Newton Denny Chapelle
SURVEYORS PLANNERS ENGINEERS

Appendix H

Flood Impact Assessment

NEWTON DENNY CHAPELLE

Flood Impact Assessment

Lot 1-20 DP 976660 and Lot 1 DP7833330, Bruxner Highway, Casino




October 2019

M7239_001-REP-001

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M7239_001 FLOOD IMPACT ASSESSMENT LOT 1-20 DP 976660 AND LOT 1 DP7833330, BRUXNER HIGHWAY, CASINO						
\\EGIBRAPP02\management$\Projects\M7000_Miscellaneous Clients\M7239_001 Bruxner Highway FIA\07 Deliv\Docs\Report\M7239_001-REP-001-0-BruxnerHwy FIA Report.docx						
REV	**DESCRIPTION**	**AUTHOR**	**REVIEWER**	**PROJECT MANAGER**	**APPROVER / PROJECT DIRECTOR**	**DATE**
Rev 0	Client Issue Final	John Nguyen	Karl Umlauff	Karl Umlauff	Mark Page	18 October 2019
Signatures						

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Appendices

List of Figures

1. INTRODUCTION

Engeny has been commissioned by Newton Denny Chapelle (NDC) on behalf of Chris and Jeff Imeson to develop a Flood Impact Assessment (FIA) for the proposed development at Lot 1-20 DP 976660 and Lot 1 DP 783330 Bruxner Highway, Casino (the site). The site is bounded by an industrial estate (western boundary), open space (north and east boundary) and the Bruxner Highway (southern boundary).

The FIA is in relation to the Gateway Determination for the rezoning of Lot 1-20 DP 976660 and Lot 1 DP 783330 from RU1 Primary Production to IN1 General Industrial and apply a 750 m^2 minimum lot size under the Richmond Valley LEP 2012 at the request of Department of Planning, Industry and Environment (DPIE). The site is located within the Richmond Valley Council (RVC) local government area and is presented as the yellow outline in Figure 1.1.

The key objectives of the FIA are to:

- Confirm the flood modelling approach to be adopted for the assessment, being the previously developed model (including consultation with DPIE and RVC)
- Assess the flood impacts (if any) for the proposed development
- Develop flood impact maps assessment the 5% AEP, 1% AEP, 0.2% AEP and PMF events
- Prepare a report summarising the methodology and flood impact assessment results, including the flood impact mapping.

Figure 1.1 Location of the Proposed Development (Google 2019)

1.1 Existing Characteristics

The site is approximately 14 hectares in area. The site is part of the Richmond River floodplain and is completely inundated within the 1% AEP and above. The river flows from the west to east through the Richmond River, with breakout flowing through the Casino township.

The existing site is currently zoned as RU1 Primary Production.

1.2 Proposed Development

The proposed development consists of a single earthwork pad with proposed access off Bruxner Highway and an internal access facing the industrial estate to the east. To undertake the development of the proposed site, the site would need to be rezoned into IN1 General Industrial in accordance with DPIE.

Figure 1.2 provides an indicative layout of the proposed site.

The fill for the proposed development will be sourced from the floodplain.

