutes of the meeting.

- 15.20 If a councillor or a member of the public fails to leave the place where a meeting of the council is being held immediately after they have been expelled, a police officer, or any person authorised for the purpose by the council or person presiding, may, by using only such force as is necessary, remove the councillor or member of the public from that place and, if necessary, restrain the councillor or member of the public from re-entering that place for the remainder of the meeting.

How disorder by councillors attending meetings by audio-visual link may be dealt with

- 15.21 Where a councillor is attending a meeting by audio-visual link, the chairperson or a person authorised by the chairperson may mute the councillor's audio link and/or turn off the councillor's video link to the meeting for the purposes of enforcing compliance with this code.

- 15.22 If a councillor attending a meeting by audio-visual link is expelled from a meeting for an act of disorder, the chairperson of the meeting or a person authorised by the chairperson, may terminate the councillor's audio-visual link to the meeting.

Use of mobile phones and the unauthorised recording of meetings

- 15.23 Councillors, council staff and members of the public must ensure that mobile phones are turned to silent during meetings of the council and committees of the council.
- 15.24 A person must not live stream or use an audio recorder, video camera, mobile phone or any other device to make a recording of the proceedings of a meeting of the council or a committee of the council without the prior authorisation of the council or the committee.
- 15.25 Without limiting clause 15.18, a contravention of clause 15.24 or an attempt to contravene that clause, constitutes disorderly conduct for the purposes of clause 15.18. Any person who contravenes or attempts to contravene clause 15.24, may be expelled from the meeting as provided for under section 10(2) of the Act.
- 15.26 If any such person, after being notified of a resolution or direction expelling them from the meeting, fails to leave the place where the meeting is being held, a police officer, or any person authorised for the purpose by the council or person presiding, may, by using only such force as is necessary, remove the first-mentioned person from that place and, if necessary, restrain that person from re-entering that place for the remainder of the meeting.

16 CONFLICTS OF INTEREST

- 16.1 All councillors and, where applicable, all other persons, must declare and manage any conflicts of interest they may have in matters being considered at meetings of the council and committees of the council in accordance with the council's code of conduct. All declarations of conflicts of interest and how the conflict of interest was managed by the person who made the declaration must be recorded in the minutes of the meeting at which the declaration was made.

- 16.2 Councillors attending a meeting by audio-visual link must declare and manage any conflicts of interest they may have in matters being considered at the meeting in accordance with the council's code of conduct. Where a councillor has declared a pecuniary or significant non-pecuniary conflict of interest in a matter being discussed at the meeting, the councillor's audio-visual link to the meeting must be suspended or terminated and the councillor must not be in sight or hearing of the meeting at any time during which the matter is being considered or discussed by the council or committee, or at any time during which the council or committee is voting on the matter.

17 DECISIONS OF THE COUNCIL

Council decisions

- 17.1 A decision supported by a majority of the votes at a meeting of the council at which a quorum is present is a decision of the council.

Note: Clause 17.1 reflects section 371 of the Act in the case of councils and section 400T(8) in the case of joint organisations.

- 17.2 Decisions made by the council must be accurately recorded in the minutes of the meeting at which the decision is made.

Rescinding or altering council decisions

- 17.3 A resolution passed by the council may not be altered or rescinded except by a motion to that effect of which notice has been given under clause 3.10.

Note: Clause 17.3 reflects section 372(1) of the Act.

- 17.4 If a notice of motion to rescind a resolution is given at the meeting at which the resolution is carried, the resolution must not be carried into effect until the motion of rescission has been dealt with.

Note: Clause 17.4 reflects section 372(2) of the Act.

- 17.5 If a motion has been lost, a motion having the same effect must not be considered unless notice of it has been duly given in accordance with clause 3.10.

Note: Clause 17.5 reflects section 372(3) of the Act.

- 17.6 A notice of motion to alter or rescind a resolution, and a notice of motion which has the same effect as a motion which has been lost, must be signed by three (3) councillors if less than three (3) months has elapsed since the resolution was passed, or the motion was lost.

Note: Clause 17.6 reflects section 372(4) of the Act.

- 17.7 If a motion to alter or rescind a resolution has been lost, or if a motion which has the same effect as a previously lost motion is lost, no similar motion may be brought forward within three (3) months of the meeting at which it was lost. This clause may not be evaded by substituting a motion differently worded, but

in principle the same.

Note: Clause 17.7 reflects section 372(5) of the Act.

- 17.8 The provisions of clauses 17.5–17.7 concerning lost motions do not apply to motions of adjournment.

Note: Clause 17.8 reflects section 372(7) of the Act.

- 17.9 A notice of motion submitted in accordance with clause 17.6 may only be withdrawn under clause 3.11 with the consent of all signatories to the notice of motion.

- 17.10 A notice of motion to alter or rescind a resolution relating to a development application must be submitted to the general manager no later than **by 5:00pm two (2) working days** after the meeting at which the resolution was adopted.

- 17.11 A motion to alter or rescind a resolution of the council may be moved on the report of a committee of the council and any such report must be recorded in the minutes of the meeting of the council.

Note: Clause 17.11 reflects section 372(6) of the Act.

- 17.12 Subject to clause 17.7, in cases of urgency, a motion to alter or rescind a resolution of the council may be moved at the same meeting at which the resolution was adopted, where:

- (a) a notice of motion signed by three councillors is submitted to the chairperson, and
- (b) a motion to have the motion considered at the meeting is passed, and
- (c) the chairperson rules the business that is the subject of the motion is of great urgency on the grounds that it requires a decision by the council before the next scheduled ordinary meeting of the council.

- 17.13 A motion moved under clause 17.12(b) can be moved without notice. Despite clauses 10.20–10.30, only the mover of a motion referred to in clause 17.12(b) can speak to the motion before it is put.

- 17.14 A motion of dissent cannot be moved against a ruling by the chairperson under clause 17.12(c).

Recommitting resolutions to correct an error

- 17.15 Despite the provisions of this Part, a councillor may, with the leave of the chairperson, move to recommit a resolution adopted at the same meeting:

- (a) to correct any error, ambiguity, or imprecision in the council's resolution, or
- (b) to confirm the voting on the resolution.

- 17.16 In seeking the leave of the chairperson to move to recommit a resolution for the purposes of clause 17.15(a), the councillor is to propose alternative wording for the resolution.

- 17.17 The chairperson must not grant leave to recommit a resolution for the purposes of clause 17.15(a), unless they are satisfied that the proposed alternative wording of the resolution would not alter the substance of the resolution previously adopted at the meeting.
- 17.18 A motion moved under clause 17.15 can be moved without notice. Despite clauses 10.20–10.30, only the mover of a motion referred to in clause 17.15 can speak to the motion before it is put.
- 17.19 A motion of dissent cannot be moved against a ruling by the chairperson under clause 17.15.
- 17.20 A motion moved under clause 17.15 with the leave of the chairperson cannot be voted on unless or until it has been seconded.

18 TIME LIMITS ON COUNCIL MEETINGS

- 18.1 Meetings of the council and committees of the council are to conclude no later than **six hours after the meeting commenced (including breaks)**.
- 18.2 If the business of the meeting is unfinished at the time referred to above, the council or the committee may, by resolution, extend the time of the meeting.
- 18.3 If the business of the meeting is unfinished at the time referred to above, and the council does not resolve to extend the meeting, the chairperson must either:
- (a) defer consideration of the remaining items of business on the agenda to the next ordinary meeting of the council, or
 - (b) adjourn the meeting to a time, date and place fixed by the chairperson.
- 18.4 Clause 18.3 does not limit the ability of the council or a committee of the council to resolve to adjourn a meeting at any time. The resolution adjourning the meeting must fix the time, date and place that the meeting is to be adjourned to.
- 18.5 Where a meeting is adjourned under clause 18.3 or 18.4, the general manager must:
- (a) individually notify each councillor of the time, date and place at which the meeting will reconvene, and
 - (b) publish the time, date and place at which the meeting will reconvene on the council's website and in such other manner that the general manager is satisfied is likely to bring notice of the time, date and place of the reconvened meeting to the attention of as many people as possible.

19 AFTER THE MEETING

Minutes of meetings

- 19.1 The council is to keep full and accurate minutes of the proceedings of meetings of the council.

Note: Clause 19.1 reflects section 375(1) of the Act.

- 19.2 At a minimum, the general manager must ensure that the following matters are recorded in the council's minutes:

- (a) the names of councillors attending a council meeting and whether they attended the meeting in person or by audio-visual link,
- (b) details of each motion moved at a council meeting and of any amendments moved to it,
- (c) the names of the mover and seconder of the motion or amendment,
- (d) whether the motion or amendment was passed or lost, and
- (e) such other matters specifically required under this code.

- 19.3 The minutes of a council meeting must be confirmed at a subsequent meeting of the council.

Note: Clause 19.3 reflects section 375(2) of the Act.

- 19.4 Any debate on the confirmation of the minutes is to be confined to whether the minutes are a full and accurate record of the meeting they relate to.

- 19.5 When the minutes have been confirmed, they are to be signed by the person presiding at the subsequent meeting.

Note: Clause 19.5 reflects section 375(2) of the Act.

- 19.6 The confirmed minutes of a meeting may be amended to correct typographical or administrative errors after they have been confirmed. Any amendment made under this clause must not alter the substance of any decision made at the meeting.

- 19.7 The confirmed minutes of a council meeting must be published on the council's website. This clause does not prevent the council from also publishing unconfirmed minutes of its meetings on its website prior to their confirmation.

Access to correspondence and reports laid on the table at, or submitted to, a meeting

- 19.8 The council and committees of the council must, during or at the close of a meeting, or during the business day following the meeting, give reasonable access to any person to inspect correspondence and reports laid on the table at, or submitted to, the meeting.

Note: Clause 19.8 reflects section 11(1) of the Act.

- 19.9 Clause 19.8 does not apply if the correspondence or reports relate to a matter that was received or discussed or laid on the table at, or submitted to, the meeting when the meeting was closed to the public.

Note: Clause 19.9 reflects section 11(2) of the Act.

- 19.10 Clause 19.8 does not apply if the council or the committee resolves at the meeting, when open to the public, that the correspondence or reports are to

be treated as confidential because they relate to a matter specified in section 10A(2) of the Act.

Note: Clause 19.10 reflects section 11(3) of the Act.

- 19.11 Correspondence or reports to which clauses 19.9 and 19.10 apply are to be marked with the relevant provision of section 10A(2) of the Act that applies to the correspondence or report.

Implementation of decisions of the council

- 19.12 The general manager is to implement, without undue delay, lawful decisions of the council.

Note: Clause 19.12 reflects section 335(b) of the Act.

20 COUNCIL COMMITTEES

Application of this Part

- 20.1 This Part only applies to committees of the council whose members are all councillors.

Council committees whose members are all councillors

- 20.2 The council may, by resolution, establish such committees as it considers necessary.
- 20.3 A committee of the council is to consist of the mayor and such other councillors as are elected by the councillors or appointed by the council.
- 20.4 The quorum for a meeting of a committee of the council is to be:
- (a) such number of members as the council decides, or
 - (b) if the council has not decided a number – a majority of the members of the committee.

Functions of committees

- 20.5 The council must specify the functions of each of its committees when the committee is established but may from time to time amend those functions.

Notice of committee meetings

- 20.6 The general manager must send to each councillor, regardless of whether they are a committee member, at least three (3) days before each meeting of the committee, a notice specifying:
- (a) the time, date and place of the meeting, and
 - (b) the business proposed to be considered at the meeting.
- 20.7 Notice of less than three (3) days may be given of a committee meeting called in an emergency.

Attendance at committee meetings

- 20.8 A committee member (other than the mayor) ceases to be a member of a committee if the committee member:
- (a) has been absent from three (3) consecutive meetings of the committee without having given reasons acceptable to the committee for the member's absences, or
 - (b) has been absent from at least half of the meetings of the committee held during the immediately preceding year without having given to the committee acceptable reasons for the member's absences.
- 20.9 Clause 20.8 does not apply if all of the members of the council are members of the committee.

Non-members entitled to attend committee meetings

- 20.10 A councillor who is not a member of a committee of the council is entitled to attend, and to speak at a meeting of the committee. However, the councillor is not entitled:
- (a) to give notice of business for inclusion in the agenda for the meeting, or
 - (b) to move or second a motion at the meeting, or
 - (c) to vote at the meeting.

Chairperson and deputy chairperson of council committees

- 20.11 The chairperson of each committee of the council must be:
- (a) the mayor, or
 - (b) if the mayor does not wish to be the chairperson of a committee, a member of the committee elected by the council, or
 - (c) if the council does not elect such a member, a member of the committee elected by the committee.
- 20.12 The council may elect a member of a committee of the council as deputy chairperson of the committee. If the council does not elect a deputy chairperson of such a committee, the committee may elect a deputy chairperson.
- 20.13 If neither the chairperson nor the deputy chairperson of a committee of the council is able or willing to preside at a meeting of the committee, the committee must elect a member of the committee to be acting chairperson of the committee.
- 20.14 The chairperson is to preside at a meeting of a committee of the council. If the chairperson is unable or unwilling to preside, the deputy chairperson (if any) is to preside at the meeting, but if neither the chairperson nor the deputy chairperson is able or willing to preside, the acting chairperson is to preside at the meeting.

Procedure in committee meetings

- 20.15 Subject to any specific requirements of this code, each committee of the council may regulate its own procedure. The provisions of this code are to be taken to apply to all committees of the council unless the council or the committee determines otherwise in accordance with this clause.
- 20.16 Whenever the voting on a motion put to a meeting of the committee is equal, the chairperson of the committee is to have a casting vote as well as an original vote unless the council or the committee determines otherwise in accordance with clause 20.15.
- 20.18 Voting at a council committee meeting is to be by open means (such as on the voices, by show of hands or by a visible electronic voting system).

Closure of committee meetings to the public

- 20.19 The provisions of the Act and Part 14 of this code apply to the closure of meetings of committees of the council to the public in the same way they apply to the closure of meetings of the council to the public.
- 20.20 If a committee of the council passes a resolution, or makes a recommendation, during a meeting, or a part of a meeting that is closed to the public, the chairperson must make the resolution or recommendation public as soon as practicable after the meeting or part of the meeting has ended, and report the resolution or recommendation to the next meeting of the council. The resolution or recommendation must also be recorded in the publicly available minutes of the meeting.
- 20.21 Resolutions passed during a meeting, or a part of a meeting that is closed to the public must be made public by the chairperson under clause 20.20 during a part of the meeting that is webcast.

Disorder in committee meetings

- 20.22 The provisions of the Act and this code relating to the maintenance of order in council meetings apply to meetings of committees of the council in the same way as they apply to meetings of the council.

Minutes of council committee meetings

- 20.23 Each committee of the council is to keep full and accurate minutes of the proceedings of its meetings. At a minimum, a committee must ensure that the following matters are recorded in the committee's minutes:
- (a) the names of councillors attending a meeting and whether they attended the meeting in person or by audio-visual link,
 - (b) details of each motion moved at a meeting and of any amendments moved to it,
 - (c) the names of the mover and seconder of the motion or amendment,
 - (d) whether the motion or amendment was passed or lost, and
 - (e) such other matters specifically required under this code.

- 20.24 All voting at meetings of committees of the council (including meetings that are closed to the public), must be recorded in the minutes of meetings with the names of councillors who voted for and against each motion or amendment, (including the use of the casting vote), being recorded.
- 20.25 The minutes of meetings of each committee of the council must be confirmed at a subsequent meeting of the committee.
- 20.26 Any debate on the confirmation of the minutes is to be confined to whether the minutes are a full and accurate record of the meeting they relate to.
- 20.27 When the minutes have been confirmed, they are to be signed by the person presiding at that subsequent meeting.
- 20.28 The confirmed minutes of a meeting may be amended to correct typographical or administrative errors after they have been confirmed. Any amendment made under this clause must not alter the substance of any decision made at the meeting.
- 20.29 The confirmed minutes of a meeting of a committee of the council must be published on the council's website. This clause does not prevent the council from also publishing unconfirmed minutes of meetings of committees of the council on its website prior to their confirmation.

21 IRREGULARITIES

- 21.1 Proceedings at a meeting of a council or a council committee are not invalidated because of:
- (a) a vacancy in a civic office, or
 - (b) a failure to give notice of the meeting to any councillor or committee member, or
 - (c) any defect in the election or appointment of a councillor or committee member, or
 - (d) a failure of a councillor or a committee member to declare a conflict of interest, or to refrain from the consideration or discussion of, or vote on, the relevant matter, at a council or committee meeting in accordance with the council's code of conduct, or
 - (e) a failure to comply with this code.

Note: Clause 21.1 reflects section 374 of the Act.

22 DEFINITIONS

| | |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| the Act | means the <i>Local Government Act 1993</i> |
| act of disorder | means an act of disorder as defined in clause 15.11 of this code |
| amendment | in relation to an original motion, means a motion moving an amendment to that motion |
| audio recorder | any device capable of recording speech |
| audio-visual link | means a facility that enables audio and visual communication between persons at different places |
| business day | means any day except Saturday or Sunday or any other day the whole or part of which is observed as a public holiday throughout New South Wales |
| chairperson | in relation to a meeting of the council – means the person presiding at the meeting as provided by section 369 of the Act and clauses 6.1 and 6.2 of this code, and in relation to a meeting of a committee – means the person presiding at the meeting as provided by clause 20.11 of this code |
| this code | means the council's adopted code of meeting practice |
| committee of the council | means a committee established by the council in accordance with clause 20.2 of this code (being a committee consisting only of councillors) or the council when it has resolved itself into committee of the whole under clause 12.1 |
| council official | has the same meaning it has in the Model Code of Conduct for Local Councils in NSW |
| day | means calendar day |
| division | means a request by two councillors under clause 11.7 of this code requiring the recording of the names of the councillors who voted both for and against a motion |
| foreshadowed amendment | means a proposed amendment foreshadowed by a councillor under clause 10.18 of this code during debate on the first amendment |
| foreshadowed motion | means a motion foreshadowed by a councillor under clause 10.17 of this code during debate on an original motion |
| open voting | means voting on the voices or by a show of hands or by a visible electronic voting system or similar means |
| planning decision | means a decision made in the exercise of a function of a council under the <i>Environmental Planning and Assessment Act 1979</i> including any decision relating to a development application, an environmental planning instrument, a development control plan or a development contribution plan under that Act, but not including |

| | |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| | the making of an order under Division 9.3 of Part 9 of that Act |
| performance improvement order | means an order issued under section 438A of the Act |
| quorum | means the minimum number of councillors or committee members necessary to conduct a meeting |
| the Regulation | means the <i>Local Government (General) Regulation 2021</i> |
| webcast | a video or audio broadcast of a meeting transmitted across the internet either concurrently with the meeting or at a later time |
| year | means the period beginning 1 July and ending the following 30 June |

23 APPENDIX A - The Role of Chairperson

1. The Chairperson shall insist upon the proper conduct of debate.
2. The Chairperson should be impartial and consistent in rulings on all occasions regardless of their personal views and beliefs on the subject being discussed whether they have made their view known.
3. The Chairperson shall receive and put to the meeting any lawful motion which is brought before the meeting.
4. The Chairperson should not permit discussion unless there is a motion before the meeting.
5. The Chairperson must rule out of order any motion or amendment to a motion that does not relate to the business before Council and any motion or amendment to a motion that is unlawful or the implementation of which would be unlawful.
6. Before ruling out of order a motion or an amendment to a motion, the Chairperson is to give the mover an opportunity to clarify or amend the motion or amendment.
7. Any motion, amendment, or other matter that the Chairperson has ruled out of order is taken to have been lost.
8. The Chairperson shall have no power to adjourn the meeting of his or her own accord except, but not limiting the provisions of the Act or the Regulation, the Chair can adjourn when the meeting lacks a quorum and when disorder arises.
9. The Chairperson shall preserve order and endeavour to prevent interference with speakers by private talk or heckling remarks, offensive statements, and the imputation of improper motives.
10. In the event of such occurrences, the Chairperson may call upon speakers to withdraw and apologise.
11. The Chairperson of Council Meetings or Committees of Council whose members are all Councillors shall have the right to exercise a casting vote

24 APPENDIX B - Motions, Amendments and Foreshadowed Motions

Motions

1. A motion is a proposal, moved by one Councillor and seconded by another calling for a specific action to be taken or a decision to be made on the particular matter before the Council or Committee of Council.
2. If that motion is passed it becomes a resolution of the Council or the Committee of Council (within the Committee's delegation).
3. The mover of a motion may be given the opportunity to explain the motion before a seconder is called for, if considered necessary by the Chairperson.
4. Once a motion is moved and seconded the meeting can then try and reach a decision by considering the specific proposal with speakers supporting it, opposing it, or suggesting changes to it.
5. If there is no objection to a motion before Council or Committee of Council, there shall be no right of reply, and the Chair shall put the motion.
6. Where there is a motion and an amendment, following debate on the amendment and then the motion, the mover of the motion has a right of reply prior to voting on the amendment taking place.
7. A motion should be very specific in its intention, must be lawful and capable of being implemented.
8. If possible, a motion should be qualified by referring to a timetable, financial implications, person required to take the necessary action, etc.
9. The motion should be simple and easy to understand so that there is no doubt about its meaning - it should be well structured and if it involves a number of different aspects then there should be different parts to the motion.
10. A Councillor seconding the motion is in effect stating, "I support this proposal." If no person present is prepared to second the motion it then lapses and should not be discussed further.
11. When a motion is complex in its wording and intent, to assist other Councillors of the Council/Committee of Council, a Councillor shall submit the motion in writing so that it can be circulated to all members present and the minute taker either electronically or in hard copy format. This will allow the motion/amendment to be displayed accurately on the visual screens at the time that the motion or amendment is being discussed. This will remove any doubt in the minds of Councillors as to what exactly is being moved. Likewise, the Chairperson should ensure that any motion/amendment is clearly understood by all Councillors present prior to voting.
12. A motion should start with the word "THAT", for example "THAT the road be closed."

13. Motions should be written in a positive sense so that a “yes” vote indicates support for the action, and a “no” vote indicates that no action should be taken.
14. The mover of the motion has the right to speak first, and a general “right of reply” at the end of the debate. No new information or material should be argued during the “right of reply.”
15. The seconder of the motion speaks after the mover, but may choose to hold over their speaking rights until later in the debate.
16. At the end of the debate, the Chairperson puts the motion to the meeting for voting by Councillors.

Amendments

1. An Amendment to a motion requires a mover and a seconder to put it forward.
2. An amendment must be lawful and capable of being implemented.
3. The Amendment must be dealt with before voting on the main motion. Debate is allowed only in relation to the amendment and not the main motion – which is suspended while the amendment is considered.
4. If the Amendment is passed, it becomes the motion and this new motion can be debated. If the Amendment is not supported, the main motion stays in its original form.
5. There should only be one Amendment to a Motion before Council at any time. If several amendments are proposed, each should be moved, seconded, debated and voted upon before the next.
6. Amendments may be in the form of additional words to a motion and/or the removal of words. Any such Amendment to a Motion must not alter the Motion to the extent that it effectively reverses the Motion. In any case an Amendment to a Motion will need to be made with the concurrence of the mover and seconder of the Motion.

Foreshadowed Motions/Amendments

1. It is possible to advise the Council of an intention of a foreshadowed Motion/Amendment that relates to the business currently before Council.
2. The Chairperson cannot accept the foreshadowed Motion/Amendment until the current Motion/Amendment has been determined.

25 APPENDIX C – Calling a Point of Order

1. A Point of Order may be called in the following circumstances:
 - (a) A matter is raised that does not relate to the subject being discussed.
 - (b) There is no quorum present in the Council Chamber.
 - (c) There has been a failure to comply with some rule, regulation, standing order, policy, or accepted rules of debate.
 - (d) A Councillor has used objectionable, insulting, offensive, abusive language or defamatory insinuations about a person's motives or conduct.
 - (e) A speaker has exceeded the time limit for speeches.
 - (f) An amendment under discussion has not been seconded.
 - (g) A matter is raised which is outside the powers of the Council.
2. The Chairperson may rule a Councillor out-of-order in two (2) ways - generally upon a ruling being given by the Chairperson after another Councillor has made a point of order, or by the Chairperson on his or her own initiative making the ruling.
3. When a Councillor raises a point of order, the person speaking must stop and resume his/her seat until the point has been dealt with. The Councillor who raises the point of order shall where possible refer to the specific section of the Code of Meeting Practice. For example: "Under section 8.4 of the Code of Meeting Practice...."
4. No other Councillor may speak on the Point of Order.
5. The Chairperson will then rule on the Point of Order, either by agreeing that the speaker is out of-order or disagreeing and allowing the speaker to continue.
6. If there is an objection to the Chairperson's ruling, a Councillor may move a Motion of Dissent.
7. A Point of Order must not be taken for the purpose of contradicting statements made by another Councillor or providing a personal explanation. It must only be concerned with the conduct of the meeting. An explanation or contradiction is not a Point of Order.

26 APPENDIX D – Practice for Written Submissions from the Public

Written submissions from the Public at Meetings Guidelines

Aim:- To assist the decision-making process, Council has provided the opportunity to members of the public to submit written submissions to Council.

General Information: Written submissions can be completed and submitted online via Council's website. Members of the public are required to register their written submission by midday on the Friday prior to the meeting. All written submissions will be distributed to Councillors after the midday deadline on the Friday prior to the meeting.

Please note that there will be no opportunity for speakers to address Council or Committee of Council meetings in person, written submissions only will be accepted.
Privacy

Note: Please be aware that:-

1. Council and Committee of Council meetings are webcast; and
2. Your personal information is collected for Council purposes and handled in accordance with the *Privacy and Personal Information Protection Act 1998*. It may be available to the public under various legislation including the Government Information (Public Access) Act 2009.

Need more information? Any questions, please phone Narrabri Shire Council's Customer Service Team on 02 6759 6966.

27 APPENDIX E – Procedure For The Conduct Of Elections

Election of Mayor / Deputy Mayor and Chairperson / Deputy Chairperson of Committees of Council

Election of Mayor

1. Mayor to Vacate Seat

Following adoption of the Minutes of the previous Council Meeting and any Mayoral Minutes, the Mayor may make a comment on their Mayoral term and vacate the chair and hand over the Mayoral Chains to the General Manager. The General Manager is appointed Returning Officer by virtue of the Local Government Act and Council Resolution and will be assisted by nominated Staff.

2. Determination of Method of Voting

The Returning Officer will ask for Council to resolve the method of voting being either Ordinary Ballot, Preferential Ballot or Open Voting.

Clause 11.9 of Council's Code of Meeting Practice states as follows:

Voting at a Council meeting, including voting in an election at such a meeting, is to be by open means (such as on the voices or by show of hands). However, the Council may resolve that the voting in an election by Councillors for Mayor or Deputy Mayor is to be by secret ballot.

Note: The *Local Government (General) Regulation 2021* provides that a Council is to resolve whether an election by the Councillors for Mayor or Deputy Mayor is to be by preferential ballot, ordinary ballot or open voting (Clause 3 of Schedule 7). Clause 3 of Schedule 7 also makes it clear that "ballot" has its normal meaning of secret ballot.

a. Ordinary Ballot

An Ordinary Ballot is a secret ballot where ballot papers are distributed to each Councillor and Councillors will vote for only one (1) candidate. If there are more than two (2) candidates, more than one (1) ballot will be required, if there is no majority arising from the first ballot.

b. Preferential Ballot

A Preferential Ballot is a secret ballot whereby all candidates are listed on the ballot paper and each Councillor is required to indicate their preference, from first to last, from the number of candidates listed on the ballot paper. This method eliminates the candidate with the lowest number of primary votes until one (1) candidate achieves a majority of votes.

c. Open Voting

An Open Voting method is done by show of hands or use of the electronic voting system to determine the number of votes for each candidate.

If required, a Ballot Form to determine the method of voting will be distributed to Councillors. The Returning Officer will declare the method of voting according to the results of the ballot.

Council Staff will conduct the election and will provide the results to the Returning Officer for validation. The Returning Officer will declare the outcome of each ballot.

Note: A majority of votes is achieved if a candidate receives half of the formal votes plus one (1) extra vote. i.e.: if 9 formal votes are received, a majority is 5 votes or higher; or if 8 formal votes are received, a majority is 5 votes or higher.

If any Councillor abstains from voting, their vote will be recorded as an Informal vote.

3. Confirmation of Nominations for Position of Mayor

The Returning Officer will inform the Council of nominations received for the position of Mayor. All nominations are to be received by the General Manager on the "Nomination Form for Election of Mayor" duly signed and completed, prior to the commencement of the Council Meeting at 6.00pm at which the election is to be conducted. The Returning Officer will also ask for further nominations at the meeting, prior to the election for the position of the Mayor.

Councillors can be nominated for both Mayor and Deputy Mayor and can withdraw either nomination prior to either election.

4. Election to be conducted

Under all methods of voting, the following general principles will apply in conducting the election –

a. One (1) Candidate

If only one (1) nomination is received, that Councillor will be declared elected unopposed as Mayor for the ensuing 2 years.

b. Two (2) Candidates

(i) If one (1) candidate receives a majority of formal votes, that candidate will be declared elected as Mayor for the ensuing 2 years.

(ii) If the two (2) candidates receive equal votes, then a draw by lot will be required to be undertaken by the Returning Officer.

The Returning Officer will organise for the names of both candidates to be written on a separate slip. The slips will then be folded and sealed inside a separate canister. The canisters will then be placed inside the ballot box and shaken around. The Returning Officer will then pull one canister from the ballot box, open it and read out the name on the slip. **The Councillor whose name is drawn will be declared elected as Mayor for the ensuing 2 years.**

c. Three (3) or more Candidates

(i) If there are three (3) or more candidates, a process of elimination will be undertaken until such time as either a majority of votes is achieved for one (1) candidate or the two (2) remaining candidates have equal votes and a draw by lot is undertaken in accordance with the method described in part (b) above.

(ii) In the scenario where three (3) or more candidates have equal votes, then a draw by lot will be required to be undertaken by the Returning Officer. The Returning Officer will organise for the names of all candidates to be written on a separate slip. The slips will then be folded and sealed inside a separate canister. The canisters will then be placed inside the ballot box and shaken around. The Returning Officer will then pull one canister from the ballot box, open it and read out the name on the slip. The Councillor whose name is drawn will be eliminated. A fresh ballot will then be conducted. See part (v) below.

(iii) In the scenario where three (3) or more candidates have unequal votes, and a majority of votes is not achieved, the candidate with the lowest number of votes will be eliminated by the Returning Officer. A fresh ballot will then be conducted. See part (v) below.

Note: In the case of a Preferential Ballot, candidates are excluded until a majority of votes is achieved.

(iv) In the scenario where three (3) or more candidates have unequal votes but two (2) or more have equal lowest votes, then a draw by lot will be required to be undertaken by the Returning Officer to eliminate one of those candidates with equal lowest votes. The Returning Officer will organise for the names of these candidates to be written on a separate slip. The slips will then be folded and sealed inside a separate canister. The canisters will then be placed inside the ballot box and shaken around. The Returning Officer will then pull one canister from the ballot box, open it and read out the name on the slip. The Councillor whose name is drawn will be eliminated. A fresh ballot will then be conducted. See part (v) below.

(v) The process of the ballot and elimination will continue until two (2) candidates remain and the result is determined in accordance with the method described in part (b) above.

5. Declaration of Mayor

Upon completing the election, the Returning Officer will declare the Mayor as elected, and the newly appointed Mayor will take his/her seat.

Election of Deputy Mayor

1. The process for Nomination of Deputy Mayor is the same as for Mayor.
2. The process for Election of Deputy Mayor is the same as for Mayor.
3. The term that a Councillor is elected as Deputy Mayor must be determined by Council.

Election of Chairperson / Deputy Chairperson – Committees of Council

1. The process for Nomination of Chairperson / Deputy Chairperson is the same that applies for Mayor and Deputy Mayor.
2. The process for Election of Chairperson / Deputy Chairperson is the same that applies for Mayor and Deputy Mayor.

The term that a Councillor is elected as Chairperson / Deputy Chairperson for a Committee of Council is one (1) year.

28 APPENDIX F – Form for Disclosure of Interests




 Narrabri Shire Council
 46 - 48 Maitland Street
 PO Box 261, Narrabri NSW 2390


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 F. (02) 6799 6888


 E. council@narrabri.nsw.gov.au
 www.narrabri.nsw.gov.au

Our Reference:
 Contact Name: Governance Coordinator

Notice of Disclosure of Interests

(Narrabri Shire Council Code of Meeting Practice 2022 cl 16)

Note: this notice must be submitted to the General Manager, prior to the meeting outlined below.

I _____ wish to notify my interest in the following matter:

Meeting: _____
 Meeting Date: _____
 Agenda Item No.: _____
 Subject: _____

Details of Interest (including relationship if applicable):

| |
|--|
| |
| |
| |

Nature of Interest:

- ☐ Pecuniary Interest
☐ Significant Non-Pecuniary Interest
☐ Non-Significant Non-Pecuniary Interest

Proposed Action:

- ☐ I will not be present or in sight of the meeting during the discussion or consideration of the matter.
☐ I will be present at the meeting, but take no part in the discussion or consideration of the matter.
☐ I propose to take no action. The reason for this is:

Our Reference:
 Contact Name: Governance Coordinator

Signature

Date

29 APPENDIX G – Form for Councillors Requesting to Attend Meetings via Audio-Visual Link



Our Reference: _____
Contact Name: Governance Coordinator

Request to Attend Meeting via Audio Visual Link

(Narrabri Shire Council Code of Meeting Practice 2022 cl 5.20)

Note: this notice must be submitted to the General Manager, prior to the meeting outlined below.

I _____ request to attend the following meeting via Audio Visual Link:

Meeting: _____
Meeting Date: _____

For the following reasons:

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Councillor Date

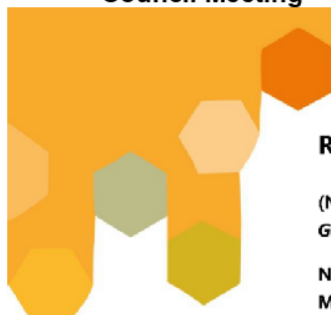



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30 APPENDIX H – Form for Councillors Requesting an Extraordinary Council Meeting



Our Reference: _____
Contact Name: _____ Governance Coordinator

Request for an Extraordinary Council Meeting

(Narrabri Shire Council Code of Meeting Practice 2022 cl 3.9; *Local Government Act 1993* (NSW) ss 366, 367)

Note: this notice must be submitted to the General Manager or the Mayor, 3 days prior to the proposed meeting date outlined below.

We, Cr _____ and Cr _____ request an Extraordinary Council Meeting to be held on:

Meeting Date: _____
Meeting Time: _____

To deal with the following matter(s):

| |
|--|
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| |

Councillor Date

Councillor Date

Note: The Mayor maintains full discretions as to when the Extraordinary Council Meeting will be held, so long as it is held as soon as practicable within 14 days of receipt of the request.

I, Mayor _____ call for the Extraordinary Council Meeting to be held on:

Meeting Date: _____
Meeting Time: _____

Mayor Date




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31 APPENDIX I – Form for Submitting a Notice of Motion



Our Reference: _____
Contact Name: Governance Coordinator

Notice of Motion

(Narrabri Shire Council Code of Meeting Practice 2022 cl 3.10)

Note: this notice must be submitted to the General Manager no less than 10 business days before the meeting is to be held

I _____ give notice in accordance with Clause 3.10 of the Council's Code of Meeting Practice, the following motion be placed on the next business paper:

THAT:

| |
|--|
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| |

A source of funding has been identified (if the motion requires expenditure of funds on works or services other than those already provided for in Council's current adopted Operational Plan)?

Yes / No

| |
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| |
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| |




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www.narrabri.nsw.gov.au

Councillor

Date

32 APPENDIX J – Form for Submitting a Leave of Absence



Our Reference:

Contact Name:

Governance Coordinator

Leave of Absence Request

(Narrabri Shire Council Code of Meeting Practice 2022 cl 5.4)

Note: this notice must be submitted to the General Manager prior to the next meeting to be held.

I _____ request a leave of absence for myself/another Councillor being: _____

from: _____ to _____ inclusive.

For the following reason/s:

| |
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| |
| |

Councillor_____
Date


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33 APPENDIX K – Form for Speaking at a Public Forum of Council

**Request to Speak at a Public Forum of Council**

(Narrabri Shire Council Code of Meeting Practice 2022 cl 4.4; *Local Government Act 1993* (NSW) ss 366, 367)

Note: this notice must be submitted to Council by 5:00pm, 3 days prior to the proposed meeting date outlined below.

I _____ request to attend speak at the Public Forum to be held prior to the Ordinary Council Meeting on:

Meeting Date: _____

I wish to speak on the following matter:

| |
|--|
| |
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| |

Pursuant to Narrabri Shire Council Code of Meeting Practice 2022 cl 4.1, members of the public may only speak on items that form part of the Council Meeting Agenda or within the scope of Council's functions.

Contact Details:

Email: _____

Phone Number: _____

Signature Date




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Narrabri Floodplain Risk Management Study and Plan

Volume II: Floodplain Risk Management Study

PUBLIC EXHIBITION DRAFT

Narrabri Shire Council
0328-08-13_DRAFT, 19 August 2022



| | |
|----------------------|-------------------------------------------------------------------------------------------------|
| Report Title | Narrabri Floodplain Risk Management Study and Plan: Volume II: Floodplain Risk Management Study |
| Client | Narrabri Shire Council 45-48 Maitland St, Narrabri, NSW, 2390 |
| Report Number | 0328-08-13_DRAFT |

PUBLIC EXHIBITION DRAFT

| Revision Number | Report Date | Report Author | Reviewer |
|-----------------|------------------|---------------|----------|
| DRAFT | 8 June 2020 | GR/HG | GR |
| 1_DRAFT | 22 October 2020 | GR/HG | GR |
| 2_DRAFT | 27 November 2020 | GR/HG | DN |
| 3_DRAFT | 19 August 2022 | GR/HG | |

For and on behalf of WRM Water & Environment Pty Ltd
Level 9, 135 Wickham Tce, Spring Hill
PO Box 10703 Brisbane Adelaide St Qld 4000
Tel 07 3225 0200



Greg Roads
Director

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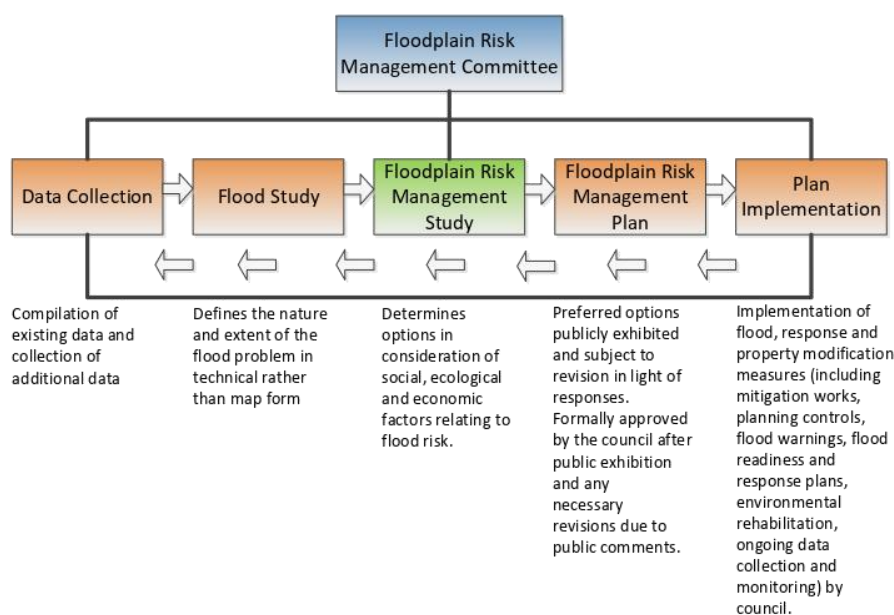
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Foreword

The NSW Government's Flood Prone Land Policy provides a framework for managing development on the floodplain. The primary objective of the policy is to develop sustainable strategies for managing human occupation and use of the floodplain using risk management principles. Under the Policy, the management of flood liable land remains the responsibility of local government. The State Government subsidises flood mitigation works to alleviate existing problems and provides specialist technical advice to assist councils in the discharge of their floodplain management responsibilities.

The NSW Government's Floodplain Development Manual (2005a) (the Manual) has been prepared to support the NSW Government's Flood Prone Land Policy. The Manual provides councils with a framework for implementing the policy to achieve the policy's primary objective. The framework is shown below.



The task outlined in this report is the floodplain risk management study component of the process. This report supersedes the previous floodplain risk management studies undertaken for Narrabri (Max Winders & Associates, 2002).

This report should be read in conjunction with Volume I: Supplementary Flood Study.

This project was prepared with financial assistance from the NSW Government's Floodplain Management Program. This document does not necessarily represent the opinions of the NSW Government or the Department of Planning, Industry and Environment.

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Executive Summary

Study objective

Narrabri Shire Council has received financial support from the State Floodplain Management Program to prepare a floodplain risk management study for Narrabri. The objective of the study, documented in this report, is to investigate a range of flood mitigation works and measures to address the existing, future and continuing flood problems in Narrabri, in accordance with the NSW Government's Flood Prone Land Policy.

Existing flood problem

The township of Narrabri is prone to flooding from the Namoi River and from the local creek catchments of Mulgate Creek/Horsearm Creek and Long Gully. Namoi River flooding poses the greatest flood risk for most residents, but the main Narrabri town area and the Narrabri North Industrial Estate have significant exposure to both regional and local catchment flooding.

With respect to Namoi River flooding, 914 residential and 305 non-residential buildings would be inundated above floor level for the 1% AEP flood with most properties experiencing some inundation except for properties in Narrabri West. Flood hazard vulnerability mapping identified 351 buildings that would be unsafe for people and vehicles. For the 5% AEP flood, 229 residential and 86 non-residential buildings would be inundated above floor level. The total flood damage costs would be about \$140 million (excluding road, bridge and agricultural flood damages).

With respect to local creek flooding, 139 residential and over 45 non-residential buildings would be inundated above floor level for the 1% AEP flood. For the 5% AEP flood, 5 residential and 1 non-residential buildings would be inundated above floor level. The total flood damage costs would be about \$24 million (excluding road, bridge and agricultural flood damages).

Flood risk management options

A range of structural, planning and emergency response measures were assessed to address the existing flood problem in Narrabri.

Structural measures

Structural measures focussed on channel upgrades, levees and house raising/voluntary purchase schemes to reduce damage, hazard and disruption from both Namoi River and local creek flooding. The study found that structural options to mitigate Namoi River flooding were not effective, caused impacts or were uneconomic. As a result, the structural options focussed on mitigating flooding from the local creek catchments. A channel and levee scheme along Horsearm and Mulgate Creek was found to dramatically reduce local catchment flooding with the benefits of the scheme ought weighing the costs for low discount rates. Further assessment and consultation with the local community is recommended for this option.

Planning measures

To manage the future flood problem, changes to the existing land use and building and development controls are recommended based on the flood hazard and vulnerability of the community. Zones of flood risk in Narrabri were defined based on an assessment of the risk and consequence of flooding for frequent, large and extreme flood events from both regional and local flooding sources.

- For low flood risk areas, new development would need to ensure the building floor level is above the flood planning level (defined as the 1% AEP plus 0.5 m freeboard). Flood impact assessments would be required for excessive filling. Minor extensions to dwellings could not be lower than the existing floor level.
- For medium flood risk areas (which covers most of the residential areas of Narrabri), a range of measures are proposed including the prohibition of land-use

intensification and development that required assisted evacuation. All new habitable residential buildings, and extensions of existing habitable residential buildings would be required to prepare a flood evacuation plan.

- For high flood risk (floodway) areas, any new development would be prohibited.

Emergency response measures

The existing Narrabri Shire Local Flood Plan covers issues such as flood warning, resupply, evacuations and flood recovery. The additional and updated flood information can be used to update the Local Flood Plan. In particular, the information on the locations and depths of road inundation for the various events would assist prioritisation of evacuations. The existing flood evacuation centres in Narrabri provide refuge up to very rare to extreme flood events. However, the three nominated evacuation centres east of Narrabri Creek would be surrounded by water in rare flood events (with two surrounded by flood events as frequent as the 5% AEP event). An additional evacuation centre on flood free land is recommended.

Floodplain Risk Management Plan outcomes

| Measure | Recommendation | Priority | Responsibility | Costing |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------------|---------|
| Flood education plan | <ul style="list-style-type: none"> • Develop and implement an ongoing flood education plan. | High | SES/Council | Low |
| Voluntary purchase scheme | <ul style="list-style-type: none"> • Consult with properties currently identified for voluntary purchase. • Apply for State government funding. | High | Council | High |
| Horsearm Creek mitigation | <ul style="list-style-type: none"> • Refine the concept design. • Consult with ARTC and community. | High | Council | High |
| Building and development controls | <ul style="list-style-type: none"> • Incorporate flood risk map into the DCP. • Update DCP to include flood risk measures. | Medium | Council | Low |
| Local flood plan | <ul style="list-style-type: none"> • Review and update the Local Flood Plan to incorporate information on flood risks to properties and additional information on road inundation and flood warning. Communicate the contents of the Local flood plan to the community. | Medium | SES | Low |
| Land use zoning | <ul style="list-style-type: none"> • Rezone vacant land located in proposed floodways. | Medium | Council | Low |
| Alternative emergency evacuation centre | <ul style="list-style-type: none"> • Investigate alternative emergency evacuation centre. | Medium | SES/Council | Medium |
| Voluntary house raising scheme | <ul style="list-style-type: none"> • Consult with local community on expected demand. • Apply for State government funding. | Medium | Council | High |
| Stormwater pipe flood gates | <ul style="list-style-type: none"> • Install devices draining to Horsearm Creek. | Medium | Council | Medium |

| Measure | Recommendation | Priority | Responsibility | Costing |
|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------------|---------|
| Narrabri North Industrial estate mitigation | <ul style="list-style-type: none"> Undertake detailed design. Establish a funding model. Consult with ARTC. | Medium | Council | High |
| Narrabri Creek channel maintenance | <ul style="list-style-type: none"> Establish a maintenance program for Narrabri Creek waterway corridor. | Medium | Council | Low |
| Mulgate Creek flood warning | <ul style="list-style-type: none"> Investigate the installation of a water level and rainfall flood alert station on Mulgate/Horsearm Creek. | Medium | Council | Low |
| Eather's Creek channel | <ul style="list-style-type: none"> Refine the concept design of the levee to mitigate the flood impacts. Evaluate the benefits and costs. | Low | Council | High |

1 Introduction

1.1 OVERVIEW

WRM Water & Environment Pty Ltd (WRM) was commissioned by Narrabri Shire Council (NSC) to undertake the Narrabri Floodplain Risk Management Study and Plan (FRMP). The FRMP has been prepared in response to the updated modelling conducted for Volume I of this study (WRM, 2019b) and the time elapsed since the adoption of the previous FRMP for Narrabri in 2002 (Max Winders & Associates, 2002). The previous FRMP has been identified as the 2002 FRMP in this study.

Figure 1.1 shows the extent of the study area covering the township of Narrabri and surrounds. The key drainage features within the study area are also shown. The main drainage features are the Namoi River, which drains through the southern and western areas of Narrabri, and Narrabri Creek, a distributary channel of the Namoi River, which splits Narrabri. There are also multiple Namoi River floodway channels that drain through the town including Lagoon Creek, Eather's Creek and O'Briens Creek. Other significant drainage features include Mulgate Creek, Horsearm Creek, Doctors Creek and Long Gully, which drain local catchment runoff into Narrabri.

The urban areas of Narrabri experience above floor flooding from these sources on average every 15 years with the largest floods occurring in 1955 and 1910. The most recent floods in February 2020 and November 2021 were localised events in response to rainfall bursts in the upper Mulgate Creek and Horsearm Creek catchments.

1.2 STUDY PROCESS

The floodplain risk management study and plan has been undertaken in three volumes:

- **Volume I** of the study collected flood related data for the study area and developed computer based hydrological and hydraulic models to define the flood flows, levels, depths and extents across the floodplain for a range of small and large events. The potential impact on peak flood levels due to climate change was also assessed.
- **Volume II** (this report) of the study reviews the existing flood risks confronting the study area and re-evaluates the potential floodplain risk management and mitigation options that are available to reduce the future flood risk. The mitigation and management measures consider the environmental, social, economic, planning and emergency management issues and constraints within the study area.
- **Volume III** of the study provides recommendations based on information gathered from Volume I and Volume II to reduce the flood hazard and risk to people and property in the existing community and to ensure future development is controlled in a manner consistent with the flood hazard and risk.

This study (Volume II) has been undertaken in accordance with the NSW Government's Floodplain Development Manual (2005a) (the Manual), which has been prepared to support the NSW Government's Flood Prone Land Policy. The Manual recognises three separate flood problems: the existing problem, the future problem and the continuing problem:

- The **existing problem** refers to existing properties that are liable to flooding and flood damage.
- The **future problem** refers to those properties, which upon development or redevelopment, become flood-labile and susceptible to significantly higher levels of flood damage.
- The **continuing problem** refers to the risk of flooding and flood damage that remains when all adopted floodplain management measures have been implemented. The continuing flood risk and associated damage can only be

eliminated by designing for the extreme flood event. In general, design for the extreme flood event is either economically or practically infeasible.

Different flood management options were assessed in this study for each flood problem.

- **Structural measures**, such as channel upgrades, levees and house raising were investigated to reduce damage, hazard and disruption associated with the existing problem.
- **Planning measures**, such as zoning and building controls (e.g. minimum floor levels) were reviewed to reduce damage, hazard and disruption associated with the future problem.
- **Emergency response measures**, such as flood warning, evacuation and recovery, were reviewed to reduce damage, hazard and disruption associated with the residual problem.

1.3 REPORT STRUCTURE

The report is structured as follows:

- Section 2 provides background information on the existing land use and the environmental and social characteristics of the study area. A description of the previous floodplain management studies that have been undertaken in Narrabri is also provided;
- Section 3 describes the flood behaviour across the study area and provides flood hazard flood risk mapping;
- Section 4 presents flood damage estimates for existing conditions;
- Section 5 presents the emergency response planning community classifications and provides additional information on flood warnings and evacuation routes to manage the residual flood risk in Narrabri;
- Section 6 outlines and assesses a range of structural flood management options to mitigate the existing flood risk in Narrabri;
- Section 7 outlines and assesses a range of non-structural flood management options to mitigate the future flood risk and manage the residual flood risk in Narrabri;
- Section 8 presents the conclusions and summarises the recommendations of the study;
- Section 9 is a list of references;
- Section 10 is a glossary of technical terms used in this report;
- Appendix A shows hydraulic hazard mapping (combined regional and local catchment flooding) for the 20% AEP, 10% AEP, 5% AEP, 2% AEP, 0.5% AEP, 0.2% AEP and extreme flood design events;
- Appendix B shows property inundation mapping for the 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP, 0.5% AEP, 0.2% AEP and extreme flood design events;
- Appendix C shows impact mapping for the proposed structural flood mitigation options; and
- Appendix D shows impact mapping for the preferred structural flood mitigation option.