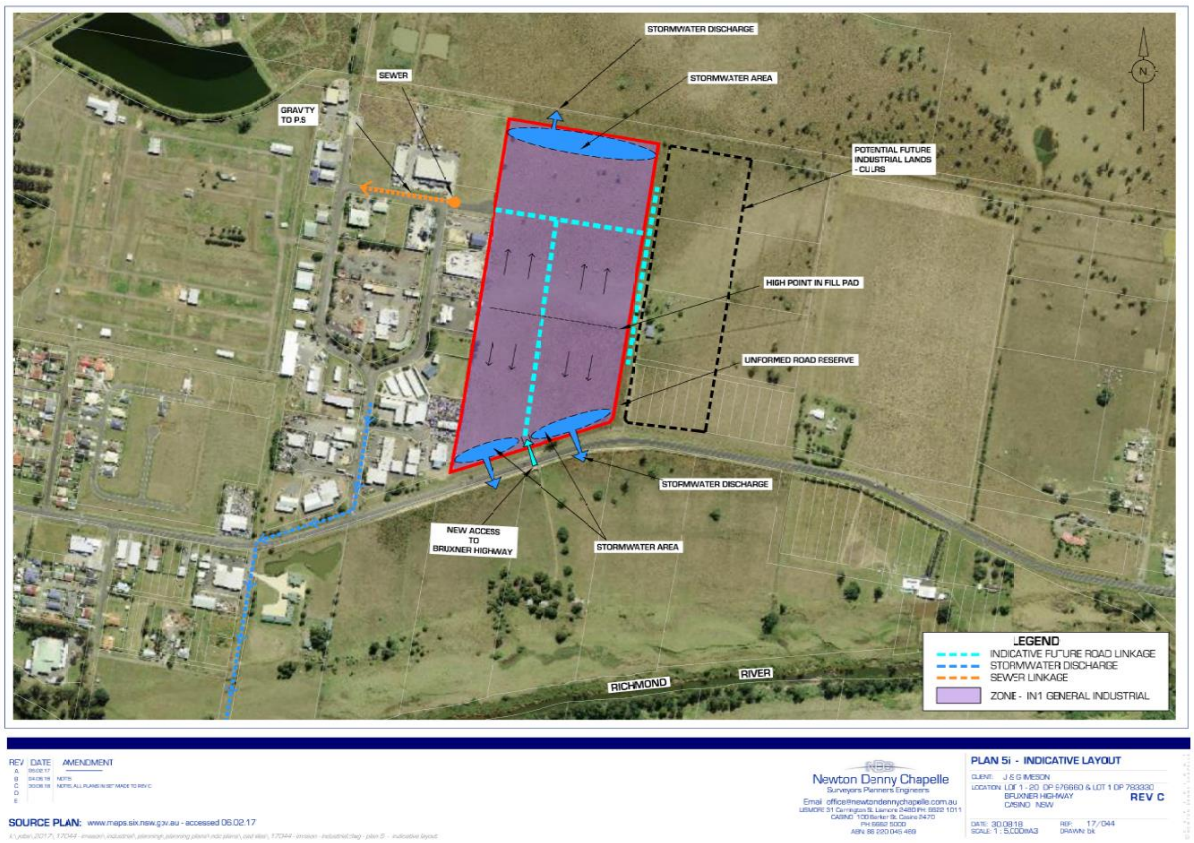

Figure 1.2 Proposed Indicative Layout (NDC 2018)

2. FLOOD IMPACT ASSESSMENT

DPIE has identified that Casino specific flood studies have been undertaken, however in consultation with RVC and DPIE it was determined that the Richmond River Flood Study (WMB 2010) model would be the preferred base case model for the assessment of the Bruxner Highway site, the reason being modelling software has drastically changed since the legacy models. It should be noted that the Richmond River flood (2010) has not been calibrated for the Casino locality, however, of the hydraulic models within the Casino area, the model provided the most accurate results.

To assess the proposed development's impact on the peak flood levels, the following scenarios were considered:

- 'Base Case' – the existing Richmond River model is unchanged, and no modifications have been undertaken.
- 'Developed – this scenario represents the post-development site. The post-development site includes a single earthwork pad, which covers the entire property area (including required earthwork batter).

2.1 Base Case Model

The TUFLOW model from the Richmond River Flood Mapping Study (2010) was utilised for the assessment and was adopted as the base case model. The Richmond River model also included the original hydrologic inputs that were not amended by Engeny.

For the purpose of this assessment and to establish the baseline flood conditions upon which flood impacts could be assessed, the model was simulated for the 1% AEP to PMF flood events as specified by RVC and DPIE. The extent of the base case model is presented in Figure 2.1.