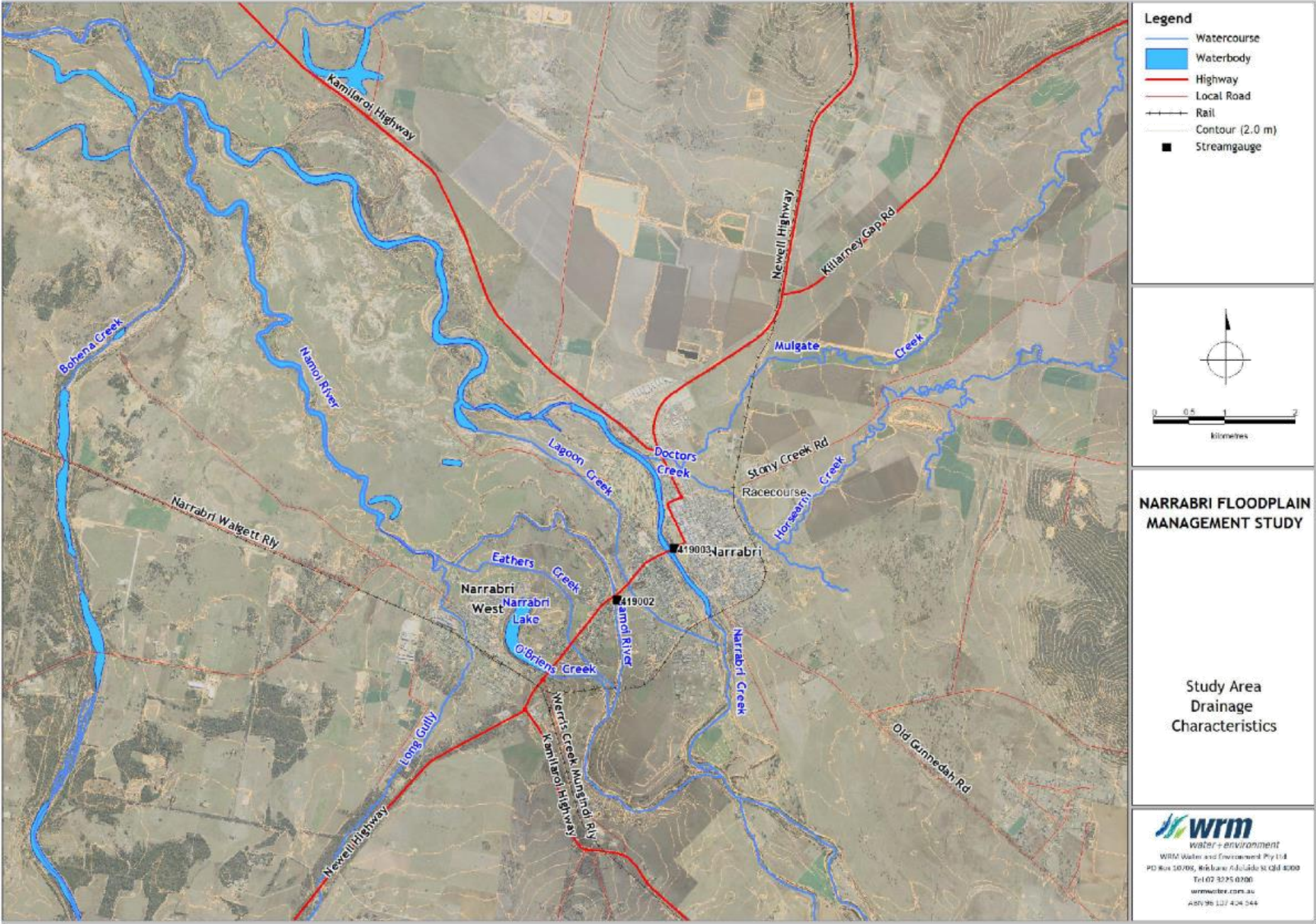


Figure 1.1 - Study area

2 Background

2.1 STUDY AREA DRAINAGE

The main drainage features in the study area are the Namoi River and Narrabri Creek, a distributary channel of the Namoi River, both of which drain through Narrabri (see Figure 1.1).

The Namoi River has a catchment area of 25,400 km² upstream of Narrabri. About 2.5 km upstream of Narrabri the Namoi River splits into two channels. The main channel is referred to as Narrabri Creek and is generally about 7 m to 9 m deep and about 50 m to 80 m wide. Through town, the Namoi River channel is approximately 7 m to 8 m deep and about 30 m to 50 m wide. Narrabri Creek and the Namoi River re-join about 10 km downstream of Narrabri.

Along with the Namoi River, O'Brien's Creek, Eather's Creek and Lagoon Creek also distribute flood flows on the western side of Narrabri Creek. O'Brien's Creek conveys local catchment flows from southwest of Narrabri, as well as Namoi River overflows, into the Narrabri West Lake. The water level in Narrabri West Lake is controlled by the weir at the northern end of the lake and two low level outflow culverts. Water released from the low-level culverts, or overtopping the weir, flows north into a small dam and then follows a gully west into the Namoi River channel.

Eather's Creek has a limited local catchment in urban Narrabri and conveys Namoi River overflows in a westerly direction. Eather's Creek passes under the Newell Highway and Ugoa Street before joining O'Brien's Creek on the northern side of Narrabri West Lake.

Lagoon Creek conveys Narrabri Creek overflows under the rail line and northwest through Narrabri before reconnecting with Narrabri Creek downstream of Narrabri.

Tributaries on the eastern side of Narrabri Creek include Doctors Creek, Horsearm Creek and Mulgate Creek. The catchment area of these tributaries totals 201 km² to Narrabri Creek. Both Mulgate Creek and Horsearm Creek drain the peaks of Mount Kaputar National Park to the east of Narrabri, flowing across agricultural land before joining to form Doctors Creek approximately 500 m east of Narrabri Creek. Doctors Creek flows under the Newell Highway before flowing into Narrabri Creek.

Bohena Creek is a major tributary of the Namoi River and flows into the Namoi River approximately 10 km downstream of Narrabri. Bohena Creek drains approximately 2,100 km², with the majority of the catchment situated within the Pilliga Forest. Overflows from Bohena Creek have the potential to impact the western fringe of Narrabri (WRM, 2019a).

2.2 LAND USE

Figure 2.1 shows the land use zones within the study area identified in the local environment plan (LEP). The existing urban areas of Narrabri are generally zoned for residential (R1), local centre (B2) or mixed use (B4). On the fringe of the urban areas are areas of large lot residential (R5) and industrial (IN1 and IN2). The bulk of the remaining land around Narrabri is zoned for recreation (RE1 or RE2) or primary production (RU1).

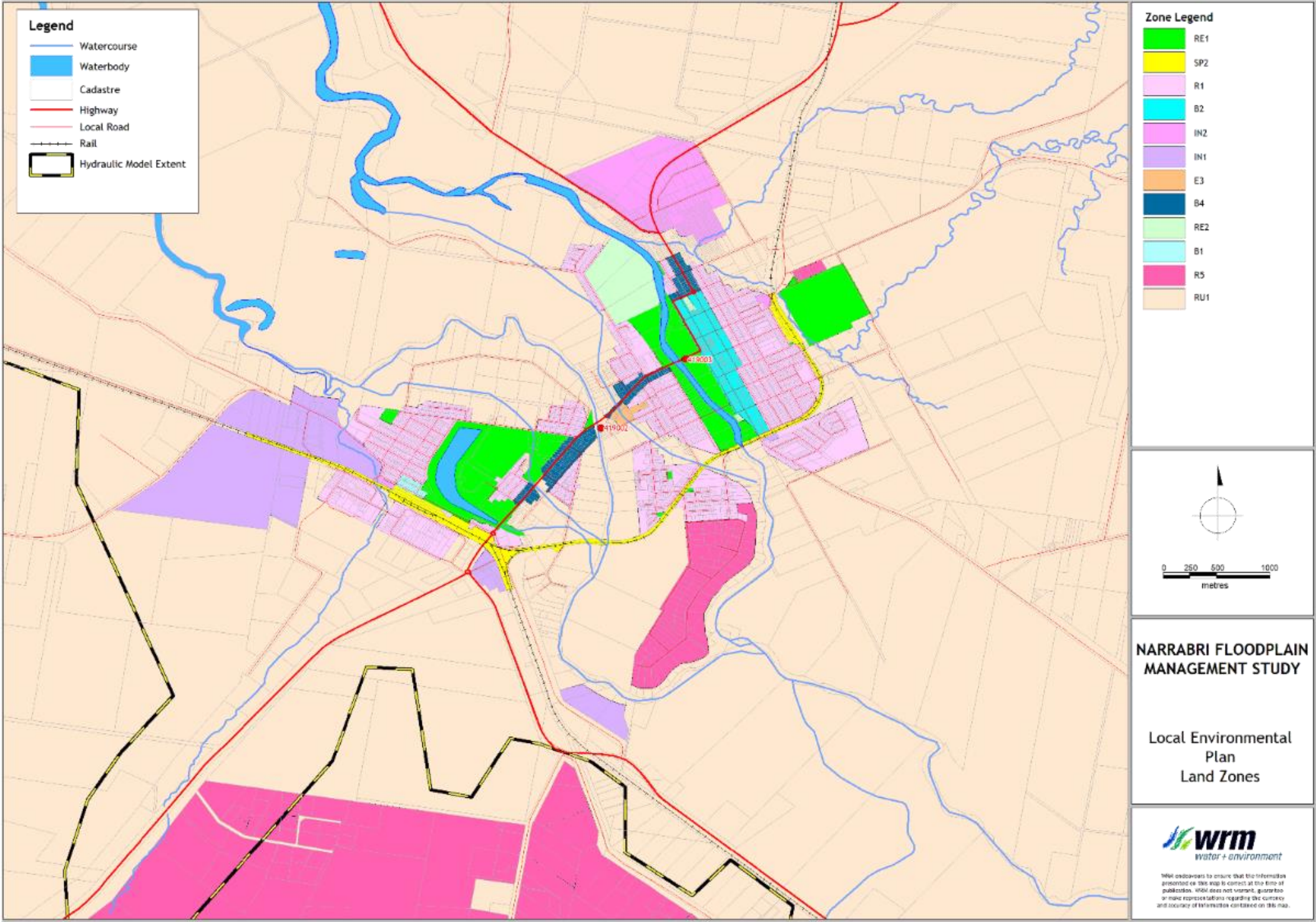


Figure 2.1 - Narrabri local environment plan land use zones

2.3 ENVIRONMENT

The Narrabri region partially overlies the Great Artesian Basin (Molino Stewart, 2016). Seasonal and semi-permanent wetlands occur along the Namoi watercourse, though little wetland storage is present around Narrabri.

There are 154 listed threatened species, endangered ecological communities and endangered populations within NSC boundaries (Molino Stewart, 2016). There are a number of threatened woodland species that have been identified as endangered and may be located within the study area including the White Box Yellow Box Blakely's Red Gum Woodland, Fuzzy Box Woodland, Myall Woodland, Brigalow and Inland Grey Box Woodland (NSW OEH, 2019).

2.4 SOCIAL CHARACTERISTICS

The Narrabri LGA has had a steady population since 2001 varying between 13,800 in 2001 census and 12,703 in the 2021 census (ABS, 2021). At the 2021 census, the township of Narrabri had a population of 6,898 people living in 3,243 private dwellings. There were 366 unoccupied private dwellings. Some 18.9% of the population were aged over 65, while 20.3% of the population are children below 14, both of which are higher than the state and national averages. This has implications for evacuation timelines, as there may be a higher proportion of both young and old people who may require assistance. The population overwhelmingly speak English.

The region's economy is based on traditional agricultural industries such as cereal grains, cotton, livestock and oilseeds (Namoi CMA, 2013). Mining and extractive industries as well as retail, finance and business services and community workers are also strongly represented (ABS, 2019).

2.5 PREVIOUS FLOOD MITIGATION AND FLOODPLAIN RISK MANAGEMENT STUDIES AND PLANS

2.5.1 Mitigation of Flood Damage Caused by Mulgate Creek, University of New South Wales Water Research Laboratory (1967)

The report published by the University of New South Wales Water Research Laboratory in 1967 detailed flooding issues experienced around Mulgate Creek, and suggested mitigation options to alleviate those issues. Up until the mid-1960's it appears that, upstream of Narrabri, Mulgate Creek frequently overflowed the defined creek bank with overflows heading west. The report proposed several options to mitigate the overflows including a culvert through the railway line and some form of embankment to inhibit the overflows travelling west. It would appear that the current railway culverts and the alignment and large embankment of the Killarney Gap Road was proposed in this 1967 report.

2.5.2 Namoi Valley Flood Mitigation Study, Laurie, Montgomerie & Pettit (1980)

The study by Laurie, Montgomerie and Pettit described wide scale flooding along the Namoi River, including flooding in Narrabri, and investigated several mitigation options. Important flow paths through the town were mapped in this study. The study concluded that "Narrabri would be among the worst two or three towns in the State as far as flood problems are concerned" and "Narrabri could hardly be worse located for flooding". The study outlined the damage flooding caused in Narrabri including the disruption of economic activity, highlighting that some portions of town can be cut off for long periods of time. Mitigation options to protect the rail lines, major highways and airport access were investigated, as well as town levees.

The study focussed on a levee and floodway proposal with the aim of substantial flood mitigation for the great majority, rather than selectively protecting certain regions of the town. The levee and floodway proposal was based on the ability to tie into transport

infrastructure (highway and railway) upgrades to also improve access during flood events. The levee option that was investigated had a freeboard of 1 metre above the highest recorded flood level (or the 1% AEP event, whichever was higher). The levee and floodway proposal consisted of around 19.3 km of levee with an average levee height of around 2.5 metres. These levees were never constructed.

2.5.3 NSW Inland Rivers Floodplain Management Studies: Summary Report - Namoi Valley, Laurie, Montgomerie & Pettit (1982)

The Namoi Valley Floodplain Management Study summarised the potential Narrabri levee scheme (from Laurie, Montgomerie & Pettit, 1980) as well as proposed flood mitigation options at several other locations throughout inland New South Wales.

2.5.4 Narrabri Floodplain Management Study, Bewsher Consulting (1996)

The Narrabri Floodplain Management Study was a comprehensive four volume report that described the existing flooding characteristics in and around Narrabri from both the Namoi River and local catchments (including Mulgate Creek), and investigated a number of structural and non-structural flood mitigation options aimed at reducing the risk of flooding in and around Narrabri. A detailed community consultation program was used to identify a number of the flood mitigation options. The mitigation options were then assessed using a MIKE-11 flood model developed by Kinhill (1991).

After all mitigation options were individually assessed a number of preferred structural floodplain management options were identified, including:

- Opening up the Namoi River and Narrabri Creek junction;
- Raising of the Long Gully bridge;
- Raising Maitland Street;
- Levees and large-scale filling at either Mackenzie Street or Shannon Estate to create new developable land options; and
- Minor embankment works at Mulgate Creek between the railway line and Saleyards Road.

The preferred non-structural floodplain management options identified in the study included:

- Voluntary purchase of residential properties in high flood risk areas;
- House raising;
- Flood-proofing of individual properties;
- Clearing of river vegetation and riverbank stability works;
- Various planning, development and building controls;
- Various flood warning and emergency management protocols; and
- Public awareness and education programs.

Flood damage modelling was undertaken to determine the economic benefits of the various mitigation options. The outcome of the study was a detailed floodplain management plan for Narrabri. It is understood that most of these measures were implemented; however, the take up of the voluntary purchase and house raising scheme was low.

2.5.5 Narrabri Supplementary Floodplain Management Study, Max Winders & Associates (2002)

The Narrabri Supplementary Floodplain Management Study was commissioned to determine appropriate floodplain management strategies for four key development areas within Narrabri. To complete the study, the MIKE-11 model developed by Kinhill (1991) and refined by Bewsher (1996), was updated to give more definition in the areas being

investigated. A number of flood-runners between the Namoi River and Narrabri Creek were incorporated into the model to improve the definition of flow distribution across the town during large events. The addition of Mulgate Creek to the model also allowed local catchment flooding to be simulated for the first time.

The study investigated various development and mitigation scenarios for the Genanagie Street Area, Narrabri North Industrial Estate (Francis Street Industrial Area), Shannon Estate and the Mackenzie Street Area. Recommendations were made and implemented for all four key development areas, though it was noted that it would be preferable for future growth to occur away from the floodplain on the more elevated land, northeast, south and west of the current town limits.

2.5.6 Narrabri - Wee Waa Floodplain Management Plan, NSW Department of Natural Resources (2005b)

The Narrabri - Wee Waa Floodplain Management Plan focussed on floodplain management downstream of Narrabri (west-northwest of Mollee Weir). The study defined a number of floodways downstream of Mollee Weir and identified development constraints for the construction of rural levees.

2.5.7 Narrabri Flood Bypass Flood Study Progress Report, Aquatech Consulting Pty Ltd et al. (2008)

The Narrabri Flood Bypass Feasibility Study investigated the possibility of taking advantage of the natural tendency for floodwater to break out of the Namoi River upstream of Narrabri and flow around the east of Narrabri. The proposal was to enlarge and deepen this natural overflow to allow bypasses to occur earlier, and for greater volumes of water to escape the Namoi River channel. It was found that the earthworks associated with the channel would also need to be accompanied with several levee structures. The total cost of the flood bypass (including 20% contingency) was found to be in the order of \$60 million to \$70 million. The estimated reduction to average annual damage in Narrabri was estimated at \$2.7 million. This option has been refined and reassessed as part of this study.

3 Flood behaviour

3.1 OVERVIEW

The principal objective of the Narrabri Flood Study (WRM, 2016) and Supplementary Flood Study (WRM, 2019b) was to define the existing flood behaviour across the study area. For these studies, a coupled one-dimensional and two-dimensional hydraulic model was developed to define the flood levels, depths, extents and flows across the study area for a range of small to extreme flood events. The model was calibrated to the 1955, 1971 and 1998 regional Namoi River flood events and the 2004 and 2012 local catchment (Long Gully and Mulgate Creek) flood events.

This section describes the flood behaviour across the study area based on the results of these studies, including an assessment of:

- the probability of flooding;
- flow conveyance and storage functions of the floodplain; and
- the variation in, and the drivers and degree of, flood hazard and flood risk within the floodplain.

3.2 FLOOD DESCRIPTION

The results of the flood modelling presented in the supplementary flood study (WRM, 2019b) are summarised below.

For regional (Namoi River) flood events:

- 20% AEP design flood - flooding through town would be mainly contained within the defined floodway, with minor flood runners activated. Upstream and downstream of town, there would be more extensive out-of-bank flooding;
- 10% AEP design flood - extensive overbank flooding would occur with most flood runners through town activated. Flow breaks out-of-bank upstream of Narrabri, which then flows to the east of town and links with Horsearm Creek;
- 5% AEP design flood - extensive out-of-bank areas would be inundated, with significant urban areas of Narrabri inundated;
- 2%, 1%, 0.5% and 0.2% AEP design flood events - much of the study area would be inundated with the inundation extent progressively extending southwest for the larger events;
- the predicted 1% AEP flood levels along Narrabri Creek are approximately 0.44 m higher than the recorded 1971 peak flood levels and approximately 0.08 m lower than the recorded 1955 peak flood levels; and
- extreme flood - this event approximates the extent of Namoi River flood liable land with almost the entire extent of urban development in Narrabri inundated.

For local catchment flood events:

- 20% AEP design flood - moderate overbank flooding would occur on the fringes of Narrabri, particularly around the Narrabri North Industrial Estate (Francis Street Industrial Area);
- 10% and 5% AEP design flood events - urban Narrabri would be affected to a similar extent to the 20% AEP flood, with moderately increased flooding around the Narrabri North Industrial Estate;
- 2%, 1%, 0.5% and 0.2% AEP design flood events - breakouts occur activating flood runners through town and impacting on multiple areas of urban Narrabri; and

- probable maximum flood (PMF) - approximates the extent of local catchment flood liable land which covers most of the urban areas of Narrabri with only a few pockets remaining local catchment flood free.

For most of the urban areas of Narrabri, the regional (Namoi River) flood events pose the greatest flood risk for residents. There are small areas on the outskirts of the urban areas of Narrabri that are an exception to this, with areas such as the Narrabri North Industrial Estate having significant exposure to both regional and local catchment flood events.

The results of the Narrabri Flood Study (WRM, 2016) and the Supplementary Flood Study (WRM, 2019) were released to the community in September 2019. Four community submissions have been made in response to the flood study. None of the four submissions identified concerns with the results of the flood study. NSC adopted the flood study (WRM, 2019b) at its meeting on Tuesday, 24 March 2020.

3.3 HYDRAULIC HAZARD

Volume I of this study (WRM, 2019b) defined provisional hydraulic hazard categories across the study area for the full range of design flood events. The provisional hydraulic hazard categories were calculated using the hydraulic model results, defined by the depth, depth-velocity product and the velocity of floodwaters, in accordance with Figure L2 of the Manual (NSW Government, 2005a).

The Australian Disaster Resilience Guideline 7-3 Flood Hazard (AIDR, 2017) recommends grouping the floodplain into six hazard categories using flood depth, flood velocity and the depth-velocity product in accordance with Figure 3.1. This figure closely resembles Figure L1 in the Manual (NSW Government, 2005a) but further delineates the floodplain based on recent research undertaken on the trafficability of vehicles and the safety of people during flood events.

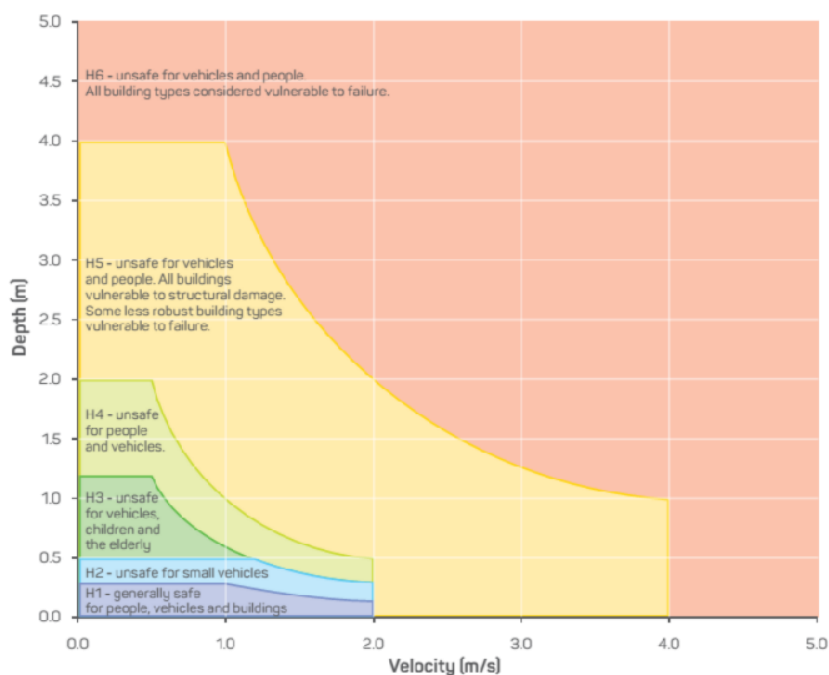


Figure 3.1 - Flood hazard vulnerability curve (source: AIDR, 2017)

Figure 3.2 shows the hydraulic hazard in Narrabri for the 1% AEP design flood, using the flood hazard vulnerability curve shown above (AIDR, 2017). For the purpose of hydraulic hazard mapping, the regional (Namoi River) and local catchment flood events have been combined to form a single hazard map.

For the 1% AEP design flood event, the H6 (most hazardous) areas are generally confined to the waterway corridors of the Namoi River, Narrabri Creek and the lower portion of Mulgate and Horsearm Creeks. The H5 areas include many of the flood runner channels, as well as additional area along the H6 waterway corridors. According to the flood hazard vulnerability curve in Figure 3.1, hazards H5 and H6 define areas where structures become vulnerable to failure. Narrabri has four buildings within these hazard zones for the 1% AEP design flood.

The H4 and H3 hydraulic hazard areas for the 1% AEP design event cover much of urban Narrabri. According to the flood hazard vulnerability curve in Figure 3.1, hazards H3 and above are unsafe for children and the elderly, and H4 and above are unsafe for all people.

Figure 3.2 shows that large scale evacuation would be required for a 1% AEP design flood event, as much of the residential and commercial areas of Narrabri are covered by hydraulic hazard areas H3 to H6 (approximately 1,674 buildings). Hydraulic hazard mapping for other design flood events is provided in Appendix A. Table 3.1 details the number of existing buildings within each hydraulic hazard zone for each modelled design flood event.

Table 3.1 - Existing building count in each hydraulic hazard zone

| Flood Event | Number of buildings per hydraulic hazard zone* | | | | | |
|--------------------------|------------------------------------------------|-----|-------|-------|-------|----|
| | H1 | H2 | H3 | H4 | H5 | H6 |
| Regional Flooding | | | | | | |
| 20% AEP | 0 | 0 | 0 | 0 | 0 | 0 |
| 10% AEP | 133 | 7 | 1 | 0 | 0 | 0 |
| 5% AEP | 563 | 171 | 180 | 2 | 0 | 0 |
| 2% AEP | 411 | 441 | 1,021 | 75 | 2 | 0 |
| 1% AEP | 227 | 296 | 1,317 | 351 | 4 | 0 |
| 0.5% AEP | 152 | 167 | 1,318 | 690 | 17 | 0 |
| 0.2% AEP | 118 | 132 | 1,104 | 1,026 | 58 | 0 |
| PMF | 29 | 19 | 213 | 381 | 2,337 | 16 |
| Local Flooding | | | | | | |
| 20% AEP | 9 | 0 | 0 | 0 | 0 | 0 |
| 10% AEP | 17 | 3 | 1 | 0 | 0 | 0 |
| 5% AEP | 20 | 8 | 1 | 0 | 0 | 0 |
| 2% AEP | 219 | 70 | 44 | 0 | 0 | 0 |
| 1% AEP | 276 | 120 | 85 | 4 | 0 | 0 |
| 0.5% AEP | 319 | 149 | 150 | 13 | 0 | 0 |
| 0.2% AEP | 366 | 165 | 198 | 23 | 0 | 0 |
| PMF | 234 | 211 | 1,349 | 549 | 148 | 0 |

* number of buildings is the count of buildings in each zone, it does not correspond to the count of flooded buildings (refer Section 4 for counts of flooded buildings)

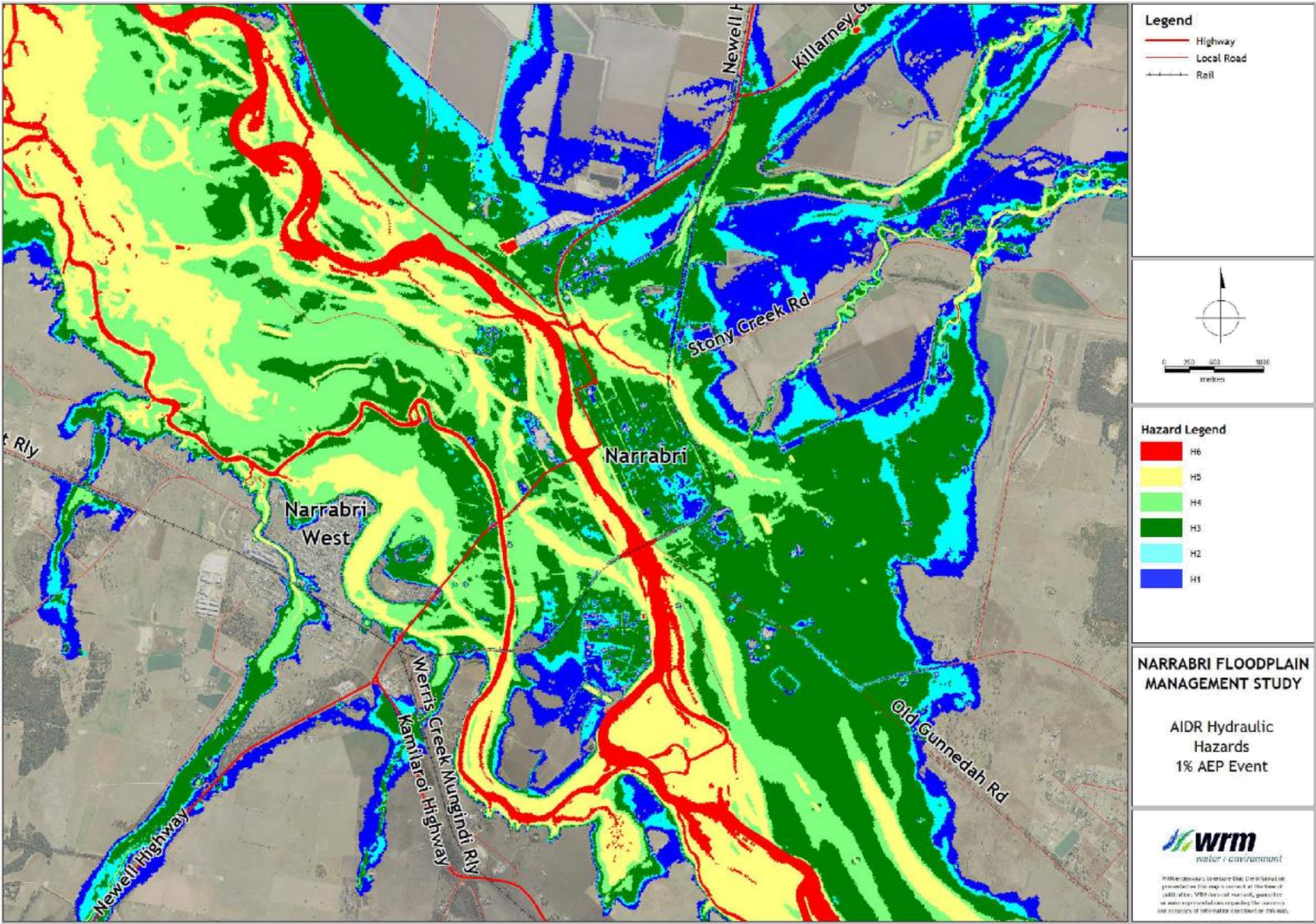


Figure 3.2 - AIDR (2017) hydraulic hazard, 1% AEP design flood (combined regional and local)

3.4 FLOODPLAIN FLOW DISTRIBUTION

Maintaining the flood function of the floodplain is essential to managing flood behaviour and hence is a key objective of flood risk management best practice (AIDR, 2017). The flood function of specific areas of the floodplain will often vary with the flood magnitude. An area that may be dry in small floods may become an active flow conveyance area during larger events.

Table 3.2 presents an analysis of the peak flood discharges at various locations across the floodplain at Narrabri for the range of regional design flood events. The locations of the reaches across the floodplain are shown in Figure 3.3. The results show that:

- Narrabri Creek and the Namoi River convey between 38.4% and 99.9% of the total regional peak flow depending on the flood magnitude (as flood magnitude increases this proportion decreases);
- For major regional flood events (events equal to and larger than 2% AEP), over 22% of the floodplain conveyance is provided by the flood runners through town (i.e. O'Brien's Creek, Eather's Creek, Lagoon Creek, Horsearm Creek and the Town Centre and Dangar Village overflows);
- For the regional 1% AEP design flood event, Eather's Creek and Horsearm Creek take the most flow after Narrabri Creek and the Namoi River (about 7% each); and
- The Town Centre overflow (Narrabri Township east of Narrabri Creek) would be extensively flood affected in larger regional flood events, but in terms of conveyance, this area takes less than 9% of the total peak flow for all regional design flood events.

Table 3.2 - Peak discharges across the floodplain (regional flooding)

| Reach | Peak Discharge (m ³ /s) | | | | | | | |
|-------------------|------------------------------------|---------|--------|--------|--------|----------|----------|---------------|
| | 20% AEP | 10% AEP | 5% AEP | 2% AEP | 1% AEP | 0.5% AEP | 0.2% AEP | Extreme Event |
| O'Brien's Creek | - | 26.0 | 78.3 | 178 | 238 | 314 | 396 | 2,095 |
| Eather's Creek | - | 12.7 | 100 | 234 | 318 | 423 | 527 | 1,576 |
| Namoi River | 156 | 342 | 499 | 662 | 746 | 845 | 931 | 1,798 |
| Lagoon Creek | - | 12.0 | 58.8 | 152 | 210 | 281 | 344 | 1,088 |
| Dangar Village | - | - | 8.7 | 50.8 | 76.9 | 108 | 135 | 525 |
| Narrabri Creek | 884 | 1,511 | 2,025 | 2,481 | 2,649 | 2,796 | 2,902 | 3,813 |
| Town Centre | - | - | 3 | 76.4 | 161 | 252 | 328 | 1,318 |
| Horsearm Creek | 0.3 | 18.9 | 88.6 | 206 | 324 | 447 | 552 | 2,209 |
| Eastern overflows | - | - | - | - | - | - | - | 177 |

Volume I of this study (WRM, 2019b) provides the floodplain flow distribution for the local catchment flood events.



Figure 3.3 - Regional flooding flow cross-section locations

3.5 FLOOD PLANNING AREA

Section 6.2 of the Narrabri LEP (NSC, 2012) outlines flood planning provisions for managing development on the Narrabri floodplain. The flood planning clauses in the LEP apply to land at or below the flood planning level, which is defined in the LEP as the level of the 1% AEP design flood event plus 0.5 metres freeboard.

The choice of event and the nominated freeboard in the 2012 LEP for the flood planning level is consistent with recommendations given in the Manual (NSW Government, 2005a). The 1% AEP event is the design event upon which flood planning levels are typically set. The freeboard is then added to this event to account for various uncertainties that may include (NSW Government, 2005a):

- uncertainties in modelling;
- localised water level differences;
- wave action;
- climate change; and
- cumulative effects of future developments.

The possible effect of climate change on flooding in Narrabri, considered in Section 3.8, validates the adoption of a 0.5 m freeboard for the flood planning area. The extent of land parcels at or below the 1% AEP design flood plus 0.5 m freeboard (i.e. the flood planning area) is shown in Figure 3.4.

3.6 FLOOD RISK

3.6.1 Overview

The flood risk to a community is measured in terms of both the scale of consequence, and the likelihood of that consequence. The previous sections define the likelihood of flooding. The consequences of flooding have been assessed to define a flood risk map that is independent of flood event magnitude (i.e. a single risk map rather than a risk map for each design flood event). This map can then be used as a decision-making tool as it concisely demonstrates where flood risk management strategies are needed.

The Australian Disaster Resilience Guideline 7-6 (AIDR, 2017) was used as a guide for assessing the flood risk across Narrabri. The guideline suggests the use of a qualitative risk matrix, an example of which is shown in Table 3.3, to define the level of flood consequence to the community and in particular people, economy, environment, public administration and social settings.

The AIDR hydraulic hazard vulnerability zones have been used to define the level of consequence to people, economy, public administration and social settings. The vulnerability of the community and assets in each hydraulic hazard zone is as follows (AIDR, 2017):

- Hydraulic hazard H1 - generally safe for people, vehicles and buildings;
- Hydraulic hazard H2 - unsafe for small vehicles;
- Hydraulic hazard H3 - unsafe for vehicles, children and the elderly;
- Hydraulic hazard H4 - unsafe for people and vehicles;
- Hydraulic hazard H5 - unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust building types vulnerable to failure; and
- Hydraulic hazard H6 - unsafe for vehicles and people. All building types considered vulnerable to failure.

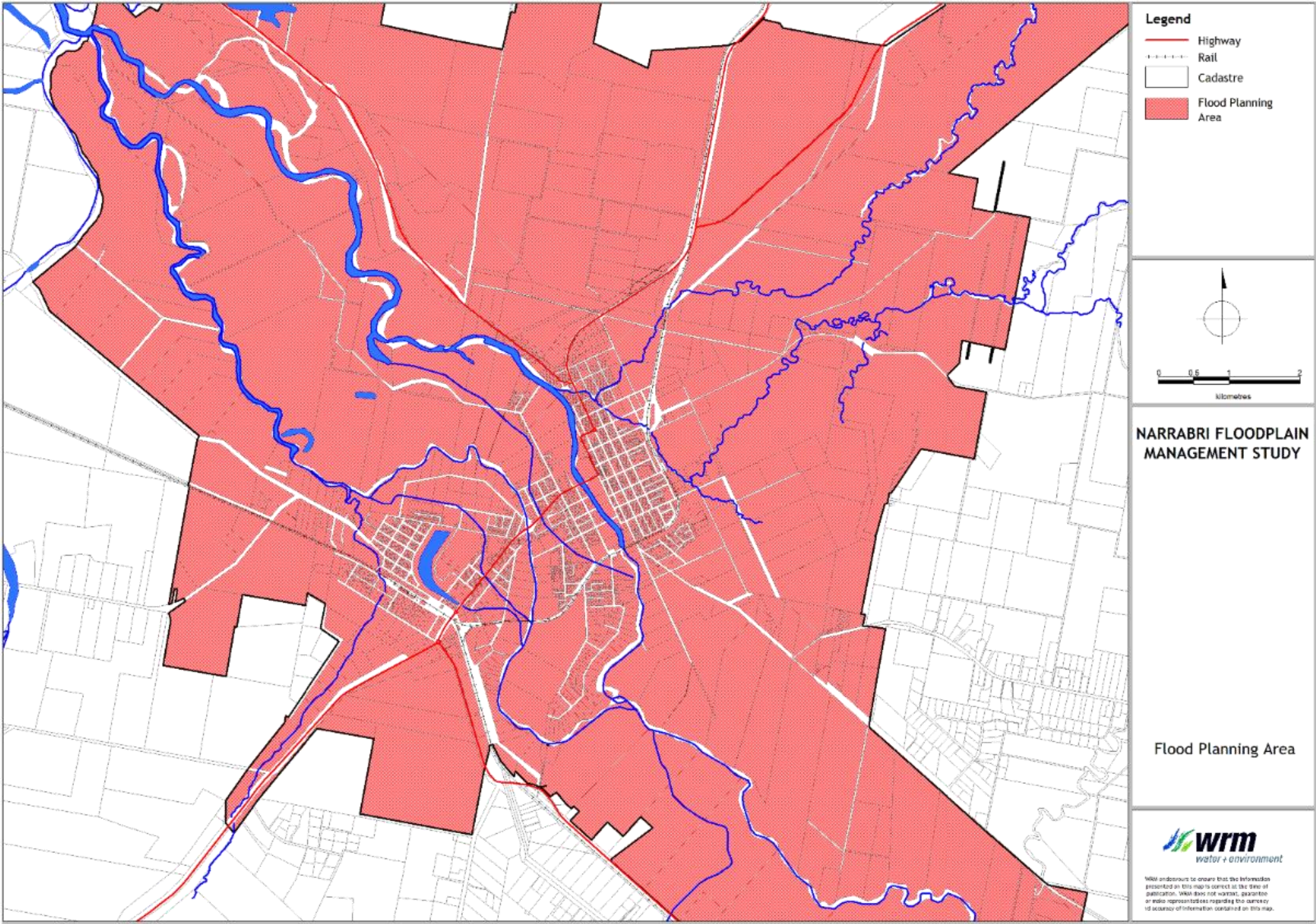


Figure 3.4 - Flood planning area

Table 3.3 - Example qualitative risk matrix (source: AIDR, 2017)

| Likelihood of consequence | AEP range (%) | Level of consequence | | | | |
|---------------------------|---------------|----------------------|-------|----------|-------|--------------|
| | | Insignificant | Minor | Moderate | Major | Catastrophic |
| Likely | >10 | | | | | |
| Unlikely | 1 to 10 | | | | | |
| Rare to very rare | 0.01 to 1 | | | | | |
| Extremely rare | <0.01 | | | | | |

Risk: Very low Low Medium High Extreme
 AEP = annual exceedance probability

The level of consequence to the environment cannot be assessed purely on hydraulic hazard but can be qualitatively assessed.

Table 3.4 provides an assessment of the consequences in each hydraulic hazard zone for each modelled design flood, including the number of existing buildings in each zone. Based on this information a risk rating has also been provided for each zone, which is then used to define the flood risk matrix for Narrabri.

Table 3.4 - Level of consequence in each hazard zone and adopted flood risk

| Row No. | Design event | Hydraulic hazard | Number of inundated buildings | Level of consequence | Adopted Risk |
|---------|--------------|------------------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1 | 20% AEP | H1 | 9 | Minor - hydraulic hazard is generally safe, but the frequent likelihood of inundation poses other threats (stress from repeated inundation etc.) | Medium |
| 2 | 20% AEP | H2 & H3 | 0 | Minor to Moderate - hydraulic hazard begins to become unsafe for certain people and the frequent likelihood of inundation poses other threats (stress from repeated inundation etc.) | High |
| 3 | 20% AEP | H4 - H6 | 0 | Major to Catastrophic - hydraulic hazard is unsafe for people and there is a frequent likelihood of inundation | Extreme |
| 4 | 10% AEP | H1 | 148 | Per row 1 | Medium |
| 5 | 10% AEP | H2 & H3 | 12 | Per row 2 | High |
| 6 | 10% AEP | H4 - H6 | 0 | Per row 3 | Extreme |
| 7 | 5% AEP | H1 | 568 | Minor - hydraulic hazard is generally safe | Low |
| 8 | 5% AEP | H2 & H3 | 356 | Moderate - hydraulic hazard begins to become unsafe for certain vehicles and people | Medium |
| 9 | 5% AEP | H4 | 2 | Major - hydraulic hazard is unsafe for people | High |

| Row No. | Design event | Hydraulic hazard | Number of inundated buildings | Level of consequence | Adopted Risk |
|---------|--------------|------------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------|--------------|
| 10 | 5% AEP | H5 & H6 | 0 | Major to Catastrophic - hydraulic hazard is unsafe for all vehicles and people | Extreme |
| 11 | 2% AEP | H1 & H2 | 861 | Minor to Moderate - hydraulic hazard begins to become unsafe for certain vehicles | Low |
| 12 | 2% AEP | H3 | 1,023 | Moderate - hydraulic hazard begins to become unsafe for certain people and all vehicles | Medium |
| 13 | 2% AEP | H4 & H5 | 77 | Major - hydraulic hazard is unsafe for people and structures | High |
| 14 | 2% AEP | H6 | 0 | Major to Catastrophic - hydraulic hazard is unsafe for all vehicles, people and buildings | Extreme |
| 15 | 1% AEP | H1 | 246 | Minor - hydraulic hazard is generally safe. | Very Low |
| 16 | 1% AEP | H2 | 299 | Moderate - hydraulic hazard begins to become unsafe for certain vehicles | Low |
| 17 | 1% AEP | H3 & H4 | 1,670 | Major - hydraulic hazard is unsafe for vehicles and either becoming unsafe or totally unsafe for people | Medium |
| 18 | 1% AEP | H5 | 4 | Major - hydraulic hazard is unsafe for people and vehicles and structures become vulnerable | High |
| 19 | 1% AEP | H6 | 0 | Per row 14 | Extreme |
| 20 | 0.5% AEP | H1 & H2 | 350 | Minor - hydraulic hazard is generally safe. A large existing population is exposed | Very Low |
| 21 | 0.5% AEP | H3 | 1,319 | Moderate to Major - hydraulic hazard begins to become unsafe for vehicles and certain people | Low |
| 22 | 0.5% AEP | H4 | 691 | Major - hydraulic hazard is unsafe for people and vehicles and a large existing population is exposed | Medium |
| 23 | 0.5% AEP | H5 | 17 | Major - hydraulic hazard is unsafe for people and vehicles and structures become vulnerable | High |
| 24 | 0.5% AEP | H6 | 0 | Major to Catastrophic - hydraulic hazard is unsafe for all vehicles, people and buildings | Extreme |
| 25 | 0.2% AEP | H1 - H3 | 1,403 | Minor to Moderate - hydraulic hazard is beginning to become unsafe for some people. A large existing population is exposed | Very Low |
| 26 | 0.2% AEP | H4 | 1,027 | Moderate to Major - hydraulic hazard is | Low |

| Row No. | Design event | Hydraulic hazard | Number of inundated buildings | Level of consequence | Adopted Risk |
|---------|---------------|------------------|-------------------------------|------------------------------------------------------------------------------------------------------------------------|--------------|
| | | | | unsafe for vehicles and people and a very large existing population is exposed | |
| 27 | 0.2% AEP | H5 | 58 | Major - hydraulic hazard is unsafe for people and vehicles and structures become vulnerable | Medium |
| 28 | 0.2% AEP | H6 | 0 | Major to Catastrophic - hydraulic hazard is unsafe for all vehicles, people and buildings | High |
| 29 | Extreme event | H1 - H3 | 268 | Minor - hydraulic hazard is beginning to become unsafe for some population but for an extreme event | Very Low |
| 30 | Extreme event | H4 | 388 | Moderate - hydraulic hazard is unsafe for vehicles and people and a large existing population is exposed | Low |
| 31 | Extreme event | H5 | 2,338 | Major - hydraulic hazard is unsafe for people and vehicles and structures become vulnerable for most of the population | Medium |
| 32 | Extreme event | H6 | 16 | Catastrophic - hydraulic hazard is unsafe for all vehicles, people and buildings. | High |

3.6.2 Flood risk matrix

Table 3.5 provides the qualitative flood risk matrix for Narrabri, which in effect is a summary of the consequence assessment provided in Table 3.4. The matrix defines six zones of flood risk on the Narrabri floodplain:

- Z1 - land free from flooding in both regional (Namoi River) and local catchment flood events; and
- Z2 (very low risk) to Z6 (extreme risk)

Table 3.5 - Flood risk matrix

| Design Flood | Flood risk per hydraulic hazard category | | | | | |
|---------------|------------------------------------------|----|----|----|----|----|
| | H1 | H2 | H3 | H4 | H5 | H6 |
| 20% AEP | Z4 | Z5 | Z5 | Z6 | Z6 | Z6 |
| 10% AEP | Z4 | Z5 | Z5 | Z6 | Z6 | Z6 |
| 5% AEP | Z3 | Z4 | Z4 | Z5 | Z6 | Z6 |
| 2% AEP | Z3 | Z3 | Z4 | Z5 | Z5 | Z6 |
| 1% AEP | Z2 | Z3 | Z4 | Z4 | Z5 | Z6 |
| 0.5% AEP | Z2 | Z2 | Z3 | Z4 | Z5 | Z6 |
| 0.2% AEP | Z2 | Z2 | Z2 | Z3 | Z4 | Z5 |
| Extreme Event | Z2 | Z2 | Z2 | Z3 | Z4 | Z5 |

3.6.3 Flood risk map

Figure 3.5 shows the flood risk map derived from the flood risk matrix. The flood risk map shows that:

- Risk zone Z6 (extreme flood risk) is limited to the Narrabri Creek and Namoi River channels as well as lower Doctors Creek, Horsearm Creek and Mulgate Creek channels and a select flood-runner channels;
- Risk zone Z5 (high flood risk) surrounds the Z6 zones and includes all major flood-runners and flow paths;
- Risk zone Z4 (medium flood risk) covers the urban area in Narrabri (except for Narrabri West). This highlights the very real risk posed by flooding to the residents of Narrabri;
- Risk zone Z3 (low flood risk) covers much of Narrabri West and some RU1 zoned (agricultural) land on the outskirts of Narrabri;
- Risk zone Z2 (very low flood risk) covers limited land, generally outside of the current urban extent of Narrabri; and
- Risk zone Z1 (flood free land) covers land unshaded on Figure 3.5. Very little development has occurred on flood free land around Narrabri with most of this land zoned RU1. The exceptions are a small number of industrial developments in Narrabri West that have been developed outside of the flood extent.

The approximate number of existing buildings located within each flood risk zone are provided below:

- Risk zone Z6 (extreme flood risk) - 0 buildings;
- Risk zone Z5 (high flood risk) - 84 buildings;
- Risk zone Z4 (medium flood risk) - 2,271 buildings;
- Risk zone Z3 (low flood risk) - 387 buildings;
- Risk zone Z2 (very low flood risk) - 268 buildings; and
- Risk zone Z1 (flood free land) - unclear (property survey was limited to the extreme flood extent - refer Section 4).

Note that other factors influence risk, including:

- effective warning time;
- flood readiness;
- rate of rise of floodwaters;
- duration of flooding;
- evacuation problems;
- effective flood access; and
- type of development.

The majority of areas across Narrabri (with the exception of Narrabri West) have a low flood island/low trapped perimeter emergency response classification (see Section 5). There is generally at least 24 hours flood warning available for the large, slow moving flood events from the Namoi River and the rate of rise of regional floodwaters is often relatively slow for all areas affected by Namoi River flooding (which is dominant across most urban areas). Long-term residents of Narrabri are also generally 'flood aware' given the frequency of flooding throughout history. These factors do not necessarily alter the flood risk, only the management measures required to mitigate the flood risk.

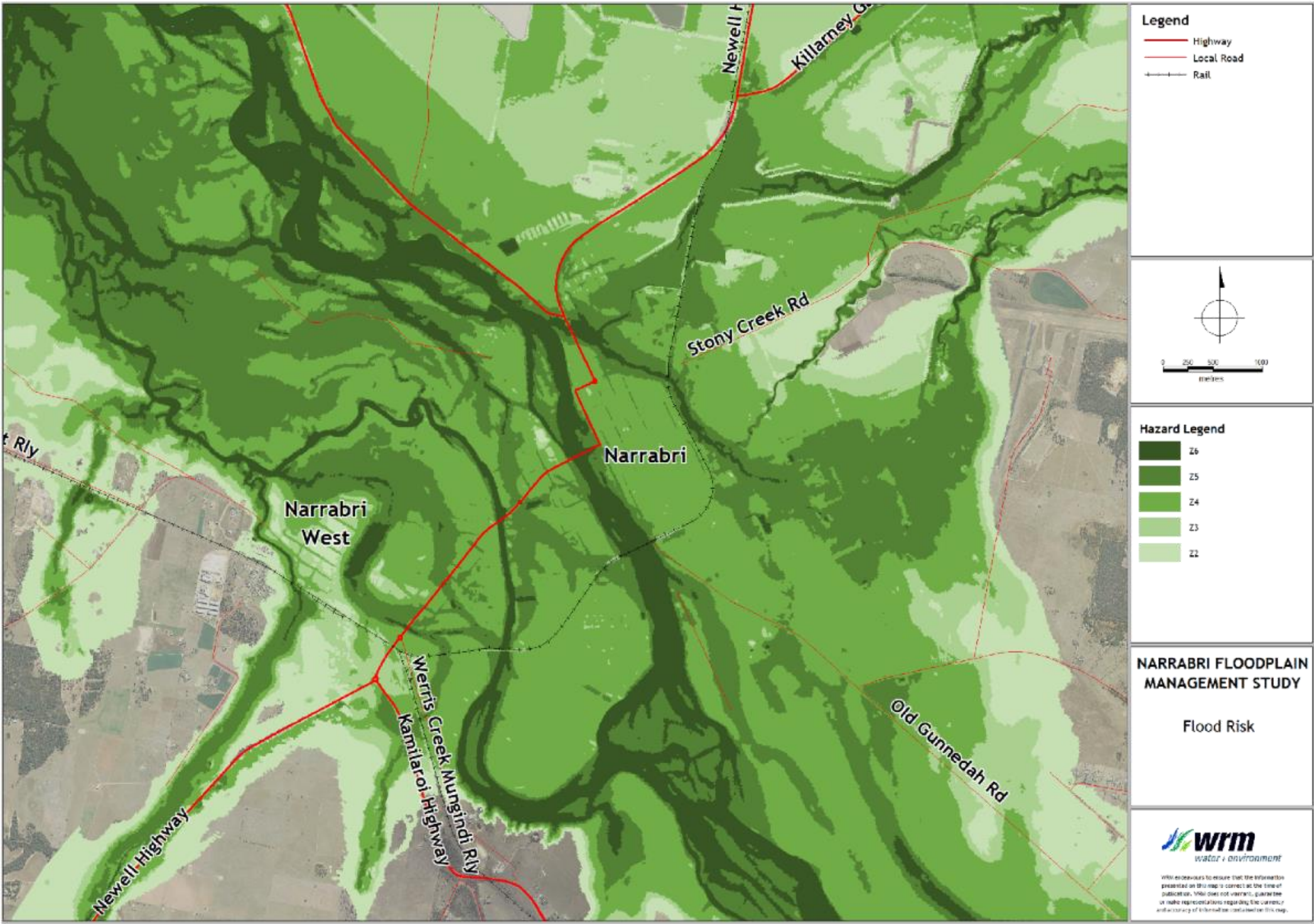


Figure 3.5 - Flood risk map

3.7 HYDRAULIC CATEGORIES

3.7.1 Background

The Manual (NSW Government, 2005a) defines three hydraulic categories of flood prone land:

- **Floodways (High risk)** are those areas where a significant volume of water flows during floods and are often aligned with obvious natural channels. They are areas that, even if only partially blocked, would cause a significant increase in flood levels and/or a significant redistribution of flood flow, which may in turn adversely affect other areas. They are often, but not necessarily, areas with deeper flow or areas where higher velocities occur.
- **Flood storage areas (Medium risk)** are those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. If the capacity of a flood storage area is substantially reduced by, for example, the construction of levees or by landfill, flood levels in nearby areas may rise and the peak discharge downstream may be increased. Substantial reduction of the capacity of a flood storage area can also cause a significant redistribution of flood flows.
- **Flood fringe (Low risk)** is the remaining area of land affected by flooding, after floodway and flood storage areas have been defined. Development in flood fringe areas would not have any significant effect on the pattern of flood flows.

Several floodways were defined in the 2002 supplementary floodplain management study (FMS) (Max Winders & Associates, 2002). Land below the predicted 5% AEP flood level was considered rural floodway, and it was proposed that additional land along Mulgate Creek downstream of the railway be re-zoned to floodway. Because of the adopted floodway definition (below the modelled 5% AEP level), floodways were limited to areas covered by the one-dimensional (quasi-two-dimensional) hydraulic model.

The flood fringe was defined in the 2002 FMS (Max Winders & Associates) as flood prone land outside of the defined floodways, while no flood storage areas were reportedly defined due to the limited impact flood storage has throughout Narrabri.

3.7.2 Floodways (High risk)

The Z6 and Z5 flood risk zones, described in Section 3.6, represent areas of significant flow depth or velocity (i.e. locations where significant flow volume occurs) and have therefore been adopted as floodways (high risk). The floodway definition aligns with natural flow conveyance channels including the Namoi River, Narrabri Creek, Eather's Creek, O'Brien's Creek, Lagoon Creek, Horsearm Creek, Doctor's Creek, Mulgate Creek, Long Gully and other flood runner channels in and around Narrabri. The results in Table 3.2 confirm that all these waterways convey significant flows during various flood events.

Where required, sections of Z6 and Z5 flood risk zones were connected to achieve continuous floodways, while isolated islands of high risk were removed as they were not in the active flow path. Figure 3.6 shows the adopted floodways (high risk).

3.7.3 Flood storage areas (Medium risk)

The Z4 flood risk zone represents areas of Narrabri that are analogous to flood storage areas, hence the Z4 area was used to define the flood storage (medium risk) areas. Again, the model results were adjusted to remove isolated islands of lower risk areas on low flood islands with no access during a flood. Figure 3.6 shows much of the existing development in Narrabri is located in the medium risk flood storage area.

3.7.4 Flood fringe areas (Low risk)

The Z3 and Z2 flood risk zones represent areas of the floodplain that are subject to either shallow inundation or are infrequently inundated. For this reason, the Z3 and Z2 zones were adopted as flood fringe areas (low risk).

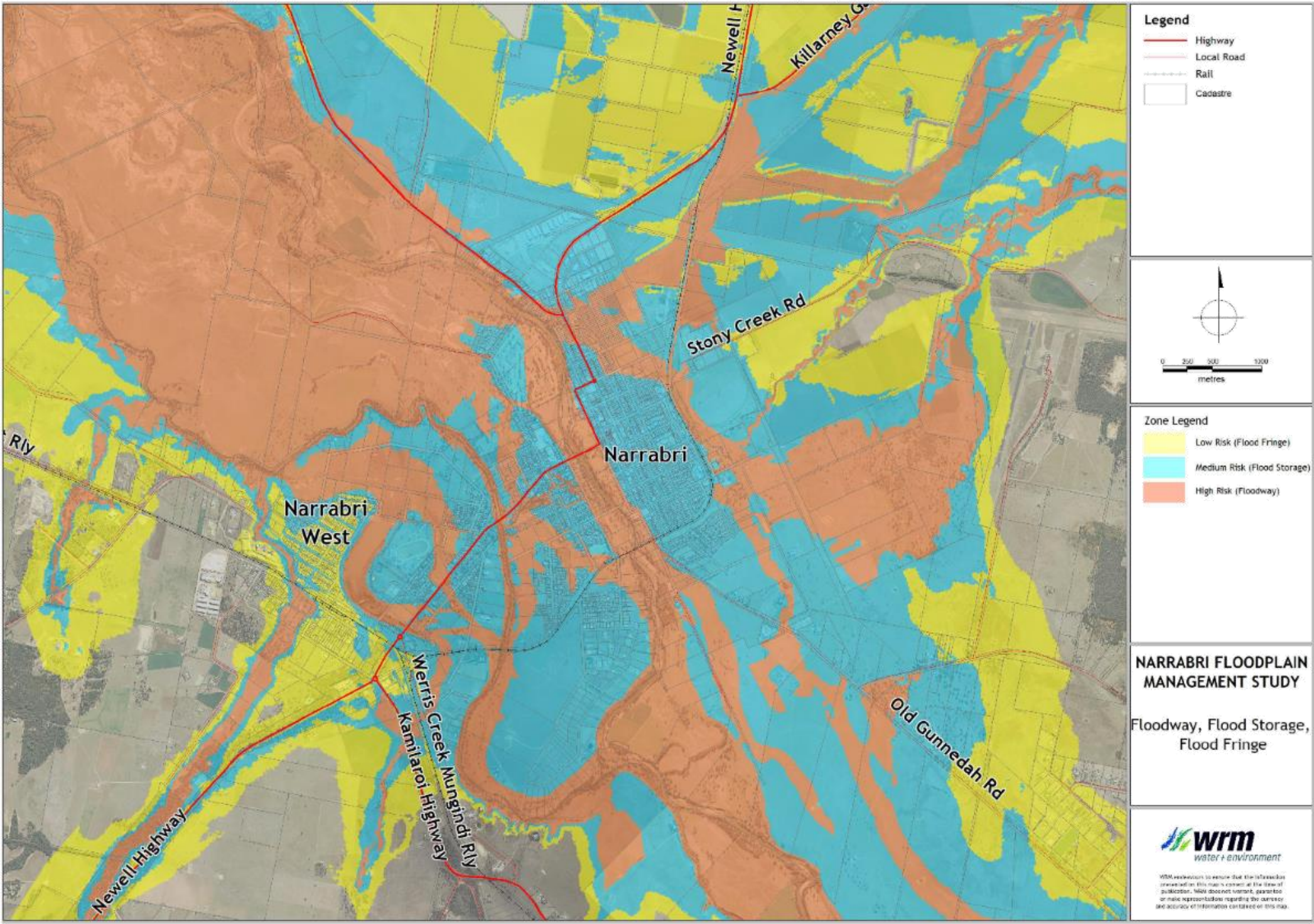


Figure 3.6 - Flood risk map (floodway, flood storage, flood fringe)

3.8 ASSESSMENT OF CLIMATE CHANGE

3.8.1 Overview

Climate change projections vary from source to source, with almost all projections agreeing rainfall intensities will increase across much of Australia as time progresses. Changes to rainfall intensity will impact flooding characteristics in and around Narrabri and these changes need to be considered as part of the flood risk management process.

3.8.2 Research

The NSW and ACT Regional Climate Modelling (NARCLIM) project is a multi-agency research partnership tasked with providing regional climate projections (NSW Government, 2014). NARCLIM modelling has predicted increased maximum and minimum temperatures both in the near future (2020-2039) and far future (2060-2079) for all of NSW (NSW Government, 2014). More hot days are predicted as are extensive seasonal shifts in rainfall (NSW Government, 2014).

Modelling conducted by CSIRO and BOM (2015) predicts the following for Narrabri (Central Slope Region):

- decreased average winter and spring rainfalls, with changes to summer and autumn rainfalls unclear;
- increased minimum, mean and maximum temperatures;
- more hot days and fewer frosts;
- increased rainfall intensity; and
- increased potential evapotranspiration across all seasons.

The latest advice on climate change given in Australian Rainfall and Runoff (AR&R) (Ball et al., 2019) recommends adoption of 4.5 and 8.5 representative concentration pathways (RCPs) from the climate futures tool developed by CSIRO. RCP4.5 and RCP8.5 represent low and high projected changes from global climate models. The 2090 planning horizon has RCP4.5 (low) and RCP8.5 (high) projected changes in rainfall intensity for Narrabri (Central Slopes region) of +10.8% and +22.8% respectively (Geoscience Australia, 2019).

3.8.3 Approach

The former NSW Office of Environment and Heritage (2019) has produced a guideline for incorporating the latest version of AR&R into NSW floodplain risk management studies. For consideration of climate change the guideline specifies:

“Rather than simulating additional scenarios specifically to consider climate change, the scale of climate change impacts can generally be practically assessed using the 0.5% and 0.2% AEP floods as proxies for the 1% AEP flood, subject to long-term changes in flood-producing rainfall events related to climate change.”

3.8.4 Impact on local catchment flooding

A preliminary assessment of the impact of climate change on local catchment flooding was undertaken in Volume I of this study (WRM, 2019b). The assessment was conducted with a 30% increase to peak rainfall and storm volume (NSW Government, 2007b). A 30% increase to peak rainfall and volume would result in local catchment 1% AEP (climate change) flood levels and extents almost the same as the local catchment 0.2% AEP (no climate change) flood levels and extent. Flood levels at reporting location across the study area were found to increase by up to 0.35 m for this scenario (WRM, 2019b).

Latest research suggests that the magnitude of increase to peak rainfall intensity and volume adopted for Volume I of this study may be conservative (high).

The critical duration 0.5% AEP rainfall for local catchments in Narrabri is approximately 13% higher than the 1% AEP rainfall, while the critical duration 0.2% AEP rainfall is

approximately 30% higher than the 1% AEP rainfall. Hence the advice given above from AR&R (Ball et al., 2019) and Geoscience Australia (2019) suggests that 1% AEP (climate change) rainfall intensities lie somewhere between just under 0.5% AEP rainfall (RCP4.5) and between 0.5% and 0.2% AEP rainfall (RCP8.5).

Rainfall intensity is not the only factor affecting flooding. The research reproduced in the preceding section also predicts a hotter climate with greater evapotranspiration meaning that it will be likely to be drier at the onset of flooding rainfalls. These changes mean that initial and continuing losses will likely increase, providing some offset to the increased rainfall intensity.

Considering the above and adopting the NSW Government (2019) methodology it would appear that the 0.2% AEP flood mapping prepared in Volume I of this study would be a conservative 1% AEP climate change representation, while the 0.5% AEP estimate is likely a better representation of the likely impact of climate change on the 1% AEP event.

3.8.5 Impact on regional (Namoi River) flooding

The peak discharge estimate for the 0.5% AEP regional flood at Narrabri is approximately 13% higher than the 1% AEP peak discharge estimate, while the 0.2% AEP peak discharge estimate is approximately 27% higher than the 1% AEP peak discharge.

Considering the research on potential changes to climate and adopting the NSW Government (2019) methodology it would appear that the regional 0.2% AEP flood mapping prepared in Volume I of this study would be too conservative to represent the 1% AEP climate change representation, while the 0.5% AEP estimate is likely a better representation of the likely impact of climate change on the 1% AEP regional event.

4 Flood damage estimation

4.1 TYPES OF FLOOD DAMAGE

The Manual (NSW Government, 2005a) defines the various types of damage caused by flooding, with these damages shown graphically in Figure 4.1. Flood damage can be divided into two major categories: tangible and intangible damages. Tangible damages are the financial costs of flooding and are quantified in dollar terms, while intangible damages are the social and environmental costs of flooding and are reflected in increased levels of emotional stress and psychological and physical illness.

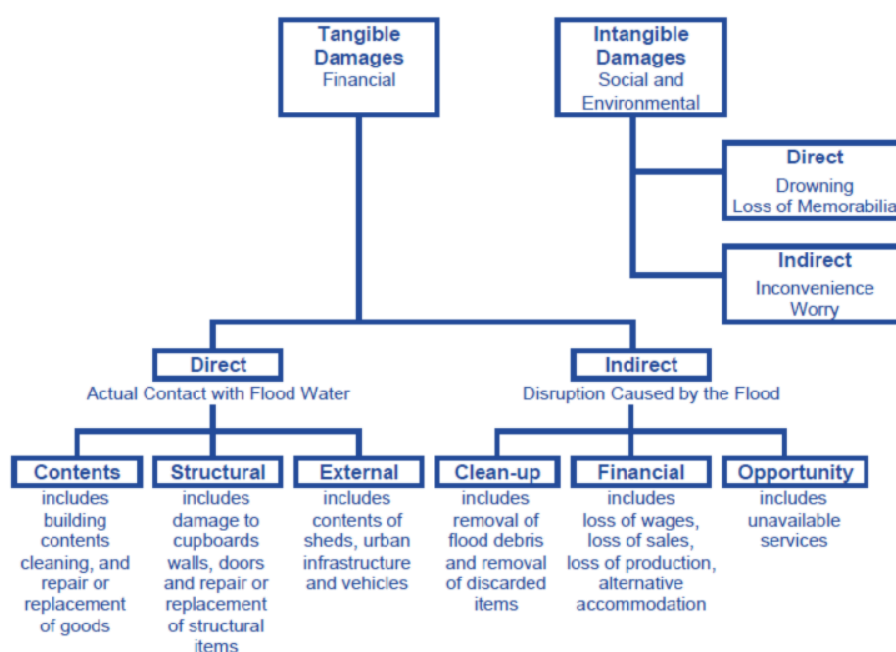


Figure 4.1 - Types of flood damage (Source: NSW Government, 2005a)

4.1.1 Tangible damages

Tangible damages can be defined as potential damages or actual damages. Potential damages are the damage that would be sustained by a property if nothing were done to attempt to reduce this damage. Actual damages are less than potential damages, particularly for places like Narrabri, where the community generally has time to relocate items before regional Namoi River floods arrive.

Tangible damages can be separated into two major sub-categories:

- direct damage - the loss in value of an object or piece of property caused by direct contact with floodwater; and
- indirect damage - the loss in production or revenue caused by a flood, e.g. the loss of wages, additional accommodation and living expenses and any other extra outlays that occur because of flood.

Indirect damages are additional to ordinary pre-flood living costs. Indirect damages are typically incurred in the post-flood recovery phase.

4.1.1.1 Direct damage

Direct damage can be incurred either as:

- a replacement cost if a flood-damaged item is discarded;
- a repair cost if the item is repaired; or
- a loss in value if the item is neither discarded nor repaired (repaired items also suffer a loss in value).

In the first case, the direct damage is either the pre-flood value or the replacement cost of the item. In the second case, the damage is the cost of repairs (plus any loss in value). In the third case, the damage is simply the loss in value.

Direct damage is divided into three categories: contents damage, external damage and structural damage (see Figure 4.1):

- contents damage refers to damage to the contents of the main building(s) on a property;
- external damage refers to damage to items external to the main building, e.g. motor vehicles, fences, gardens, the contents of sheds or outbuildings, etc.; and
- structural damage refers to the damage sustained by the fabric of a building (foundations, floors, walls, doors, windows, etc.) and the damage sustained by permanent fixtures in the building, such as built-in cupboards, benches, etc.

4.1.1.2 Indirect damages

Indirect damage is also divided into three categories:

- indirect financial damage refers to the loss of income or increased expenditure caused by a flood;
- clean-up cost refers to the cost of labour and materials required to clean out a flooded building. Typical clean-up activities include the hosing down of walls and floors to remove silt, the taking up of flooded carpets, the removal and discarding of irreparably damaged items, the drying of rooms, etc.; and
- opportunity costs which arise from direct damage to public assets. Because of this damage, a period elapses when the public is not provided with these services or is provided with a reduced level of service.

It is difficult to realistically evaluate opportunity costs. On the one hand, opportunity costs can be estimated in terms of the total operating cost of the facility (wages, maintenance, interest on capital assets, etc.). Society is prepared to pay this cost to provide the services; thus their absence must be worth a corresponding amount. On the other hand, during the aftermath of a flood, public employees often undertake non-duty tasks useful to society when not providing public services (e.g. clean-up operations). For reasons of convenience, opportunity costs are often estimated as the wages cost over the period public facilities are not operating.

4.1.1.3 Potential versus actual damage

Potential damage refers to the damage that would be sustained if no actions whatsoever were taken by householders, or others, to reduce flood damage, i.e. the damage that would occur if the entire population was absent when a flood occurred.

The actual damage sustained at a property is always less than the potential damage. Notwithstanding the shortness or absence of flood warnings, people will attempt to save items by lifting them onto benches or shelves, by shifting motor vehicles, by evacuating their possessions, etc.

Potential and actual damage costs are the same for structural damage, as it is generally impossible to reduce structural damage to buildings in the onset of a flood.

4.1.2 Intangible damages

Intangible damage is difficult to measure and impossible to meaningfully quantify in dollar terms. Nevertheless, it is a very real, significant and often enduring 'cost' that emerges during the recovery phase of a disaster.

The social impacts of flooding include:

- the loss of irreplaceable items, such as family photographs;
- the stress induced by the flood itself;
- temporary evacuation of the home whilst the damage is repaired;
- the disruption caused by the flood to the life of the individual household and to the community as a whole; and
- the effect of floods upon the physical and mental health of those affected.

Research in the past has shown that social impacts can be more important to the victims of floods than the financial losses that they suffer.

4.2 TANGIBLE FLOOD DAMAGE ESTIMATION METHODOLOGY

4.2.1 Overview

Many factors affect flood damage (e.g. depth of inundation, flow velocity, duration of inundation, time of occurrence, debris/sediment loads, water quality etc.). However, other than the depth of inundation, very little guidance and information is available on how to take the relevant factors into account when estimating flood damage.

In most studies, flood damages are related to only the depth of inundation because the other factors are heterogeneous in space and time, difficult to predict, and there is limited information on their quantitative effects (Merz et al., 2010). As a result, flood stage-damage curves are typically used to estimate flood damages. However, accurate flood damage estimates cannot be made without stage-damage curves that are accurate and locally relevant.

Flood damage estimates made from stage-damage curves require the following information:

- property data;
- floor level data;
- ground level data;
- flood level data; and
- stage-damage curves.

4.2.2 Property and floor level data

A property floor level survey was conducted by Gleeson Surveying between November 2018 and May 2019. All properties within the study area that were within the local catchment PMF extent and/or regional extreme flood extent (based on the Narrabri Flood Study (WRM, 2016)) were included in the survey.

Gleeson Surveying undertook the floor level survey using both GPS and robotic total stations, with laser distance measurement also being used. Data collected as part of the floor level survey included other relevant property data, such as:

- unique building ID;
- building address;

- survey coordinates;
- property ground level;
- building floor level
- building coordinates;
- building use (residential/non-residential);
- building size estimate (residential only);
- building type (detached/non-detached);
- building condition;
- number of storeys;
- building foundation (slab/piers);
- business type (non-residential only);
- business name (non-residential only); and
- miscellaneous comments.

A few properties were added to the database after the completion of the survey due to updates to modelling, which increased the extreme flood extent in some areas. Floor levels for these properties were assumed using the LiDAR topographic level (ground level) at each property and adding the average freeboard for slab-on-ground properties from the survey dataset (i.e. it was conservatively assumed that the small number of added properties were all slab-on-ground buildings).

4.2.3 Ground level and flood level data

The ground level at each property was recorded during the property survey. Any properties not given a ground level during the survey were assigned a ground level using the available LiDAR topographic data (captured in January 2014). Design flood levels at each property were assigned by inspecting the building coordinates captured during the property survey against flood surfaces produced during Volume I of this study (WRM, 2019b). Further information on the flood level data is provided in Volume I of this study (WRM, 2019b).

4.2.4 Residential stage-damage curves

Flood stage-damage curves (flood damage curves) relate the depth of flooding at a residential property to an estimate of the corresponding flood damage.

For this study, the residential stage-damage curves described in the Residential Flood Damages flood risk management guideline (NSW Government, 2007c) have been used to estimate tangible residential flood damages. The NSW Government approach uses a typical damage curve, which allows damages to be estimated for individual dwellings based on the property type. The use of these curves provides a consistent basis for calculation of flood damage between different projects across NSW whilst allowing consideration for local variation through the scale of a typical house and the value of its contents.

The NSW Government residential flood damage methodology does not account for calculation of damage to multi-residential properties (flats, units, townhouses etc.). Where properties were identified as multi-residential a residential damage multiplier (based on the number of structures in the complex and the total number of residences within the complex) was included to give more appropriate damage estimates.

The NSW Government stage-damage curves are factored to account for available warning time and likely duration of inundation. Therefore, two sets of residential stage-damage curves were used. One set of curves was used for calculating damages from regional (Namoi River) flooding, where warning of impending flooding is often available, and the duration of flooding can exceed a week. A second set of curves was calculated for local catchment flooding where warning times are short, and durations of flooding are likely from a couple of hours up to a couple of days.

The parameters used to define the residential stage-damage curves are given in Table 4.1. Figure 4.2 graphically shows the residential stage-damage curves adopted for the study.

Table 4.1 - Residential flood damage curve values, NSW Government method

| Parameter | Value |
|------------------------------------------------------------|---------------------------|
| Regional cost variation factor (from Rawlinsons, 2016) | 1.15 |
| Post late 2001 adjustments (AWE adjustment*) | 1.866 |
| Post flood inflation factor (No. flooded properties > 700) | 1.45 |
| Typical duration of immersion | >12 hours (R) 6 hours (L) |
| Building damage repair limitation factor | 0.90 (R) 0.85 (L) |
| Typical house size | 240 m ² |
| Average content relevant to site | \$60,000 |
| Contents damage repair limitation factor | 0.80 (R) 0.75 (L) |
| Level of flood awareness | High (R) Low (L) |
| Effective warning time | 12 hours (R) 0 hours (L) |
| Likely time in alternative accommodation | 3 weeks |

*AWE = Average Weekly Earning
R = Regional (Namoi River) flooding
L = Local catchment flooding

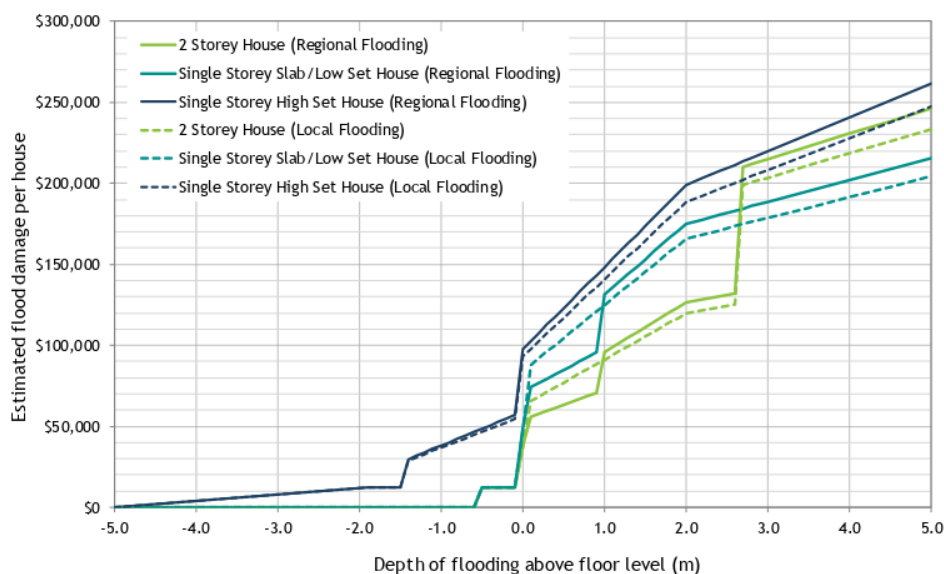


Figure 4.2 - Residential stage-damage curves

The level of flood awareness and effective warning time given in Table 4.1 have been used to adjust the stage-damage curves from potential flood damages (damages that would be sustained by a property if nothing was done to attempt to reduce this damage) to actual damages.

4.2.5 Commercial and industrial stage-damage curves

Although commercial and industrial damage can be a significant component of overall flood damage, to date there has been less research on non-residential stage-damage curves than residential stage-damage curves. A possible reason for this is that it is very difficult to provide accurate estimates given that the costs can vary significantly between each commercial property type and use.

For this study, flood damage curves developed by researchers at Australian National University (CRES, 1992) in the 1980's (ANUFLOOD) have been used. In ANUFLOOD, the commercial and industrial damage is defined on building size and business type. Three building sizes (small/medium/large) and five classes of building value category (1/2/3/4/5) are combined for a total of fifteen different building categories.

In applying these curves, the type of business/industry can be defined using the Australia & New Zealand Standard Industrial Classification Code (ANZIC) (ABS, 2013). These code numbers provide a profile of the commercial and industrial composition of the building. ANZIC is an internationally recognised code to describe (among other things) building use. It provides a simple way of describing the use of commercial and industrial buildings.

The ANZIC value class is assessed from 1 (low value) to 5 (high value). The value class is a subjective estimate of the likely loss that would be sustained if the building was inundated by floodwaters. Guidance on the selection of value class is given in Figure 4.3.

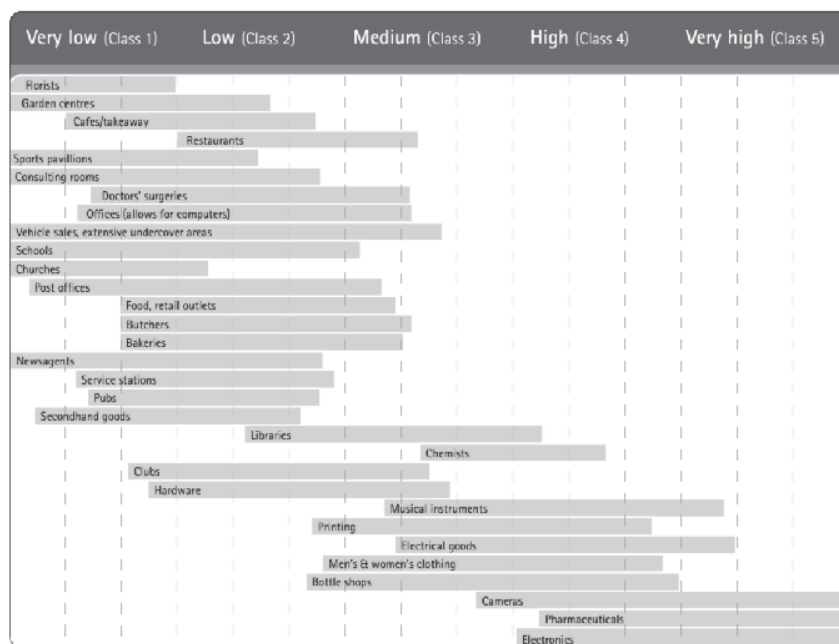


Figure 4.3 - Damage categories for commercial properties (Source: CRES, 1992)

If necessary, this guide can be used as an alternative to the ANZIC code number. It is noted that even a brief field inspection allows for the determination of value class variations. For example, a dress shop can have a few high value items or consist of hundreds of garments on racks. Field assessment permits such differences within a single ANZIC class code to be better defined. Data obtained during the floor level survey on building condition, business name and type, and any comments, were used to inform the selection of value class for all non-residential buildings.

Table 4.2 shows ANUFLOOD commercial/industrial stage-damage curves updated to December 2019 prices using changes in the Consumer Price Index (CPI). For each non-residential property, damage is also dependent on the size of the building. ANUFLOOD defines three building size ranges:

- small properties (floor area <186m²);
- medium properties (floor area 186 - 650m²); and
- large properties (floor area >650m²).

Table 4.2 - Stage-damage curves for commercial properties (Source: CRES 1992)

| Depth of Flooding Above Floor Level (m) | Potential Direct Damage (December 2019 Dollar Values) | | | | |
|------------------------------------------------------------------------------|----------------------------------------------------------|----------|-------------|-----------|----------------|
| | Value Class | | | | |
| | 1 Very Low | 2 Low | 3 Medium | 4 High | 5 Very High |
| Small Properties (Floor Area <186m²) (\$) | | | | | |
| ≤ 0.00 | 0 | 0 | 0 | 0 | 0 |
| 0.25 | 5,097 | 10,196 | 20,391 | 40,781 | 81,565 |
| 0.75 | 12,745 | 25,488 | 50,978 | 101,955 | 203,910 |
| 1.25 | 19,115 | 38,235 | 76,465 | 152,933 | 305,863 |
| 1.75 | 21,240 | 42,480 | 84,963 | 169,925 | 339,848 |
| ≥ 2.00 | 22,513 | 45,031 | 90,060 | 180,119 | 360,239 |
| Medium Properties (Floor Area 186-650m²) (\$) | | | | | |
| ≤ 0.00 | 0 | 0 | 0 | 0 | 0 |
| 0.25 | 16,145 | 32,286 | 64,572 | 129,142 | 258,286 |
| 0.75 | 39,082 | 78,164 | 156,331 | 312,661 | 625,320 |
| 1.25 | 59,473 | 118,948 | 237,893 | 475,851 | 951,576 |
| 1.75 | 65,843 | 131,693 | 263,383 | 526,766 | 1,053,531 |
| ≥ 2.00 | 70,093 | 140,190 | 280,375 | 560,751 | 1,121,501 |
| Large Properties (Floor Area >650m²) (\$/m²) | | | | | |
| ≤ 0.00 | 0 | 0 | 0 | 0 | 0 |
| 0.25 | 16.20 | 34.72 | 74.07 | 141.2 | 282.4 |
| 0.75 | 90.27 | 180.5 | 356.5 | 712.9 | 1,433 |
| 1.25 | 187.5 | 375.0 | 754.6 | 1,502 | 3,002 |
| 1.75 | 305.5 | 618.0 | 1,234 | 2,465 | 4,928 |
| ≥ 2.00 | 368.0 | 736.1 | 1,472 | 2,944 | 5,891 |

For small and medium size properties, damage is specified in total dollar values. Damage for large properties is specified as a dollar value per unit floor area. It is not clear what damage components are included and/or excluded in the ANUFLOOD damage values. It appears that damage estimates include structural damages. However, it does not appear that these damage curves include external damages.

The stage-damage curves given in Table 4.2 are potential stage-damage curves. The NSW Government methodology used for the residential stage-damage curves converted potential damages to actual damages, hence a similar conversion was required for the commercial stage-damage curves.

For this study, the ratio of actual to potential flood damages was varied depending on the depth of flooding, the available warning time and level of flood awareness. This methodology is more realistic than a simpler constant ratio methodology and is consistent with the residential stage-damage methodology.

For regional (Namoi River) flood events it was assumed that all commercial buildings in Narrabri have a similar warning time of at least 12 hours and flood awareness in the Narrabri community is high. Hence the actual to potential flood damage ratio was varied based only on the depth of flooding. The adopted actual to potential damage ratios were based on Figure 4.4 with flood depths of 0.5 m or less assigned an actual to potential damage ratio of 0.4, while flood depths of 2.0 m or greater were assigned a ratio of 0.7, with the ratio for depths in between linearly interpolated.

For local catchment (Mulgate Creek and Long Gully) flood events the available warning time is negligible so the actual damages would likely approach potential damages. Hence, for local catchment flooding the adopted actual to potential damage ratios were based on Figure 4.4 with flood depths of 0.5 m or less assigned an actual to potential damage ratio of 0.8, while flood depths of 2.0 m or greater were assigned a ratio of 0.9, with the ratio for depths in between linearly interpolated.

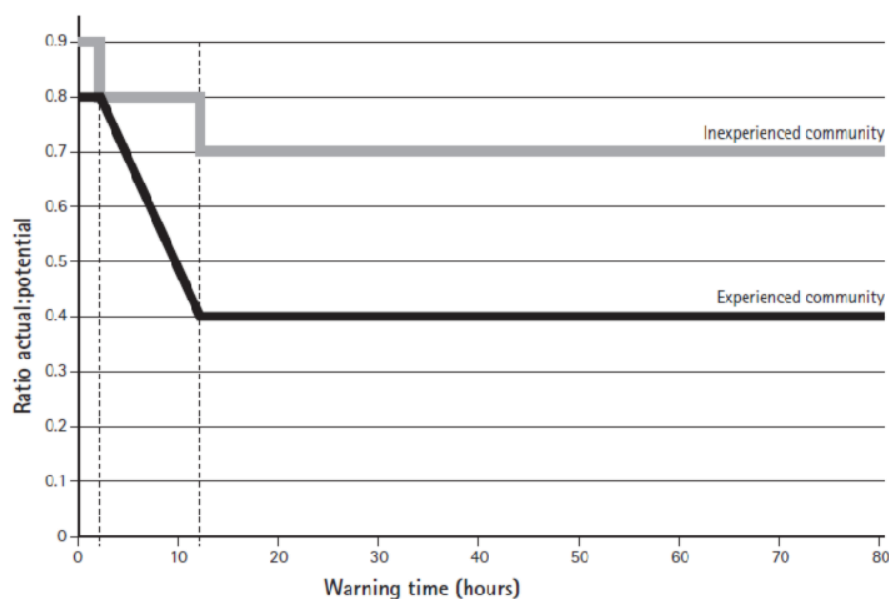


Figure 4.4 - Actual to potential damage ratio relationship (Source: VDNRE, 2000)

4.2.6 Public authority buildings and public utilities

Direct damage to public and community owned buildings and assets must also be considered when estimating overall flood damage. These include:

- hospitals, schools, police and fire stations, and other government owned buildings;
- parks and recreational facilities;
- sporting facilities; and

- communication, electricity, water supply, sewerage and drainage systems.

Ideally, damage to these properties should be estimated on a case by case basis. In the absence of better data, damage to these properties were evaluated using the stage-damage curves given for commercial/industrial damage in Section 4.2.5.

4.2.7 Roads and bridges

Flooding can cause significant damage to roads and bridges. The use of generalised damage rates to calculate road and bridge damage is not applicable as the cost is often closely related to the distance required to travel to access suitable materials (quarries and depots).

In a recent floodplain management study, Moree Plains Shire Council advised that the repair cost incurred in the shire as a result of the November 2011 and February 2012 floods was \$36.1 million (WRM, 2017). Of this, some \$4.4 million was incurred in the urban areas of Moree and the remainder of the damage was incurred in the rural areas. Whilst all floods are different, this gives an indication of the likely magnitude of road infrastructure damage that could be expected for a moderate sized flood event at Narrabri.

4.2.8 Average annual damage

Over a long period of time, a flood liable community will be subject to a succession of floods. In many years, no floods may occur or the floods may be too small to cause damage. In some years, the floods will be large enough to cause damage, but the damage will generally be small because the floods are of small to medium size. On rare occasions, major floods will occur and cause great damage.

The average annual damage (AAD) is equal to the total damage caused by all floods over a long period of time divided by the number of years in that period (assuming that the population and development situation does not change over the period of analysis). By estimating the damage caused by floods of different severity, e.g. the 20%, 10%, 5%, 2%, 1%, 0.2% and 0.5% AEP and extreme flood events from this study, it is possible to combine the likelihood of a flood occurring, with the damage it causes, and so estimate the AAD.

4.3 INTANGIBLE FLOOD DAMAGE ESTIMATION METHODOLOGY

For this study, intangible damages have been defined on a qualitative basis by comparing the relative flood mitigation benefits of each option to the existing scenario (refer Section 6). Though intangible damages have only been qualitatively assessed it should be remembered that intangible flood damages represent a not insignificant component of overall flood damage. The Brisbane River Strategic Floodplain Management Plan (QRA, 2018) estimated that for the Brisbane River floodplain the total average annual damage incorporating tangible and intangible damages would be approximately 55% greater than tangible damages alone.

4.4 EXISTING CONDITIONS TANGIBLE FLOOD DAMAGE ESTIMATES

Tangible building flood damages were estimated in the study area for both regional (Namoi River) flooding and local catchment (Mulgate Creek and Long Gully) flooding. The flood damages presented in the following sections are tangible building flood damage estimates only, hence are exclusive of road, agricultural and public infrastructure damages (parks, sporting fields etc.).

4.4.1 Regional flooding

The spatial distribution of Namoi River flood affected properties is shown in Figure B.1 and Figure B.2 in Appendix B. Table 4.3 shows the estimated number of properties flooded above and below floor level and the estimated residential and non-residential building damages for each regional design flood event (in December 2019 dollar values). The

estimated regional flooding average annual building damage (AAD) is also shown. With respect to the regional 1% AEP flood, the results show that:

- there are more than 2,190 flood affected buildings. Of these:
 - over 900 residential buildings would be inundated above floor level;
 - over 300 non-residential buildings would be inundated above floor level; and
- the total flood damage costs would be in the order of \$140 million (excluding road, bridge and agricultural flood damages).

Table 4.3 - Estimated number of flood affected buildings and flood damage, existing conditions, regional flood events

| Parameter | Event (AEP) | | | | | | | |
|-------------------------------------------|----------------|-------|--------|--------|---------|---------|---------|---------|
| | 20% | 10% | 5% | 2% | 1% | 0.5% | 0.2% | Extreme |
| No. residential buildings flooded AGL | - | 54 | 670 | 1,526 | 1,743 | 1,847 | 1,939 | 2,417 |
| No. residential buildings flooded AFL | - | 17 | 229 | 664 | 914 | 1,102 | 1,267 | 2,389 |
| Total residential damages (\$M) | \$0.0 | \$2.1 | \$30.6 | \$98.9 | \$134.4 | \$165.1 | \$192.9 | \$444.4 |
| No. non-residential buildings flooded AGL | - | 91 | 229 | 413 | 453 | 482 | 496 | 573 |
| No. non-residential buildings flooded AFL | - | 5 | 86 | 243 | 305 | 354 | 391 | 573 |
| Total non-residential damages (\$M) | \$0.0 | \$0.0 | \$0.7 | \$3.4 | \$6.0 | \$9.4 | \$12.7 | \$74.5 |
| Building average annual damage | \$6.22M | | | | | | | |

AGL - above ground level (count includes buildings flooded above both ground level and floor level)
AFL - above floor level

4.4.2 Local flooding

The spatial distribution of local catchment flood affected properties is shown in Figure B.3 and Figure B.4 in Appendix B. Table 4.4 shows the number of properties flooded above and below floor level and the estimated residential and non-residential building damages for each local catchment design flood event (in December 2019 dollar values). The estimated average annual building damage (AAD) is also shown.

Table 4.4 - Estimated number of flood affected buildings and flood damage, existing conditions, local flood events

| Parameter | Event (AEP) | | | | | | | |
|-------------------------------------------|----------------|-------|-------|--------|--------|--------|--------|---------|
| | 20% | 10% | 5% | 2% | 1% | 0.5% | 0.2% | PMF |
| No. residential buildings flooded AGL | 4 | 13 | 19 | 286 | 405 | 503 | 590 | 1,943 |
| No. residential buildings flooded AFL | 2 | 2 | 5 | 86 | 139 | 184 | 242 | 1,277 |
| Total residential damages (\$M) | \$0.2 | \$0.6 | \$1.1 | \$15.5 | \$23.7 | \$31.3 | \$38.4 | \$186.3 |
| No. non-residential buildings flooded AGL | 2 | 5 | 7 | 53 | 79 | 116 | 152 | 537 |
| No. non-residential buildings flooded AFL | - | 1 | 1 | 27 | 45 | 63 | 93 | 412 |
| Total non-residential damages (\$M) | \$0.0 | \$0.0 | \$0.0 | \$0.4 | \$0.7 | \$1.2 | \$1.7 | \$26.5 |
| Building average annual damage | \$1.05M | | | | | | | |

AGL - above ground level (count includes buildings flooded above both ground level and floor level)
AFL - above floor level

With respect to the local catchment 1% AEP flood, the results show that:

- there are more than 180 flood affected buildings. Of these:
 - over 130 residential buildings would be inundated above floor level;
 - over 40 non-residential buildings would be inundated above floor level; and
- the total flood damage costs would be in the order of \$24 million (excluding road, bridge and agricultural flood damages).

4.4.3 Discussion

Table 4.3 and Table 4.4 show the estimated building damages for regional and local design flood events respectively. In addition to the tabulated building damages, there would also be tangible road infrastructure and agricultural damages, as well as the intangible damages. From the tabulated results it can be seen that:

- regional (Namoi River) flooding causes substantially greater damage in the study area than local catchment flood damage for all design events except the 20% AEP design flood;
- regional design flood events equal to or rarer than 5% AEP would inundate hundreds of buildings above floor level, causing building damages in the tens to hundreds of millions of dollars;
- the regional 1% AEP flood event would potentially flood over 1,200 buildings above floor level. This represents around one third of the buildings within Narrabri and surrounds;
- between 79% and 84% of the properties inundated above floor level for regional flood events between 5% AEP and 0.2% AEP are located within the Main Town South and The Village North communities (refer Figure 5.1);
- on average, regional flooding costs the Narrabri community around \$6.22 million per year with approximately 95% associated with residential buildings;
- local catchment (Mulgate Creek and Long Gully) flooding has a large jump in flood damage cost between the 5% and 2% AEP flood. Local flood events up to the 5% AEP design flood would inundate less than 10 buildings above floor level, while a local catchment 2% AEP design flood would inundate over 110 buildings above floor level;
- between 67% and 85% of the properties inundated above floor level for local catchment flood events between 5% AEP and 0.2% AEP are located within the Main Town South community (refer Figure 5.1); and
- on average, local catchment flooding costs the Narrabri community around \$1.05 million per year with approximately 95% associated with residential buildings.

Assuming independence of local catchment flooding and regional (Namoi River) flooding, the total building average annual flood damage to Narrabri for existing conditions is approximately \$7.27 million.

5 Emergency response planning

5.1 OVERVIEW

The principal residual flood risk management option for Narrabri is evacuation. The Narrabri Shire Local Flood Plan covers “preparedness measures, the conduct of response operations and the coordination of immediate recovery measures from flooding” (NSW SES, 2015). Issues such as flood warning, evacuations and flood recovery are discussed in the Local Flood Plan.

For the purpose of emergency response planning, the township of Narrabri was split into the following communities based on their differing emergency response requirements:

- Main Town North;
- Main Town South;
- Old Gunnedah Road;
- The Village South;
- The Village North; and
- Narrabri West.

Figure 5.1 shows the emergency response communities including locations of the various properties that are at risk within each community. Each community has been delineated using the Flood Emergency Response Planning Classification Of Communities flood risk management guideline (NSW Government, 2007a).

5.2 ACCESS ROAD INUNDATION

Figure 5.2 shows roads estimated to be inundated by more than 0.3 m for greater than 24 hours in the 5% and 1% AEP design events respectively. It should be noted that each individual flood event is unique, and the design flood modelling has been based on the 1974 flood hydrograph. Some flood events, for example the 1971 flood, where flood levels were elevated for more than 10 days, may inundate other roads for extended periods of time, hence Figure 5.2 should be used as a guide only.

The results show that several key roads would likely be cut for extended periods during a 5% AEP design flood event. The results also show that most roads within the flood extent would be cut for extended periods during a 1% AEP design flood event. For the purposes of evacuation, it was assumed that a road would be closed if it is overtopped by more than 0.3 m.

5.3 EVACUATION CENTRES

The Local Flood Plan nominates the following locations as flood evacuation centres for Narrabri (refer Figure 5.2):

- The Crossing Theatre on the western side of Tibbereena Street (Newell Highway);
- Narrabri Public School on the eastern side of Barwan Street;
- Narrabri RSL Club on the western side of Maitland Street; and
- Narrabri West Public School on the eastern side of Cooma Road (Newell Highway).

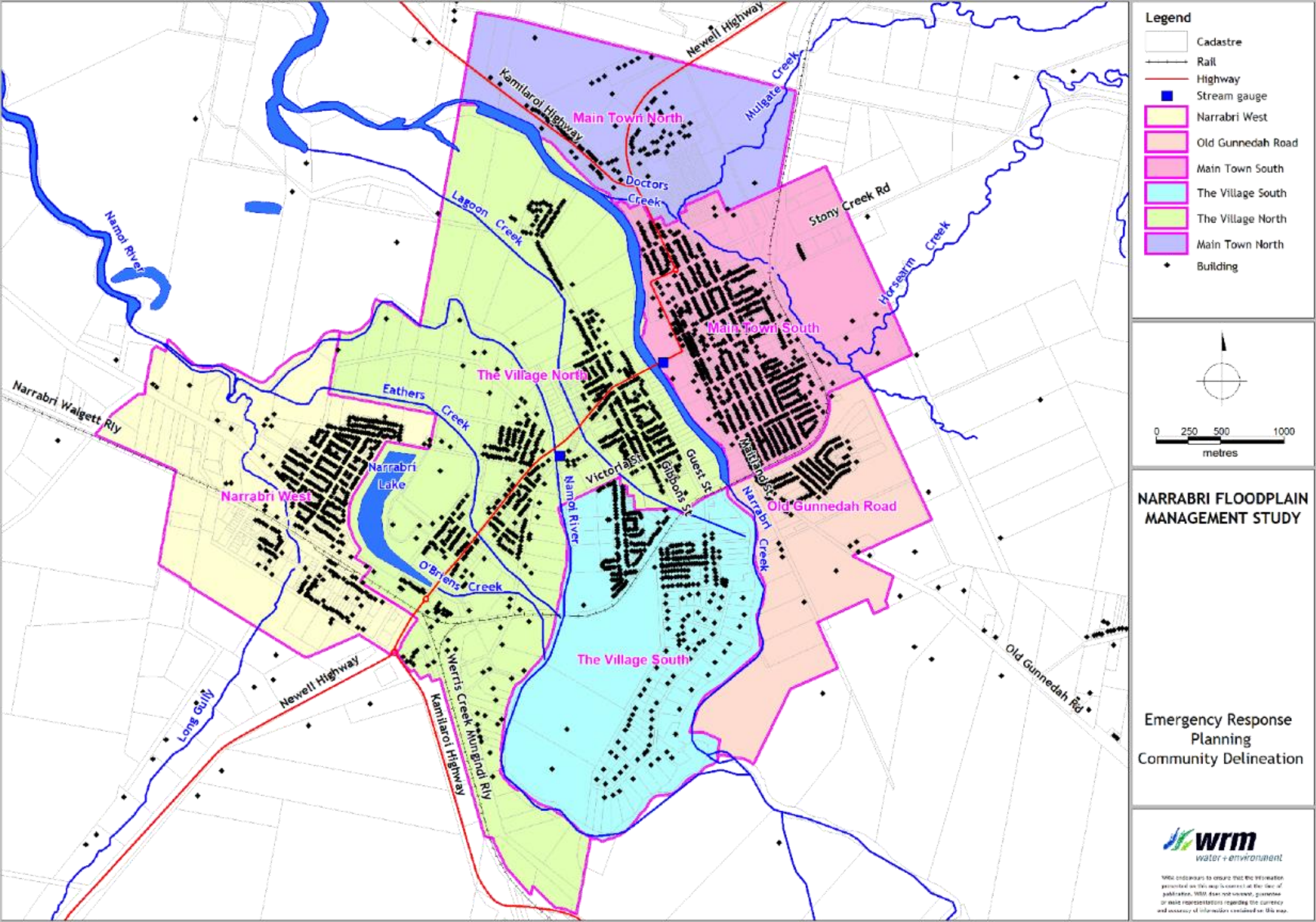


Figure 5.1 - Flood emergency response planning communities

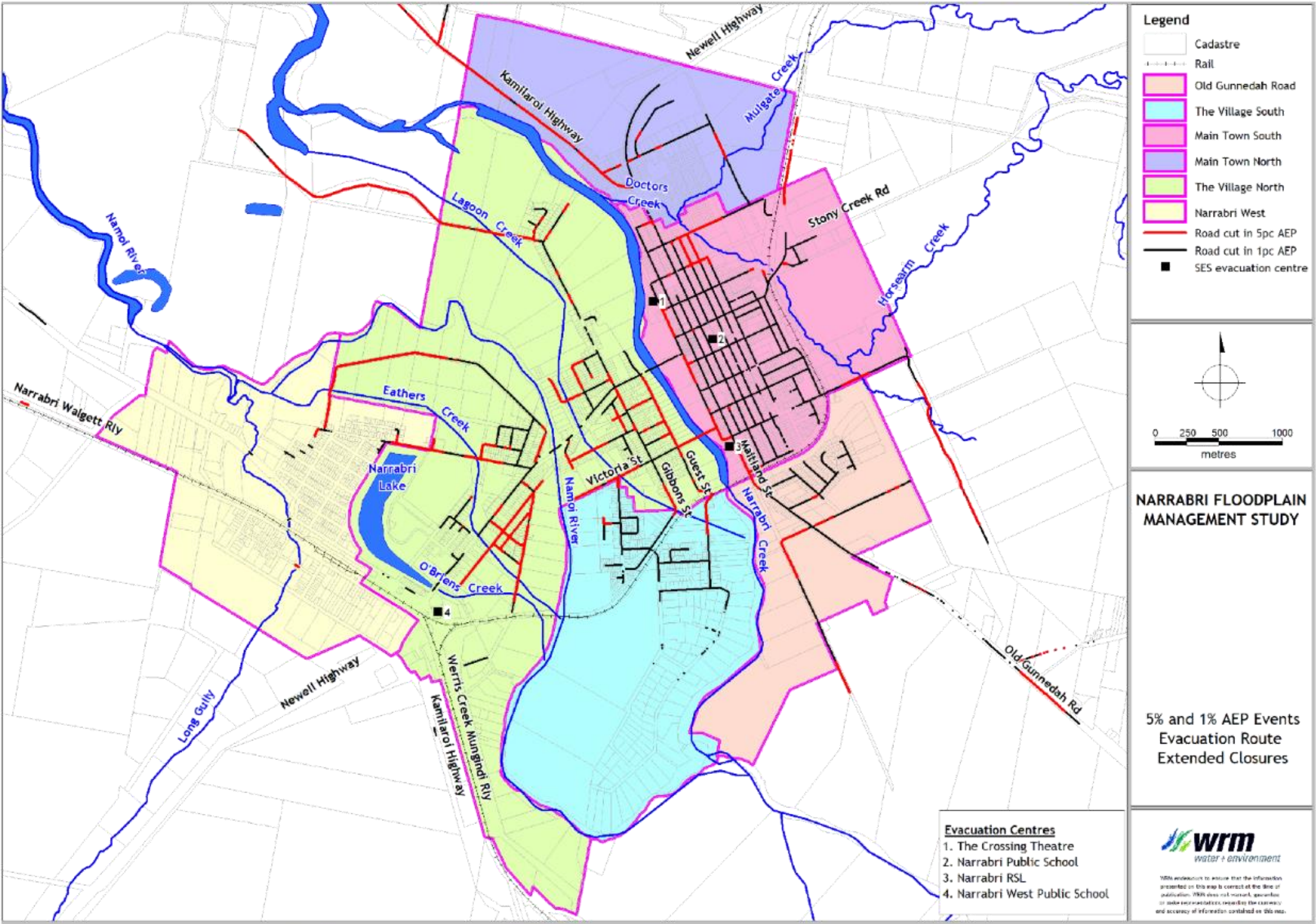


Figure 5.2 - Locations of access roads inundated by 0.3 m for more than 24 hours, 5% AEP event and 1% AEP event

Each of these four evacuation centres are flood affected to varying degrees:

- the Crossing Theatre is surrounded by water for a 5% AEP regional flood event, though only inundated above floor level for a 0.2% AEP regional flood event;
- the Narrabri RSL Club is surrounded by water for a 5% AEP regional flood event though not inundated above floor level for regional flood events up to and including the 0.2% AEP flood;
- Narrabri Public School is surrounded by water for a 2% AEP regional flood event and 1% AEP local catchment flood event, though some of the school buildings are not inundated above floor level for regional and local flood events up to and including the 0.2% AEP flood; and
- Narrabri West Public School is flood affected for regional flood events greater than or equal to 1% AEP, though some of the school buildings are not inundated above floor level for regional flood events up to and including the 0.2% AEP flood.

The four currently nominated flood evacuation centres for Narrabri are therefore generally resilient to above floor level flooding, except for the most extreme flood events. However, all but one of the nominated flood evacuation centres would only be able to be accessed by boat once regional flood levels reach 2% AEP severity.

5.4 FLOOD WARNING

5.4.1 Regional (Namoi River) flooding

Historically, flood emergency response planning at Narrabri has been based on flood level predictions provided by the Commonwealth Bureau of Meteorology (BOM). Key gauges upstream of Narrabri include Tamworth (419009), Manilla (419022), Gunnedah (419001) and Boggabri (419012) gauges. The BOM predictions at Narrabri are determined using computer based hydrologic models of the catchment using real time recorded water levels at the upper catchment stream gauges and predictions of future stream flows based on rainfall that has fallen (and potentially could fall) in the catchment. The travel time of the flood peak from Boggabri to Narrabri is in the order of 20-24 hours (NSW SES 2015).

5.4.2 Local catchment flooding

There is currently no flood warning available for local catchment flooding in and around Narrabri. The only stream gauge on a tributary to the Namoi River that flows through, or near, Narrabri is Bohena Creek at the Newell Highway. This gauge is situated at the lower end of the Bohena Creek catchment and would give less than three hours' notice to residents of Narrabri West of rising water levels.

There is sporadic coverage of rainfall stations in and around Narrabri with limited pluviograph stations able to provide sub-daily updates. The Narrabri Airport AWS is the only BOM pluviograph station currently operating in the vicinity of Narrabri.

Severe weather warnings issued by BOM give indications that large rainfall events may occur. Due to the lack of water level gauging and sub-daily rainfall data for local catchments these severe weather warnings are often the only form of warning available.