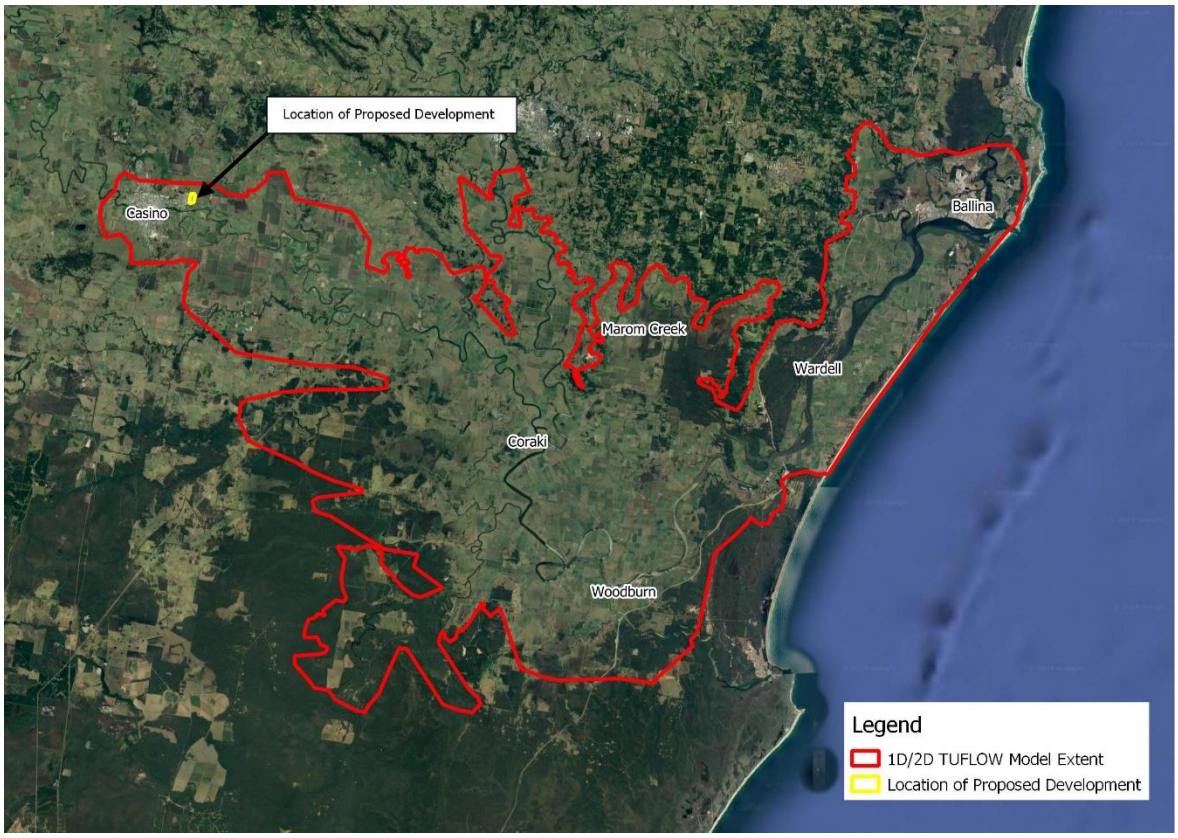

Figure 2.1 Base Case Hydraulic Model Extent

2.2 Developed Case Model

Flood impacts associated with the proposed development works were assessed by comparing the flood levels from the developed case model against the base case flood levels for the design events analysed.

The base case model was amended to represent the proposed development fill that were based on the supplied design file provided by NDC named *1m tin 000000 STIN DESIGN SITE.dem* and dated 23 August 2019. As such the design tin supplied by NDC was incorporated into the model as a design survey. No other modifications were made to the base case model.

The proposed earthwork pad is presented in Figure 2.2.