5.5 EMERGENCY RESPONSE PLANNING COMMUNITIES

5.5.1 Overview

Figure 5.1 shows the six communities adopted for emergency response planning (ERP). Approximately 94% of the area enclosed by the six ERP communities is inundated by the extreme flood with only the southern tip of the Village North and the western side of Narrabri West remaining flood free. The area of inundated land reduces to approximately 80% in the 1% AEP design flood and 59% in the 5% AEP design flood. Local roads often inundate to great depth prior to primary escape routes inundating in many of the ERP communities, hence early evacuation during flooding can be critical.

All four of the Narrabri flood evacuation centres are confined to two of the six ERP communities. Hence inundation in these two communities (Main Town South and The Village North) can be critical to not only the population of those communities, but also to the population of neighbouring ERP communities.

Though there are six distinct ERP communities, there are two distinct regions of Narrabri, the area east of Narrabri Creek and the area west of Narrabri Creek. There are two bridges across Narrabri Creek open to vehicle access. The low-level Violet Street bridge is overtopped by around 2 m in a 20% AEP regional flood event so no travel across this bridge is possible for any Namoi River flood. The deck of the Newell Highway bridge across Narrabri Creek will not overtop until around a 0.5% AEP regional flood. However, the bridge obvert will be reached for events greater than or equal to 5% AEP and the bridge approaches are much lower than the bridge deck, both of which will mean that travel across the bridge will be ceased prior to the deck overtopping.

5.5.2 Main Town North

The Main Town North ERP community is the area north of Doctors Creek and west of Mulgate Creek. This community is susceptible to local flooding from Mulgate Creek and Doctors Creek, as well as regional Namoi River (Narrabri Creek) flooding. In regional flood events the Main Town North community is affected by Narrabri Creek backwater rising into Doctors Creek, as well as Namoi River overflows that break out upstream of Narrabri and flow east of town before connecting into Horsearm Creek and Doctors Creek. Flood behaviour in the Main Town North community is significantly influenced by the Werris Creek Mungindi Railway embankment and Newell Highway embankment.

Table 5.1 details design flood behaviour in the Main Town North community, including the flood depths over the key evacuation routes and the number of buildings flooded for regional (Namoi River) design flood events. The Main Town North community consists of approximately 94 buildings, 75 of which are commercial. The Main Town North community is highly flood prone with a significant portion of the community impacted by both Namoi River and Mulgate Creek floods as frequent as 10% AEP.

Table 5.1 - Predicted regional flood behaviour, Main Town North ERP community

| Event (% AEP) | Predicted Namoi River (419002) and Narrabri Creek (419003) gauge heights | Approx. flood depth over road crown (m) | | | No. buildings flooded * | |
|---------------------|--------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------|-----------------------------|----------------------------|-------------------------|
| | | Kamilaroi Hwy @ Francis St | Newell Hwy near Saleyards Ln | Newell Hwy @ Segol St | Above ground level | Above floor level |
| 20 | 6.03 ft 6.56 | - | - | - | 0 | 0 |
| 10 | 7.51 ft 7.80 | 0.15 | - | - | 13 | 6 |
| 5 | 7.91 ft 8.53 | 0.7 | - | 0.4 | 37 | 26 |
| 2 | 8.34 ft 9.11 | 1.2 | 0.1 | 1.0 | 51 | 36 |
| 1 | 8.56 ft 9.36 | 1.5 | 0.3 | 1.3 | 67 | 58 |
| 0.5 | 8.81 ft 9.58 | 1.7 | 0.5 | 1.6 | 77 | 71 |
| 0.2 | 9.02 ft 9.77 | 1.9 | 0.7 | 1.7 | 82 | 77 |

* count of buildings flooded above ground level will include any buildings flooded above ground level and above floor level

The first buildings inundated above floor level in regional flood events are situated along Wee Waa Road (Kamilaroi Highway). These properties require the earliest evacuation as flood depths over the Kamilaroi Highway are more than 0.5 m for a 5% AEP event. By the time properties in the Narrabri North Industrial Estate begin to flood above floor level,

evacuation routes will have been cut from the Main Town North community towards evacuation centres to the southeast.

The options for evacuation routes from the Main Town North community are the Kamilaroi Highway travelling northwest, the Newell Highway travelling northeast or the Newell Highway travelling southeast. The Kamilaroi Highway will overtop prior to the Newell Highway during regional flooding (refer Table 5.1). The Kamilaroi Highway leads away from Narrabri, and the nominated flood evacuation centres, and is cut at multiple locations between Narrabri and Wee Waa. Hence it does not provide a viable evacuation route for this community.

The Newell Highway travelling southeast is cut at Segol Street at around a 5% AEP magnitude flood, meaning early evacuation is required. As the Newell Highway is significantly raised above the natural ground level, local streets in the Main Town North community are much more flood prone than the highway. Hence evacuation will need to occur while local roads remain trafficable.

Some overtopping of the Newell Highway north of the Doctors Creek Bridge may occur in the regional 2% and 1% AEP flood events, though the depth of overtopping (up to around 0.3 m) may still allow this section of highway to be trafficable. However, evacuation on the Newell Highway to the northeast leads away from Narrabri and the nominated flood evacuation centres.

The Main Town North community would best be described as a low trapped perimeter area. Early evacuation is critical to avoid being cut-off from evacuation centres in the Main Town South ERP community. There is a relatively small residential population in the Main Town North community, so for significant regional flood events when warning is available there should be a relatively small population to evacuate (as people would not be at work in the commercial and industrial properties).

5.5.3 Main Town South

The Main Town South ERP community is bounded by Mulgate Creek/Doctors Creek to the north, the Werris Creek Mungindi Railway to the south and Narrabri Creek to the west. The Main Town South community consists of approximately 921 buildings, of which at least 678 are residential (noting that some commercial buildings may serve residential purposes, i.e. motels). Table 5.2 details design flood behaviour in the Main Town South community, including the flood depths over the key evacuation routes and the number of buildings flooded for regional (Namoi River) design flood events.

Table 5.2 - Predicted regional flood behaviour, Main Town South ERP community

| Event (% AEP) | Predicted Namoi River (419002) and Narrabri Creek (419003) gauge heights | Approx. flood depth over road crown (m) | | | No. buildings flooded * | |
|---------------------|--------------------------------------------------------------------------------------|--------------------------------------------|--------------------------------|-----------------------------------------------|----------------------------|-------------------------|
| | | Fitzroy St Floodway | Fitzroy St @ Maitland St | Tibbereena St @ The Crossing Theatre | Above ground level | Above floor level |
| 20 | 6.03 ft 6.56 | - | - | - | 0 | 0 |
| 10 | 7.51 ft 7.80 | 0.6 | - | - | 9 | 3 |
| 5 | 7.91 ft 8.53 | 1.2 | 0.3 | 0.3 | 230 | 81 |
| 2 | 8.34 ft 9.11 | 1.7 | 0.8 | 0.8 | 791 | 427 |
| 1 | 8.56 ft 9.36 | 2.1 | 1.0 | 1.0 | 904 | 598 |
| 0.5 | 8.81 ft 9.58 | 2.4 | 1.3 | 1.2 | 914 | 703 |
| 0.2 | 9.02 ft 9.77 | 2.6 | 1.4 | 1.4 | 918 | 781 |

* count of buildings flooded above ground level will include any buildings flooded above ground level and above floor level

The Main Town South community includes three of Narrabri's four flood evacuation centres. These three evacuation centres serve the entire population east of Narrabri Creek (the entire Main Town North, Main Town South and Old Gunnedah Road communities) and any population west of Narrabri Creek that chooses early evacuation to the east.

For a 10% AEP regional event, most of the Main Town South community will not be inundated. At the 5% AEP level the Main Town North and Old Gunnedah Road communities will have been cut off from the Main Town South community and the three evacuation centres. At this level, access to the RSL and The Crossing Theatre evacuation centres also begins to become difficult as many roads around these centres begin to be overtopped by significant depth.

For the 5% AEP regional flood evacuation from the Main Town South community west into The Village North ERP community may be feasible. While there is a lot of land not inundated for a 5% AEP event, there is very little land not inundated for events equal to or larger than 2% AEP. The first buildings inundated above floor level in regional flood events are situated along Balonne, Barwan, Denison, Doyle, Lloyd, Maitland, Namoi, Nandewar and Tibbereena streets.

The Main Town South community is best described as a low flood island. Evacuation towards the hills east-northeast of Narrabri may be feasible in an emergency, though there is little infrastructure east of Narrabri to support an influx of evacuees. Access to neighbouring communities is cut-off early, though evacuation west may be feasible if completed early. There are three evacuation centres in The Main Town South ERP community, though subject to the event magnitude, all evacuation centres will eventually be surrounded by water (floor levels at these buildings are much higher than surrounding ground levels).

5.5.4 Old Gunnedah Road

The Old Gunnedah Road ERP community is south of the Werris Creek Mungindi Railway and east of Narrabri Creek. The Old Gunnedah Road community consists of approximately 251 buildings, of which at least 164 are residential (noting that some commercial buildings may serve residential purposes, i.e. Civeo Narrabri Village). The first buildings inundated above floor level in regional flood events are located on Old Gunnedah Road, Dale Street and Jenkins Street, with one property each in Fitzroy and Regent Street. Table 5.3 details the flood behaviour in the Old Gunnedah Road community, including the flood depths over the key evacuation routes and the number of buildings flooded for regional (Namoi River) design flood events.

Table 5.3 - Predicted regional flood behaviour, Old Gunnedah Road ERP community

| Event (% AEP) | Predicted Namoi River (419002) and Narrabri Creek (419003) gauge heights | Approx. flood depth over road crown (m) | | No. buildings flooded * | |
|---------------------|--------------------------------------------------------------------------------------|--------------------------------------------|----------------------------|----------------------------|-------------------------|
| | | Old Gunnedah Rd @ Railway | Regent St @ 9 Regent St | Above ground level | Above floor level |
| 20 | 6.03 & 6.56 | - | - | 0 | 0 |
| 10 | 7.51 & 7.80 | - | 0.2 | 101 | 5 |
| 5 | 7.91 & 8.53 | 0.45 | 0.3 | 137 | 25 |
| 2 | 8.34 & 9.11 | 1.1 | 1.0 | 212 | 49 |
| 1 | 8.56 & 9.36 | 1.3 | 1.3 | 232 | 67 |
| 0.5 | 8.81 & 9.58 | 1.6 | 1.5 | 245 | 73 |
| 0.2 | 9.02 & 9.77 | 1.7 | 1.7 | 248 | 78 |

* count of buildings flooded above ground level will include any buildings flooded above ground level and above floor level

The primary escape routes for this community are north along Old Gunnedah Road towards evacuation centres in the Main Town South ERP community or southeast along Old Gunnedah Road (though there is little infrastructure southeast of Narrabri to support an evacuating population). The depth of flooding over Old Gunnedah Road makes it difficult to evacuate in any direction unless evacuation is completed prior to Narrabri Creek reaching 5% AEP levels. Events greater than or equal to 2% AEP result in almost the entire Old Gunnedah Road community being inundated and surrounded by water. The Old Gunnedah Road Precinct is best described as a low trapped perimeter area.

5.5.5 The Village North

The Village North ERP community is bounded by Narrabri Creek to the east and Narrabri West Lake to the west and has a number of flood runners within its bounds. The Village North community consists of approximately 753 buildings, of which at least 652 are residential (noting that some commercial buildings may serve residential purposes, i.e. motels). Table 5.4 details the flood behaviour in The Village North ERP community, including the flood depths over the key evacuation routes and the number of buildings flooded for regional (Namoi River) design flood events.

Table 5.4 - Predicted regional flood behaviour, The Village North ERP community

| Event (% AEP) | Predicted Namoi River (419002) and Narrabri Creek (419003) gauge heights | Approx. flood depth over road crown (m) | | | | No. buildings flooded * | |
|---------------------|--------------------------------------------------------------------------------------------|-----------------------------------------|-------------------------------------|----------------------------|----------------------------------|----------------------------|-------------------------|
| | | Gibbons St @ Kate St | Gibbons St @ 71 Gibbons St | Newell Hwy @ Ugoa St | Newell Hwy @ Boheena St | Above ground level | Above floor level |
| 20 | 6.03 & 6.56 | - | - | - | - | 0 | 0 |
| 10 | 7.51 & 7.80 | - | 0.25 | - | - | 17 | 6 |
| 5 | 7.91 & 8.53 | 0.5 | 0.85 | 0.25 | - | 403 | 168 |
| 2 | 8.34 & 9.11 | 0.95 | 1.3 | 0.6 | 0.5 | 601 | 330 |
| 1 | 8.56 & 9.36 | 1.15 | 1.5 | 0.8 | 0.8 | 632 | 399 |
| 0.5 | 8.81 & 9.58 | 1.35 | 1.7 | 1.05 | 1.1 | 670 | 473 |
| 0.2 | 9.02 & 9.77 | 1.5 | 1.9 | 1.3 | 1.4 | 701 | 523 |

* count of buildings flooded above ground level will include any buildings flooded above ground level and above floor level

The Village North community includes one nominated evacuation centre, which serves the entire population west of Narrabri Creek (the entire Village North, Village South and Narrabri West communities) and any population east of Narrabri Creek that chooses early evacuation to the west. The Village North community also contains the Narrabri Hospital and nearby nursing home. Table 5.4 shows that access to the hospital would almost certainly be cut once flood levels reach 5% AEP severity.

For the 10% AEP regional event, most of The Village North community would not be inundated. However, there is little land not inundated for events equal to or larger than 5% AEP. Before reaching the 5% AEP level, the Village South community would have been cut off from The Village North, while evacuation east across Narrabri Creek into Main Town South may still be feasible for some. The first buildings inundated above floor level in regional flood events are situated along Gibbons, Selina, Droubalgie, Violet, Peele and Ugoa streets.

The Village North Precinct community is best described as a low flood island. Much of this community will require early evacuation during a significant regional flood event.

5.5.6 The Village South

The Village South ERP community is bounded by the Namoi River to the west and south and Narrabri Creek to the east. The Village South community consists of approximately 357 buildings, of which at least 347 are residential (noting that some commercial buildings may serve residential purposes, i.e. motels). Table 5.5 details the flood behaviour in The Village South ERP community, including the flood depths over the key evacuation routes and the number of buildings flooded for regional (Namoi River) design flood events. The first buildings inundated above floor level in regional flood events are situated along Guest, Hinds, Violet and Taylor streets and Riverside Drive.

Table 5.5 - Predicted regional flood behaviour, The Village South ERP community

| Event (% AEP) | Predicted Namoi River (419002) and Narrabri Creek (419003) gauge heights | Approx. flood depth over road crown (m) | | | No. buildings flooded * | |
|---------------------|--------------------------------------------------------------------------------------|--------------------------------------------|---------------------------------|--------------------------------|----------------------------|-------------------------|
| | | Selina St @ Railway | Gibbons St @ Lagoon Creek | Violet St @ Lagoon Creek | Above ground level | Above floor level |
| 20 | 6.03 ft 6.56 | - | - | - | 0 | 0 |
| 10 | 7.51 ft 7.80 | 1.2 | <0.05 | 0.2 | 2 | 1 |
| 5 | 7.91 ft 8.53 | 2.0 | 1.15 | 1.1 | 63 | 8 |
| 2 | 8.34 ft 9.11 | 2.6 | 1.8 | 1.65 | 220 | 43 |
| 1 | 8.56 ft 9.36 | 2.9 | 2.05 | 1.9 | 278 | 65 |
| 0.5 | 8.81 ft 9.58 | 3.1 | 2.25 | 2.15 | 318 | 88 |
| 0.2 | 9.02 ft 9.77 | 3.25 | 2.45 | 2.3 | 341 | 117 |

* count of buildings flooded above ground level will include any buildings flooded above ground level and above floor level

The Village South ERP community is surrounded by major watercourses but is mostly not inundated for events up to 5% AEP. Evacuation from this community would be cut at Violet Street and Gibbons Street by the Lagoon Creek flood runner prior to flooding reaching 5% AEP levels. The Selina Street rail underpass is cut by Narrabri Creek flooding prior to flood levels reaching 10% AEP severity. In the 5% AEP event Violet Street is inundated prior to Gibbons Street, however high hazard is experienced on both roads at approximately the same time. For frequent to rare flood events there are significant areas not inundated by regional flooding, should residents not evacuate prior to Violet Street and Gibbons Street being cut, however once the event magnitude exceeds 1% AEP there is almost no land not inundated to seek refuge. The Village South Precinct community is therefore a low flood island.

5.5.7 Narrabri West

The Narrabri West ERP community is land on the western side of Narrabri West Lake. The Narrabri West community consists of approximately 509 buildings, of which at least 467 are residential (noting that some commercial buildings may serve residential purposes, i.e. motels). Table 5.6 details the flood behaviour in the Narrabri West ERP community, including the flood depths over the key evacuation routes and the number of buildings flooded for regional (Namoi River) design flood events. The first buildings flooded above floor level in regional flood events are located at the northern end of the community along Villarette and Ugoa streets and Milner Place.

Inundation during both the local and regional 5% AEP events is minimal. Evacuation to the Narrabri West Public School evacuation centre in The Village North should be reasonably unhindered for all but very rare or extreme regional flood events. Moolobar Street becomes cut above a 2% AEP event, though alternate routes to the south remain accessible. Evacuation from the northern properties in this community, particularly on

Villarette Street, needs to occur early and if the northern reaches are evacuated early the entire community should be able to evacuate to the south towards flood free land. This community is best described as an overland refuge area or high trapped perimeter area.

Table 5.6 - Predicted regional flood behaviour, Narrabri West ERP community

| Event (% AEP) | Predicted Namoi River (419002) and Narrabri Creek (419003) gauge heights | Approx. flood depth over road crown (m) | | | No. buildings flooded * | |
|------------------|--------------------------------------------------------------------------|-----------------------------------------|----------------------------------|--------------------------|-------------------------|-------------------|
| | | Ugoa St @ Narrabri West Lake outflow | Mooloolbar St @ 10 Mooloolbar St | Villarette Ave @ Ugoa St | Above ground level | Above floor level |
| 20 | 6.03 & 6.56 | - | - | - | 0 | 0 |
| 10 | 7.51 & 7.80 | - | - | - | 2 | 1 |
| 5 | 7.91 & 8.53 | 0.65 | - | 1.0 | 11 | 2 |
| 2 | 8.34 & 9.11 | 1.3 | 0.25 | 1.7 | 31 | 13 |
| 1 | 8.56 & 9.36 | 1.65 | 0.6 | 2.0 | 44 | 18 |
| 0.5 | 8.81 & 9.58 | 1.95 | 0.9 | 2.3 | 57 | 25 |
| 0.2 | 9.02 & 9.77 | 2.2 | 1.2 | 2.6 | 90 | 51 |

* count of buildings flooded above ground level will include any buildings flooded above ground level and above floor level

5.5.8 Rural

There are approximately 134 buildings in the property database (refer Section 4) outside of the ERP communities detailed above. These rural properties are spread across the outskirts of Narrabri and hence generally are situated away from the Namoi River and Narrabri Creek. Due to the spread of these properties an emergency response classification has not been made, though authorities still need to consider emergency responses for these rural residents. Table 5.7 shows the number of rural buildings inundated for regional (Namoi River) design flood events.

Table 5.7 - Rural community regional flood behaviour

| Event (% AEP) | Predicted Namoi River (419002) and Narrabri Creek (419003) gauge heights | No. buildings flooded * | |
|------------------|--------------------------------------------------------------------------|-------------------------|-------------------|
| | | Above ground level | Above floor level |
| 20 | 6.03 & 6.56 | 0 | 0 |
| 10 | 7.51 & 7.80 | 1 | 0 |
| 5 | 7.91 & 8.53 | 18 | 5 |
| 2 | 8.34 & 9.11 | 33 | 9 |
| 1 | 8.56 & 9.36 | 39 | 14 |
| 0.5 | 8.81 & 9.58 | 48 | 24 |
| 0.2 | 9.02 & 9.77 | 55 | 31 |

* count of buildings flooded above ground level will include any buildings flooded above ground level and above floor level



5.6 DISCUSSION

Further to the analysis conducted in the preceding sections (which has focussed on regional flooding), local catchment flooding would also pose a significant challenge to emergency responders in Narrabri. As previously discussed, local catchment flooding is generally to lower levels across much of Narrabri, though the warning time is greatly decreased (or negligible).

Significant issues identified in the preceding sections that may require further consideration include:

- Access to the Narrabri Hospital and the adjacent aged care facilities during flood events; and
- The relative low immunity of road access to the nominated flood evacuation centres.

6 Structural flood management options

6.1 OVERVIEW

A range of structural flood management options have been identified for Narrabri determined from previous investigations, recommendations from the FMP, the public and observations by the study team. The investigated options have been based on a review of the flood risk zones, with the primary aim of reducing the existing flood risk, and/or improving flood emergency response and evacuation. The options investigated include:

- voluntary purchase and house raising programs;
- levee and channel schemes, including:
 - Mulgate Creek diversion (reversing UNSW Water Research Laboratory (1967) mitigation recommendation);
 - Narrabri bypass (Narrabri Creek duplication) as suggested by Aquatech Consulting Pty Ltd et al. (2008);
 - Horsearm Creek levee (including backflow prevention);
 - Narrabri North Industrial Estate mitigation option; and
 - Eather's Creek channel and localised levees.
- other options, including:
 - investigating the Narrabri West Lake's role in relation to flooding;
 - potential Narrabri Creek and Namoi River modifications;
 - on-going maintenance of drainage and stormwater infrastructure; and
 - structural management options to improve emergency response during a flood event.

This section outlines a preliminary assessment of the tangible and intangible benefits and indicative cost of each potential structural flood management measure. The concepts and associated modelling results have not been endorsed by the FMP but have been assessed to determine whether they are potentially viable for more detailed investigation.

For each option, the costs have been determined using unit rates and construction composite rates based on the Australian Construction Handbook (Rawlinsons, 2020). A 40% contingency cost has also been included to account for the uncertainties surrounding each option at this preliminary stage. The costing is suitable for the comparative evaluation of each option.

6.2 VOLUNTARY PURCHASE AND HOUSE RAISING

6.2.1 Purpose

The primary objectives of a voluntary purchase and house raising program would be to:

- reduce the impact of flooding;
- reduce flood liability on individual owners and occupiers of flood prone property; and
- reduce private and public losses resulting from floods.

If enacted, the voluntary purchase component of the program would be targeted at the most at-risk properties, i.e. properties in floodways (high risk zone) - refer Figure 3.6. The

house raising component would then be targeted at residential properties able to be raised (i.e. not slab-on-ground properties) with an existing floor level below the flood planning level (1% AEP + 0.5 m).

6.2.2 Considerations

Given the current government legislation and practical considerations, a voluntary purchase program would likely only apply to:

- residential properties constructed prior to 1986 when the original Floodplain Development Manual was gazetted by the State Government; and
- residential buildings located in floodways (high risk zones).

Given the current government legislation and practical considerations, a house raising program would likely only apply to:

- residential properties constructed prior to 1986 when the original Floodplain Development Manual was gazetted by the State Government;
- single storey residential buildings located outside of floodways (high risk zones). (A voluntary purchase program is recommended for residential properties in floodways);
- residential buildings structurally able to be raised (i.e. buildings on stumps, not slab-on-ground); and
- residential buildings where the floor level of the residence is below the adopted residential flood planning level (1% AEP flood level + 0.5 m). Any house raising should result in the new floor level being, as a minimum, at the flood planning level.

Given the above criteria, there would be approximately 906 residential properties potentially eligible for house raising. No investigation of building age has been undertaken, so the actual number of eligible properties will be less than this. More than 600 residential properties in Narrabri are of slab-on-ground construction. As a result, a significant residual flood problem would remain, even if all eligible residential properties were raised.

Subject to Government agreement, funding for the program could potentially be provided at ratio of \$2 from the State Government for every \$1 provided by the property owner (or council), in accordance with the NSW Government's Floodplain Management Program for voluntary house raising schemes.

A potential house raising priority list was based on depth of flooding above floor level, with the highest priority has given to properties inundated above floor level by the most frequent floods. Residential properties located within floodways (high risk zones) were not considered for house raising. These properties have instead been identified for potential voluntary purchase. No analysis of the age of a property has been undertaken, hence there may be some properties on the priority list, constructed after 1986, that may not be eligible.

The list of potential voluntary purchase properties and list of prioritised properties for house raising has been provided to NSC for consideration.

6.2.3 Tangible benefits

Table 6.1 shows the number of properties flooded above and below floor level and the estimated residential and commercial damages (in December 2019 dollar values) assuming all potentially eligible residential properties have been raised and all potential voluntary purchase properties have been removed from the floodway. The estimated building average annual damage (AAD) under the fully implemented scenario is also shown.

With respect to the 1% AEP flood and comparing to existing conditions (see Table 4.3 and Table 4.4), the results show that:

- the number of regional flood affected residential properties would reduce by 69 (from 1,743);
- the number of local catchment flood affected residential properties would reduce by 27 (from 405);
- the number of residential properties flooded above floor level for regional flooding would reduce by 573 (from 914);
- the number of residential properties flooded above floor level for local catchment flooding would reduce by 88 (from 139);
- the total regional flooding residential flood damages would reduce by approximately \$44.3 million (from \$134.4 million under existing conditions); and
- the total local catchment flooding residential flood damages would reduce by approximately \$10.8 million (from \$23.7 million under existing conditions).

Table 6.1 - Number of properties flooded and flood damage costs, fully implemented voluntary purchase and house raising program

| Parameter | Event (AEP) | | | | | | | |
|-------------------------------------------|-------------|-------|--------|--------|--------|--------|---------|---------|
| | 20% | 10% | 5% | 2% | 1% | 0.5% | 0.2% | PMF |
| Regional flooding | | | | | | | | |
| No. residential buildings flooded AGL | - | 30 | 601 | 1,457 | 1,674 | 1,778 | 1,870 | 2,347 |
| No. residential buildings flooded AFL | - | 7 | 150 | 270 | 295 | 328 | 463 | 2,319 |
| Total residential damages (\$M) | \$0.0 | \$0.6 | \$18.0 | \$58.7 | \$82.6 | \$98.6 | \$129.3 | \$408.9 |
| No. non-residential buildings flooded AGL | - | 91 | 229 | 413 | 453 | 482 | 496 | 573 |
| No. non-residential buildings flooded AFL | - | 5 | 86 | 243 | 305 | 354 | 391 | 573 |
| Total non-residential damages (\$M) | \$0.0 | \$0.0 | \$0.7 | \$3.4 | \$6.0 | \$9.4 | \$12.7 | \$74.5 |
| Building average annual damage | \$3.97M | | | | | | | |
| Local catchment flooding | | | | | | | | |
| No. residential buildings flooded AGL | 2 | 7 | 9 | 260 | 378 | 466 | 548 | 1,873 |
| No. residential buildings flooded AFL | 1 | 1 | 2 | 22 | 36 | 52 | 72 | 926 |
| Total residential damages (\$M) | \$0.1 | \$0.3 | \$0.4 | \$6.8 | \$10.9 | \$14.7 | \$18.8 | \$140.1 |
| No. non-residential buildings flooded AGL | 2 | 5 | 7 | 53 | 79 | 116 | 152 | 537 |
| No. non-residential buildings flooded AFL | - | 1 | 1 | 27 | 45 | 63 | 93 | 412 |
| Total non-residential damages (\$M) | \$0.0 | \$0.0 | \$0.0 | \$0.4 | \$0.7 | \$1.2 | \$1.7 | \$26.5 |
| Building average annual damage | \$0.56M | | | | | | | |

AGL - above ground level (count includes buildings flooded above both ground level and floor level)
AFL - above floor level

The total building average annual damage from flooding, assuming complete uptake of a voluntary purchase and house raising program, is \$4.53 million. This is approximately \$2.74 million less than existing conditions. Approximately \$0.61 million of this reduction is from the potential voluntary purchase component of the program, with the remaining \$2.13 million reduction from the potential raising of 906 residential buildings.

6.2.4 Estimated cost

No investigation or costing has been undertaken for the properties suitable for voluntary purchase. The cost of house raising can vary widely depending upon the size of the house

and the availability of suitable contractors. In South East Queensland, house raise quotations typically range from \$15,000 to \$50,000. Molino Stewart (2014) estimated the cost of house raising in Moree to be \$80,000 per structure. For this assessment, a cost of \$88,200 per structure was assumed for this study (the Molino Stewart estimate was factored using CPI as an indicator of price rise).

6.2.5 Economic evaluation

Table 6.2 shows an economic evaluation of the voluntary house raising component of the program. The reduction in average annual damage was calculated assuming that the six highest priority houses were raised to the flood planning level every year. The net present value of the savings was then determined for discount rates of 4%, 7% and 10%, which was compared to the cost of the raising to determine the benefit cost ratio. The total building AAD each year was then calculated as the sum of AAD for regional flooding and AAD for local catchment flooding.

Table 6.2 - Economic evaluation of the proposed house raising program

| Yr | Total building AAD after each year | AAD savings | NPV Savings over 20 years | | | Cost of year | Benefit Cost Ratio | | |
|----|------------------------------------|-------------|---------------------------|-----------|-----------|--------------|--------------------|------|-------|
| | | | @ 4% | @ 7% | @ 10% | | @4% | @7% | @10 % |
| | \$7,270,898 | - | | | | | | | |
| 1 | \$7,217,585 | \$53,313 | \$724,544 | \$564,801 | \$453,885 | \$529,200 | 1.37 | 1.07 | 0.86 |
| 2 | \$7,166,222 | \$51,363 | \$698,037 | \$544,138 | \$437,280 | \$529,200 | 1.32 | 1.03 | 0.83 |
| 3 | \$7,121,870 | \$44,351 | \$602,750 | \$469,859 | \$377,588 | \$529,200 | 1.14 | 0.89 | 0.71 |
| 4 | \$7,076,228 | \$45,642 | \$620,292 | \$483,534 | \$388,577 | \$529,200 | 1.17 | 0.91 | 0.73 |
| 5 | \$7,026,687 | \$49,541 | \$673,279 | \$524,838 | \$421,771 | \$529,200 | 1.27 | 0.99 | 0.80 |
| 6 | \$6,978,872 | \$47,815 | \$649,820 | \$506,552 | \$407,075 | \$529,200 | 1.23 | 0.96 | 0.77 |
| 7 | \$6,944,586 | \$34,287 | \$465,966 | \$363,233 | \$291,901 | \$529,200 | 0.88 | 0.69 | 0.55 |
| 8 | \$6,901,890 | \$42,696 | \$580,248 | \$452,319 | \$363,492 | \$529,200 | 1.10 | 0.85 | 0.69 |
| 9 | \$6,860,925 | \$40,965 | \$556,730 | \$433,986 | \$348,760 | \$529,200 | 1.05 | 0.82 | 0.66 |
| 10 | \$6,828,319 | \$32,606 | \$443,129 | \$345,431 | \$277,595 | \$529,200 | 0.84 | 0.65 | 0.52 |
| 11 | \$6,794,832 | \$33,487 | \$455,099 | \$354,762 | \$285,094 | \$529,200 | 0.86 | 0.67 | 0.54 |
| 12 | \$6,765,202 | \$29,630 | \$402,680 | \$313,900 | \$252,256 | \$529,200 | 0.76 | 0.59 | 0.48 |
| 13 | \$6,734,689 | \$30,513 | \$414,681 | \$323,255 | \$259,774 | \$529,200 | 0.78 | 0.61 | 0.49 |
| 14 | \$6,705,450 | \$29,239 | \$397,369 | \$309,759 | \$248,929 | \$529,200 | 0.75 | 0.59 | 0.47 |
| 15 | \$6,678,265 | \$27,184 | \$369,442 | \$287,990 | \$231,435 | \$529,200 | 0.70 | 0.54 | 0.44 |
| 16 | \$6,651,238 | \$27,028 | \$367,316 | \$286,332 | \$230,103 | \$529,200 | 0.69 | 0.54 | 0.43 |
| 17 | \$6,622,923 | \$28,315 | \$384,810 | \$299,970 | \$241,062 | \$529,200 | 0.73 | 0.57 | 0.46 |
| 18 | \$6,601,757 | \$21,166 | \$287,646 | \$224,228 | \$180,194 | \$529,200 | 0.54 | 0.42 | 0.34 |
| 19 | \$6,569,942 | \$31,815 | \$432,374 | \$337,047 | \$270,857 | \$529,200 | 0.82 | 0.64 | 0.51 |
| 20 | \$6,542,778 | \$27,164 | \$369,170 | \$287,778 | \$231,264 | \$529,200 | 0.70 | 0.54 | 0.44 |

The economic evaluation results suggest that the house raising component of the proposed program is economically viable for the highest priority properties only. At a 4% discount rate eight of the first nine years of the program would be economically viable. At a 7% discount rate only the twelve highest priority properties yield a positive benefit cost ratio, while at a 10% discount rate, the program is not economically viable in any year.

It should be noted that costs and tangible benefits given in Table 6.2, consider only the house raising component of the program. The potential voluntary purchase component of the program has been excluded from this analysis due to uncertainty around market

pricing of properties around Narrabri. Further detailed costings would be required to include this component in the benefit cost analysis.

6.2.6 Environmental impacts

There are no detrimental environmental impacts associated with a voluntary purchase and house raising program. There would be minor localised reductions in flood impacts due to a less obstructed floodplain.

6.2.7 Social impacts

A voluntary purchase and house raising program would have largely positive social impacts on the Narrabri community. Potential positive social impacts of the program include:

- reduced community impact during frequent to rare regional and local catchment flood events; and
- reduced stress towards flooding for house owners who participate in the program.

Potential negative social impacts of the program include:

- house owner's financial pressure of partly funding house raising;
- house owner's need to relocate if opting for voluntary purchase and to find a comparable property; and
- potential inequity for residents that are ineligible or unsuitable for house raising/voluntary purchase.

6.3 MULGATE CREEK DIVERSION

6.3.1 Purpose

Prior to the construction of levee banks and the raising of Killarney Gap Road, Mulgate Creek would have overflowed to the west through what is now the University of Sydney Plant Breeding Institute (UNSW Water Research Laboratory, 1967). The objective of the Mulgate Creek diversion scheme would be to utilise, and formalise, this natural tendency of water to overflow west, thus reduce the volume of water flowing down Mulgate Creek and into Narrabri.

6.3.2 Considerations

Figure 6.1 shows a possible concept design of the Mulgate Creek diversion. The diversion concept includes:

- a 475 m long bund on the eastern side of Killarney Gap Road (Bingara Road) to divert Mulgate Creek overflows west (the bund level would be above the road crown level to the west); and
- a 225 m long section of Killarney Gap Road lowered to natural ground levels on the northern side of the bund to act as a floodway.

For this preliminary assessment, Killarney Gap Road (Bingara Road), the Newell Highway and the Werris Creek Mungindi Railway were not upgraded. Works to the west of the Newell Highway were not included.

6.3.3 Hydraulic assessment

The bund and floodway shown in Figure 6.1 are outside of the regional flood extent, hence the Mulgate Creek diversion would not have a direct impact on regional flooding. The effectiveness of this concept on mitigating local catchment flooding was tested with the hydraulic model for representative frequent (10% AEP) and rare (1% AEP) local catchment flood events.



Figure 6.1 -Mulgate Creek diversion concept

Impact mapping of the Mulgate Creek diversion is presented in Figures C.1 and C.2 of Appendix C. Note that the impact mapping does not show impacts within the Narrabri Creek channel (due to the channel being represented in 1D).

The hydraulic modelling shows the following:

For the 10% AEP local catchment flood -

- there are several Mulgate Creek flow paths with only one flow path redirected across Killarney Gap Road;
- the redirected overflows are then “dammed” against the embankment of the Newell Highway and redirected back towards Narrabri; and
- there would be little change to flooding in Narrabri, with minor flood level increases on mainly undeveloped land, and some increase to the flood extent (again mainly contained to undeveloped land).

For the 1% AEP local catchment flood -

- only the one flow path of Mulgate Creek would be redirected across Killarney Gap Road;
- redirected flows are initially “dammed” against the embankments of the Newell Highway and railway line and redirected back towards Narrabri, until the redirected water reaches a height to overtop these embankments at which point it continues flowing in a westerly direction;
- a significant area of mainly agricultural land west of Killarney Gap Road would be subject to increased or new inundation; and
- flood levels decrease over a significant number of developed lots at Narrabri, mainly in the Narrabri North Industrial Estate and northern part of town. Flood level reductions are generally in the order of 0.01 m to 0.05 m with some lots experiencing reductions greater than 0.05 m.

6.3.4 Tangible benefits

An evaluation of the option shown in Figure 6.1 is given below.

For the 10% AEP local catchment event:

- no buildings would experience flood reductions greater than 0.01 m;
- 2 buildings would experience flood increases greater than 0.01 m or new flooding; and
- The estimated flood damage cost for the local catchment 10% AEP event would be \$0.7 million, an increase of \$0.1 million.

For the 1% AEP local catchment event:

- 10 buildings would no longer be inundated;
- 192 would experience flood reductions greater than 0.01 m;
- 2 buildings would experience flood increases greater than 0.01 m or new flooding; and
- the estimated flood damage cost for the local catchment 1% AEP event would be \$23.8 million, a reduction of \$0.6 million.

Note that the Narrabri property survey was limited to properties near Narrabri within the local catchment and regional flood extents for existing conditions. There may be a small number of rural residential properties that were not captured in the property survey and therefore, the above analysis should be considered indicative.

From the results of the hydraulic modelling and the property impact analysis, it is apparent that the Narrabri bypass concept would require further modification and analysis

to determine whether it is a viable flood mitigation option for Narrabri. The testing of the concept shows the following:

- The concept can provide local catchment flood level reductions for residential and non-residential properties in northern Narrabri.
- To get the full benefit of this option, the Newell Highway (and potentially the railway) would require upgrades to allow overflows to continue west and not get diverted by the embankments back into Narrabri. Hence the flood level reductions shown in Appendix C are considered the minimum reductions that could be expected from a Mulgate Creek diversion scheme.
- The diverted flows would significantly impact on agricultural land to the west of the Newell Highway currently not inundated.
- The cost of the Mulgate Creek diversion would be significant due to the required modifications to the Highway (and potentially the rail line).
- Local catchment flooding in northern Narrabri would not be fully mitigated by this option. Only the frequency and severity of local catchment flooding would be reduced. Local catchment flooding would remain from Mulgate Creek flows not captured by the bund together with flows from Horsearm Creek and Stony Creek.

6.3.5 Economic cost

Table 6.3 shows an indicative cost estimate for the Mulgate Creek diversion as shown in Figure 6.1.

Table 6.3 - Indicative cost of the Mulgate Creek Diversion infrastructure

| Item | Unit Cost | Unit | Quantity | Estimate |
|----------------------|-----------|----------------|----------|------------------|
| Levee | | | | |
| Site preparation | \$20,000 | ha | 0.5 | \$9,500 |
| Base prep | \$62.70 | m ³ | 475 | \$29,783 |
| Fill | \$18.00 | m ³ | 3,800 | \$68,400 |
| Causeway | | | | |
| Killarney Gap Rd | \$600 | m | 250 | \$150,000 |
| Contingencies | | | | |
| 40% Contingency | | | | \$103,073 |
| Total | | | | \$360,756 |

6.3.6 Environmental impacts

The environmental impacts of the Mulgate Creek diversion concept are not likely to be significant. This concept would return Mulgate Creek's natural overflow behaviour that was modified by the construction of Killarney Gap Road.

6.3.7 Social impacts

The social impacts of this option would be:

- Potential positive social impacts of the Mulgate Creek diversion include reduced flooding during frequent to rare local catchment flood events for some properties.
- Potential negative social impacts of a Mulgate Creek diversion include increased flooding to the University of Sydney and owners of agricultural land north of Narrabri. The flood immunity of Killarney Gap Road would also be reduced impacting on residents using this road.

6.4 NARRABRI BYPASS

6.4.1 Purpose

During moderate to large flow events, the Namoi River overflows upstream of Narrabri (upstream of the bifurcation into the Namoi River and Narrabri Creek). Overflows from the northern bank of the river initially flow along natural flow paths of Horsearm Creek around the eastern side of Narrabri. The objective of a Narrabri bypass scheme would be to utilise, and formalise, this natural tendency of overflows to bypass Narrabri to the east, thus reducing the volume of water flowing down the Namoi River and Narrabri Creek.

6.4.2 Considerations

The concept of using the natural Namoi River overflow path to the advantage of Narrabri is not new. Kinhill (1991) estimated that 5% of the Namoi River flow upstream of the bifurcation overflowed into Horsearm Creek.

Bewsher Consulting (1996) investigated a Narrabri bypass concept, formalising the natural flowpath such that a 1% AEP event upstream of the bifurcation would result in a 5% AEP event in town, bypassing up to 2,500 m³/s to the east of town. Bewsher Consulting (1996) found that, to provide this level of protection, a 550 m wide and 4 m deep channel would need to be constructed for approximately 10 km. The estimated cost of the concept exceeded \$100 million, with a benefit cost ratio of around 0.18.

A consortium of local engineers and surveyors further investigated the Narrabri bypass concept (Aquatech Consulting et al., 2008 and Aquatech Consulting et al., 2012). Following a detailed ground survey, several alternative bypass routes and configurations were investigated. The adopted bypass proposal was a 650 m wide channel with associated levees. This solution reportedly could convey 2,150 m³/s to the east of town in a 1% AEP event (Aquatech Consulting et al., 2012). The estimated cost of the concept was \$70 million. The interface between the proposed Narrabri bypass, the expanding Narrabri North Industrial Estate and local catchment flows was highlighted as a key issue for the bypass concept.

All previous investigations into the concept of the Narrabri bypass have identified cost as being prohibitive. All previous investigations have also been based on one-dimensional (quasi-two-dimensional) modelling. The Narrabri bypass option was revisited to test the concept with two-dimensional modelling and revisit the cost estimate.

Figure 6.2 shows the layout of the Narrabri bypass concept investigated in this study. The bypass concept includes:

- an excavated channel approximately 10,400 m long with a 200 m wide base:
 - the channel cross-section was based on a 0.5% crossfall to the invert at the centre of the channel, with 1:6 side slopes back to natural ground; and
 - maximum channel excavation depth was approximately 4 m.
- causeway crossings of the excavated channel (no culverts) for Old Gunnedah Road, Kaputar Road, Fitzroy Street, Old Cemetery Road and Namoi Street.
- new bridge structures over the excavated channel across the Newell Highway, Kamilaroi Highway, the Werris Creek-Mungindi Rail line and the grain silo rail spur.
- the relocation of the racecourse and sale yards and removal of at least two houses.
- a 9,300 m long levee to provide immunity for the 1% AEP flood (maximum height exceeding 3 m) (the location of this levee will be determined following consultation) including:
 - a temporary barrier or permanent raising of Old Gunnedah Road, Fitzroy Street, Old Cemetery Road, Namoi Street and the Newell Highway at the location of the levee; and
 - a temporary barrier across the Werris Creek-Mungindi Rail line.



Figure 6.2 - Narrabri bypass concept layout (overlayed on 1998 flood extent)

Note that the proposed Inland Rail would now cross the northern end of the proposed channel and if adopted would require the Inland Rail alignment to be altered. The impact of the Inland Rail has not been considered in this assessment.

6.4.3 Hydraulic assessment

The hydraulic model was used to test the effectiveness of this concept on mitigating both regional and local catchment flooding. Given the preliminary phase of the investigation, the bridge infrastructure has not been modelled. The 5% and 1% AEP event were used for the preliminary assessment.

Impact mapping from the hydraulic modelling of the Narrabri bypass is presented in Figures C.3 to C.5 of Appendix C. Note that the impact mapping presented does not show impacts within the Narrabri Creek channel (due to the channel being represented in 1D).

The hydraulic modelling shows the following:

For the 1% AEP regional flood -

- significant areas of The Village South and Main Town South ERP communities would no longer be inundated by this event;
- most developed areas within Narrabri would have flood level reductions of between 0.10 m and 0.50 m, with areas of the Main Town South ERP community having reductions greater than 0.50 m;
- flood level increases would occur on land east of the bypass levee, from around 830 m upstream of Kaputar Road, to the downstream end of the bypass;
- flood level increases would also be experienced downstream of the bypass, for around 7.4 km along and east of the Kamilaroi Highway; and
- the Werris Creek Mungindi rail line would be significantly impacted with flood level increases of over 1 m near Old Cemetery Road.

For the 5% AEP regional flood -

- significant areas of Narrabri would no longer be inundated by this event;
- most flooded areas within Narrabri would have flood level reductions of between 0.1 m and 0.5 m; and
- flood level increases would occur on land east of the bypass levee.

For the 1% AEP local catchment flood -

- flood level reductions would be experienced for most areas to the west of the levee with all developed areas of the Main Town North and Main Town South ERP communities no longer being inundated by this event; and
- flood increases would be experienced east of the levee and downstream of the bypass.

6.4.4 Tangible benefits

The tangible benefits of the Narrabri bypass configured per Figure 6.2 is as follows:

For the regional 1% AEP event:

- 367 properties would no longer be inundated above ground level;
- 1,677 would experience flood reductions greater than 0.01 m;
- 77 buildings would experience flood increases greater than 0.01 m or new flooding; and
- the estimated flood damage cost for the regional 1% AEP event would be \$92.7 million, a reduction of \$47.7 million.

For the regional 5% AEP event:

- 387 properties would no longer be inundated above ground level;
- 410 would experience flood reductions greater than 0.01 m;
- 36 buildings would experience flood increases greater than 0.01 m or new flooding; and
- the estimated flood damage cost for the regional 5% AEP event would be \$17.0 million, a reduction of \$14.3 million.

For the local catchment 1% AEP event:

- 428 buildings would no longer be inundated above floor level;
- 16 would experience flood reductions greater than 0.01 m;
- 26 buildings would experience flood increases greater than 0.01 m or new flooding; and
- the estimated flood damage cost for the local 1% AEP event would be \$2.7 million, a reduction of \$21.7 million.

Note that the Narrabri property survey was limited to properties near Narrabri within the local catchment and regional flood extents for existing conditions. Hence there may be a small number of rural residential properties that were not captured in the property survey, potentially impacted by this mitigation option. For this reason, the analysis above should be considered provisional only.

The results of the hydraulic modelling and the flooded property analysis show that Narrabri bypass concept would benefit most property owners but would increase flooding for some. Further modification and analysis would be required to determine whether it is a viable flood mitigation option and whether the impacts could be reduced without compromising the benefits of the proposal.

6.4.5 Estimated cost

Table 6.4 shows a preliminary estimate of the Narrabri Bypass option. As shown, the estimated cost is substantial and consistent with the previous estimates.

6.4.6 Environmental impacts

A detailed study would be required to determine the potential environment impacts of the Narrabri bypass. While the bypass concept is utilising natural overflow behaviour, the channel and levee works would need to be designed to ensure stability and erodibility is minimised.

6.4.7 Social impacts

The social impacts of this option would be significant. Potential positive social impacts of the bypass include:

- reduced community impact during frequent to rare regional and local catchment flood events.

Potential negative social impacts of the bypass include:

- significant impacts to owners of properties within or east of the bypass corridor;
- the relocation of the Narrabri racecourse and sale yards;
- the additional flood impacts at the cemetery; and
- the inequitable distribution of potential impacts.

Table 6.4 - Indicative cost of the Narrabri bypass infrastructure

| Item | Unit Cost | Unit | Quantity | Estimate |
|----------------------------|-----------|----------------|-----------|----------------------|
| Levee | | | | |
| Site preparation | \$20,000 | ha | 10 | \$200,000 |
| Base prep | \$62.70 | m ³ | 27,900 | \$1,749,330 |
| Fill | \$18.00 | m ³ | 185,000 | \$3,330,000 |
| Channel | | | | |
| Site preparation | \$20,000 | ha | 232 | \$4,640,000 |
| Excavation | \$11.40 | m ³ | 4,120,000 | \$46,968,000 |
| Topsoil | \$6.15 | m ³ | 348000 | \$2,140,200 |
| Causeways | | | | |
| Old Gunnedah Road | \$600 | m | 250 | \$150,000 |
| Kaputar Rd | \$600 | m | 250 | \$150,000 |
| Fitzroy St | \$400 | m | 250 | \$100,000 |
| Old Cemetery Rd | \$400 | m | 250 | \$100,000 |
| Namoi St | \$400 | m | 250 | \$100,000 |
| Bridge crossings | | | | |
| Rail | \$7,580 | m | 375 | \$2,842,500 |
| Newell Highway | \$8,180 | m | 937.5 | \$7,668,750 |
| Kamilaroi Highway | \$8,180 | m | 750 | \$6,135,000 |
| Rail spur | \$7,580 | m | 375 | \$2,842,500 |
| Miscellaneous Items | | | | |
| Racecourse relocation | \$250,000 | Item | 1 | \$250,000 |
| Detail design | | Item | 1 | \$1,000,000 |
| Land acquisition | | Item | 1 | \$3,000,000 |
| Contingency (40%) | | | | \$33,346,512 |
| | | | | \$116,712,792 |

6.5 HORSEARM CREEK LEVEE AND BACKFLOW PREVENTION

6.5.1 Purpose

Narrabri experienced a Mulgate Creek/Horsearm Creek flood in February 2020 similar to what occurred in 2004 and 2012. Several properties were inundated in the eastern areas of the Main Town South ERP community (refer Section 5) from this event.

The objective of this flood mitigation option would be to mitigate the inundation of the Main Town South ERP community from Horsearm Creek.

6.5.2 Considerations

WRM (2020) prepared a detailed assessment of the February 2020 event. The assessment found that flooding occurred due to Horsearm Creek overflowing (and possibly permeating) through the rail. The Narrabri stormwater network was not included in the flood

modelling. However, a review of the flood model results for the February 2020 (and February 2012) events showed that water levels in Horsearm Creek would have inundated the stormwater pipe outlets to Horsearm Creek to cause the floodwater to surcharge the gully pits in Narrabri, particularly Logan, Eleanora, Bowen and Denison streets. The modelling suggests that Horsearm Creek floodwater would have backflowed the stormwater pipes and surcharged prior to the rail line being overtopped. This was supported by reports from the community. Community surveys undertaken for the Narrabri Flood Study also identified backflow occurred the stormwater pipes during the 2012 event.

The option proposed to mitigate Horsearm Creek flooding in the Main Town South ERP assessed includes:

- a levee on the eastern side of the rail; and
- backflow prevention devices installed on the stormwater networks draining to Horsearm Creek.

The locations of the Horsearm Creek levee and backflow prevention devices are shown in Figure 6.3.

6.5.3 Hydraulic assessment

Figures C.6 and C.7 in Appendix C show the impact mapping for the proposed Horsearm Creek levee. For this concept assessment, the levee was located along the rail line and raised to provide protection up to the 1% AEP event. An assessment was undertaken for both local catchment and regional 1% AEP flood events. The impact mapping presented does not show impacts within the Narrabri Creek channel (due to the channel being represented in 1D). The hydraulic modelling shows the following.

For the 1% AEP local catchment flood:

- the eastern region of the Main Town South ERP community would not be inundated by this event, with the benefits extending across much of the Narrabri town area; and
- flood level increases would occur on land and for several properties east of the levee.

For the 1% AEP regional flood -

- the eastern region of the Main Town South ERP community could have flood level reductions of up to 0.5 m, with small areas no longer inundated by this event; and
- flood level increases would occur on land and property east and north of the levee.

Note that that local rainfall would be unable to drain away due to the high tailwater levels in Horsearm Creek, meaning there would potentially be localised stormwater drainage issues.

6.5.4 Tangible benefits

The tangible benefits of the Horsearm Creek levee and backflow prevention option (configured as per Figure 6.3) is described below.

For the local catchment 1% AEP event:

- 201 properties would no longer be inundated above ground level;
- 85 properties would experience flood reductions greater than 0.01 m;
- 29 buildings would experience flood increases greater than 0.01 m or new flooding; and
- the estimated flood damage cost for the local 1% AEP event would be \$15.7 million, a reduction of \$8.7 million.



Figure 6.3 - Main Town South flood mitigation concept

For the regional 1% AEP event

- 16 buildings would no longer be inundated;
- 429 properties would experience flood reductions greater than 0.01 m;
- 141 properties would experience flood increases greater than 0.01 m or new flooding; and
- the estimated flood damage cost for the regional 1% AEP event would be \$138.3 million, a reduction of \$2.1 million.

It is apparent that the Horsearm Creek levee would provide significant flood mitigation for the Narrabri township for local catchment flooding events but would also cause some flood impacts for properties outside of the levee. In its current form, the option would not be viable without further works to mitigate the impacts. Notwithstanding, the provision of backflow prevention on the stormwater networks draining this area would provide a benefit with minor peak flood level reductions likely for some events.

6.5.5 Estimated cost

Table 6.5 shows an indicative cost estimate for the Horsearm Creek mitigation option. Given the tangible benefits are significant, a variation of this option has progressed through to the preferred options described in Section 6.11.

Table 6.5 - Indicative cost of the proposed Horsearm Creek infrastructure

| Item | Unit Cost | Unit | Quantity | Estimate |
|-------------------------|-----------|----------------|----------|--------------------|
| Levee | | | | |
| Site preparation | \$20,000 | ha | 1.2 | \$24,000 |
| Base prep | \$62.70 | m ³ | 3,600 | \$225,720 |
| Fill | \$18.00 | m ³ | 23,871 | \$429,677 |
| Backflow devices | \$15,000 | item | 3 | \$45,000 |
| 40% Contingency | | | | \$289,759 |
| Total | | | | \$1,014,156 |

6.5.6 Environmental impacts

The environmental impacts of the Horsearm Creek levee and backflow prevention device would not be significant. The location of the levee may change the potential impacts. Also, the mitigation of the flood impacts, which are discussed in Section 6.11, would require the excavation of the Horsearm Creek channel and the removal of the remnant vegetation between Fitzroy Street and Old Cemetery Road, which may be significant.

6.5.7 Social impacts

A Horsearm Creek levee and backflow prevention device option would have positive social impacts within the township of Narrabri due to reduced local catchment flooding. However, the inequitable distribution of impacts inside and outside the levee would mean that the option would not be viable from a social perspective without further mitigation.

6.6 NARRABRI NORTH INDUSTRIAL ESTATE MITIGATION

6.6.1 Purpose

The Narrabri North Industrial Estate is an established light industrial hub for Narrabri. It has high commercial value partly because of its high visibility and connection to the Newell Highway. Over the last 25 years, much of Narrabri's new commercial and industrial

development has located to this area. More importantly, the future demand for these lots is expected to exceed the lots that remain undeveloped.

The Narrabri North Industrial Estate has been identified as particularly flood prone, with inundation of the area occurring from both frequent local catchment flooding and moderate sized regional flooding. The Narrabri Supplementary Floodplain Management Study (Max Winders & Associates, 2002) developed restrictions on development in this area to mitigate the impact of this development. The purpose of this option is to maximise the developable potential for the area with consideration to the constraints given in the Supplementary Floodplain Management Study (2002).

6.6.2 Considerations

Previous investigations of the Narrabri North Industrial Estate (WRM, 2018) investigated several potential development and flood mitigation options for this area. The following strategy (shown in Figure 6.4) was recommended:

- a 2,170 m long levee along the southern and eastern sides of the Narrabri North Industrial Estate:
 - approximately 1,060 m of the levee alignment would be along an existing levee;
 - the levee height was set 0.5 m above the maximum of the ground level, local catchment 1% AEP flood level and regional 1% AEP flood level;
- an 80 m diversion bund (up to 2.8 m high) downstream of the Newell Highway; and
- an excavated channel to drain the Mulgate Creek flows to Doctors Creek that would be approximately 730 m long and 50-70 m wide channel.

The recommended Narrabri Industrial Estate flood mitigation option has been reassessed as part of this study.

6.6.3 Hydraulic modelling

This option was re-modelled for all local catchment and regional flood events for this study. Impact mapping from the hydraulic modelling of the Narrabri North Industrial Estate levee and channel upgrade option is presented in Figures C.8 to C.23 of Appendix C. The impact mapping presented does not show impacts within the Narrabri Creek channel (due to the channel being represented in 1D). The hydraulic modelling shows:

For local catchment flooding -

- events up to an including 1% AEP would experience flood level reductions or would not be inundated. Flood level increases would occur upstream of the levee and these increases extend onto mainly agricultural land. Flood level increases also occur downstream of the channel works, though these increases are generally limited to largely undeveloped waterway corridor areas;
- impacts on the railway are significant for events greater than 2% AEP; and
- events greater than 1% AEP provide protection behind the levee with flood level increases now intruding southwards into the more developed part of town.

For regional flooding -

- there would be no impacts for events up to and including 5% AEP; and
- there would be minor reductions in flood levels both within the Narrabri North Industrial Estate and adjoining urban areas due to the construction of the drain increasing waterway flow area for events larger than this. There would be minor increases immediately upstream of the levee.



Figure 6.4 - Narrabri North Industrial Estate mitigation layout

6.6.4 Tangible benefits

Table 6.6 shows the number of properties flooded above and below floor level and the estimated residential and commercial damages (in December 2019 dollar values) assuming the Narrabri North Industrial Estate mitigation option was constructed. The estimated building average annual damage (AAD) is also shown.

With respect to the 1% AEP flood and comparing to existing conditions (see Table 4.3 and Table 4.4), the results show that:

- the number of regional flood affected properties would not change;
- the number of local catchment flood affected properties would reduce by 13 (from 405);
- the number of properties flooded above floor level for local catchment flooding would reduce by 12 (from 139); and
- the total local catchment flood damages would reduce by approximately \$0.8 million (from \$23.7 million under existing conditions).

The total building AAD from flooding for the Narrabri North Industrial Estate mitigation option is \$7.22 million. This is approximately \$0.04 million less than existing conditions. The small change is reflective of the mitigation option being targeted at a potential future development area (currently undeveloped).

Table 6.6 - Number of properties flooded and flood damage costs, Narrabri North Industrial Estate flood mitigation option

| Parameter | Event (AEP) | | | | | | | |
|-----------------------------------------------------------------------------------------------------|-------------|-------|--------|--------|---------|---------|---------|---------|
| | 20% | 10% | 5% | 2% | 1% | 0.5% | 0.2% | PMF |
| Regional flooding | | | | | | | | |
| No. residential buildings flooded AGL | - | 54 | 670 | 1526 | 1743 | 1847 | 1939 | 2417 |
| No. residential buildings flooded AFL | - | 17 | 229 | 664 | 914 | 1102 | 1267 | 2389 |
| Total residential damages (\$M) | \$0.0 | \$2.1 | \$30.6 | \$98.9 | \$134.4 | \$165.1 | \$192.9 | \$444.4 |
| No. non-residential buildings flooded AGL | - | 91 | 229 | 413 | 453 | 482 | 496 | 573 |
| No. non-residential buildings flooded AFL | - | 5 | 86 | 243 | 305 | 354 | 391 | 573 |
| Total non-residential damages (\$M) | \$0.0 | \$0.0 | \$0.7 | \$3.4 | \$6.0 | \$9.4 | \$12.7 | \$74.5 |
| Building average annual damage | \$6.21M | | | | | | | |
| Local catchment flooding | | | | | | | | |
| No. residential buildings flooded AGL | 4 | 14 | 14 | 256 | 392 | 502 | 597 | 1,958 |
| No. residential buildings flooded AFL | 2 | 3 | 4 | 72 | 134 | 181 | 247 | 1,296 |
| Total residential damages (\$M) | \$0.2 | \$0.7 | \$0.8 | \$13.9 | \$22.9 | \$31.3 | \$39.7 | \$190.5 |
| No. non-residential buildings flooded AGL | - | 1 | 2 | 39 | 73 | 115 | 151 | 539 |
| No. non-residential buildings flooded AFL | - | 1 | 1 | 19 | 38 | 64 | 91 | 418 |
| Total non-residential damages (\$M) | \$0.0 | \$0.0 | \$0.0 | \$0.2 | \$0.6 | \$1.1 | \$1.7 | \$27.5 |
| Building average annual damage | \$1.01M | | | | | | | |
| AGL - above ground level (count includes buildings flooded above both ground level and floor level) | | | | | | | | |
| AFL - above floor level | | | | | | | | |

AGL - above ground level (count includes buildings flooded above both ground level and floor level)
AFL - above floor level

6.6.5 Estimated cost

Table 6.7 provides indicative costings of the levee and channel works. Note that no changes to the rail have been proposed given the low immunity level of the rail under existing conditions. It is predicted to be overtopped for the 10 % AEP local event under existing conditions. No flood level impacts are predicted for this event. Peak flood levels increase for the larger events when the rail would already be overtopped under existing conditions. Further discussion is required with ARTC on these impacts and whether further mitigation measures are required.

The results of the analysis suggest that the Narrabri North Industrial Estate is not economically viable. However, this analysis only considers the existing development state, much of the benefit is experienced by a currently undeveloped area.

Table 6.7 - Indicative cost of the Narrabri North Industrial Estate infrastructure

| Item | Unit Cost | Unit | Quantity | Estimate |
|---------------------------------|-----------|----------------|----------|--------------------|
| Levee and diversion bund | | | | |
| Site preparation | \$20,000 | ha | 1 | \$26,040 |
| Base prep | \$62.70 | m ³ | 2,170 | \$136,059 |
| Fill | \$18.00 | m ³ | 29,870 | \$537,660 |
| Channel | | | | |
| Site preparation | \$20,000 | ha | 4.5 | \$90,000 |
| Excavation | \$11.40 | m ³ | 129,600 | \$1,477,440 |
| Topsoil | \$6.15 | m ³ | 6750 | \$41,513 |
| Causeway | | | | |
| Saleyard Lane | \$400 | m | 100 | \$40,000 |
| Railway Crossing | | | | |
| | \$150,000 | Item | 1 | \$150,000 |
| Miscellaneous Items | | | | |
| Site Establishment and drainage | \$250,000 | Item | 1 | \$250,000 |
| Detail Design | \$100,000 | Item | 1 | \$100,000 |
| Land Acquisition | \$10,000 | ha | 10 | \$100,000 |
| 40% Contingency | | | | \$1,179,485 |
| Total | | | | \$4,128,196 |

6.6.6 Environmental impacts

There would be limited environmental impacts associated with the Narrabri North Industrial Estate flood mitigation option. The stability and erodibility of the channel works would need to be addressed through revegetation and potentially some scour protection measures. No vegetation removal will be required.

6.6.7 Social impacts

The social impacts of the proposed mitigation option are largely positive for those business protected by the levee. The potential positive social impacts of the scheme include:

- slightly reduced community impact during the full range of flood events; and
- the potential for development within the levee extent.

Potential negative social impacts of the proposal include:

- reduced visual amenity due to the levee, particularly for properties adjacent to the levee (though given there is already a levee along much of the proposed alignment this impact will be minimal); and
- increased flooding and flood levels at properties outside the levee extent for some flood events.

Undeveloped Industrial zoned land to the south of the proposed levee would need to be rezoned as rural. Figure 3.5 shows that this area has a Z5 (high) hazard risk for flooding and therefore would not be possible to ever develop. As such the rezoning of this area would not have a significant impact on the property value.

6.7 TARGETED CHANNEL UPGRADES AND LEVEES

6.7.1 Purpose

While many townships across New South Wales and Australia only experience minimal disruption due to moderate sized flood events, events in the order of 5% AEP cause great disruption to Narrabri. The property flooding analysis (refer Section 4.4) revealed that approximately 900 residential and commercial buildings would experience above ground level flooding, with over 300 of these also experiencing above floor level flooding for a 5% AEP regional flood event. With residential building flood damage estimated at \$30.6 million for a 5% AEP event (refer Section 4.4), the benefit cost ratio of any mitigation options providing protection for this event is likely to be quite favourable.

The purpose of these options is to develop targeted mitigation strategies that would reduce flood damages for the moderate sized floods.

6.7.2 Considerations

For this strategy, clusters of properties inundated above floor level for regional flood events up to and including 5% AEP (refer Appendix B) were identified and potential mitigation options devised. The following flood mitigation options were investigated:

- **Selina Street levee** - a 620 m levee with a crest level at the 5% AEP flood level along the eastern side of Selina Street between the Newell Highway (Dangar Street) and Violet Street, including compensatory earthworks east of the Selina Street levee to mitigate any impacts;
- **Manning Street levee** - a 290 m levee with a crest level at the 5% AEP flood level along the western bank of the Namoi River at Manning Street;
- **Regent Street levee** - a 540 m levee with a crest level at the 5% AEP flood level from Old Gunnedah Road along the southern side of Regent Street;
- **Eather's Creek channel** - an excavated channel approximately 2,900 m long along the existing Eather's Creek channel consisting of:
 - 30 m channel base;
 - 1V:6H side slopes back to natural ground;
 - maximum channel excavation depth of approximately 4 m;
 - causeway crossings of Ugoa and Peele streets; and
 - reconstruction of the Cooma St (Newell Highway) bridge.

Figure 6.5 shows the locations of the proposed levee and channel upgrades targeted at mitigating 5% AEP regional flooding overlaid on the 1998 flood extent, which had an AEP of between 10% and 5%.



Figure 6.5 - Targeted channel and levees upgrade layout

6.7.3 Concept hydraulic modelling

The impacts of the proposed channel upgrade and levees were assessed for the target event (5% AEP regional flood) and the 1% AEP regional flood. The measures would generally not be impacted by local catchment flows and as such were not assessed.

Impact mapping from the hydraulic modelling of the targeted channel upgrades and levees is presented in Figures C.24 and C.25 of Appendix C. The impact mapping does not show impacts within the Narrabri Creek channel (due to the channel being represented in 1D).

The hydraulic modelling shows the following:

For the 5% AEP regional flood -

- the Manning Street and Regent Street levees prevent the inundation of properties immediately behind the levees;
- the Selina Street levee does not get overtopped but overland flows from the west would inundate much of the land behind the levee (though to a lesser extent), which would reduce its effectiveness;
- the Eather's Creek channel upgrade would reduce flood levels through much of Narrabri West;
- the Selina Street levee would increase flooding within Narrabri; and
- the Regent Street levee and Eather's Creek upgrade would increase levels but not at locations of existing dwellings.

For the 1% AEP regional flood -

- the Eather's Creek channel upgrade would reduce flood levels through much of Narrabri West but increase flood levels downstream of Narrabri (no dwellings would be impacted); and
- The Selina Street levee and Regent Street levee would increase flood levels.

6.7.4 Tangible benefits

The tangible benefits of the targeted channel upgrade and levees option (configured per Figure 6.5) is given below.

- For the regional 5% AEP event up to 113 buildings would not be inundated, up to 442 would experience flood reductions greater than 0.01 m, while up to 130 buildings would experience flood increases greater than 0.01 m or new flooding. The estimated flood damage cost for the local 5% AEP event would be \$25.7 million, a reduction of \$5.6 million; and
- For the regional 1% AEP up to 6 buildings would no longer be inundated, up to 460 would experience flood reductions greater than 0.01 m, while up to 243 buildings would experience flood increases greater than 0.01 m or new flooding. The estimated flood damage cost for the local 1% AEP event would be \$139.5 million, a reduction of \$0.9 million.

From the results of the hydraulic modelling and the property analysis, it is apparent that the targeted channel upgrades and levees would provide protection for the areas they are targeted at protecting but would also increase flood impacts elsewhere. Further iteration of the levee alignments and potentially compensatory earthworks would be required to determine whether the levee options are viable. Most of the properties with reduced flooding are associated with the Eather's Creek upgrade.

6.7.5 Estimated cost

Table 6.8 shows the indicative costing of the Eather's Creek channel upgrade option. Cost estimates of the levee options have not been provided given they cause detrimental impacts.

Table 6.8 - Indicative cost of the proposed Eather's Creek mitigation option

| Item | Unit Cost | Unit | Quantity | Estimate |
|------------------------|-----------|----------------|----------|--------------------|
| Channel | | | | |
| Site preparation | \$20,000 | ha | 20 | \$400,000 |
| Excavation | \$11.40 | m ³ | 260,000 | \$2,964,000 |
| Topsoil | \$6.15 | m ³ | 30000 | \$184,500 |
| Causeways | | | | |
| Ugoa St | \$400 | m | 80 | \$32,000 |
| Peele St | \$400 | m | 80 | \$32,000 |
| Bridge crossing | | | | |
| Newell Highway | \$1,750 | m ² | 1260 | \$2,205,000 |
| 40% Contingency | | | | \$1,419,400 |
| Total | | | | \$7,236,900 |

6.7.6 Environmental impacts

A detailed study would be required to determine the potential environment impacts of the Eather's Creek channel upgrade. Although the floodway is generally clear of vegetation, some loss of mature trees would be expected. The channel would need to be designed to ensure stability and limit erosion potential.

6.7.7 Social impacts

The social impacts of the proposed levees would generally be negative, given they increase flooding. The Eather's Creek channel upgrade would see reduced community impact during moderate to large floods. There would be some loss of amenity due to the channel works.

6.8 OTHER STRUCTURAL MITIGATION CONSIDERATIONS

6.8.1 Narrabri West Lake

Narrabri West Lake was constructed between 1989 and 1991 on land that was previously O'Brien's Creek floodway (Molino Stewart, 2016). A concrete wall with two low-flow pipe outlets was used to formalise the area into a lake.

While the lake is a community recreation hub its impact on flooding is not well understood. To test the flooding impact of Narrabri West Lake the concrete wall at the northern end of the lake was removed from the hydraulic model. Impact mapping from the removal of Narrabri West Lake for the 1% AEP regional flood event is presented in Figure C.26 of Appendix C. The model results reveal that for significant regional flood events the lake has little impact on flood levels. Note that the impact mapping presented does not show impacts within the Narrabri Creek channel (due to the channel being represented in 1D).

There are a small number of residential properties upstream of the Narrabri West Lake that would be inundated above floor level for the 20% AEP regional flood event. It is unlikely that any of the properties flooded above floor level would be saved by removing the lake (based on the crest level of the lake wall and the flood slope along O'Brien's Creek). On this basis, the Narrabri West Lake would appear to not have a detrimental impact on flood levels in Narrabri.

6.8.2 Narrabri Creek tree clearing

The flooding impact of vegetation in the Namoi River and Narrabri Creek has been questioned by residents of Narrabri for decades. Clearing of willow trees and undergrowth conducted by NSC in 1997 was modelled by Max Winders & Associates (2002). The result of the clearing was found to have limited impact, with flood level reductions of up to 0.05 m for the 1% AEP flood event.

The hydraulic model was used to further test the impact of vegetation clearing in and around Narrabri Creek. Vegetation clearing was simulated by reducing the Manning's roughness in the Narrabri Creek channel (and on the overbanks up to the edge of existing development), from 100 m upstream of the river bifurcation to approximately 150 m downstream of Doctors Creek. The Manning's roughness was reduced by 25%, which would represent significant channel and overbank clearing.

Impact mapping from the hydraulic modelling of the Narrabri Creek modification is presented in Figures C.27 of Appendix C. The impact mapping presented does not show impacts within the Narrabri Creek channel (due to the channel being represented in 1D). The model results reveal that:

- for a 1% AEP regional flood event extensive channel clearing would result in flood level decreases of between 0.1 and 0.2 m over much of Narrabri; and
- some land in the Village South ERP community would not be inundated by the 1% AEP event.

The modelled 25% reduction in Manning's roughness represents an upper limit on what may be achieved with channel clearing. It is likely that extensive tree clearing on the riverbank and overbank areas would be involved to achieve this reduction in roughness. Further, continued maintenance (mowing) would be required to maintain the channel and overbanks at the reduced roughness value. The remnant vegetation is predominantly red gum with little non-native vegetation that could be readily removed and as such the legislative constraints around native vegetation clearing would be a significant issue. Also, the removal of vegetation at this scale would significantly reduce the visual amenity and environmental diversity of the river corridor.

Notwithstanding, the hydraulic modelling shows that this clearing would provide some flood benefit. It would not solve the flooding problem in Narrabri. However, maintaining the overbank areas to minimise any obstructions to flow would be important to maintain flow conveyance.

6.8.3 Stormwater drainage infrastructure

The significant number of waterways and flood runners across Narrabri presents a unique challenge to NSC. While much of the drainage network drains overland, there is also a significant pit and pipe stormwater infrastructure network, as well culvert and bridge structures.

Regular maintenance of the waterways, flood runners and stormwater infrastructure can have a positive impact on flooding for both regional and local catchment flood events. NSC currently have an unfinished GIS database of stormwater infrastructure within Narrabri. It is recommended that this GIS database be expanded to include:

- the entire pit and pipe stormwater network;
- all culvert and bridge structures (whether on council-controlled infrastructure or not); and
- all constructed and natural channels.

Once the database is complete a stormwater drainage maintenance program should be enacted to ensure the infrastructure is operating effectively. The completed database should be also be analysed to identify locations where backflow may occur in the stormwater network. Some of the potential backflow locations have already been identified (refer Section 6.5). Backflow prevention devices may not always stop flooding

(due to the many drainage mechanisms across Narrabri), but will often decrease the duration of flooding, giving residents greater time to prepare.

6.9 POTENTIAL STRUCTURAL EMERGENCY RESPONSE MEASURES

The flood emergency response planning (detailed in Chapter 5) revealed that evacuation routes to evacuation centres for many Narrabri residents are cut for greater than 24 hours in flood events as frequent as 5% AEP. The existing evacuation centres are also located in flood prone areas that have various levels of flood immunity. Vehicle access to the Narrabri RSL evacuation centre is cut for the 5% AEP event by more than 24 hours and is cut for all centres by more than 24 hours for the 1% AEP event (see Figure 5.2). Further discussion on the evacuation centres is given in Section 7.5.

The number of roads cut by flooding make it difficult to prioritise structural emergency response measures. However, improving access to the least flood-prone evacuation centre (Narrabri West Public School) and one not located on a low flood island would be a priority. The primary access to the Narrabri West Public School for most properties would be the Newell Highway (Cooma Road). The Newell Highway would be cut near Ugoa Street and Boheena Street (see Table 5.4) for the 5% AEP event. Much of the road would be impassable for the 1% AEP event.

Raising the road to be passable for the 5% AEP flood would increase flood levels at properties immediately upstream. There is no clear sag in the road that would indicate that it is low, which suggests that any minor road raise would force the water across the road at a different location. The road is also a primary access to many private and commercial properties, which would make it difficult to raise the road to provide immunity up to the 1% AEP level or higher.

Given the considerable constraints, hydraulic analysis of raising the Newell Highway has not been undertaken.

6.10 INLAND RAIL PROJECT

The Australian Government, through the Australian Rail Track Corporation (ARTC), are proposing to construct an Inland Rail link from Melbourne to Brisbane. The Werris Creek to Mungindi rail line that passes across the study area is currently proposed to form part of the upgraded line. ARTC and NSC have begun and should continue a collaborative approach to assessing the flooding impacts of the Inland Rail project.

6.11 EVALUATION OF STRUCTURAL MITIGATION OPTIONS

Table 6.9 provides a comparative assessment of the mitigation options that provided a flood mitigation benefit. A relative ranking ranging from minus 3 (major negative impacts) through to plus 3 (major positive impacts) has been provided for four criteria:

- Tangible benefit (reduction in the number of properties inundated by the 1%AEP event (local or regional);
- Relative cost;
- Environmental constraint; and
- Social impact (related to the reduction in flooding for smaller events and flood impacts).

An objective ranking has been applied based on the discussion provided in the above sections. Given the disparity between the relative costs and tangible benefits, a comparative ranking has been applied to these criteria. For instance, the Narrabri bypass and house raising options have similar tangible benefit, but their relative cost have been used to separate the options. The rankings for each option have been summed to provide an indication of which option should be considered for more detailed assessment.

Table 6.9 - Comparative assessment of Mitigation Options

| Option | Tangible benefit | Relative cost | Environmental constraint | Social impact | Total |
|---------------------------|------------------|---------------|--------------------------|---------------|-------|
| Voluntary Purchase | 3 | -1 | 0 | 1 | 3 |
| Horsearm Creek levee | 3 | -1 | 0 | 1 | 3 |
| House raising | 3 | -3 | 0 | 2 | 2 |
| Narrabri North Industrial | 1 | -2 | 0 | 3 | 2 |
| Narrabri Bypass | 3 | -3 | -1 | 2 | 1 |
| Eather's Creek channel | 2 | -1 | -1 | 2 | 1 |
| Channel clearing | 2 | 0 | -2 | -1 | -1 |
| Mulgate Creek diversion | 0 | 0 | 0 | -2 | -2 |

Based on the investigations conducted in this chapter the following is recommended:

- The voluntary purchase program was ranked the highest (equal). It complies with recommended non-structural flood management options recommended in Chapter 6.12. Voluntary purchase also directly addresses the most at-risk properties on the floodplain. This option is recommended for adoption and implementation.
- Horsearm Creek levee and backflow prevention option was also ranked the highest (equal) due to its relatively low cost and its ability to reduce flooding from Horsearm Creek. Further investigation of this option is recommended to mitigate the flood impacts and provide a suitable alignment of the levee.
- The house raising program has a reasonable benefit cost ratio for at least the first five rounds of the scheme and is recommended for consideration by the community. It is possible that only those properties that have a positive benefit-cost may qualify for the scheme, which could further reduce the suitability of the scheme.
- The Narrabri North Industrial option achieves a high rating due to the social benefits of providing additional industrial area for Narrabri, which is currently in short supply.
- The Narrabri bypass option would provide the greatest flood mitigation and reduction of flood risk in Narrabri of any option tested. The high cost of this option will continue to be the biggest drawback. The significant flood increases east of the bypass impacting property would also suggest the option is not viable. Due to the reasoning above, further consideration of the Narrabri bypass is not recommended. However, a reduced scheme (like the Horsearm Creek levee option) may be worth considering.
- The Eather's Creek channel upgrade was found to reduce flood levels across much of Narrabri West. However, the cost of this option is likely to considerably outweigh the benefits. It is recommended for further consideration as a low priority.
- Clearing of the Narrabri Creek channel and overbanks was shown to reduce flood levels. However, most of the existing vegetation is native, which makes it difficult to justify removal. It is recommended to improve the maintenance of this area by removing unnecessary blockages to maintain the conveyance of this area.
- Mulgate Creek diversion was not shown to be overly effective without significant additional costs to major road and rail infrastructure upgrades. This option is not recommended for further consideration.

6.12 DETAILED ASSESSMENT OF UPDATED HORSEARM CREEK MITIGATION

6.12.1 Overview

Of the structural options considered, the Horsearm Creek levee option was ranked the highest. However, this option caused impacts to properties outside of the levee. The levee was also aligned along the rail, which was not possible.

Figure 6.6 shows an updated configuration of the Horsearm Creek Mitigation option. The option includes the following:

- A new levee with a crest level 1 m above the 1% AEP event that extends along on the eastern side of the rail between Queen Elizabeth Avenue (to the south) and Old Cemetery Road;
- The existing bund/levee located to the east of Queen Elizabeth Avenue (at its current height);
- A new levee between Regent and Arnold streets extending from the Queen Elizabeth Avenue bund to Old Gunnedah Road (with a crest level equal to the 5% AEP event);
- An excavated channel along Horsearm Creek with a 50 m wide base, 1V:5H sides and a 0.2% slope extending from an existing stormwater sump adjacent to Queen Elizabeth Avenue to the Newell Highway. The levee and channel have been aligned so that no residential lots or the racecourse would be impacted by the works;
- Backflow prevention devices installed on the stormwater networks draining to Horsearm Creek;
- A new bridge for Old Cemetery Road (new 36 m long bridge as per NSC drawing 1718392-1);
- A new culvert for the Werris Creek Mungindi Rail (13 by 3.6 m X 3.6 m box culvert); and
- New causeways for Fitzroy and Namoi Streets.

The Narrabri North Industrial Estate mitigation has also been included in the analysis and are also shown in Figure 6.6.

6.12.2 Hydraulic assessment

Figures D.1 to D.7 in Appendix D show the impact mapping for the proposed Horsearm Creek levee for local catchment flooding and Figures D.8 to D.14 in Appendix D show the impact mapping for Namoi River flooding. Results have been provided for the 20% AEP to the 0.2% AEP events. The impact mapping presented does not show impacts within the Narrabri Creek channel (due to the channel being represented in 1D).

The hydraulic modelling shows the following:

For local catchment flooding -

- events up to and including 1% AEP would experience significant flood level reductions or would not be inundated. Flood level increases would occur upstream of the Narrabri North Industrial area mitigation measures as described in Section 6.6. Flood level increases also occur downstream of the channel works as a result of the Narrabri North Industrial area measures, though these increases are generally limited to largely undeveloped waterway corridor areas; and
- events greater than 1% AEP provide protection behind the levee with flood level increases now intruding southwards into the more developed part of town.

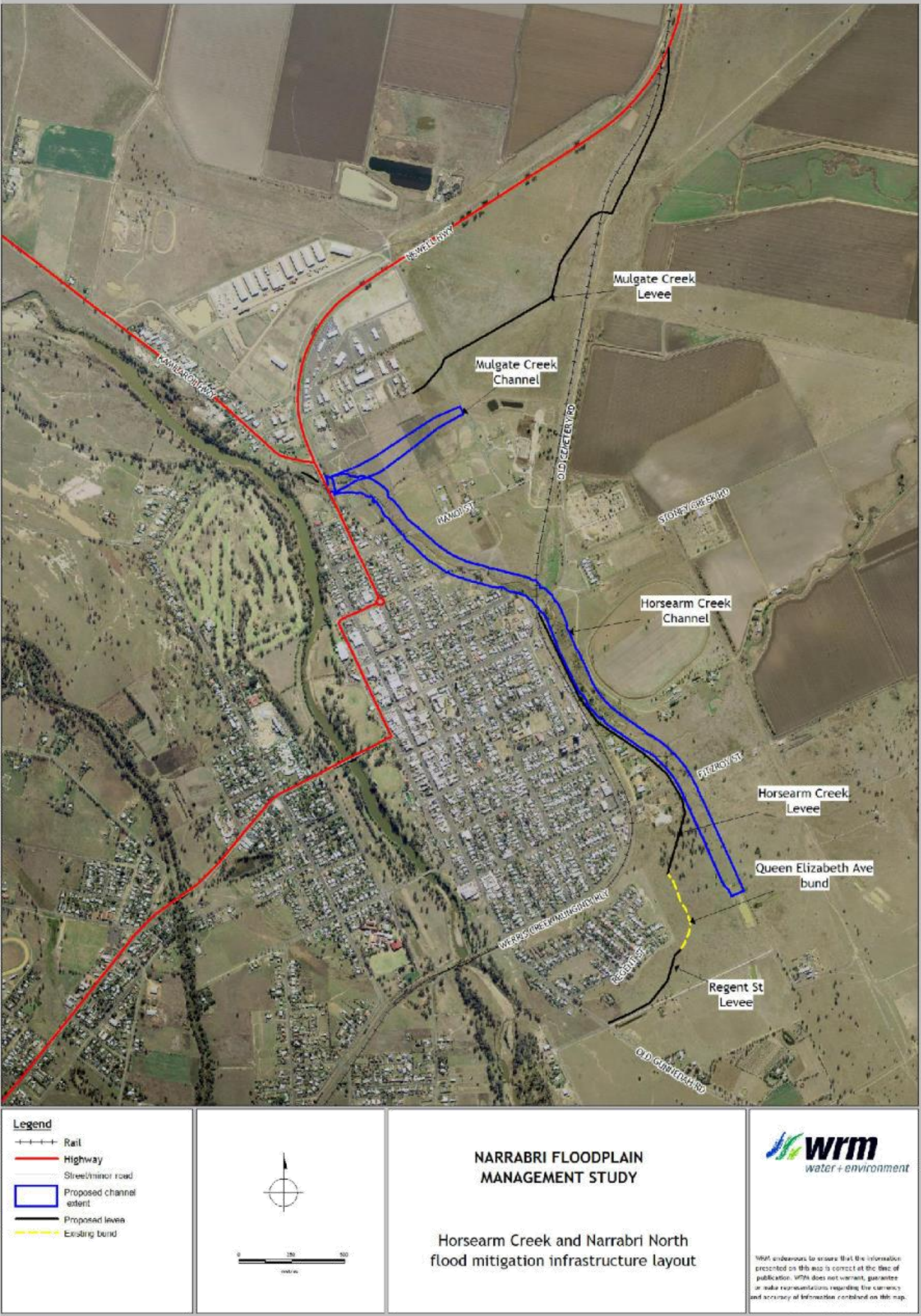


Figure 6.6 - Horsearm Creek and Narrabri North mitigation infrastructure

For regional flooding -

- there would be no impacts for events up to and including 5% AEP; and
- there would be minor reductions in flood levels both within the Narrabri North Industrial Estate and adjoining urban areas due to the construction of the drain increasing waterway flow area for events larger than this. There would be minor increases immediately upstream of the levee.

The reduction in flooding for Namoi River flooding is not as significant. Minor reductions in inundation would occur within Narrabri for the large and rare events.

6.12.3 Tangible benefits

Table 6.10 shows the number of properties flooded above and below floor level and the estimated residential and commercial damages (in December 2019 dollar values) assuming both the Narrabri North Industrial Estate mitigation and the Horsearm Creek channel and levee works were constructed. The estimated building average annual damage (AAD) is also shown.

Table 6.10 - Number of properties flooded and flood damage costs, Narrabri North Industrial Estate flood mitigation option

| Parameter | Event (AEP) | | | | | | | |
|-----------------------------------------------------------------------------------------------------|-------------|-------|--------|--------|---------|---------|---------|---------|
| | 20% | 10% | 5% | 2% | 1% | 0.5% | 0.2% | PMF |
| Regional flooding | | | | | | | | |
| No. residential buildings flooded AGL | - | 42 | 658 | 1,493 | 1,714 | 1,829 | 1,925 | 2,418 |
| No. residential buildings flooded AFL | - | 13 | 218 | 632 | 871 | 1,032 | 1,184 | 2,390 |
| Total residential damages (\$M) | \$0 | \$1.6 | \$29.9 | \$94.8 | \$129.8 | \$155.2 | \$182.3 | \$443.7 |
| No. non-residential buildings flooded AGL | - | 91 | 235 | 406 | 447 | 480 | 497 | 573 |
| No. non-residential buildings flooded AFL | - | 5 | 92 | 238 | 297 | 347 | 379 | 573 |
| Total non-residential damages (\$M) | \$0 | \$0.0 | \$0.8 | \$3.3 | \$5.8 | \$8.3 | \$11.5 | \$74.2 |
| Building average annual damage | \$5.96M | | | | | | | |
| Local catchment flooding | | | | | | | | |
| No. residential buildings flooded AGL | 5 | 6 | 6 | 56 | 151 | 269 | 336 | 1,943 |
| No. residential buildings flooded AFL | 2 | 2 | 2 | 21 | 61 | 112 | 154 | 1,206 |
| Total residential damages (\$M) | \$0.3 | \$0.4 | \$0.4 | \$3.0 | \$8.9 | \$16.8 | \$22.8 | \$178.3 |
| No. non-residential buildings flooded AGL | 84 | - | - | 6 | 25 | 59 | 75 | 536 |
| No. non-residential buildings flooded AFL | - | - | - | 4 | 14 | 36 | 53 | 408 |
| Total non-residential damages (\$M) | \$0.0 | \$0.0 | \$0.0 | \$0.0 | \$0.2 | \$0.7 | \$1.1 | \$25.5 |
| Building average annual damage | \$0.53M | | | | | | | |
| AGL - above ground level (count includes buildings flooded above both ground level and floor level) | | | | | | | | |
| AFL - above floor level | | | | | | | | |

AGL - above ground level (count includes buildings flooded above both ground level and floor level)
AFL - above floor level

With respect to the 1% AEP flood and comparing to existing conditions (see Table 4.3 and Table 4.4), the results show that:

- the number of regional flood affected residential properties would reduce by 29 (from 1,743);

- the number of residential properties flooded above floor level for regional flooding would reduce by 43 (from 914);
- the number of local catchment flood affected residential properties would reduce by 254 (from 405);
- the number of residential properties flooded above floor level for local catchment flooding would reduce by 78 (from 139);
- the total regional flooding flood damages would reduce by \$4.8 million (from \$140 million under existing conditions); and
- the total local catchment flooding flood damages would reduce by approximately \$15.3 million (from \$24.4 million under existing conditions).

The total building AAD from flooding for the Horsearm Creek and Narrabri North Industrial Estate mitigation option is \$6.49 million. This is approximately \$0.79 million less than existing conditions. The overwhelming benefit of this option is from local catchment (Horsearm Creek) flooding. The benefits from Namoi River flooding are not significant.

6.12.4 Updated cost estimate

Table 6.11 provides indicative costings of the levee and channel works. Note that no changes to the rail have been proposed given the low immunity level of the rail under existing conditions. Also note that ARTC are currently proposing to upgrade the existing rail crossing using a similar configuration.

6.12.5 Economic evaluation

Table 6.12 provides the results of an economic evaluation of the Horsearm Creek Upgrade option. The net present value of the savings has been determined for discount rates of 4%, 7% and 10%, which has been compared to the cost of the scheme to determine the benefit cost ratio. The total building AAD was calculated as the sum of AAD for regional flooding and local catchment flooding as described in Section 6.12.3.

The analysis suggests that the economic benefits of the Horsearm Creek scheme outweigh the costs for the 4% discount rate. The costs marginally outweigh the benefits for the 7% and 10% discount rates. However, further work to reduce the high contingency cost would provide a positive benefit cost ratio for the higher discount rates. Note also that the analysis of tangible benefits excludes the costs associated with backwater flooding under the current scenario.

6.12.6 Environmental impacts

The environmental impacts associated with the proposed scheme would be limited to the removal of riparian vegetation and floodplain vegetation along the levee and channel alignment.

6.12.7 Social impacts

The social impacts of the proposed scheme to the community are largely positive for those within the levee. The potential positive social impacts of the scheme include:

- significantly reduced community impact during Horsearm Creek flooding for the full range of flood events;
- potentially reduced insurance costs for property owners within the levee; and
- reduced stress during flood events for those within the town.

The potential negative social impacts of the proposal include changes to the immunity of Fitzroy and Namoi Street crossings.

Table 6.11 - Indicative cost of the proposed Horsearm Creek mitigation works

| Item | Unit Cost | Unit | Quantity | Estimate |
|----------------------------|-----------|----------------|----------|---------------------|
| Levee | | | | |
| Site preparation | \$20,000 | ha | 3 | \$60,000 |
| Base prep | \$62.70 | m ³ | 4,500 | \$282,150 |
| Fill | \$18.00 | m ³ | 50,500 | \$909,000 |
| Channel | | | | |
| Site preparation | \$20,000 | ha | 25 | \$500,000 |
| Excavation | \$11.40 | m ³ | 431,000 | \$4,913,400 |
| Topsoil | \$6.15 | m ³ | 37500 | \$230,625 |
| Causeways | | | | |
| Fitzroy St | \$400 | m | 100 | \$40,000 |
| Namoi St | \$400 | m | 100 | \$40,000 |
| Culvert crossings | | | | |
| Rail | \$7,580 | m | 50 | \$379,000 |
| Old Cemetery Rd | \$16,695 | m | 36 | \$601,020 |
| Miscellaneous Items | | | | |
| Backflow devices | \$15,000 | item | 3 | \$45,000 |
| Detail design | | Item | 1 | \$500,000 |
| Land acquisition | | Item | 1 | \$1,000,000 |
| Contingencies | | | | |
| 40% Contingency | | | | \$3,800,078 |
| Total | | | | \$13,300,273 |

Table 6.12 - Economic evaluation of the proposed Horsearm Creek upgrade

| Scenario | Total building AAD | AAD savings | NPV Savings over 50 years | | | Cost | Benefit Cost Ratio | | |
|-----------|--------------------|-------------|---------------------------|---------|--------|---------|--------------------|------|------|
| | | | @ 4% | @ 7% | @ 10% | | @4% | @7% | @10% |
| Existing | \$7.27M | - | | | | | | | |
| Mitigated | \$6.49M | \$0.78 | \$16.81 | \$10.80 | \$7.76 | \$13.30 | 1.26 | 0.81 | 0.58 |

7 Non-structural flood management options

7.1 EXISTING NON-STRUCTURAL FLOOD MANAGEMENT

NSC currently manage the development of flood prone land via land use zoning within the LEP (refer Figure 2.1) and development requirements specified in the Narrabri Development Control Plans (DCPs).

The LEP defines land use zones in and around Narrabri and defines the flood planning area and flood planning level. The current LEP flood planning area mapping is similar to the flood planning area shown in Figure 3.4. The LEP stipulates that:

Development consent must not be granted to development on land to which this clause applies (land within the flood planning area) unless the consent authority is satisfied that the development:

- (a) is compatible with the flood hazard of the land, and*
- (b) is not likely to significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties, and*
- (c) incorporates appropriate measures to manage risk to life from flood, and*
- (d) is not likely to significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses, and*
- (e) is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding.*

The DCPs set standards for new developments and modifications to existing developments within the flood planning area. The DCPs reference the Narrabri Shire Interim Floodplain Management Policy, which is an extract of the study undertaken by Max Winders & Associates (2002). This extract requires that:

- *all habitable floor levels for residential properties shall be at least 0.5 m above the estimated 1% AEP flood level at the site;*
- *floor levels for commercial and industrial properties shall be at least 0.1 m above the estimated 2% AEP flood level at the site;*
- *a Certificate of Structural Adequacy, prepared by a suitably qualified structural engineer shall be submitted for all buildings to be erected on flood liable land;*
- *filling of land affected by the 1% AEP design flood event shall require Council consent where the height of filling exceeds 225 mm.*

Some additional development constraints are also specified for the four key development areas identified in the 2002 study (Genanagie Street Study Area, Narrabri North Industrial Estate, Shannon Estate Study Area and Mackenzie Street Study Area).

The DCPs also specify several other 'soft' flood-related requirements that are open to interpretation. The current DCPs do not vary development controls between low and high flood hazard (or flood risk) areas (apart from the four previously mentioned areas).

7.2 OPTIONS FOR FUTURE NON-STRUCTURAL FLOOD MANAGEMENT

The updated flood modelling presented in Volume I of this study, along with the flood behaviour information presented in Section 3 of this report have been used to recommend the following non-structural flood management options be considered for Narrabri:

- A risk-based approach to land use planning, including updated land use zoning and associated building and development controls;
- Improved flood forecasting, flood warning systems and strategic emergency response planning; and
- Improved public awareness and education.

7.3 LAND USE PLANNING - LAND USE ZONING

7.3.1 Purpose

The application of land use zoning is an effective and long-term means of controlling development in flood affected areas. The Australian Disaster Resilience Guideline 7-5 Flood Information to Support Land-use Planning (AIDR, 2017) recommends “limiting the growth in flood risk because of new land uses and development in the floodplain”. Land use zoning is therefore key to restricting or preventing incompatible development on flood prone land.

7.3.2 Considerations

Land use zonings over flood prone land should be based on an objective assessment of flood hazard and risk, environmental and social factors including:

- the NSW Governments Flood Prone Land Policy;
- whether the land is in a high flood risk area;
- the potential for future development to have an adverse impact on flood behaviour and thereby negatively impact existing development;
- whether adequate access is available during floods;
- whether certain activities should be excluded because of additional or special risk to their users, e.g. accommodation for aged people, hospitals etc.; and
- existing planning controls.

7.3.3 Proposed strategy

It is proposed that the zoning of land in and around Narrabri consider the flood risk presented in Section 3.6 and the hydraulic categories map presented in Section 3.7 (Figure 3.6). Figure 7.1 shows the existing LEP land use zones and the designated floodways (based on extreme (Z6) and high (Z5) flood risk zones). Figure 7.1 shows that most of the land cover by proposed floodways is currently zoned RU1, RE1 or RE2. There are a number of lots zoned for development (i.e. R1 - residential and IN2 along the lower end of Mulgate Creek) covered or partly covered by proposed floodways. It is recommended that:

- any vacant land within the floodway be zoned as RU1 (primary production) or RE1 or RE2 (public or private recreation) to prevent future development on this land;
- any existing development within floodways be considered for voluntary purchase (refer Section 6.2 discussion), then removing the structures and rezoning the lots;
- as further flood studies are conducted for the region (i.e. Bohena Creek), once these studies are adopted by NSC the modelling from these further studies be used to expand the flood risk mapping presented in Section 3.6 and the hydraulic categories map presented in Section 3.7 (Figure 3.6).

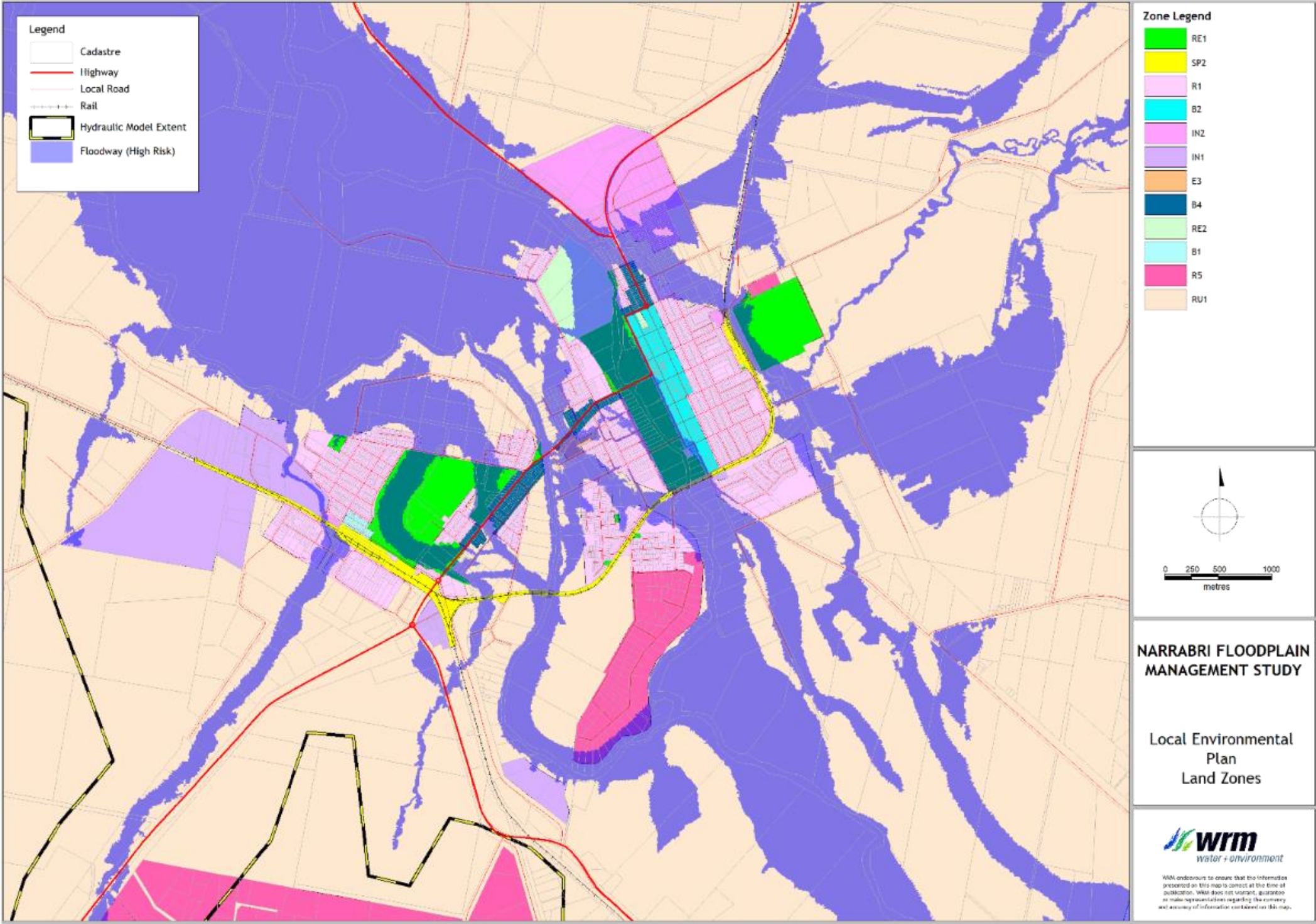


Figure 7.1 - Floodway overlaid on existing land use zones

Given that most of the existing development in Narrabri is within the flood storage (medium risk) zone, the rezoning of land within this area would not be practical. Any future rezoning of RU1 (primary production) to residential, commercial or industrial land uses to encourage development should be preferentially directed toward land covered by low risk or no risk zones (i.e. flood fringe or land outside of the modelled flood extent). This would ensure new development within Narrabri is focused on areas with lower flood risk than the majority of existing development.

7.4 LAND USE PLANNING - BUILDING AND DEVELOPMENT CONTROLS

7.4.1 Purpose

The NSC DCP is the primary instrument for managing development on the floodplain while ensuring development is compatible with the potential flood risk. Given the existing flood risk, the DCP is also to ensure that development within the medium risk zones is not increased.

7.4.2 Considerations

Sections of the current Narrabri DCPs that reference flooding are based on the study undertaken by Max Winders & Associates (2002) and the flood planning area (FPA) map (the FPA map was updated after the publication of the Narrabri Flood Study (WRM, 2016)). The flood mapping provided in Section 3 details the flood risk for both regional and local catchment flooding, something that was not previously available from the 2002 study. For this reason, the DCP should be updated to reflect this extra information (i.e. Figure 3.6).

In particular, the floodways (high risk zones) shown in Figure 3.6, which are similar to the floodways defined in the 2002 study (extent of 5% AEP inundation) should specifically be addressed in the DCP (historically the land zoning has reflected the floodways (high flood risk zones) but no specific mention of floodways (high flood risk zones) is made in the current DCPs). Flood management best practice would suggest that further intensification of development within any floodway (flood risk zones Z5 (high risk) and Z6 (extreme risk)) should be prevented. These areas are frequently flooded, generally have poor evacuation access and generally are subject to high flood hazard for moderate sized (frequent) flood events.

Of particular relevance is the Mulgate Creek/Horesearm Creek floodway along the eastern side of Narrabri, which experiences both local and regional flooding with little flood warning provided for local flooding.

The proposed strategy has been formulated considering the existing flood risk in Narrabri. With the vast majority of the population situated in the defined flood storage area (medium risk), allowance is made for small scale intensification of this area, where appropriate, without allowing large scale intensification that would increase flood risk for neighbouring properties and emergency services.

7.4.3 Proposed strategy

It is recommended that development within the flood planning area be managed using the flood risk map (Figure 3.6). The flood planning area map (recommended to be included in the DCP) would be used to define when floodplain development controls would be required, and the flood risk map would be used to define the development controls.

Outlined below are general principles that are recommended for inclusion into the revised DCP. Some of these measures are consistent with the existing DCP. While the existing DCP includes specific controls for several areas, it is proposed that one set of rules be adopted for all of Narrabri and surrounds. It is recommended:

For development within risk zone Z1 (as defined by flood free land in Figure 3.6):

- no flood related development controls be enforced (apart from general drainage related clauses).

For development within low risk (flood fringe) zone (as defined in Figure 3.6):

- the floor level of all new residential buildings be above the flood planning level (1% AEP (regional or local catchment, whichever is higher) + 0.5 m);
- the floor level of all new commercial buildings be above the 1% AEP level (regional or local catchment, whichever is higher);
- where the height of fill for residential single detached dwellings does not exceed 225 mm, the filling need not be assessed for flood impact;
- where the fill for residential development exceeds 225 mm and is greater than 50 m², or more than 20% of the lot area (whichever is smaller), it will be required to be assessed for flood impact;
- foundations and other construction below the flood planning level be of suitable flood compatible materials, or utilise equivalent alternative methods of flood proofing;
- the floor level of a minor extension be required to not be less than the habitable floor level of the existing structure;
- the use and storage of hazardous materials be prohibited at levels below the flood planning level in all circumstances, unless suitably banded (i.e. service station fuel tanks etc.); and
- for new commercial buildings, a flood management plan would be required to detail what measures would be enacted to reduce flood damage, manage hazardous materials and ensure employees are safe.

For development within medium risk (flood storage) (as defined by Figure 3.6) development controls be per low risk, with the addition of:

- prohibition of land use intensification (i.e. subdivision, construction of additional habitable residential structures on already developed lots);
- prohibition of development for which assisted evacuation would be required (aged care, some medical facilities etc. or a childcare centre in an area affected by local catchment flooding);
- minor extensions to existing habitable residential buildings would be encouraged to raise the floor level to the flood planning level (not mandatory);
- extensions that increase the gross floor area of a residential dwelling by 50% would be required to have the new floor level above the flood planning level;
- non-habitable buildings such as a shed (Building Code of Australia Class 10A) be constructed with flood resilient materials: and
- all new habitable residential buildings, and extensions of existing habitable residential buildings be required to prepare a flood evacuation plan.