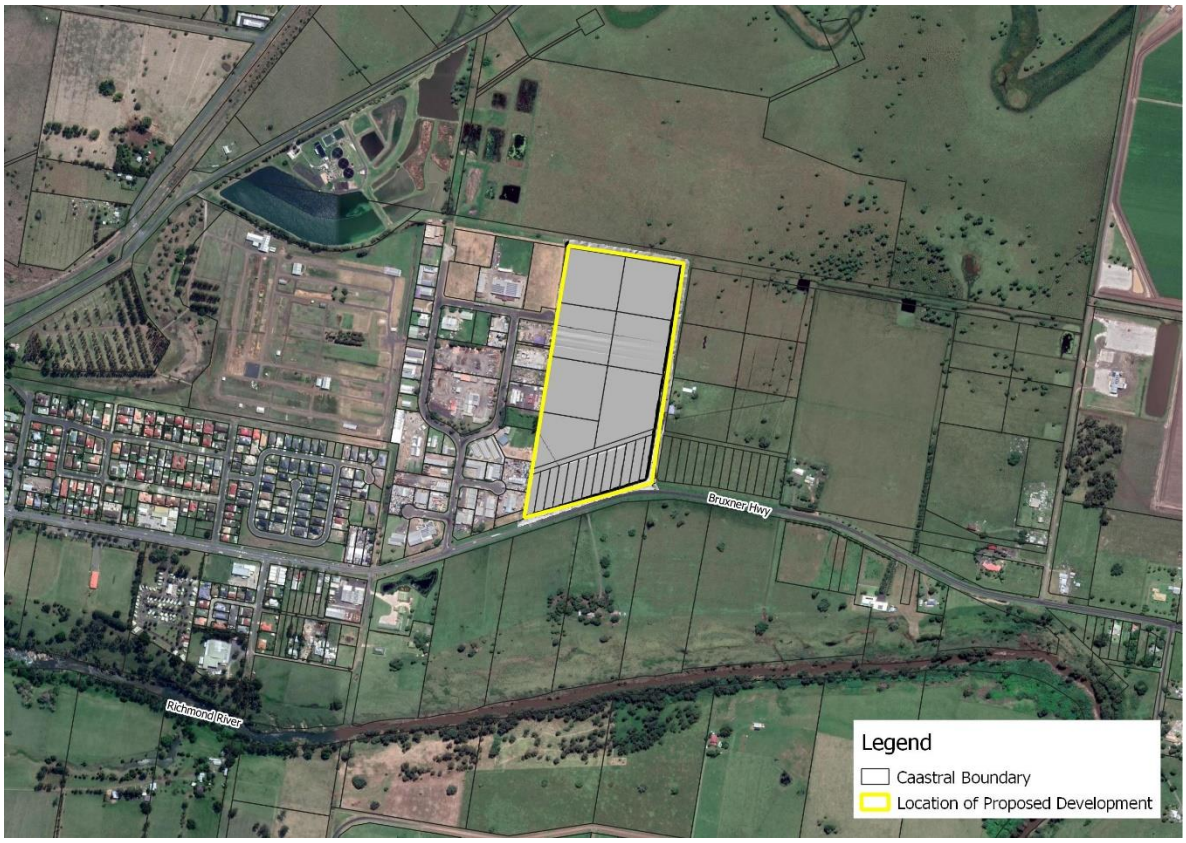

Figure 2.2 Proposed Development Earthwork Pad

3. RESULTS

3.1 Flood Impact Results

The peak flood level impact mapping results for the 5% AEP to PMF events are presented in Appendix B.

Key observations based on the post-development modelling results are as follows:

- In the 5% AEP flood event, the flood levels are wholly contained within the Richmond River floodplain and do not encroach into the extent of the proposed development. No adverse impacts are predicted in this event.

- In the 1% AEP flood event, there are predicted:
  - Flood impacts of up to 200 mm extending 90 m and 40 m to the west and south of the property boundary, respectively
  - Flood impacts of up to 600 mm to the north of the property boundary, and
  - Flood impacts of up to 400 mm to the west of the property boundary

- In the 0.2% AEP flood event, there are predicted:
  - Flood impacts of up to 300 mm extending up to 300 m to the west of the property boundary
  - Flood impacts of up to 350 mm extending up to 650 m north to the model boundary (the extent of the model is insufficient to accurately model the floodplain)
  - Flood impacts of up to 300 mm extending up to 80 m south of the property onto Bruxner Hwy, and
  - Flood impacts of up to 200 mm to the west of the property boundary.