For development within the high risk zone (designated floodways) (as defined by Figure 3.6):

- prohibition of all new buildings;
- prohibition of subdivision, which would create an additional building entitlement;
- prohibition of filling, other than that required to fill local depressions to the natural level of the surrounding land;
- prohibition of any extensions to existing buildings within the floodway:
 - with the exception of house raising, which is to be accompanied by an adequate flood management/evacuation plan.

For lots covered by multiple flood risk zones the applicable development controls are based on the portion of the lot on which the development is being planned. It is also recommended that a consistent flood impact threshold be adopted for which developments with assessable fill can be evaluated against. A notional acceptable impact would be 0.01 m.

7.5 FLOOD EMERGENCY PLANNING

7.5.1 Overview

As discussed in Section 5, the principal residual flood risk management option for Narrabri is evacuation. The existing Narrabri Shire Local Flood Plan covers issues such as flood warning, resupply, evacuations and flood recovery. The additional and updated information provided in Section 5 can be used to update the Local Flood Plan. In particular, the information on the locations of road inundation depths for the various events could assist prioritisation of evacuations for regional flood events.

7.5.2 Evacuation centres

As detailed in Section 5.3, there are currently four evacuation centres listed in the Narrabri Shire Local Flood Plan (NSW SES, 2015). While these four locations provide refuge up to very rare to extreme flood events, the three nominated evacuation centres east of Narrabri Creek would be surrounded by water in rare flood events (with two surrounded as soon as 5% AEP levels are reached). Two are located within the floodway. Once surrounded by water it becomes more difficult to take additional evacuees and resupply becomes more difficult. These evacuation centres would need to be evacuated for an extreme flood event, which would be very difficult and unsafe once all of the roads were inundated. For these reasons, an evacuation centre off the floodplain should be considered.

To establish and maintain a viable formal evacuation centre the following provisions would be required:

- a clear plan on how to get the population of Narrabri to the evacuation area, including:
 - knowledge of when evacuation routes are cut; and
 - provision for evacuation once roads are cut.
- essential services to this area would need to be flood proofed to ensure that the area could sustain an influx in population during a flood event, including:
 - provision of supplies (food and medical supplies);
 - potable water; and
 - sewer service.

The obvious place to establish a formal evacuation area for both regional and local flooding is Narrabri West given its low or no flood risk. However, there are no buildings within Narrabri West large enough. It is also potentially inaccessible for the population in the eastern precincts. Figure 5.2 shows that the Newell Highway would likely be cut for greater than 24 hours once water reaches 5% AEP levels. Once roads are cut, evacuation options are reduced to boat and/or air, both of which have significantly less capacity than road transport and possibly not practical given the population.

It is recommended to consider entering an arrangement with a commercial operation that has a large shed that could be retrofitted for emergency accommodation.

Regardless of whether the existing nominated evacuation centres are maintained, an alternative Narrabri West evacuation centre is formalised, or another evacuation centre east of Narrabri Creek with greater road access immunity is formalised, the early evacuation of the population east of Narrabri Creek would be critical in the event of a significant regional flood.

7.5.3 Other evacuation considerations

As shown in Figure 5.2, NSC's road network is particularly susceptible to flooding. Several bridge structures around Narrabri are currently in the process of being replaced. For these projects, and future road-related projects, the significance of each road's flood immunity should be reviewed, and where a road is identified as being of potential significance to flood evacuation the upgrade should take this into account (i.e. some road raising may be justified).

The existing rail line (which is largely an elevated structure - particularly over Narrabri Creek) could help facilitate rapid evacuation during the onset of a significant flood. It is recommended to discuss with ARTC whether this is a suitable or appropriate emergency evacuation route.

NSC should continue to liaise with the SES to ensure that any changes to the road network are communicated to the SES so that potential impacts these changes may have on evacuation routes can be considered.

7.5.4 Flood warning for local catchment flood events

While regional flood events are often preceded by warnings from population centres upstream of Narrabri, local flood events often have little to no warning. The local creek catchments northeast and southwest of Narrabri respond to short duration storm events, leaving little warning time between the rainfall starting and creek levels rising. There are a number of options that could potentially be implemented to try to improve flood warning for those areas of Narrabri subjected to local catchment flooding. These options include installing additional ALERT (sub-daily) rainfall stations and/or stream gauges.

The Bohena Creek catchment has one existing stream gauge at the Newell Highway. Increases in flood level at this gauge would likely provide 2-3 hours warning for properties on the western edge of Narrabri that may be affected by Bohena Creek flooding. Due to the limited population affected by Bohena Creek flooding this local catchment is not a high priority for further monitoring. Notwithstanding this, NSC could investigate obtaining further monitoring data (potentially sub-daily rainfall data) in partnership with Santos who hold petroleum exploration leases further upstream in the Bohena Creek catchment.

Due to the relatively small size of the Long Gully catchment, rainfall at the very top of the catchment would take less than 3 hours to reach Narrabri once runoff commences throughout the catchment. This likely rules out water level monitoring, as the ideal location for water level monitoring would be at the Newell Highway, which would likely only provide an hour notice. A sub-daily rainfall station could potentially be installed in the upper reaches of the catchment to try and provide some warning.

The Mulgate Creek, Horsearm Creek and Doctors Creek catchment to the east of Narrabri is a large local catchment draining peaks on the fringe of the Mount Kaputar National Park. The size of this local catchment means monitoring in the upper reaches of the catchment could potentially provide in excess of 3 hours warning for rising floodwaters. The one existing pluviograph rainfall station (Narrabri Airport AWS) is located within this local catchment, however the airport is in the lower reaches of the catchment so there is limited warning available from this monitoring data.

Ideally both water level and sub-daily rainfall monitoring would be established in the upper reaches of the catchment to allow both rainfall and water level rise triggers for potential flood warning. For ease of installation and maintenance it would be ideal to include the water level and rainfall monitoring at one location, near one of the few roads in the upper catchment. There are four significant waterway crossings along Mulgate Creek Road so it is likely that these locations would be the first investigated to install water level and/or rainfall monitoring stations.

7.6 PUBLIC AWARENESS, COMMUNITY CONSULTATION AND EDUCATION

7.6.1 Purpose

Appropriate and timely public response during flooding is related to the level of understanding in the community of the nature, frequency and extent of flooding, the rate of rise of floodwaters and the degree of risk. Therefore, public awareness of the potential risk should be an integral and ongoing part of managing flood affected areas.

7.6.2 Considerations

Significant local catchment flood events have occurred since the turn of the century, however a significant regional (Namoi River) flood event has not occurred for over 20 years. Historically the Narrabri community have had a high level of flood awareness, however due to extended drought conditions and lack of recent regional flooding events, this awareness may be waning. A continuing public education programme is recommended on the basis that a well-prepared community will suffer less damage and other flood related problems during a significant flood event.

Public education is relatively inexpensive and has the potential to reduce the risk to life and property. Significant flood events are infrequent. Therefore, a programme of public information must be ongoing and sustained if it is to be effective.

7.6.3 Proposed strategy

The following public awareness strategies are proposed:

- publish the Narrabri Flood Study (WRM, 2016) and the Narrabri Floodplain Risk Management Study and Plan: Volume 1: Supplementary Flood Study (WRM 2019b) on the NSC website;
- display historical flood marks and the 1% AEP flood level throughout Narrabri and the surrounding areas (i.e. with signs on electricity poles etc.);
- provide flood related property information on the NSC website or make this available to anyone enquiring through NSC, including:
 - property ground level and floor levels;
 - design flood levels; and
 - the flood planning level.
- incorporate the flood risk categorisation map presented in Section 3.7 (Figure 3.6) in the Narrabri DCP alongside the flood planning area mapping. Links to this mapping to be prominently displayed on NSC's website;
- send a flier to residents annually, potentially as part of the rates notice reminding residents to review their flood evacuation plan. The flier could highlight Narrabri's significant exposure to flood risk, identify nominated evacuation centres and provide information on emergency response numbers;
 - the flier would likely be an updated SES flood information brochure. The current SES residential and commercial flooding brochures (published in January 2006) should be updated to include the latest flood modelling, including the latest 1% AEP flood level. The count of properties flooded at various levels of flooding should also be updated based on the latest property survey and flood modelling; and
 - residents located within designated floodways may need the flier to be hand delivered to ensure all residents (including renters) are aware of the flood risk and know their best evacuation route (and to ensure these residents are aware of the voluntary purchase policy - refer Section 6.2).

8 Conclusions and recommendations

This floodplain risk management study has highlighted the existing flood risk in Narrabri. The results of hydraulic modelling from Volume I of the study have been used to assess the flood hazard, which has then been summarised into a single flood risk map, independent of flood severity.

The existing flood risk analysis has been complemented with a comprehensive building flood damage assessment. The total average annual damage to buildings in Narrabri due to local catchment and regional flooding has been estimated at \$7.27M.

The existing problem, future problem and continuing flood problem have been analysed with structural measures, planning measures and emergency response measures considered to address these problems.

Following consideration of hydraulic, environmental, economic and social issues, a range of structural flood risk management measures have been assessed and a recommendation has been made for implementation as part of Volume III of this study. This assessment is provisional only, with community feedback to also inform the prioritisation and refinement of structural mitigation measures. The mitigation measures in order of highest priority to lowest priority are given in Table 8.1.

Table 8.1 - Recommended floodplain risk management measures for Narrabri

| Measure | Report section | Recommendation | Priority | Responsibility | Costing |
|---------------------------------------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------------|---------|
| Flood education plan | 7.6 | <ul style="list-style-type: none"> Develop and implement an ongoing flood education plan. | High | SES/Council | Low |
| Voluntary purchase scheme | 6.2 | <ul style="list-style-type: none"> Consult with properties currently identified for voluntary purchase. Apply for State government funding. | High | Council | High |
| Horsearm Creek mitigation | 6.12 | <ul style="list-style-type: none"> Refine the concept design. Consult with ARTC and community. | High | Council | High |
| Building and development controls | 0 | <ul style="list-style-type: none"> Incorporate flood risk map into the DCP. Update DCP to include flood risk measures. | Medium | Council | Low |
| Local flood plan | 7.5 | <ul style="list-style-type: none"> Review and update the Local Flood Plan to incorporate information on flood risks to properties and additional information on road inundation and flood warning. Communicate the contents of the Local flood plan to the community. | Medium | SES | Low |
| Land use zoning | 7.3 | <ul style="list-style-type: none"> Rezone vacant land located in proposed floodways. | Medium | Council | Low |
| Alternative emergency evacuation centre | 7.5 | <ul style="list-style-type: none"> Investigate alternative emergency evacuation centre. | Medium | SES/Council | Medium |
| Voluntary house raising scheme | 6.2 | <ul style="list-style-type: none"> Consult with local community on expected demand. Apply for State government funding. | Medium | Council | High |
| Stormwater pipe flood gates | 6.5 | <ul style="list-style-type: none"> Install devices draining to Horsearm Creek. | Medium | Council | Medium |
| Narrabri North Industrial estate mitigation | 6.6 | <ul style="list-style-type: none"> Undertake detailed design. Establish a funding model. Consult with ARTC. | Medium | Council | High |
| Narrabri Creek channel maintenance | 6.8 | <ul style="list-style-type: none"> Establish a maintenance program for Narrabri Creek waterway corridor. | Medium | Council | Low |
| Mulgate Creek flood warning | 7.5 | <ul style="list-style-type: none"> Investigate the installation of a water level and rainfall flood alert station on Mulgate/Horsearm Creek. | Medium | Council | Low |
| Eather's Creek channel | 6.7 | <ul style="list-style-type: none"> Refine the concept design of the levee to mitigate the flood impacts. Evaluate the benefits and costs. | Low | Council | High |

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| WRM (2019b) | <i>'Narrabri Floodplain Risk Management Study and Plan: Volume I: Supplementary Flood Study - Namoi River, Mulgate Creek and Long Gully'</i> , Report prepared for Narrabri Shire Council by WRM Water & Environment Pty Ltd, Brisbane, QLD, June 2019. |
| WRM (2020) | <i>'Narrabri Floodplain Risk Management Study and Plan: Volume I: Supplementary Flood Study - Namoi River, Mulgate Creek and Long Gully: Addendum 1 - February 2020 Validation'</i> , Report prepared for Narrabri Shire Council by WRM Water & Environment Pty Ltd, Brisbane, QLD, December 2020. |

10 Glossary

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| annual exceedance probability (AEP) | the chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. (see ARI) |
| Australian Height Datum (AHD) | a common national surface level datum approximately corresponding to mean sea level. |
| average recurrence interval (ARI) | the long-term average number of years between the occurrence of a flood as big as or larger than the selected event. |
| catchment | the land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location. |
| development control plan (DCP) | provides detailed planning and design guidelines to support the planning controls in the Local Environmental Plan (LEP) |
| discharge | the rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m ³ /s). Discharge is different from the speed or velocity of flow, which is a measure of how fast the water is moving for example, metres per second (m/s). |
| effective warning time | the time available after receiving advice of an impending flood and before floodwaters prevent appropriate flood response actions being undertaken. The effective warning time is typically used to move farm equipment, move stock, raise furniture, evacuate people and transport their possessions. |
| emergency management | a range of measures to manage risks to communities and the environment. In the flood context it may include measures to prevent, prepare for, respond to and recover from flooding. |
| extreme flood | for the purpose of this study the extreme flood was taken to mean the flood caused by three times the 1% AEP discharge estimates. For the purpose of this study the extreme flood has approximated the probable maximum flood. |
| flash flooding | flooding which is sudden and unexpected. It is often caused by sudden local or nearby heavy rainfall. Often defined as flooding which peaks within six hours of the causative rain. |
| flood | relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami. |
| flood awareness | an appreciation of the likely effects of flooding and a knowledge of the relevant flood warning, response and evacuation procedures. |
| flood fringe areas | the remaining area of flood prone land after floodway and flood storage areas have been defined. |
| flood liable land | is synonymous with flood prone land, i.e., land susceptible to flooding by the PMF event. Note that the term flood liable land covers the whole floodplain, not just that part below the FPL (see flood planning area). |

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| flood mitigation standard | the average recurrence interval of the flood, selected as part of the floodplain risk management process that forms the basis for physical works to modify the impacts of flooding. |
| floodplain | area of land which is subject to inundation by floods up to and including the probable maximum flood event, that is, flood prone land. |
| floodplain risk management options | the measures that might be feasible for the management of a particular area of the floodplain. Preparation of a floodplain risk management plan requires a detailed evaluation of floodplain risk management options. |
| floodplain risk management plan | a management plan developed in accordance with the principles and guidelines in the Manual. Usually includes both written and diagrammatic information describing how particular areas of flood prone land are to be used and managed to achieve defined objectives. |
| flood plan (local) | a sub-plan of a disaster plan that deals specifically with flooding. They can exist at state, division and local levels. Local flood plans are prepared under the leadership of the SES. |
| flood planning area | the area of land below the FPL and thus subject to flood related development controls. |
| flood planning levels (FPLs) | are the combinations of flood levels (derived from significant historical flood events or floods of specific AEPs) and freeboards selected for floodplain risk management purposes, as determined in management studies and incorporated in management plans. |
| flood prone land | land susceptible to flooding by the PMF event. Flood prone land is synonymous with flood liable land. |
| flood proofing | a combination of measures incorporated in the design, construction and alteration of individual buildings or structures subject to flooding, to reduce or eliminate flood damages. |
| flood readiness | readiness is an ability to react within the effective warning time. |
| flood risk | potential danger to personal safety and potential damage to property resulting from flooding. The degree of risk varies with circumstances across the full range of floods. Flood risk in the Manual is divided into 3 types, existing, future and continuing risks. They are described below. |

existing flood risk: the risk a community is exposed to as a result of its location on the floodplain.

future flood risk: the risk a community may be exposed to as a result of new development on the floodplain.

continuing flood risk: the risk a community is exposed to after floodplain risk management measures have been implemented. For a town protected by levees, the continuing flood risk is the consequences of the levees being overtopped. For an area without any floodplain risk management measures, the continuing flood risk is simply the existence of its flood exposure.

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| flood storage areas | those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. The extent and behaviour of flood storage areas may change with flood severity, and loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation. Hence, it is necessary to investigate a range of flood sizes before defining flood storage areas. |
| floodway areas | those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood levels. |
| freeboard | an additional margin that provides reasonable certainty that the risk exposure selected in deciding on a particular flood chosen as the basis for the FPL is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc. Freeboard is included in the flood planning level. |
| hazard | a source of potential harm or a situation with a potential to cause loss. In relation to this study the hazard is flooding which has the potential to cause damage to the community. Definitions of high and low hazard categories are provided in Appendix L of the Floodplain Development Manual (NSW Government, 2005a). |
| historical flood | a flood which has actually occurred. |
| 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 stage/flood level 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. |
| local environmental plan (LEP) | guide planning decisions for local government areas. They do this through zoning and development controls, which provide a framework for the way land can be used. |
| mathematical / computer models | the mathematical representation of the physical processes involved in runoff generation and stream flow. These models are often run on computers due to the complexity of the mathematical relationships between runoff, stream flow and the distribution of flows across the floodplain. |
| MIKE-FLOOD | one-dimensional and two-dimensional flood simulation software. It simulates the complex movement of floodwaters across a particular area of interest using mathematical approximations to derive information on floodwater depths, velocities and levels. |
| peak discharge | the maximum discharge occurring during a flood event. |
| probability | a statistical measure of the expected chance of flooding (see annual exceedance probability). |
| probable maximum flood (PMF) | the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation, and where applicable, snow melt, coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. |

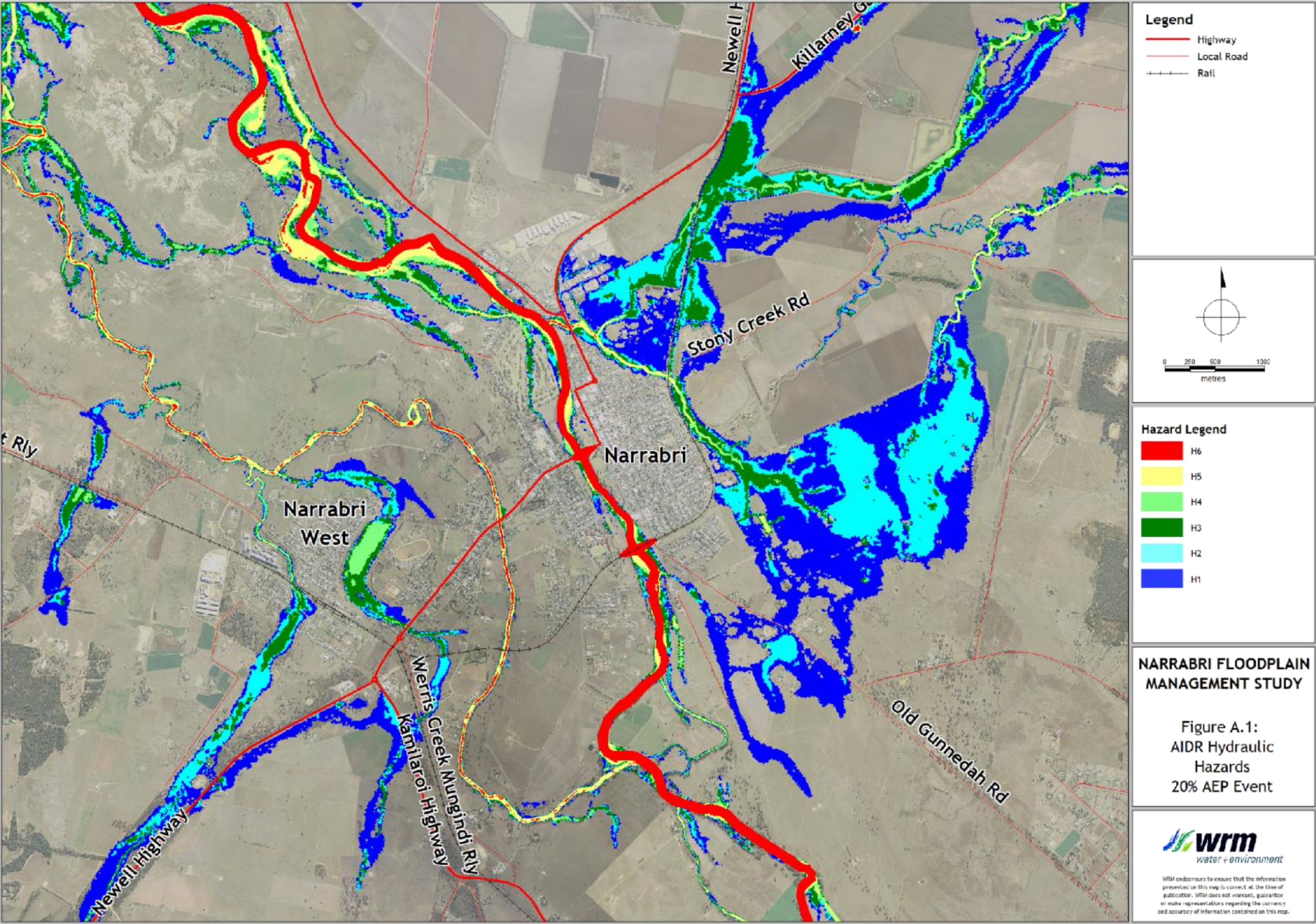


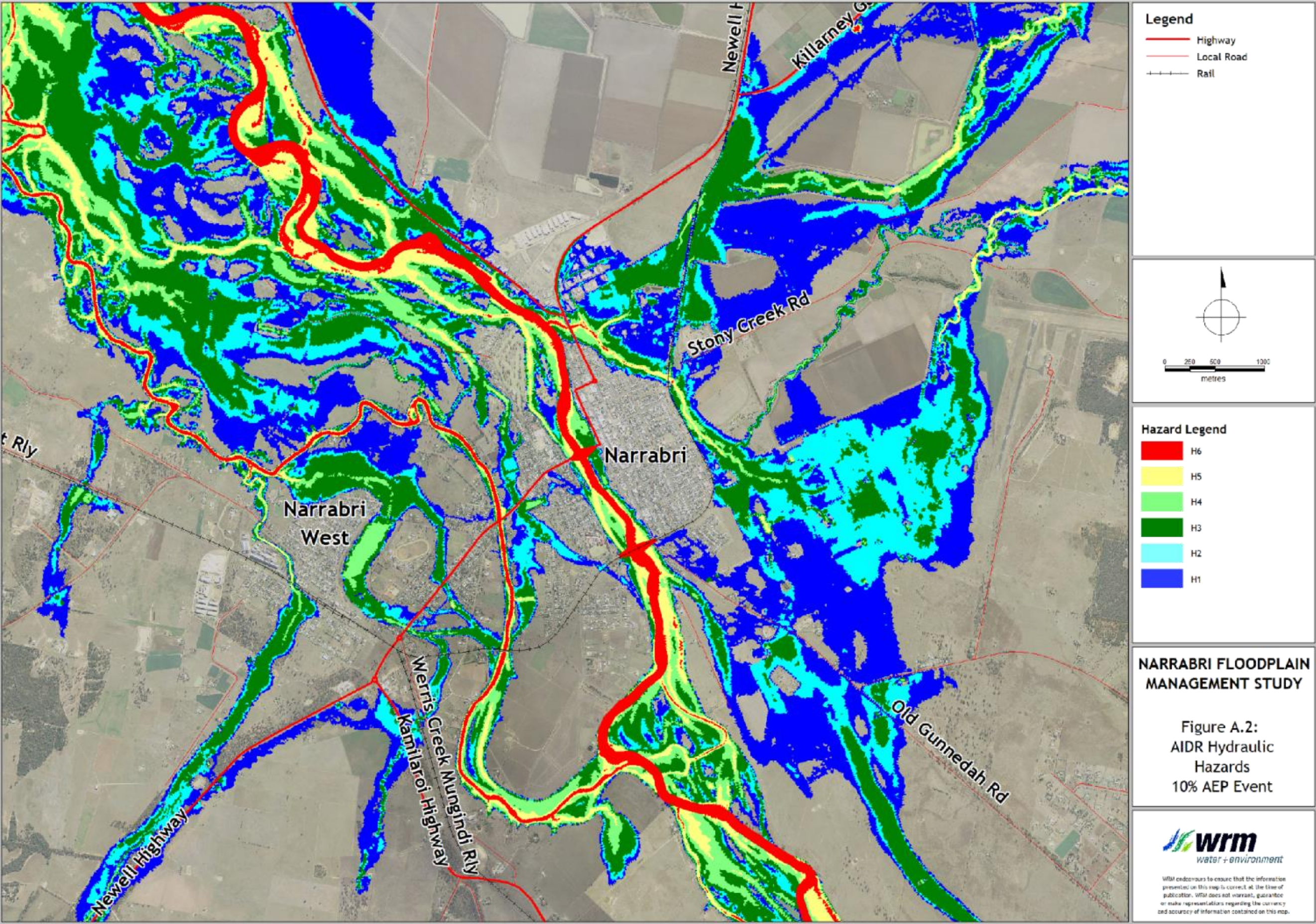
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| probable maximum precipitation (PMP) | the greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location at a particular time of the year, with no allowance made for long-term climatic trends (World Meteorological Organisation, 1986). It is the primary input to PMF estimation. |
| risk | chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. In the context of the Manual it is the likelihood of consequences arising from the interaction of floods, communities and the environment. |
| runoff | the amount of rainfall which actually ends up as streamflow, also known as rainfall excess. |
| stage | equivalent to water level (both measured with reference to a specified datum). |
| stage hydrograph | a graph that shows how the water level at a particular location changes with time during a flood. It must be referenced to a particular datum. |
| velocity | the speed or rate of motion (distance per unit of time, e.g., metres per second) in a specific direction at which the flood waters are moving. |
| water surface profile | a graph showing the flood stage at any given location along a watercourse at a particular time. |

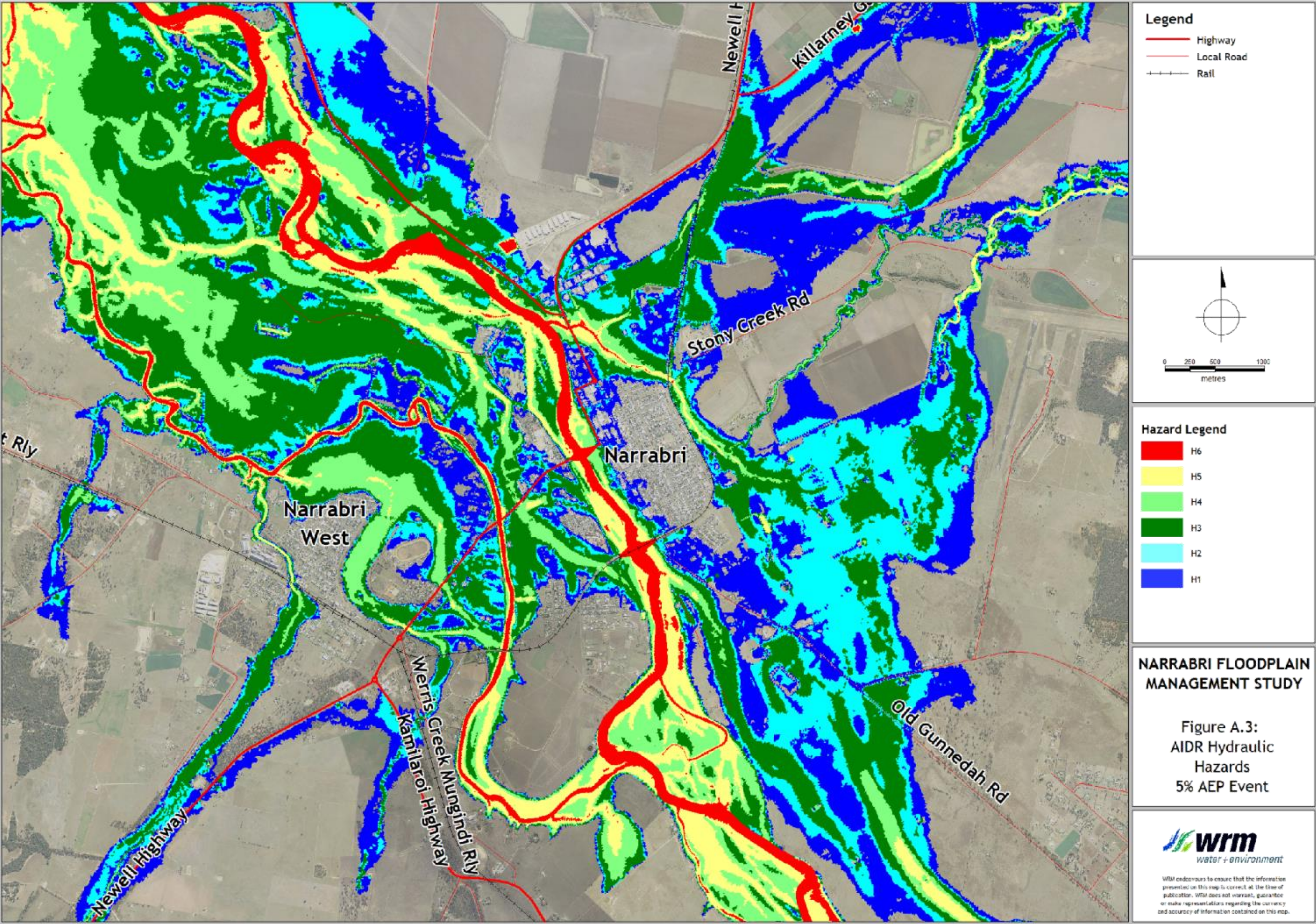


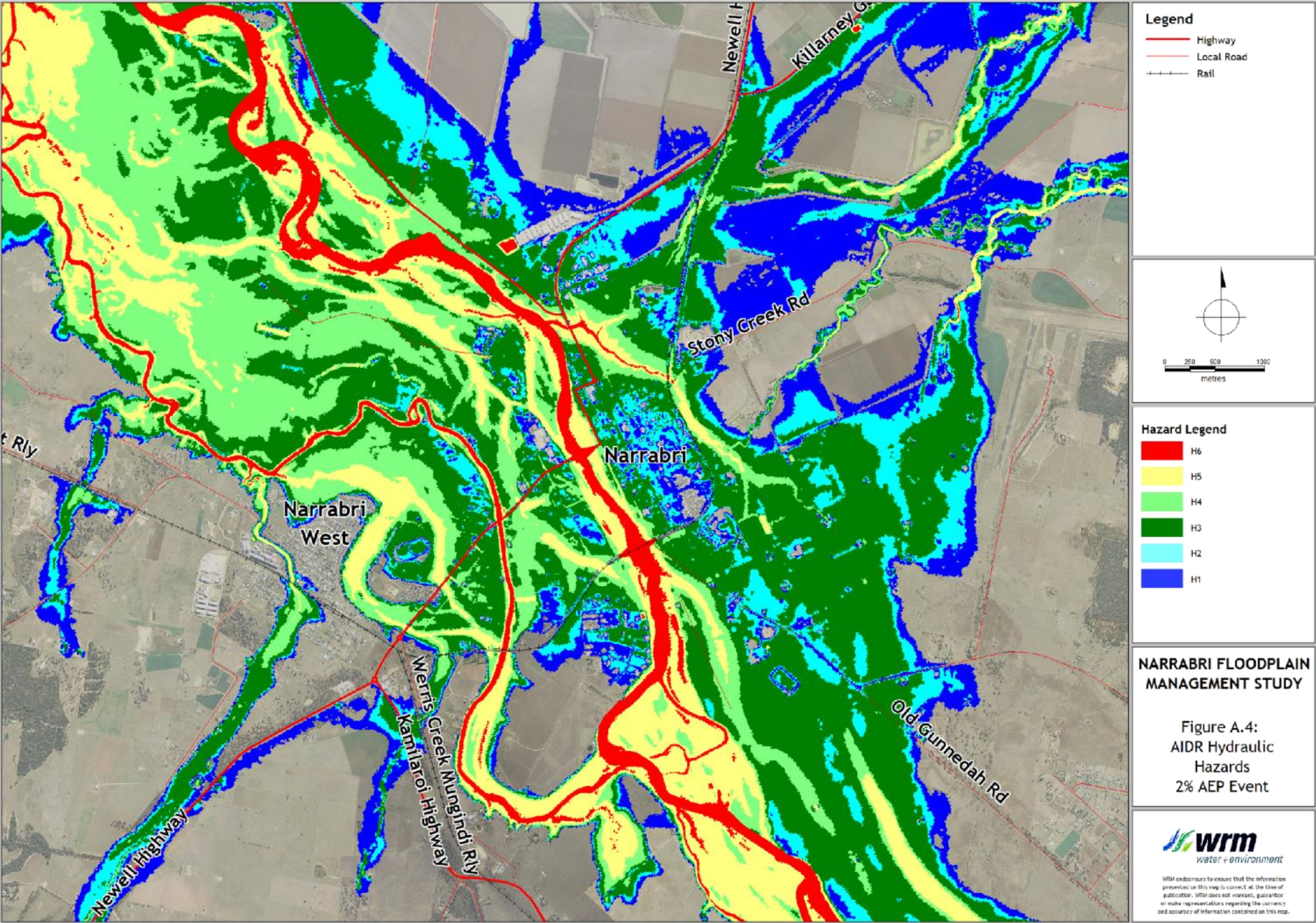
Appendix A - Hydraulic hazard maps

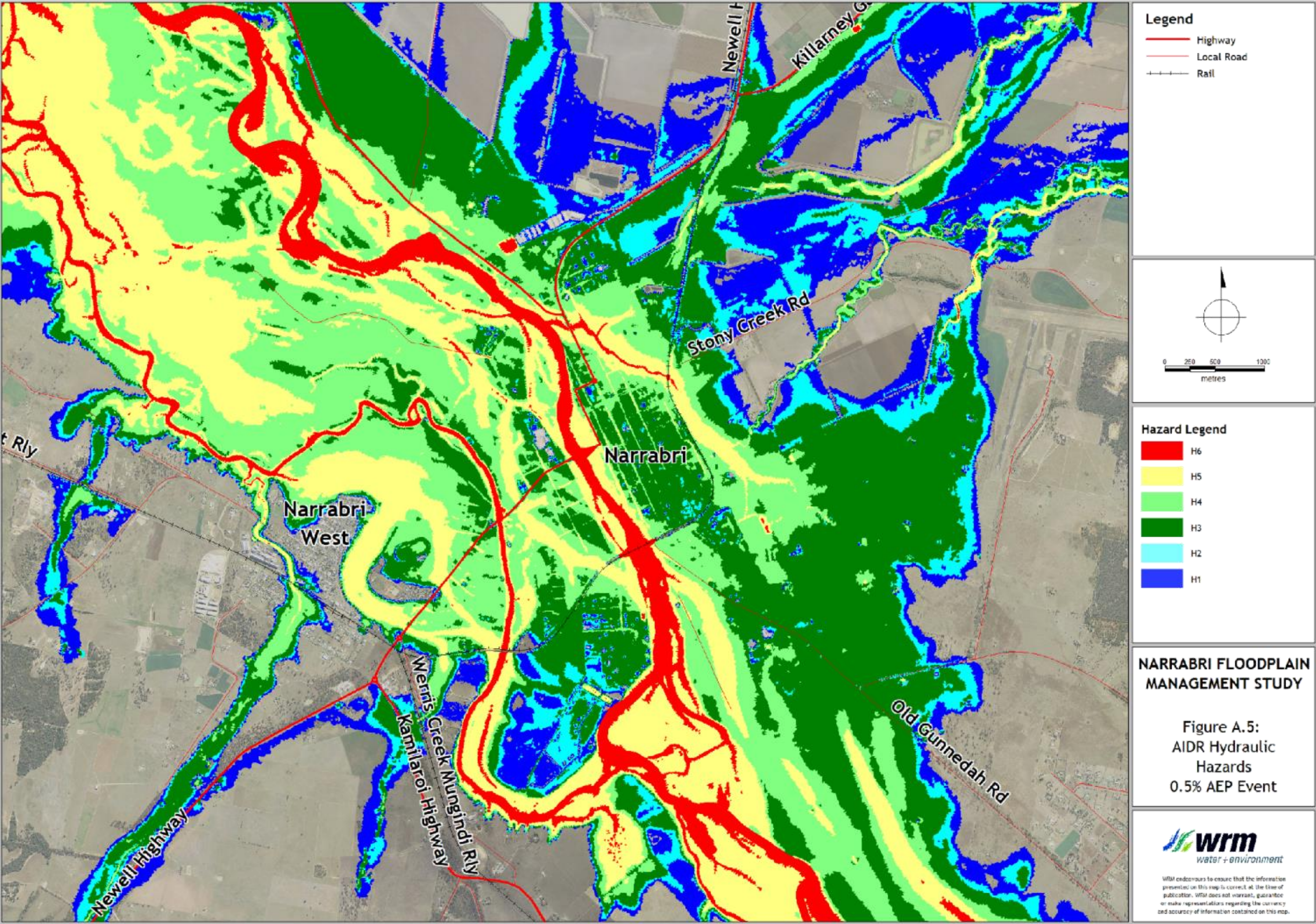
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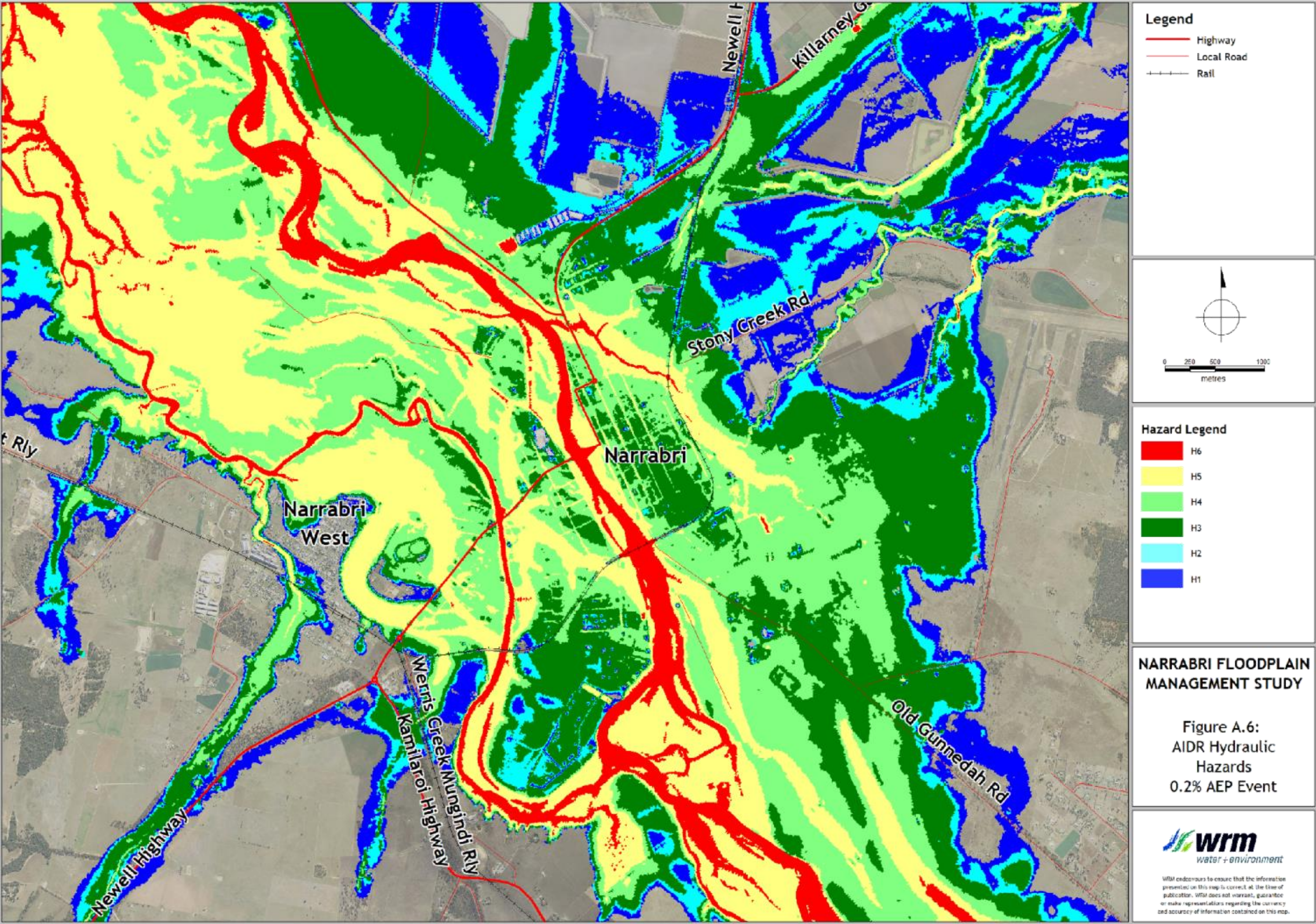


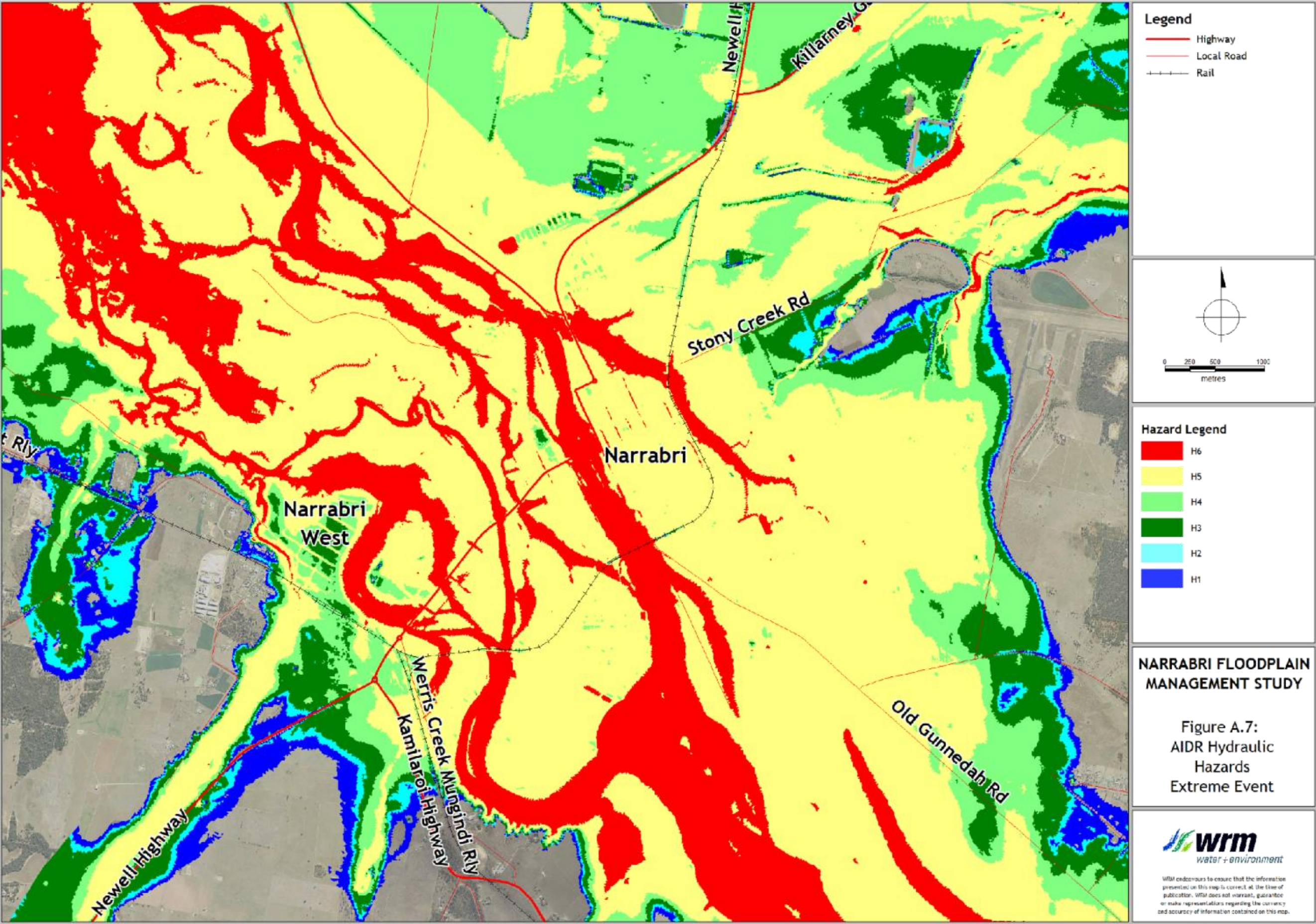








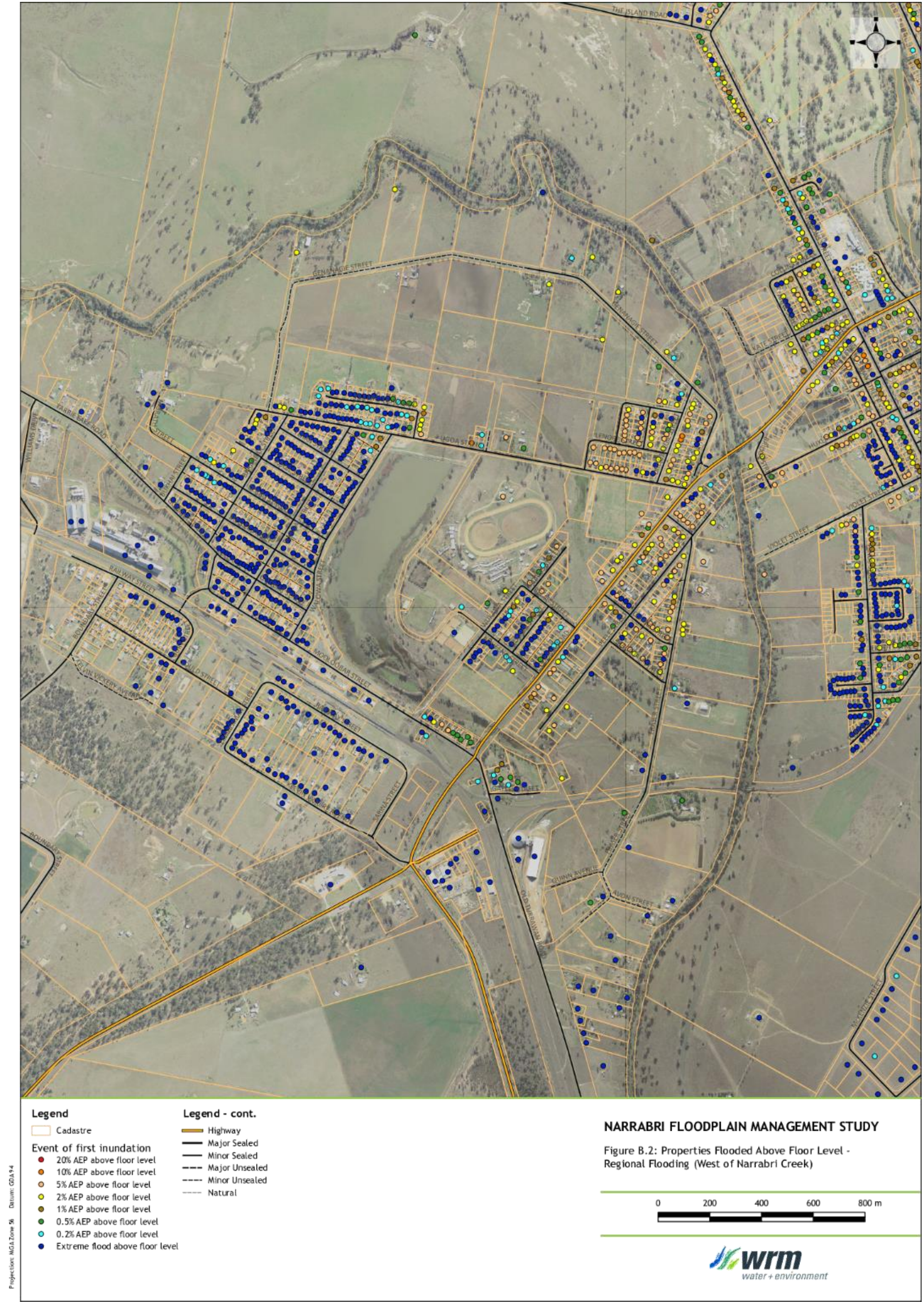


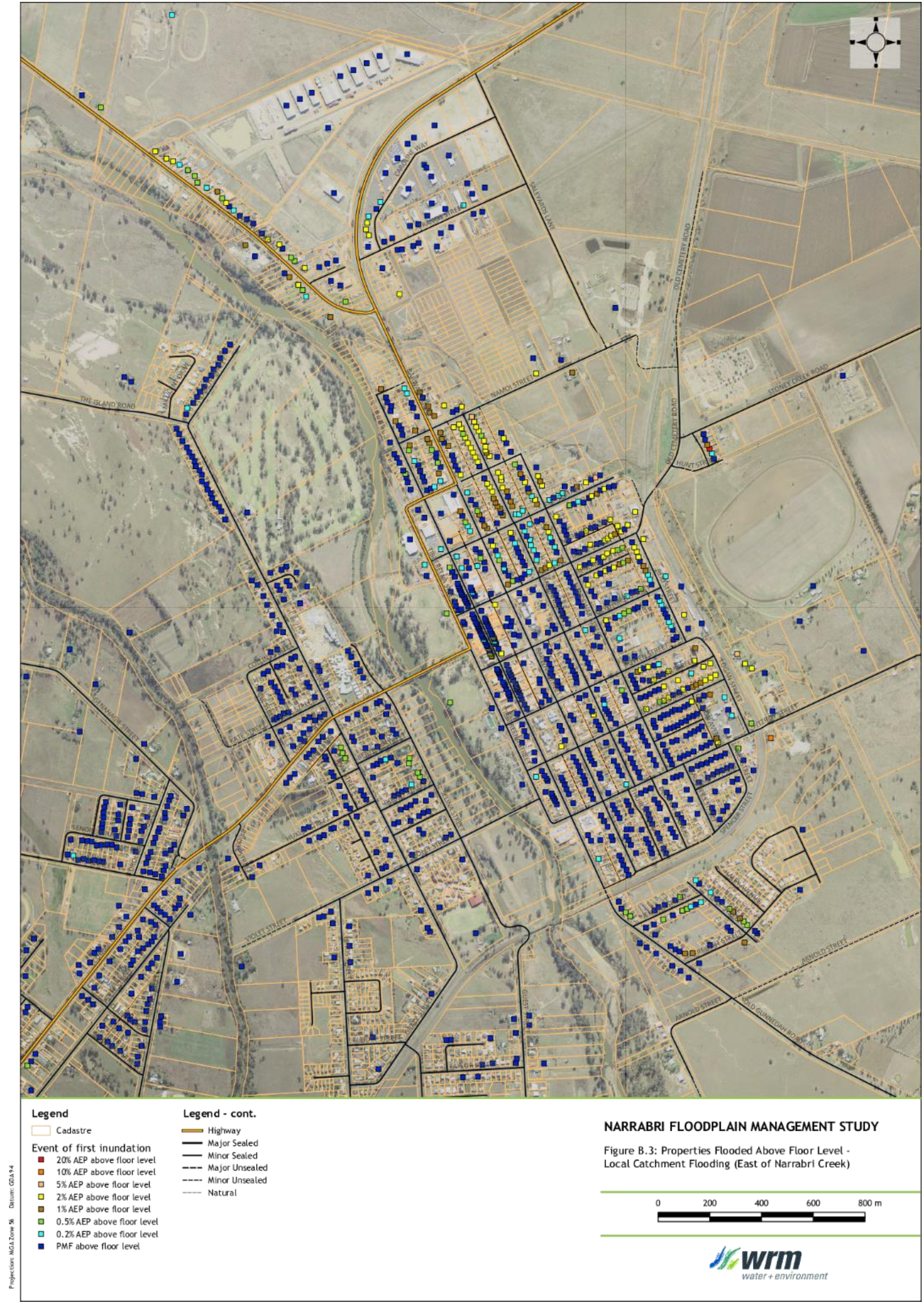


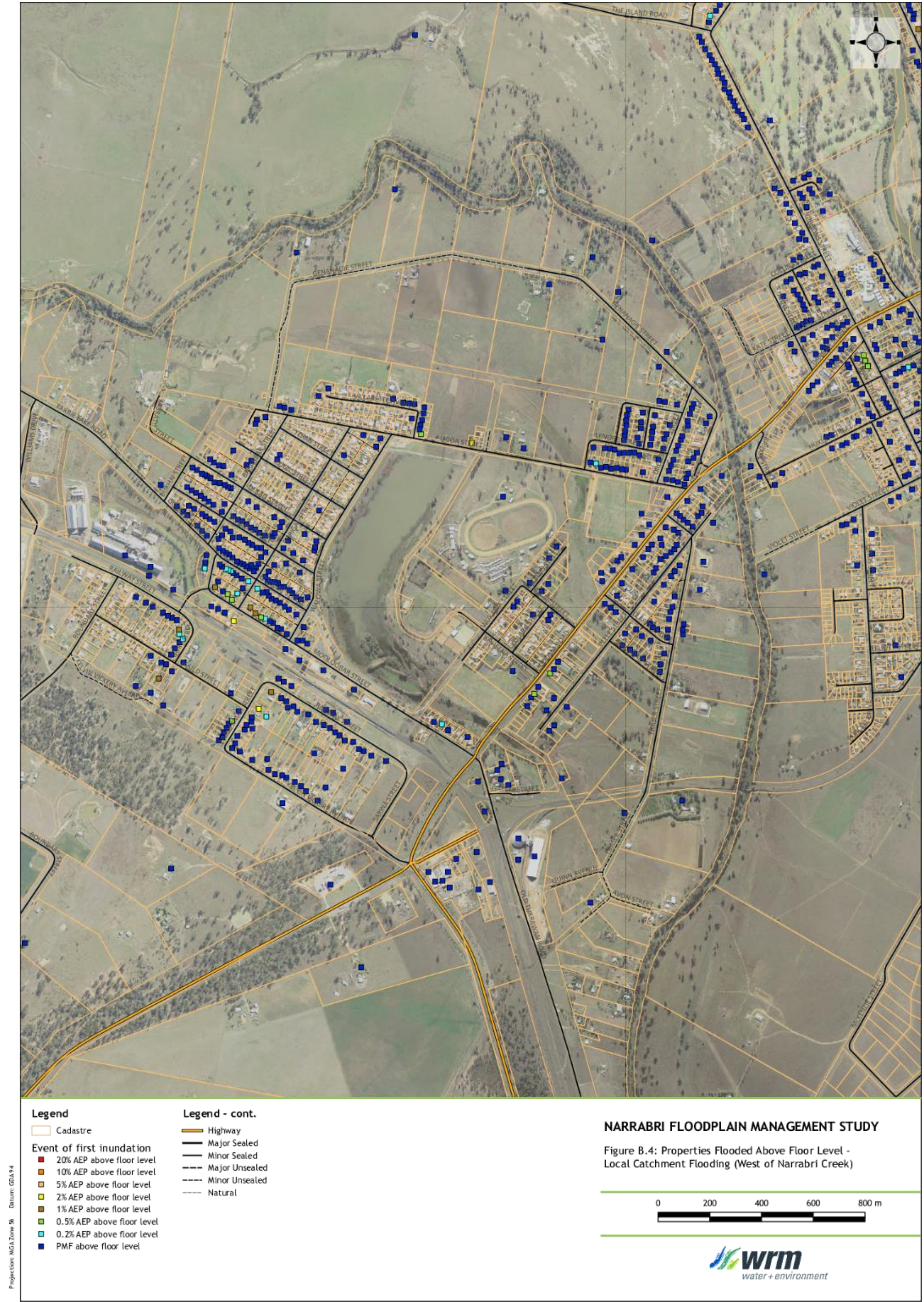
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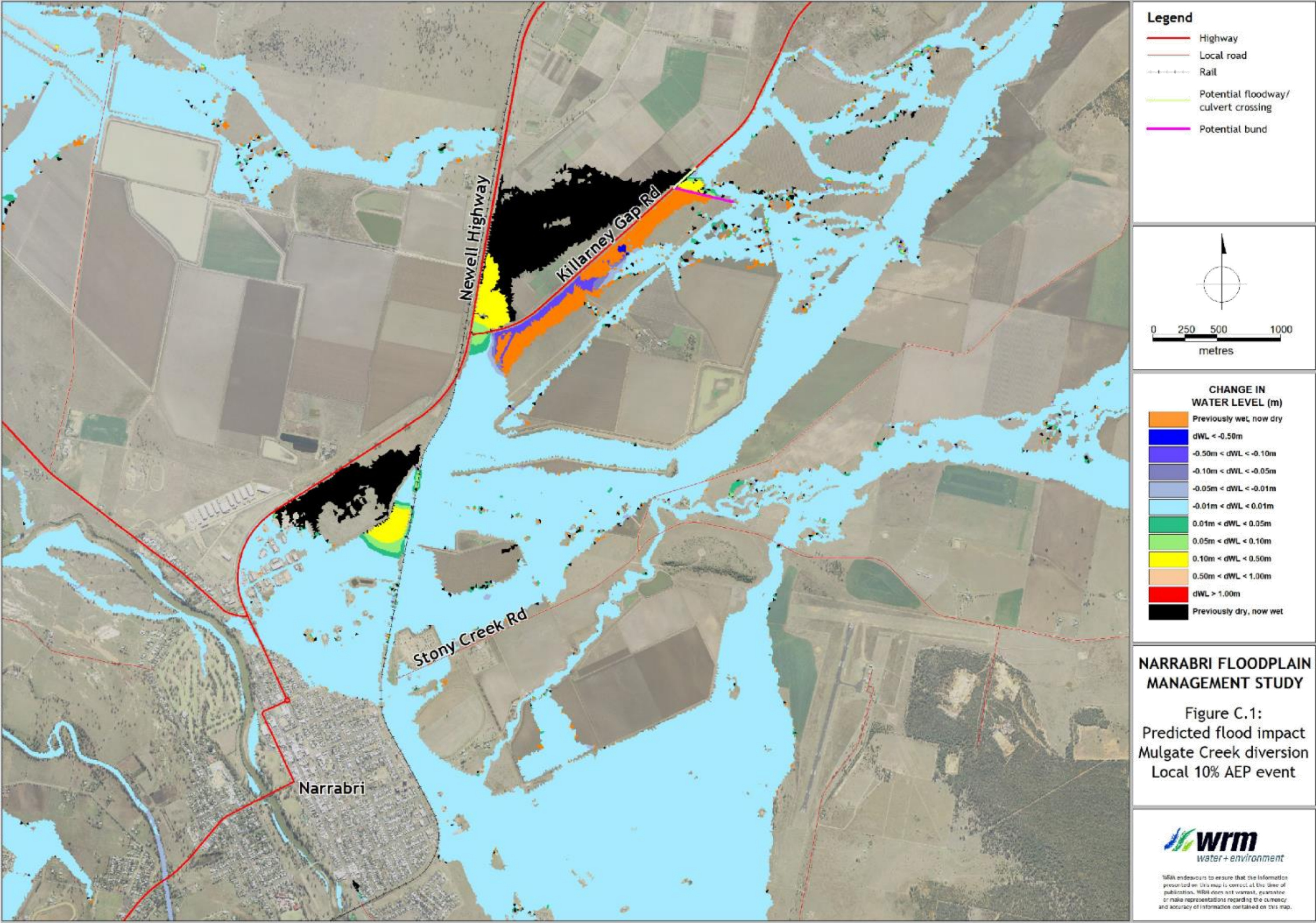


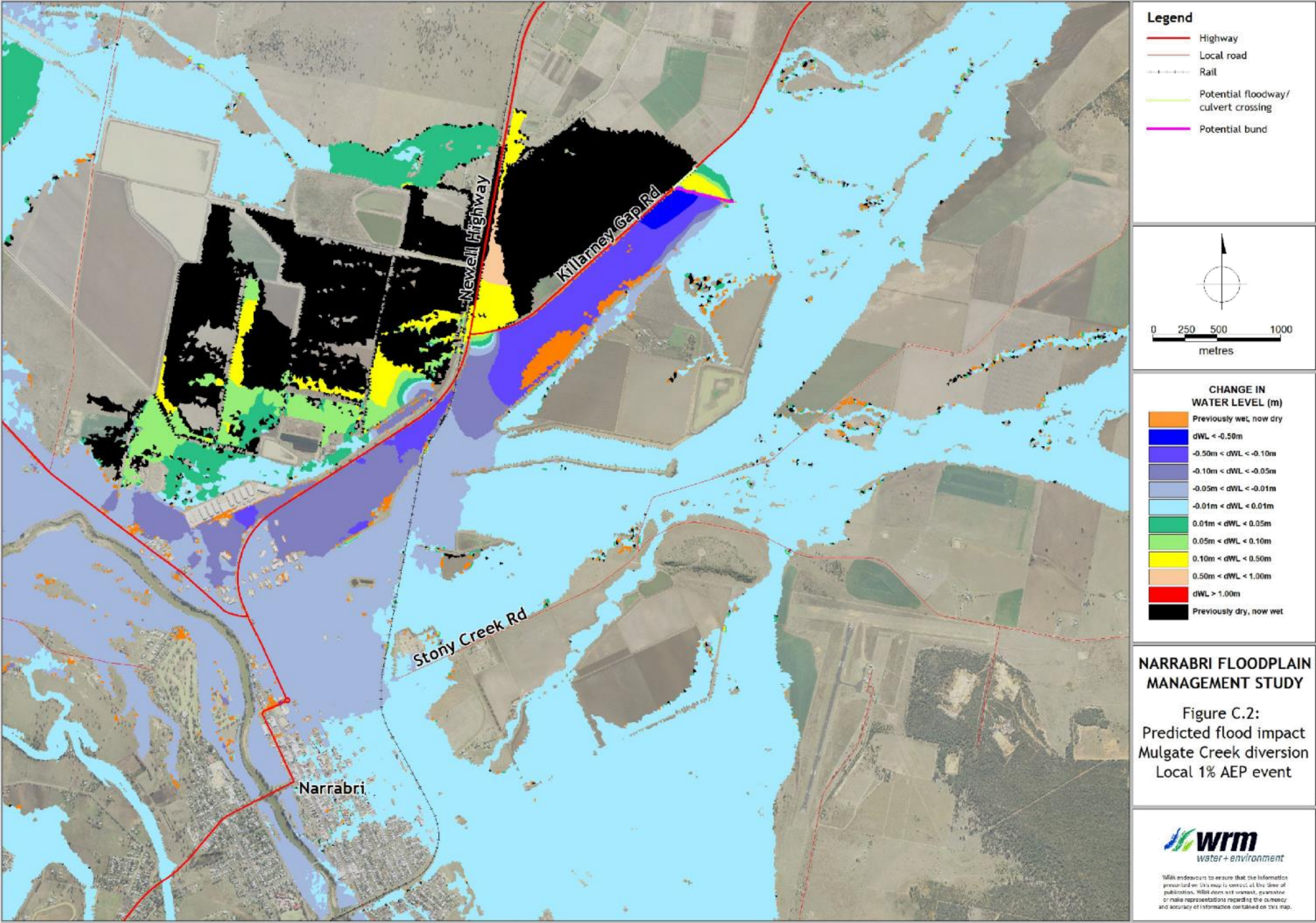
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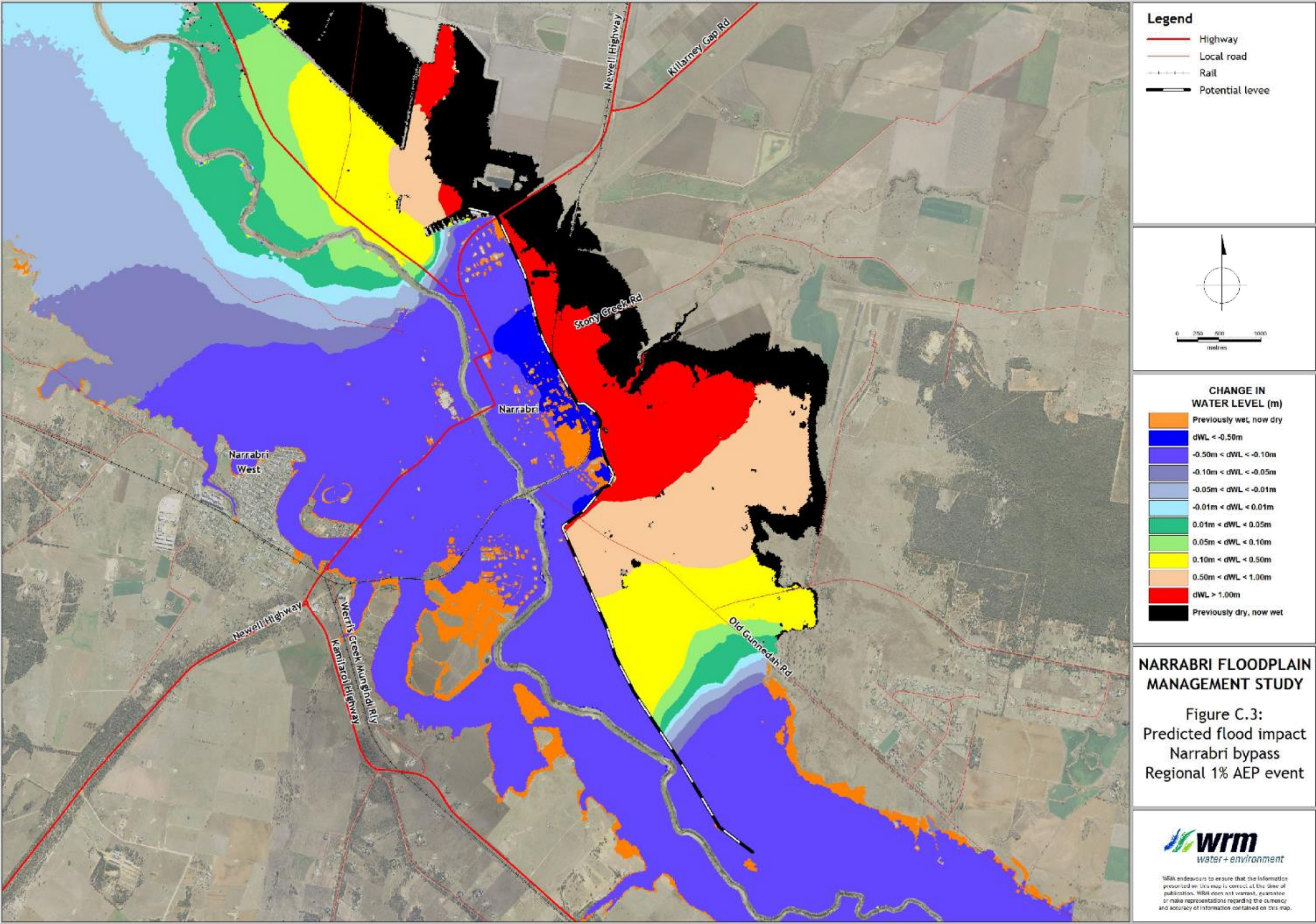
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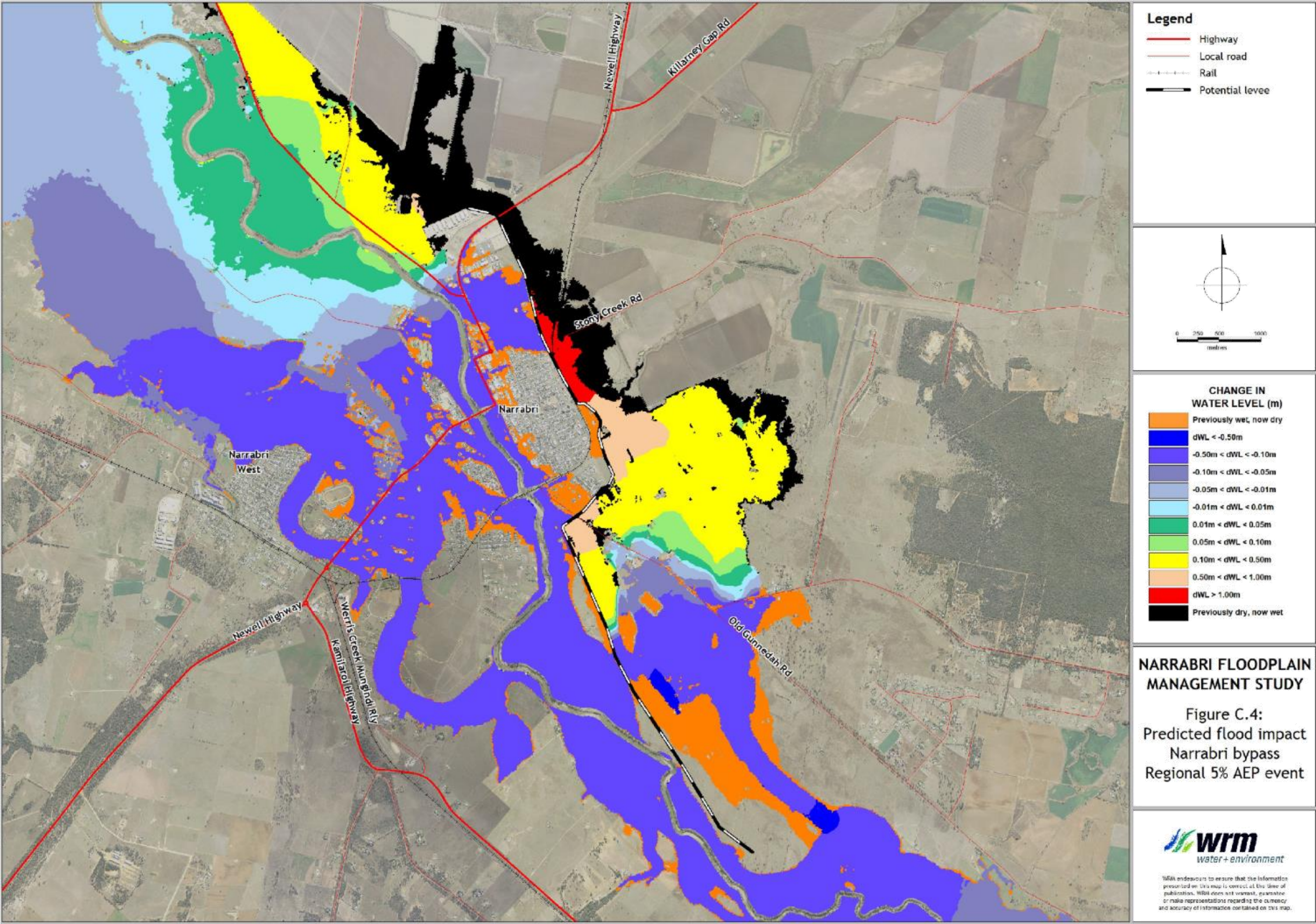


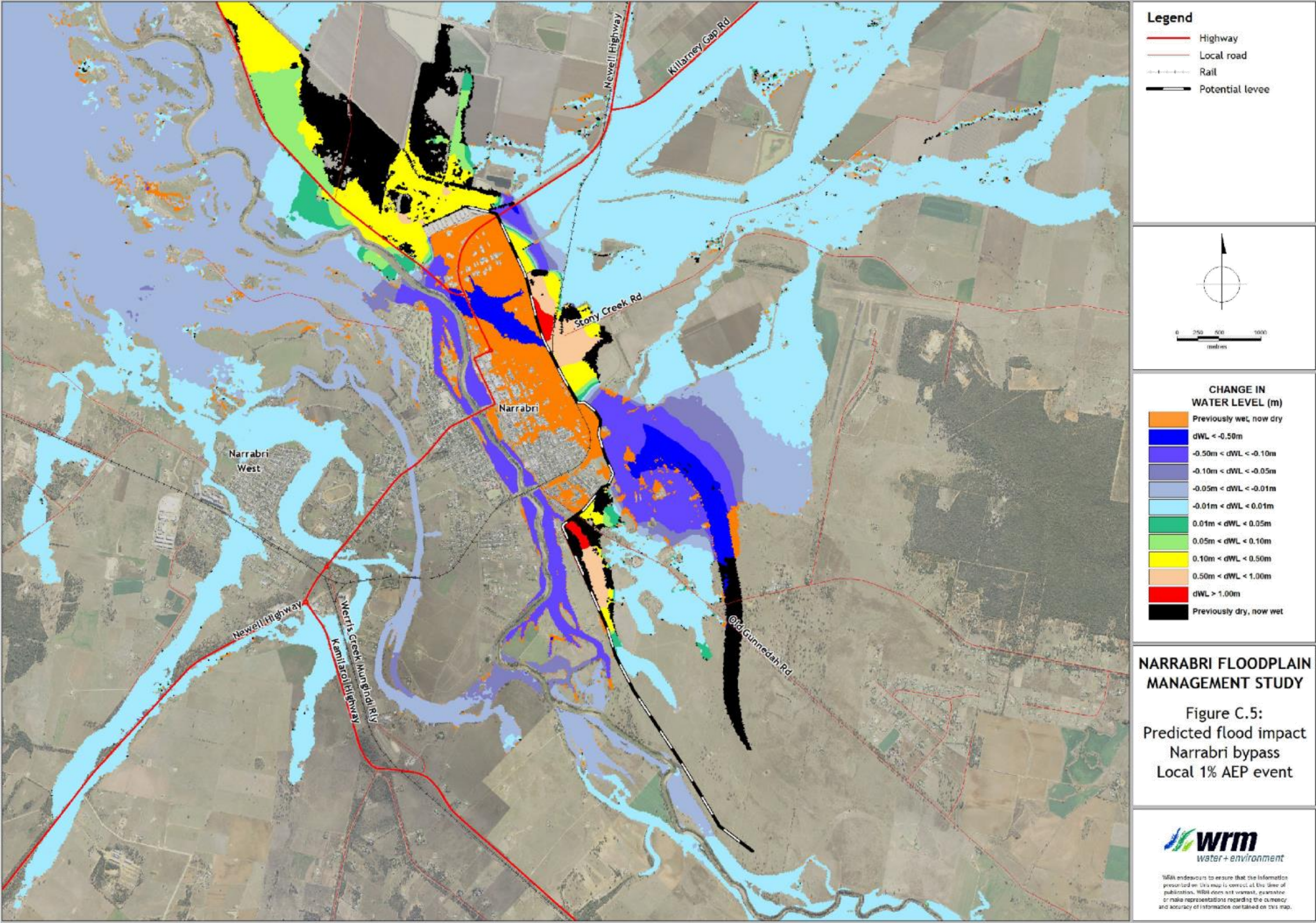
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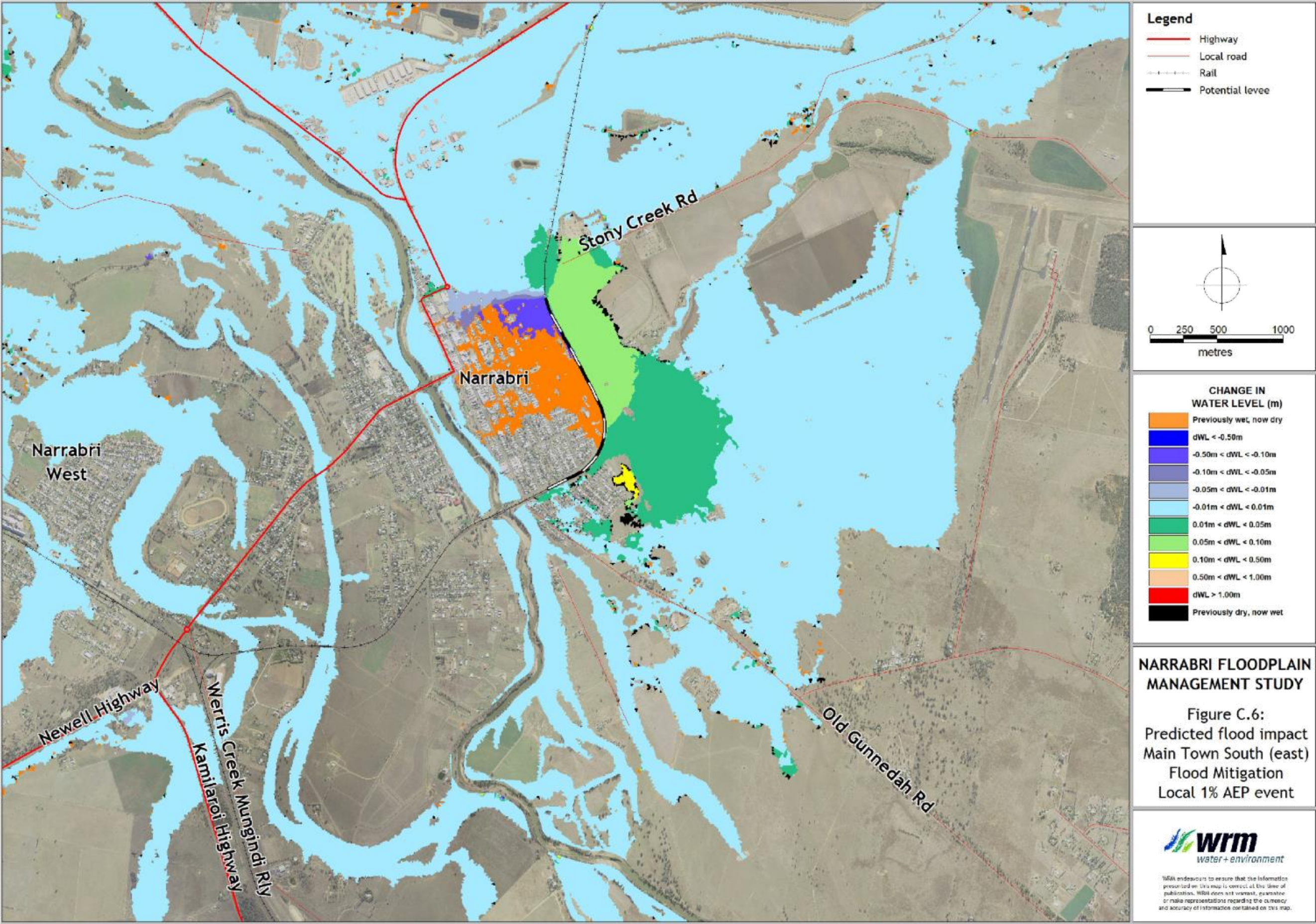


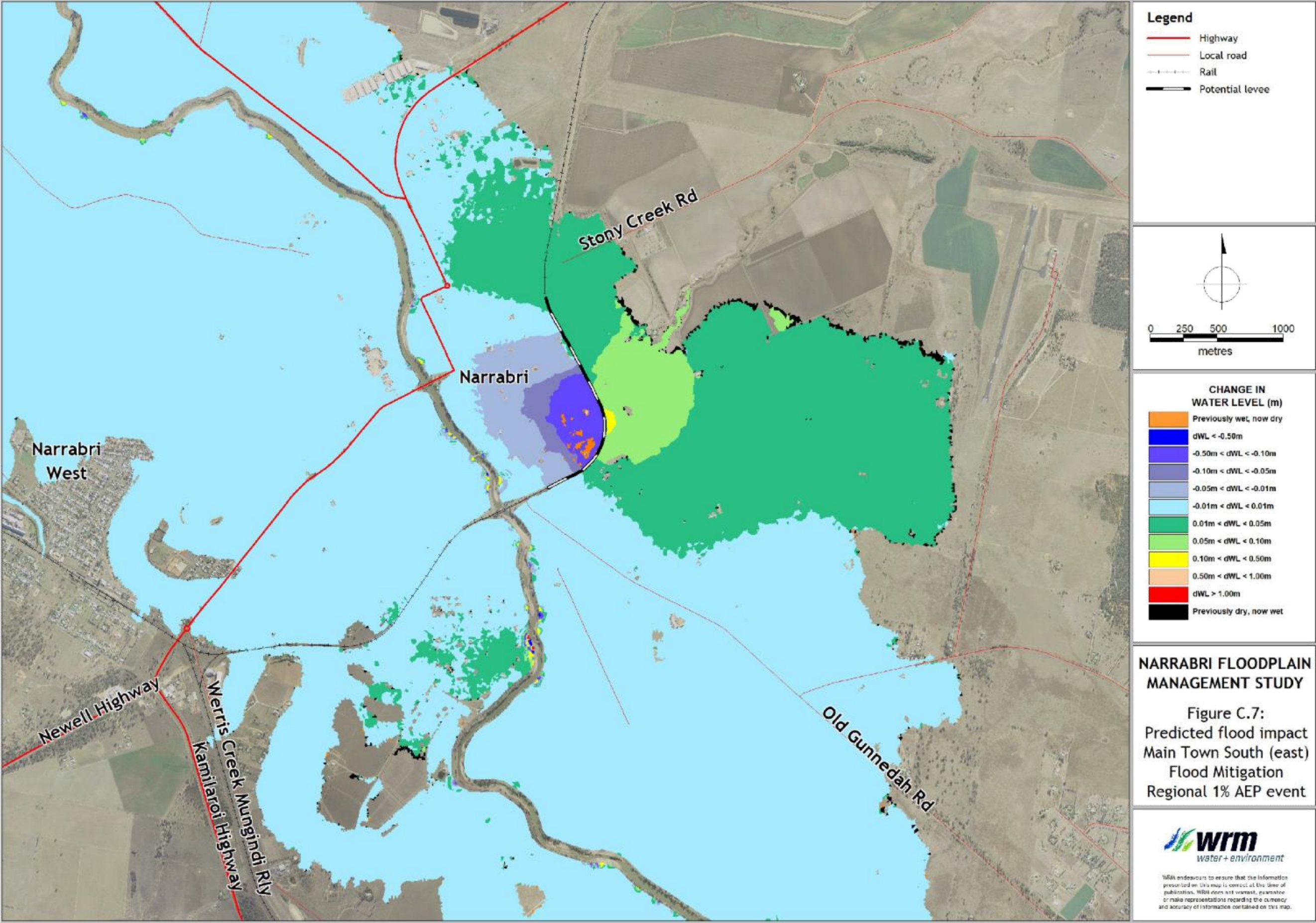


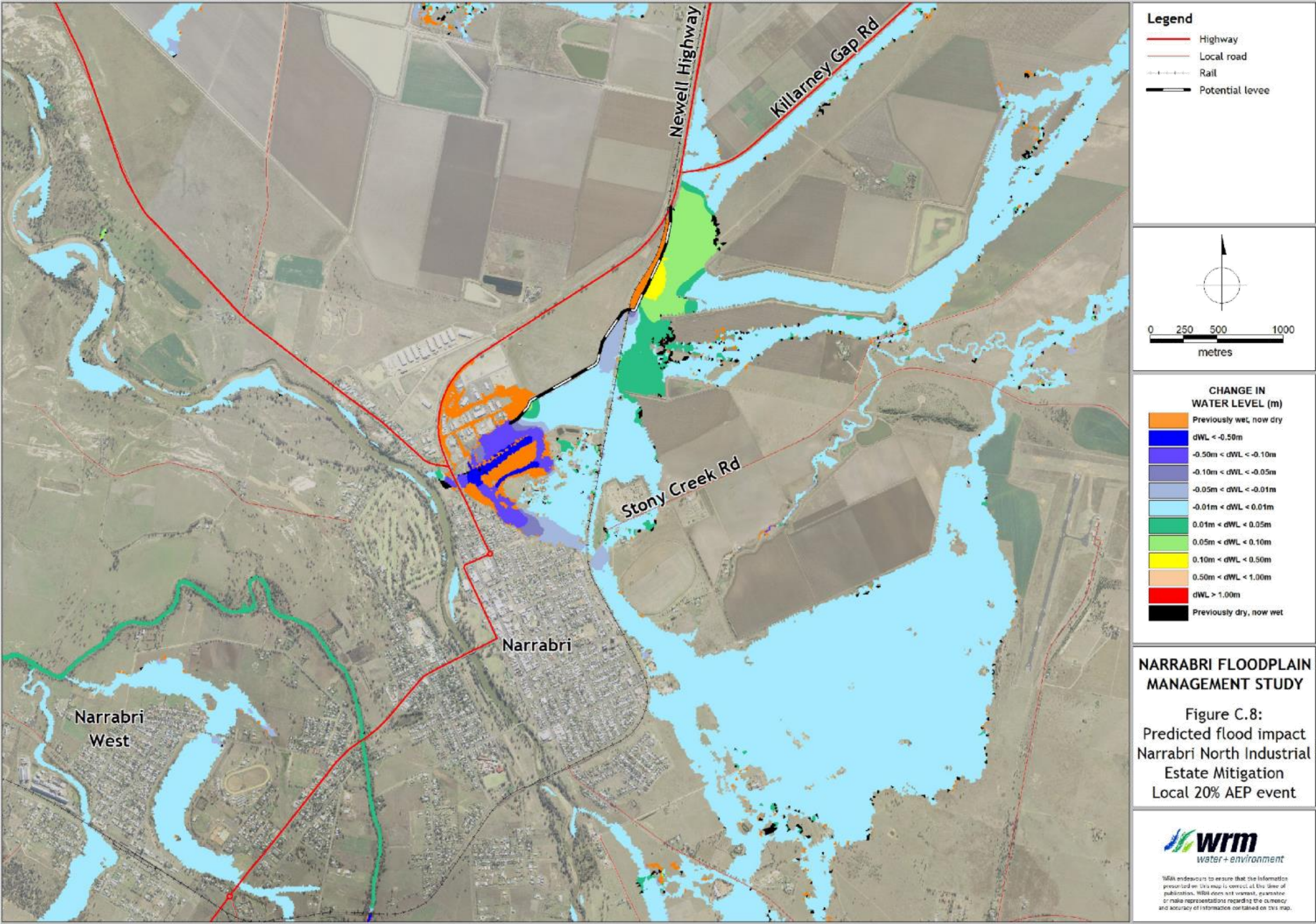


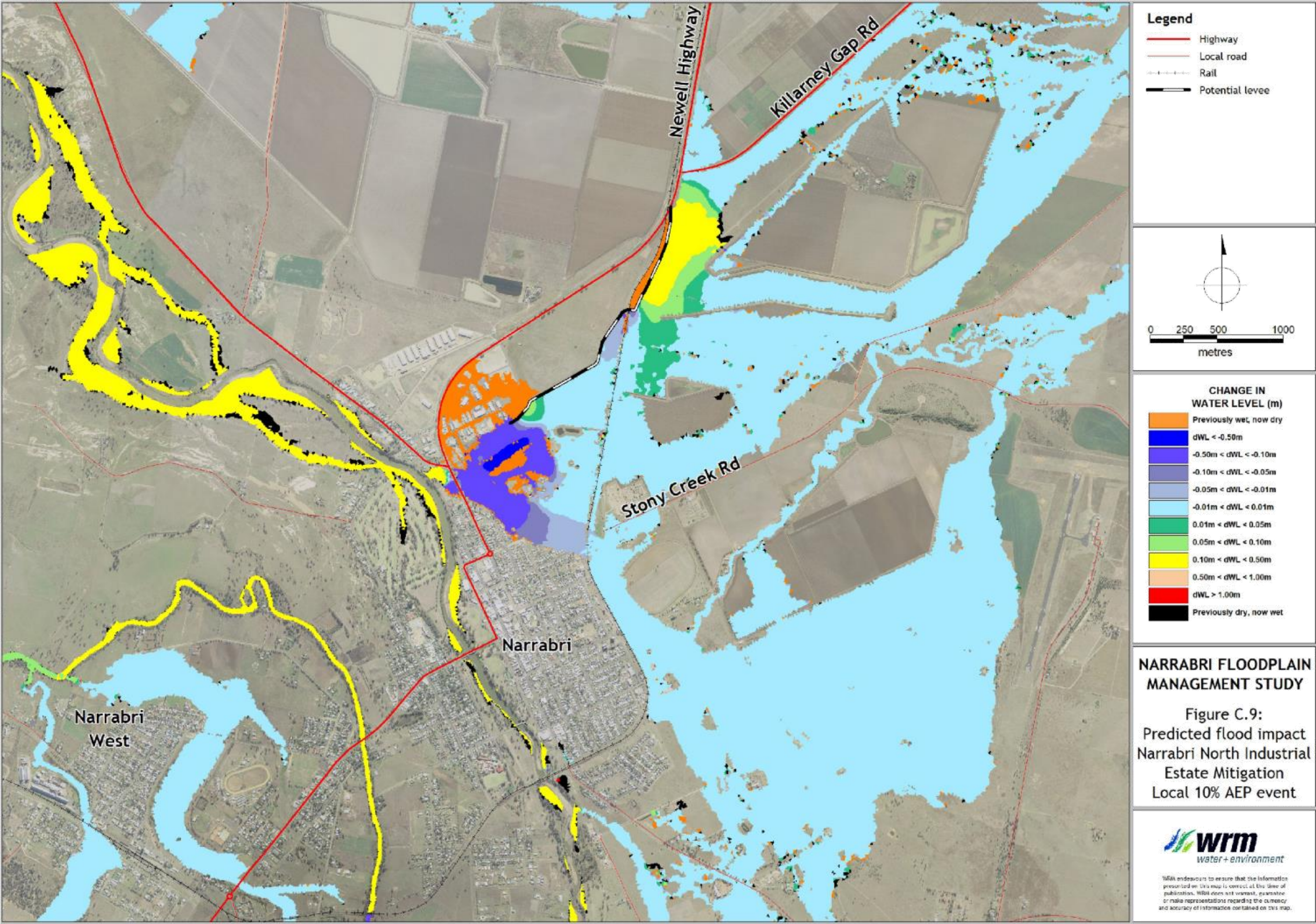


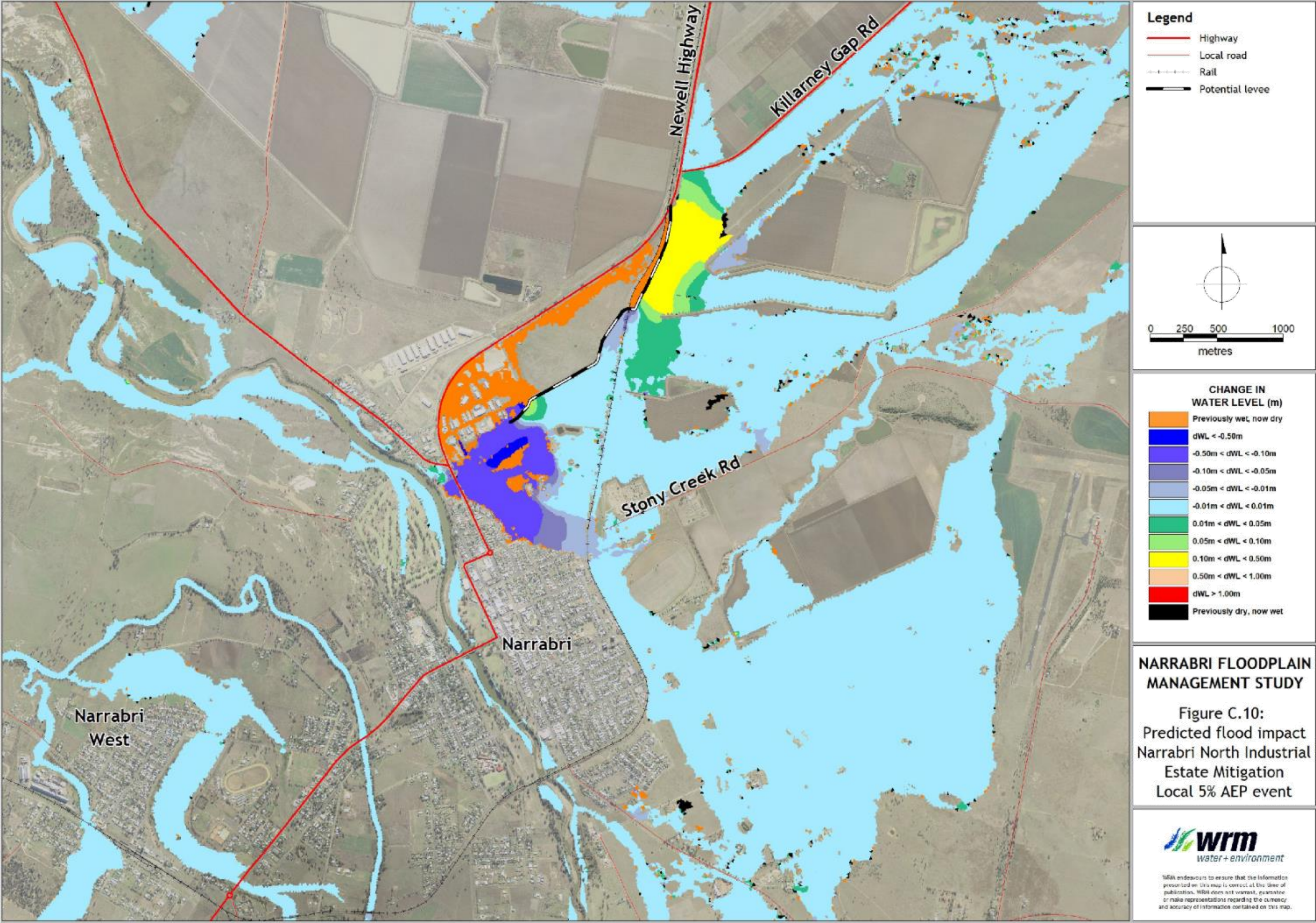


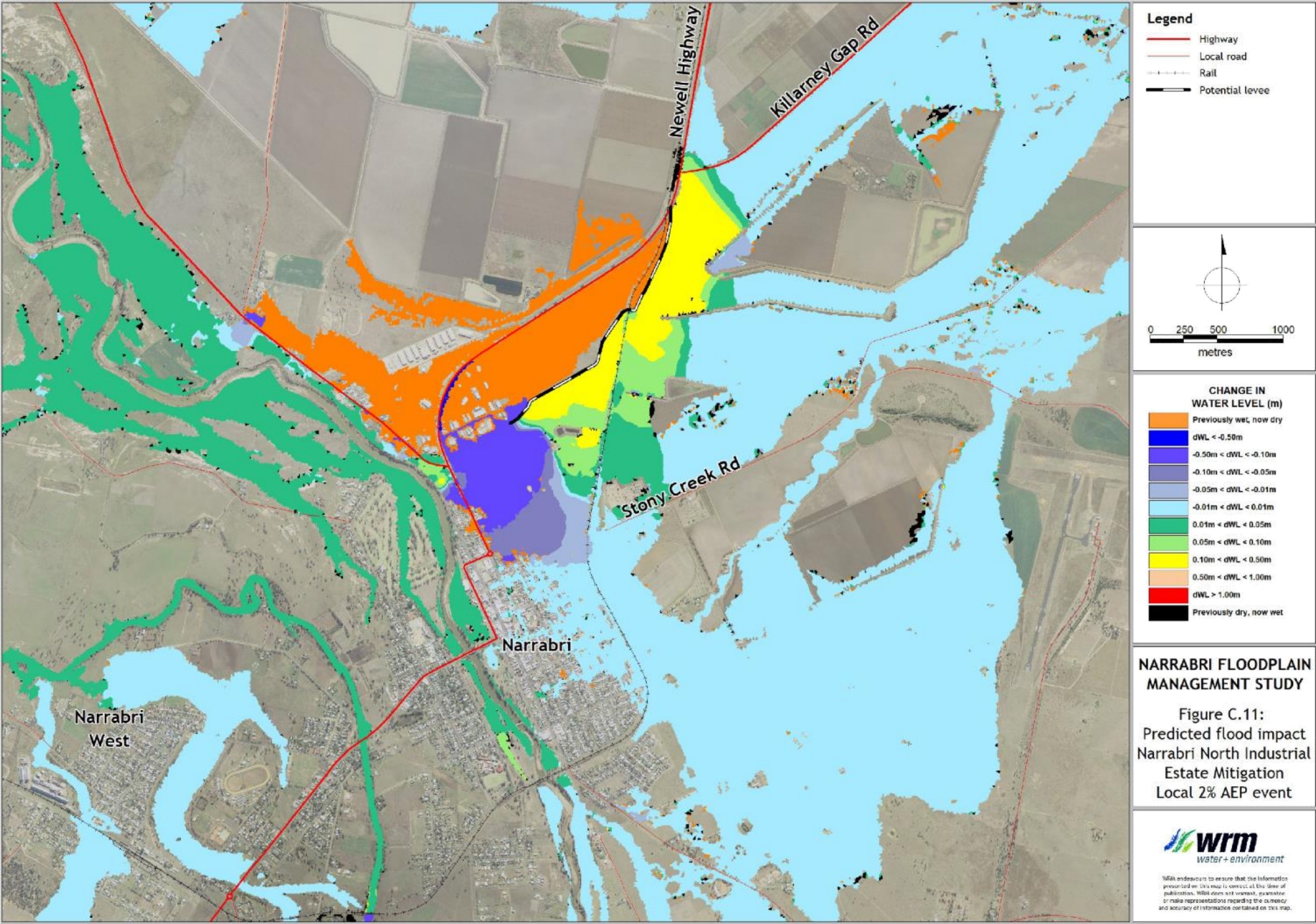


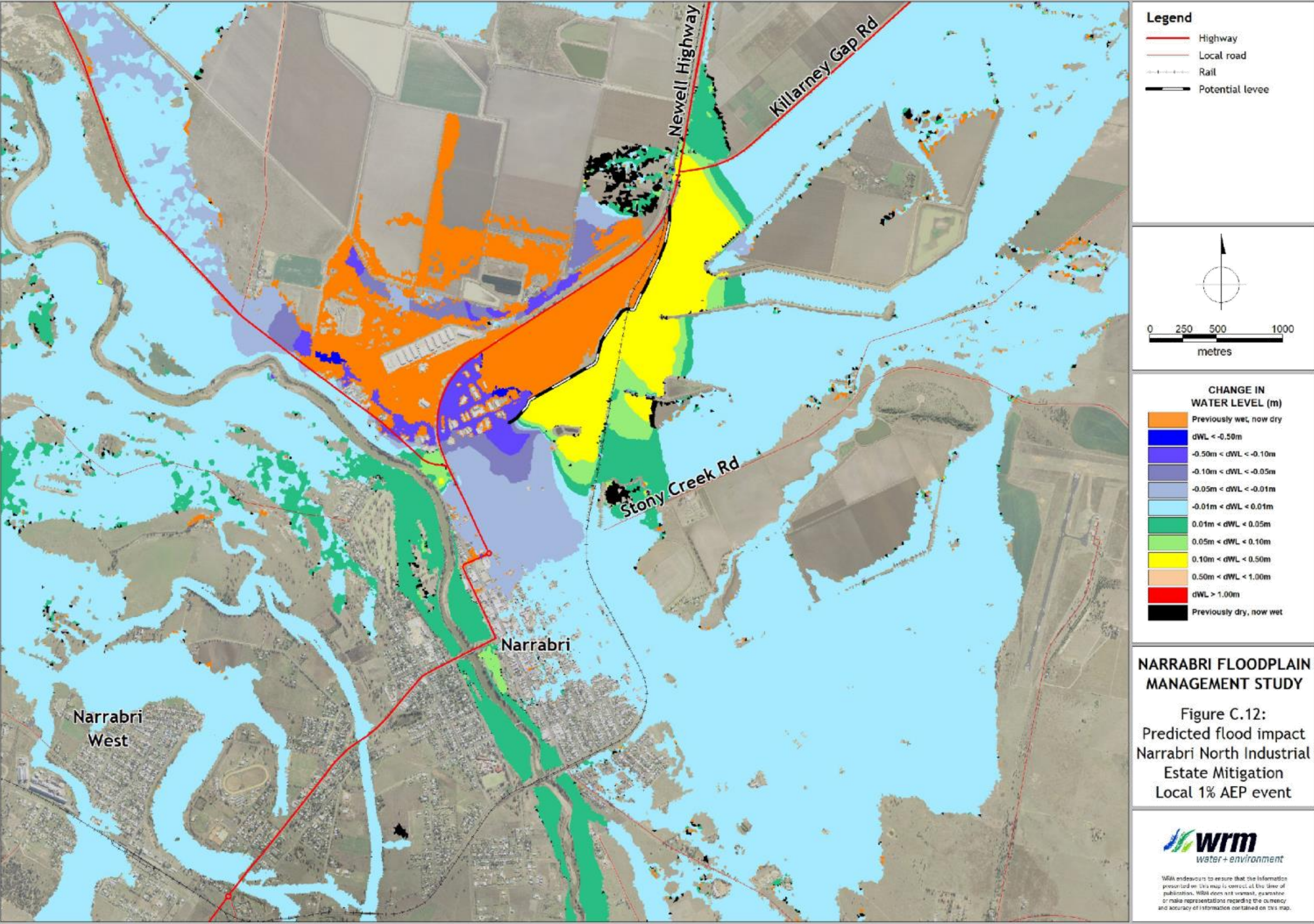


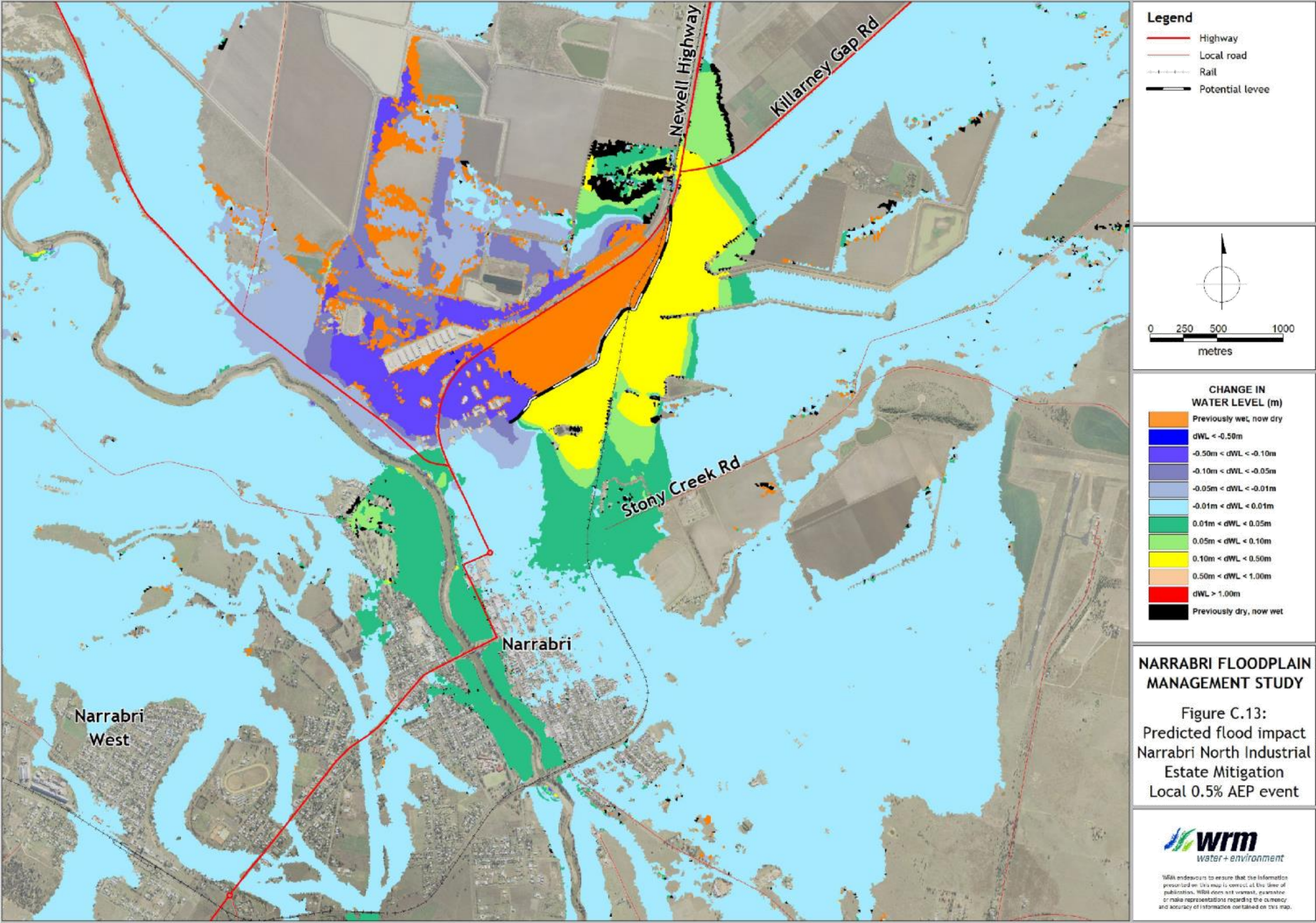


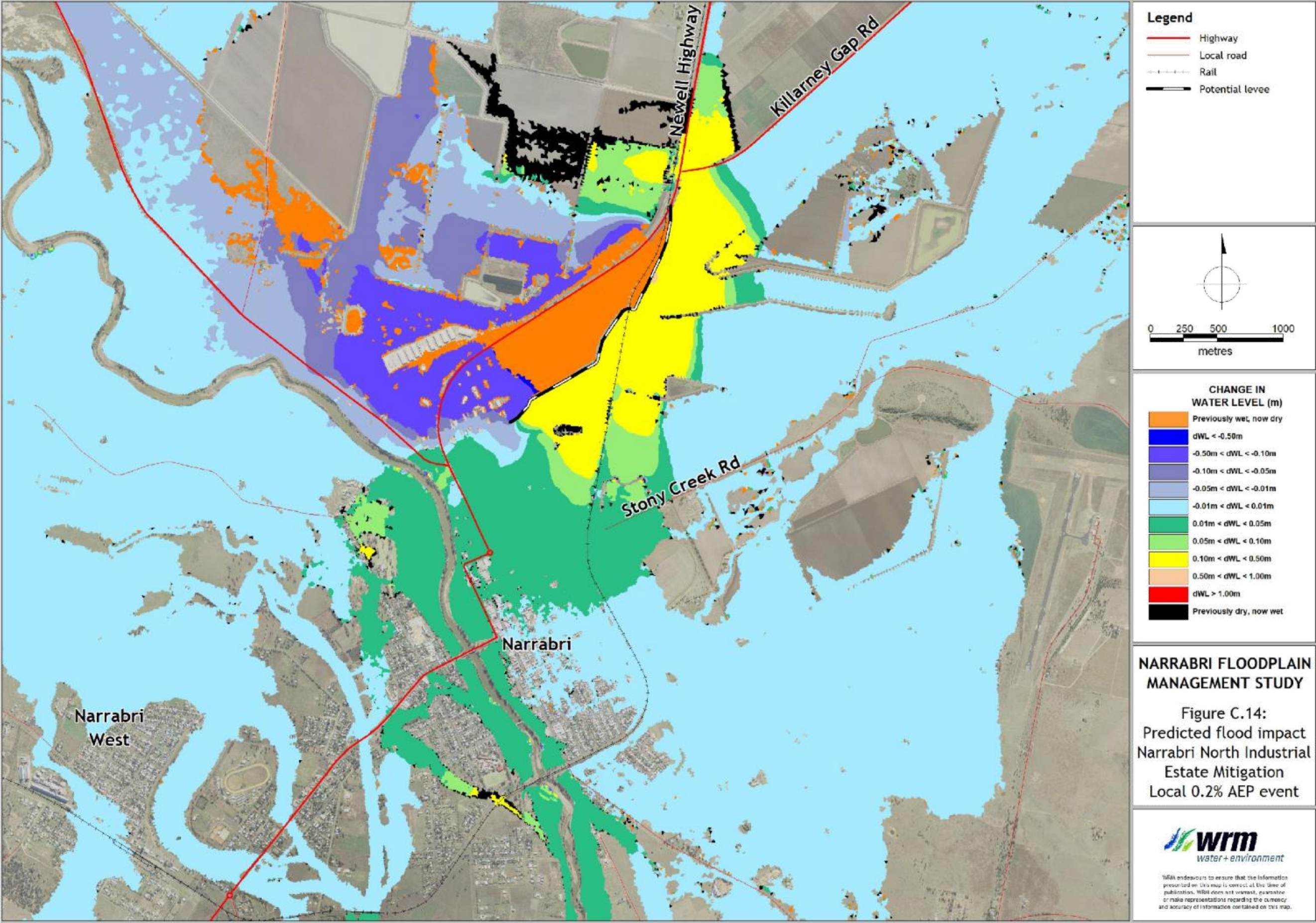


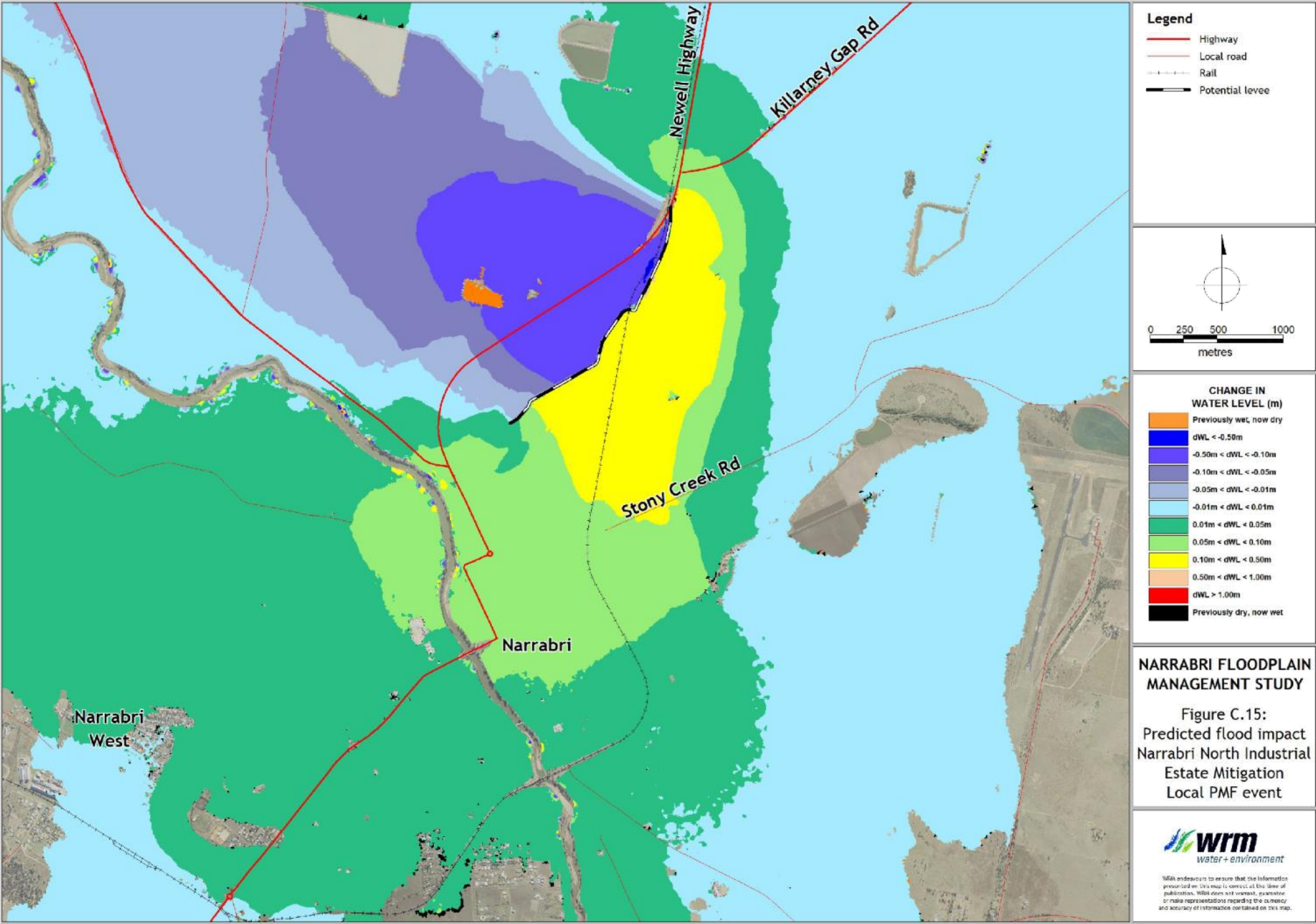


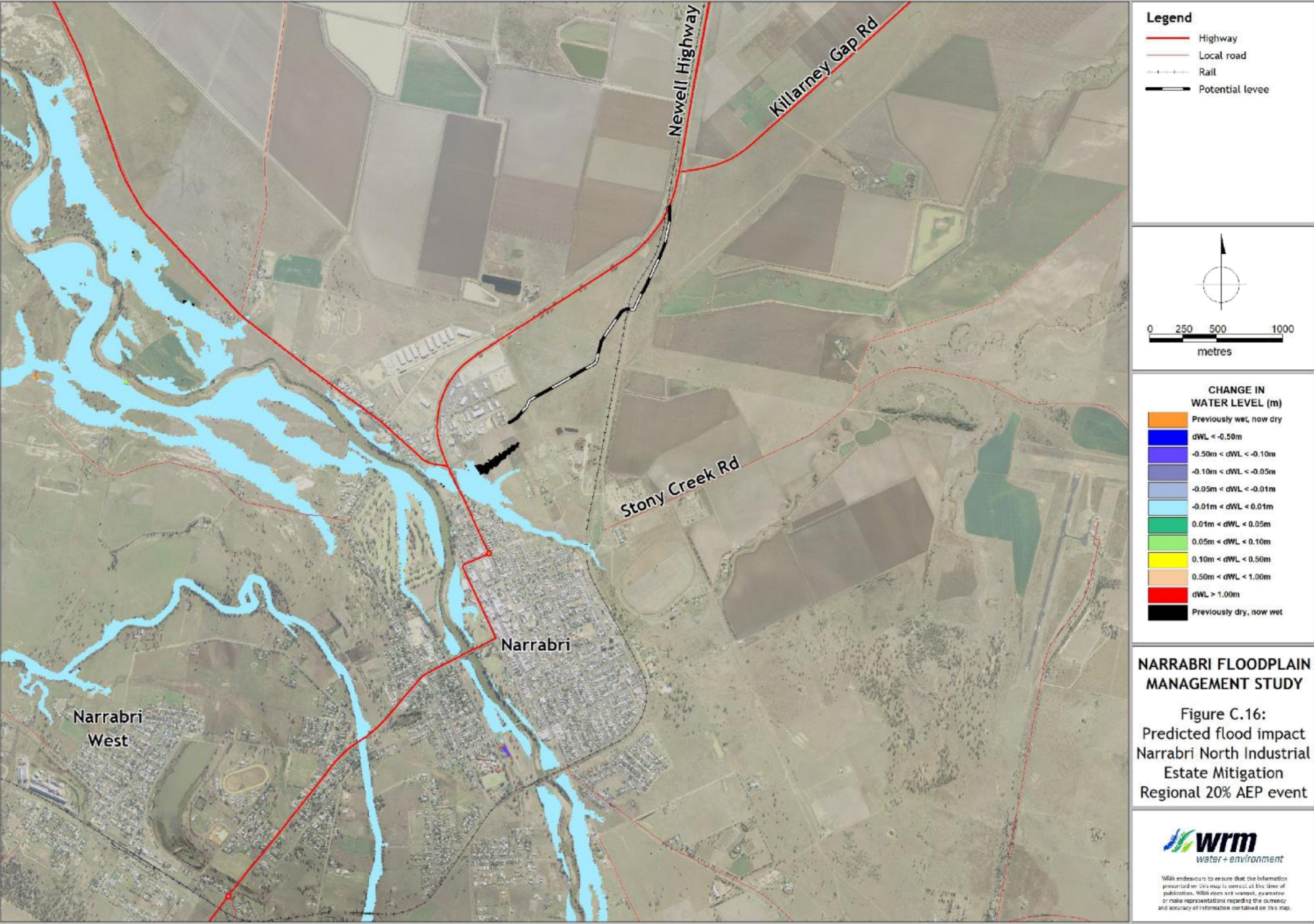


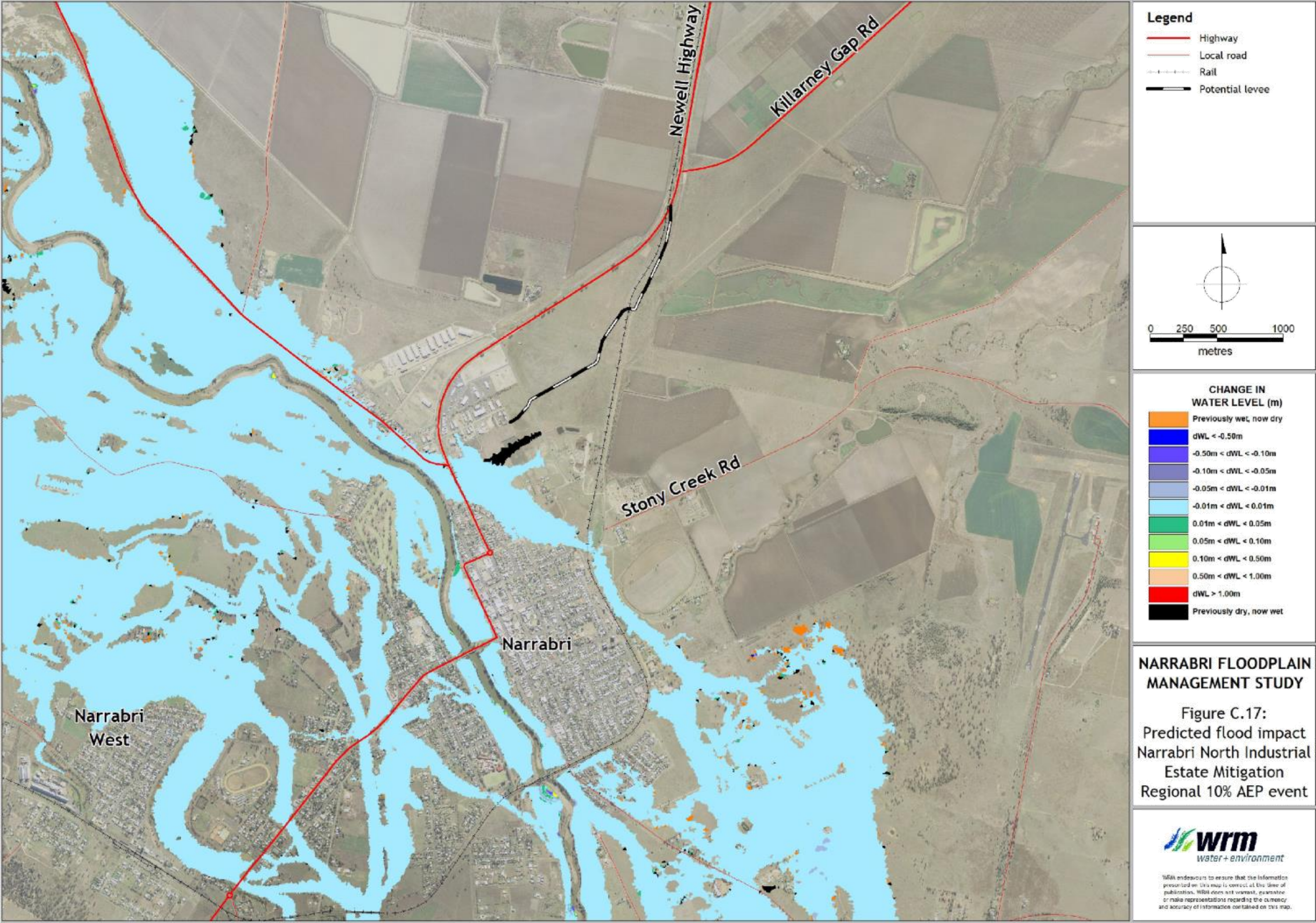


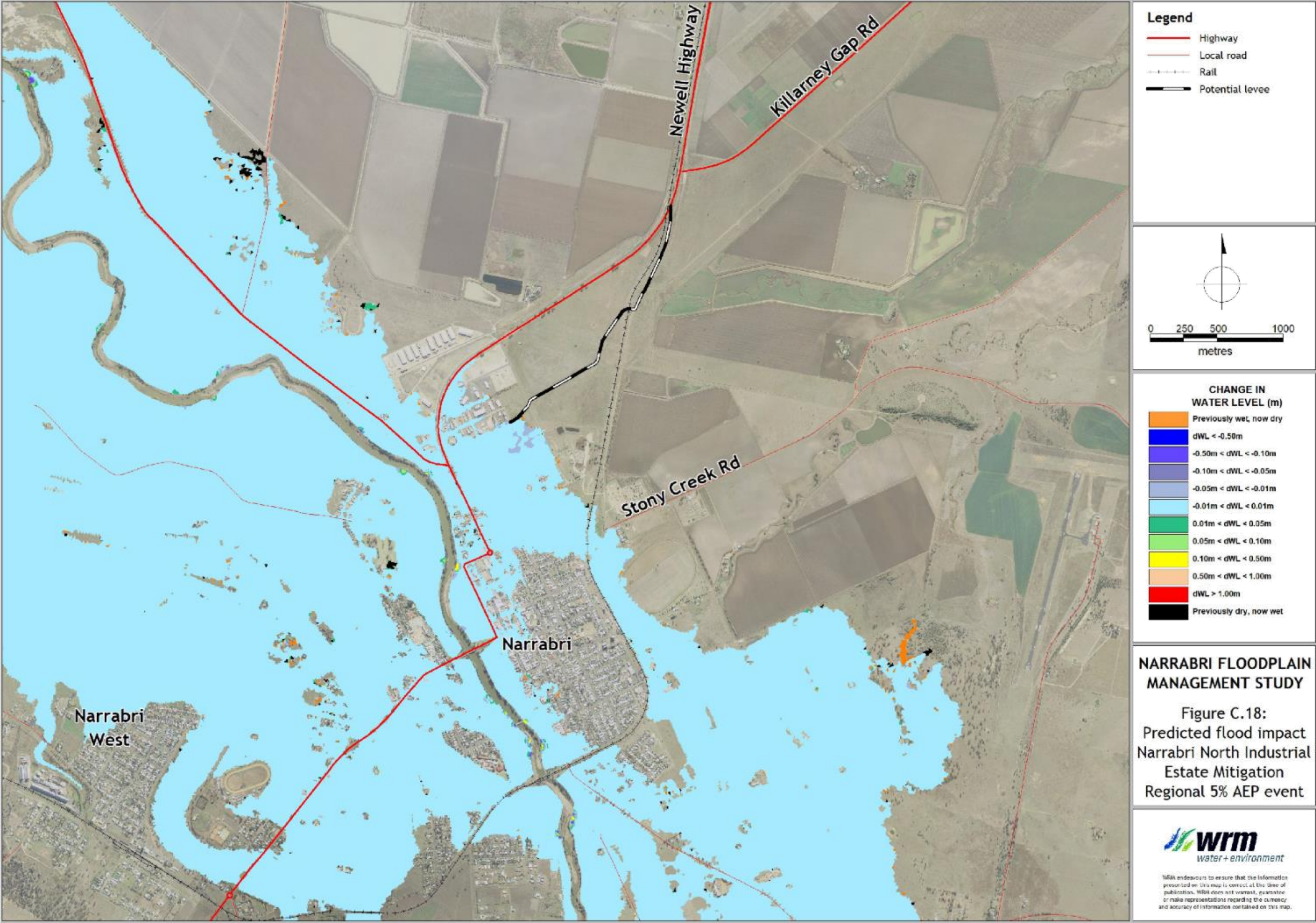


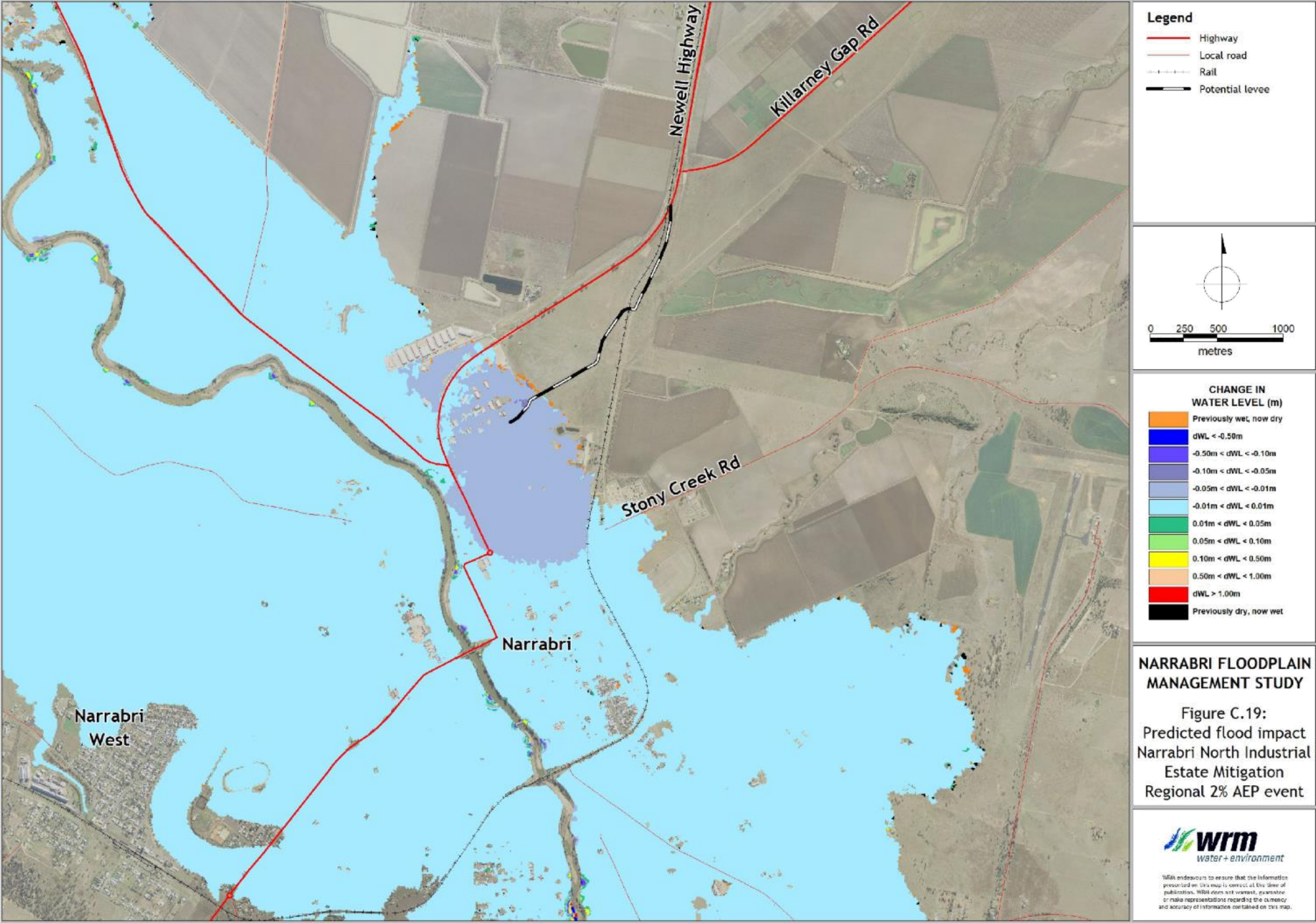


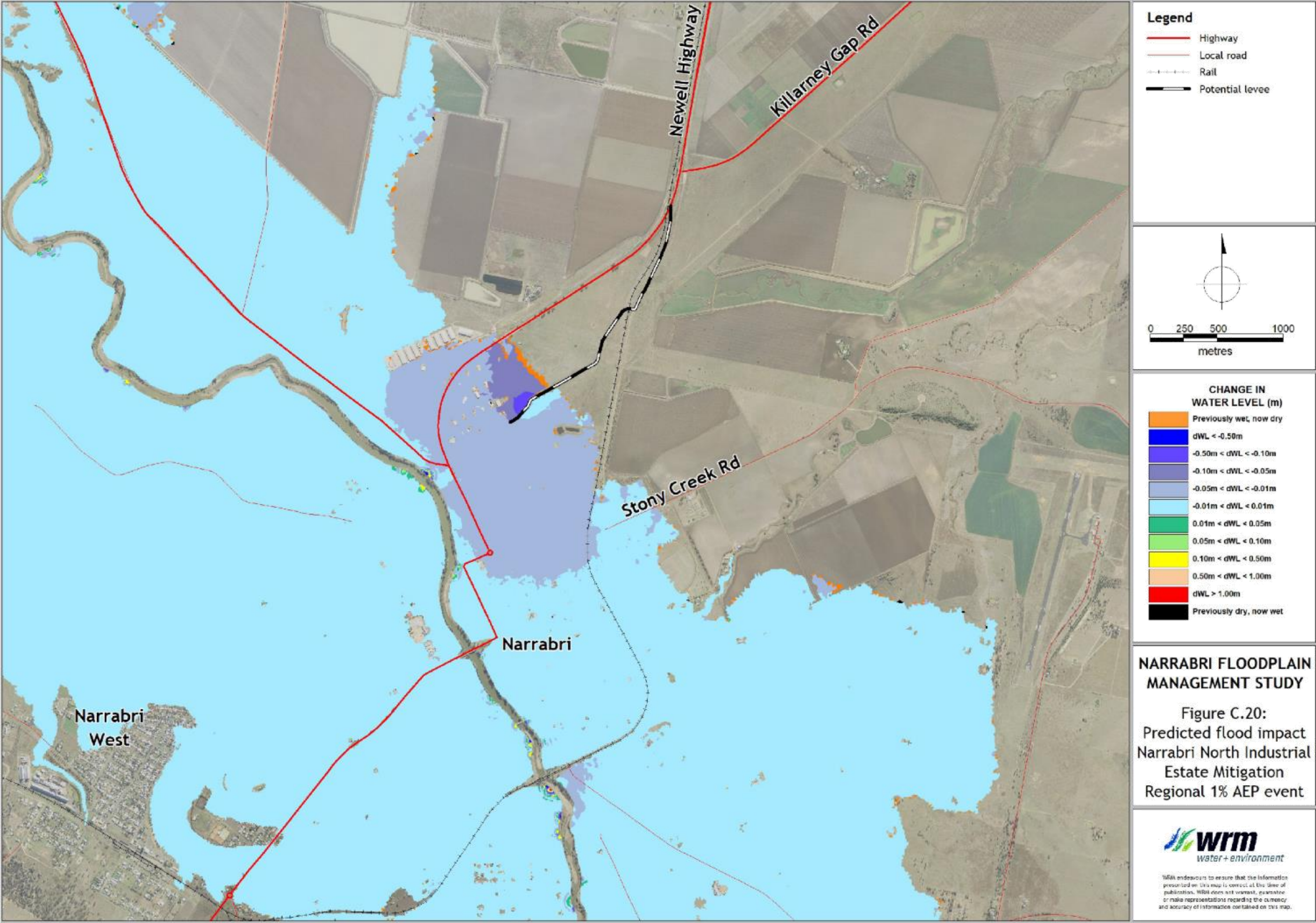


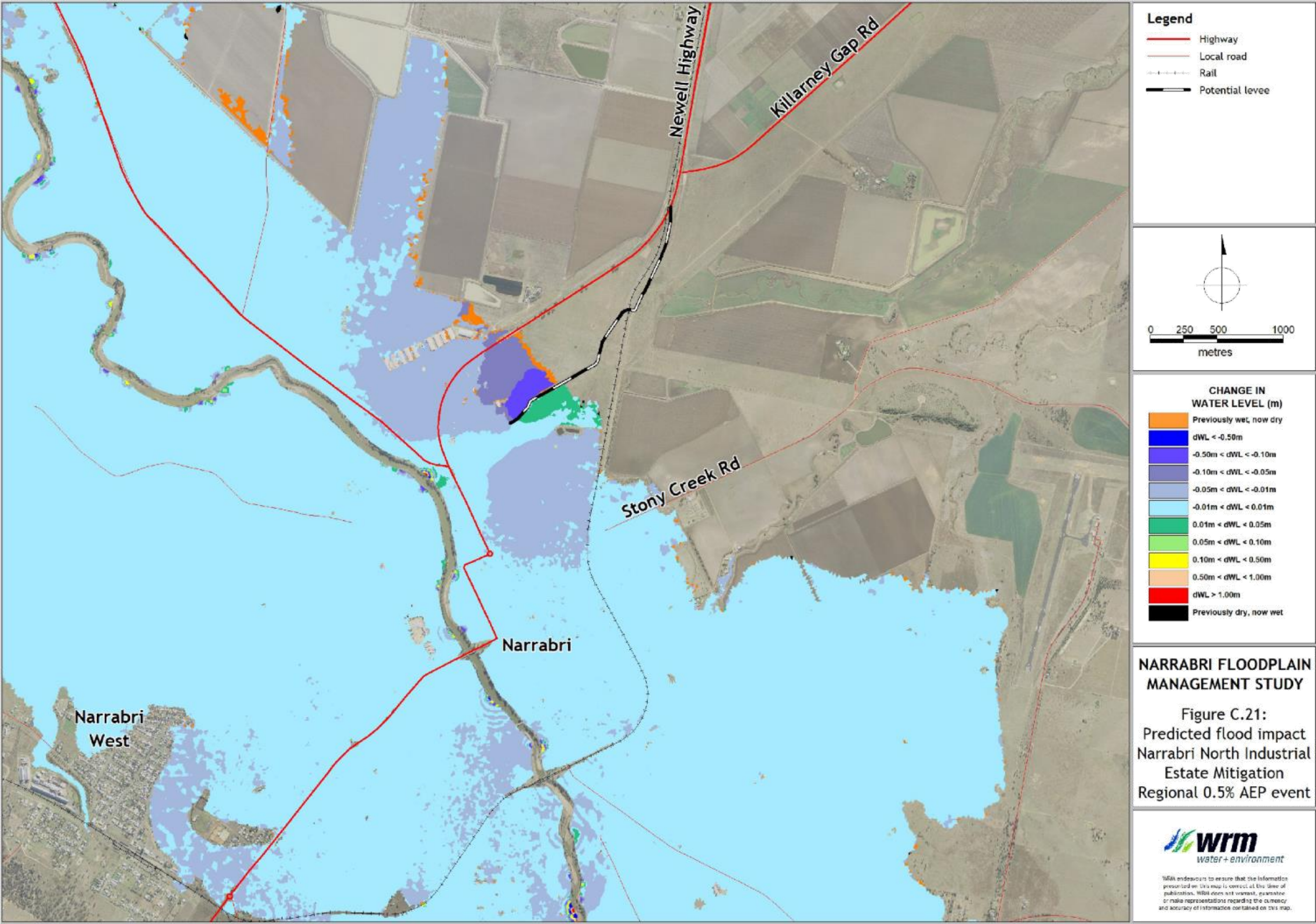


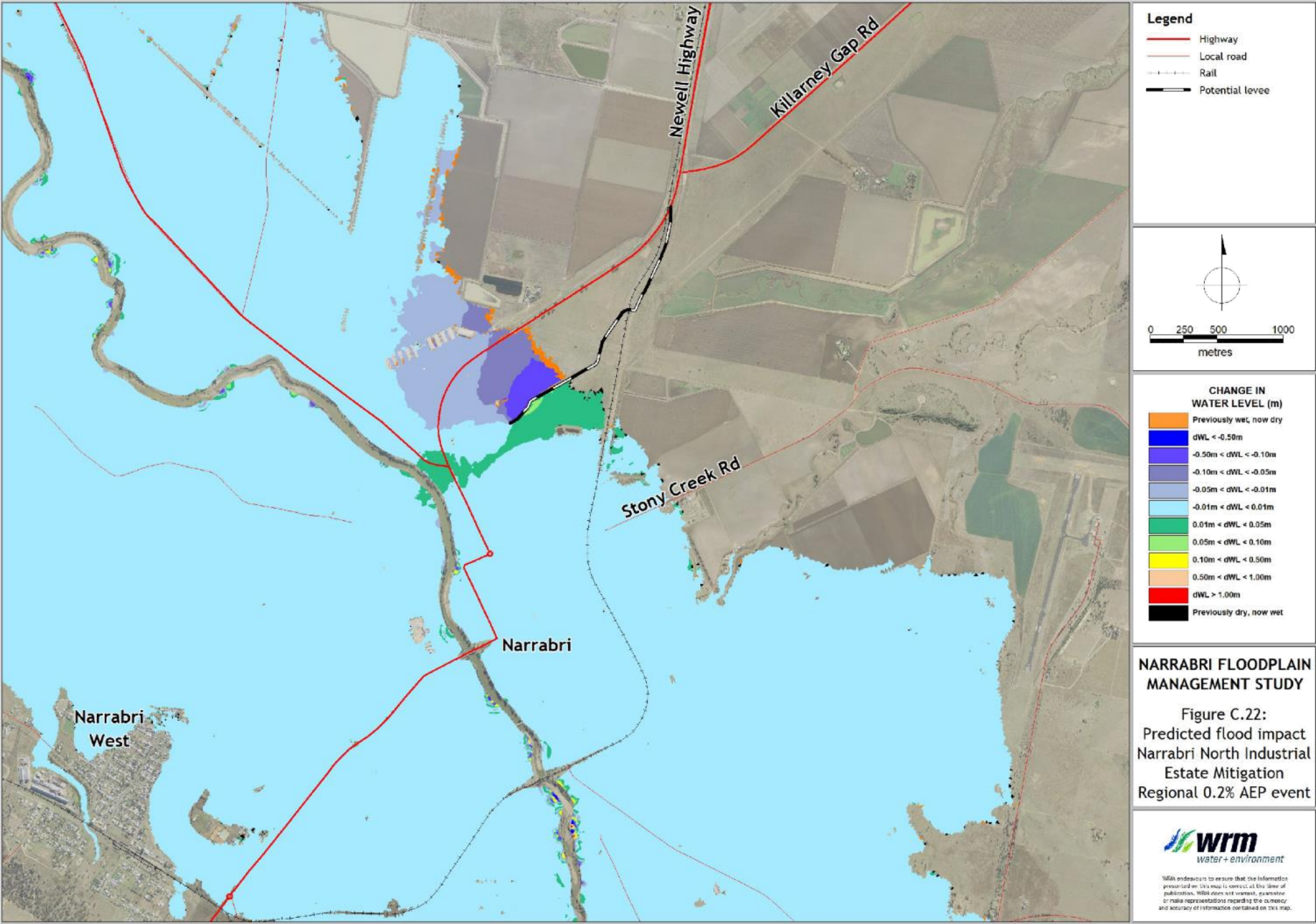


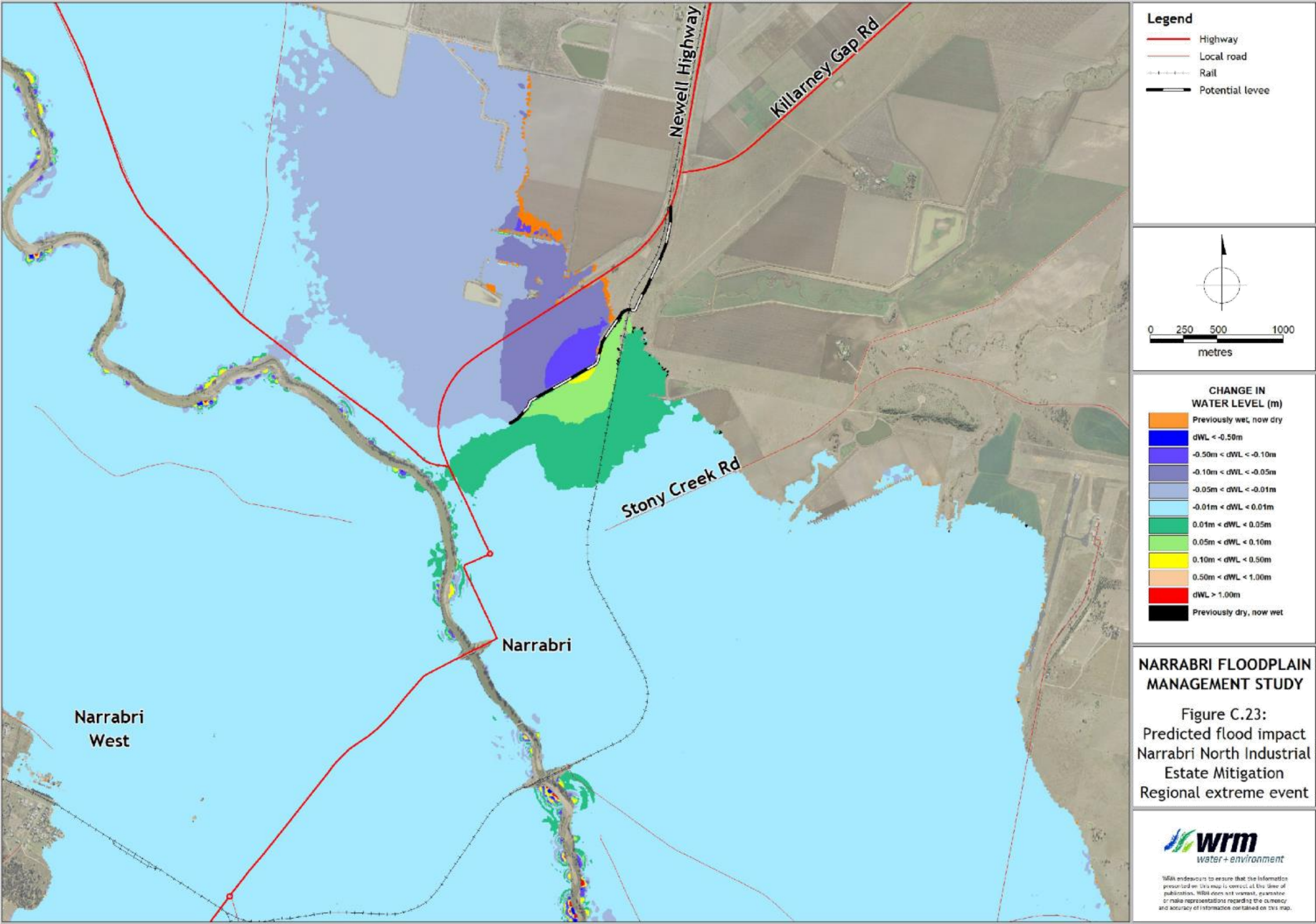


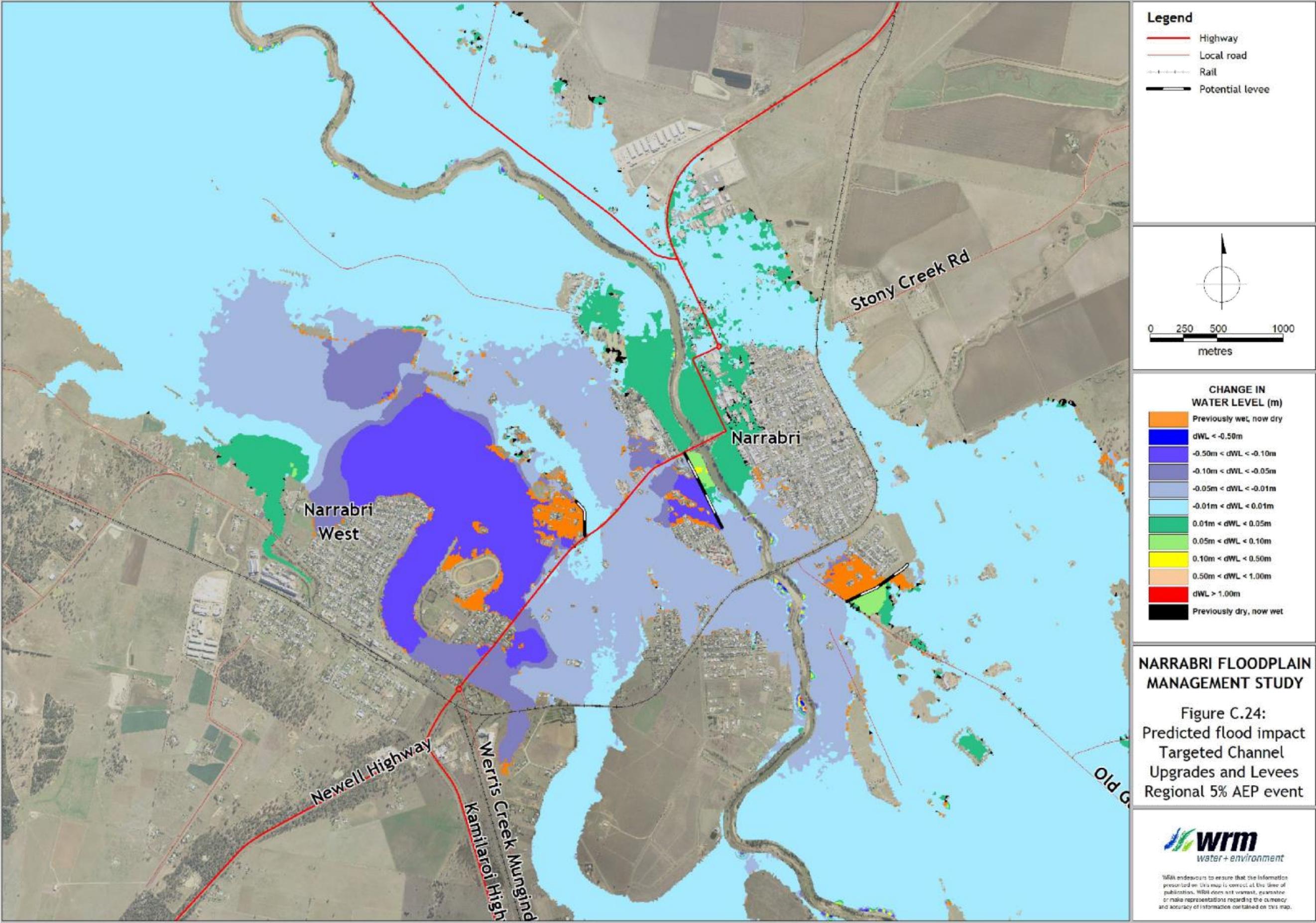


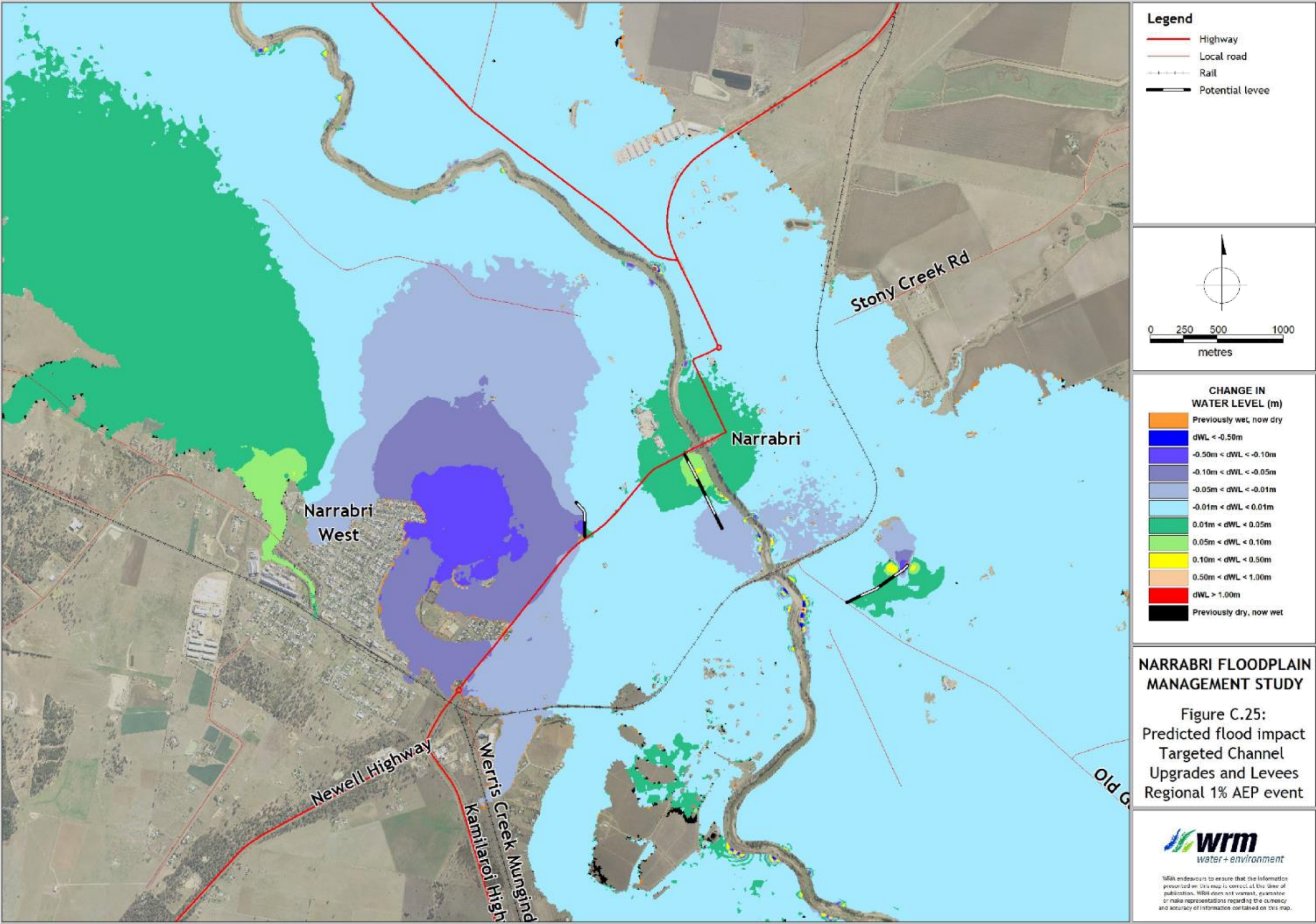


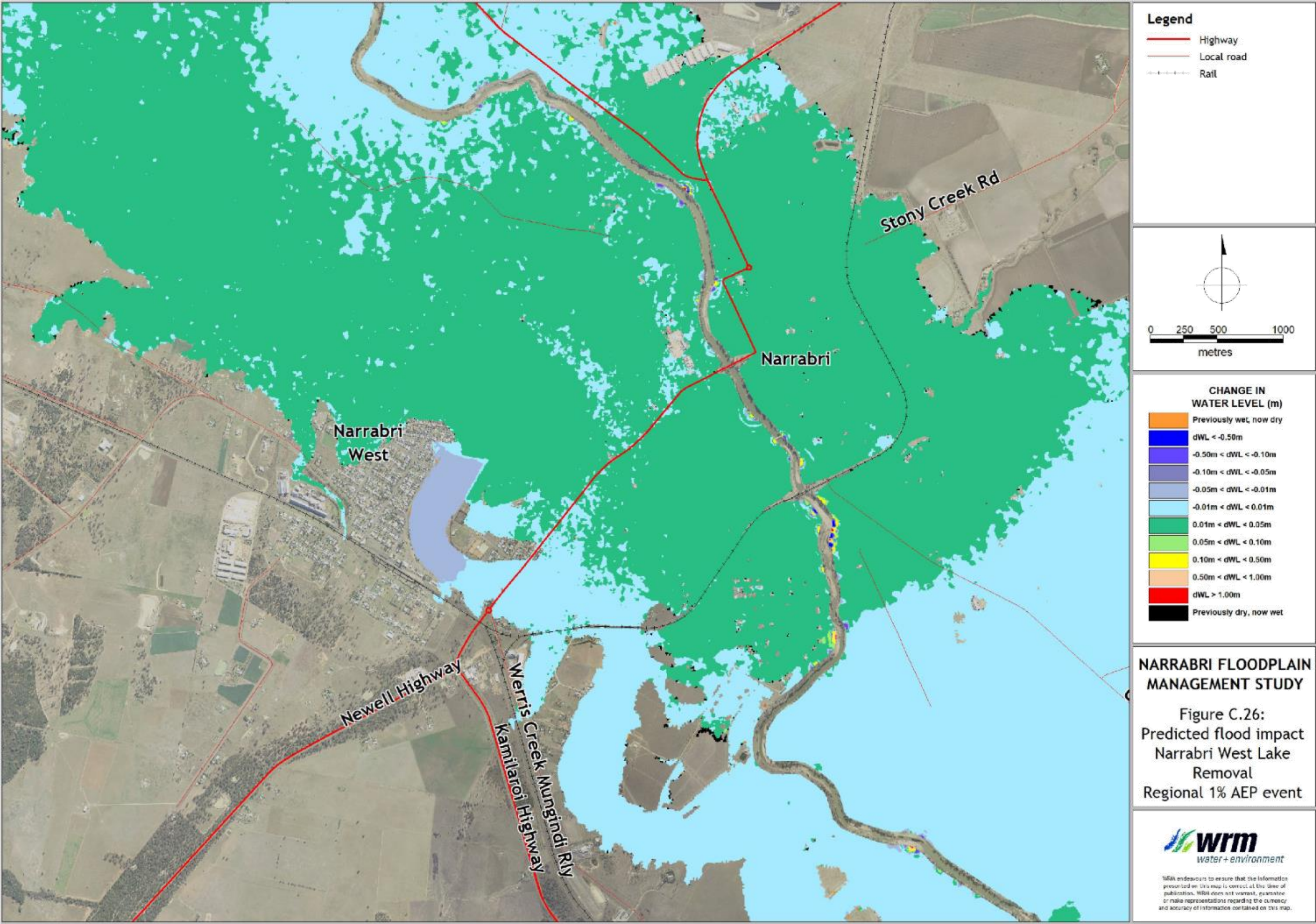


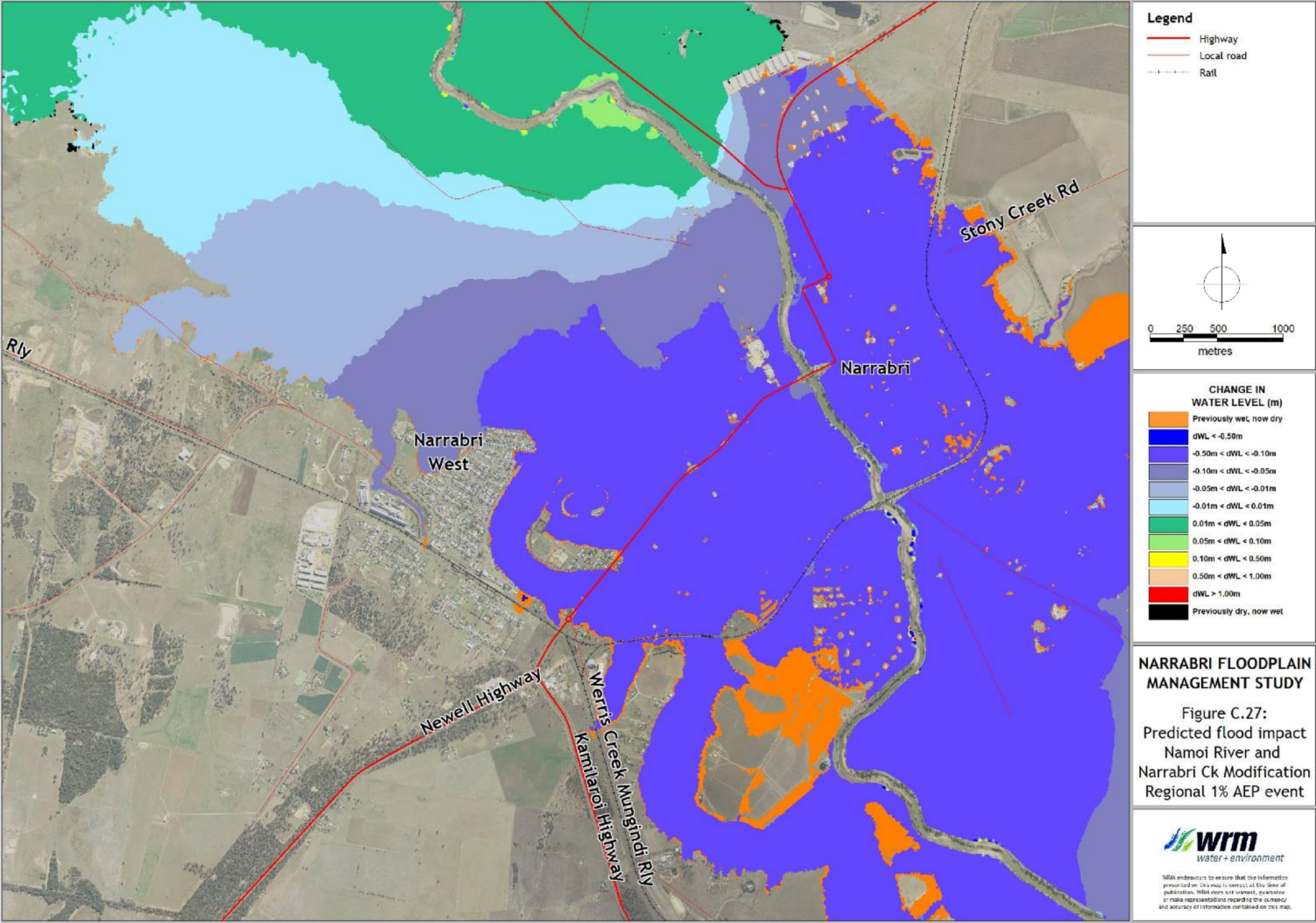












Appendix D - Preferred mitigation option assessment

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