- In the PMF event, there are predicted:
  - Flood reduction of up to 50 mm extending up to 250 m downstream of the site (to the east)
  - Flood impacts of up to 200 mm extending up to 300 m to the west of the site
  - Flood impacts of up to 100 mm extending up to 100 m to the south of the site, and
  - Flood impacts of up to 200 mm extending up to 650 m north to the model boundary (the extent of the model is insufficient to accurately model the floodplain).

Based on the results, there are impacts predicted for the 1% AEP, 0.2% AEP & PMF events as a result of the proposed development. It is emphasised that impacts are generally exacerbated in the open space area north of the property due to the constriction of the floodplain (i.e. the model boundary does not include the floodplain past Barlings Creek).

3.2 Model Limitations

There are model limitations that are demonstrated by the flood mapping results. The base case model does not provide representative or favourable potential flood impacts as a result of the development. The potential model issues are as follows:

- A “Glass Wall” at the Northern boundary due to insufficient model extent –
  - The model does not fully represent the Casino floodplain due to “glass walling” and as such provides a potentially highly conservative assumption for peak flood levels. Impacts near the model boundaries would be exacerbated by the “glass wall”.
- Coarse resolution resulting in flood impacts – the model utilises 60 m grid resolution that can cause embankments and other existing infrastructure to be poorly represented
  - e.g. the industrial estate (east of the site) is modelled within the DEM, however earthfill pad levels are not property captured with the 60 m grid cell sized utilised by the model
- The model is not calibrated to the Casino region.

An updated Richmond River flood study would need to be undertaken to covering a larger model extent and calibrated for the Casino area to provide an improvement in the accuracy of results.

4. CONCLUSION AND RECOMMENDATION

Engeny was engaged to undertake a Flood Impact Assessment for the proposed rezoning of Lot 1-20 DP 976660 and Lot 1 DP7833330 from RU1 Primary Production to IN1 General Industrial (the site). The proposed development consists of a single earth-filled pad. The site is bounded by an industrial estate (to the west), open space (north and east) and Bruxner Hwy (south).

The purpose of the assessment is to determine the potential impacts of the Gateway Determination application for the proposed rezoning of the site.

A 1D/2D TUFLOW model and hydrologic output developed by BMT WBM (BMT) in 2010 for the Richmond River Flood Study was provided by RVC and adopted for the purpose of the flood impact assessment. No modifications were made to the model for the base case scenario. A design survey was provided for the developed case, which was included into the model as a digital elevation model (DEM) for the developed case.

Existing and developed conditions were assessed for the 5% AEP, 1% AEP, 0.2% AEP and PMF design flood events. The results are as follows:

- In the 5% AEP event, flood levels are contained within the Richmond River and does not impact the site. No adverse impacts are predicted.
- In the 1% AEP, 0.2% AEP & PMF events, there are potential adverse impacts with peak impacts of 600 mm, 350 mm, and 200 mm, respectively, outside the property boundary. Adverse impacts are predicted.

Based on the results of the simulation, there were adverse impacts predicted as part of the flood impact assessment, however the model does not truly represent an appropriate extent of the floodplain (i.e. the extent of the model is “glass walled” and causes flood level impacts to be exacerbated by the constriction of flow).

As such, the recommended model for the purpose of this assessment, provided by RVC and DPIE does not accurately model the proposed development. It is recommended for the Richmond River flood study model to be reviewed, extended and calibrated to the Casino area to provide an improvement in the accuracy of results.

5. QUALIFICATIONS

a. In preparing this document, including all relevant calculation and modelling, Engeny Water Management (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

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g. This report does not provide legal advice.

6. REFERENCES

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors) Australian Rainfall and Runoff: A Guide to Flood Estimation, © Commonwealth of Australia (Geoscience Australia), 2019.

NSW Government (2019). Gateway Determination.

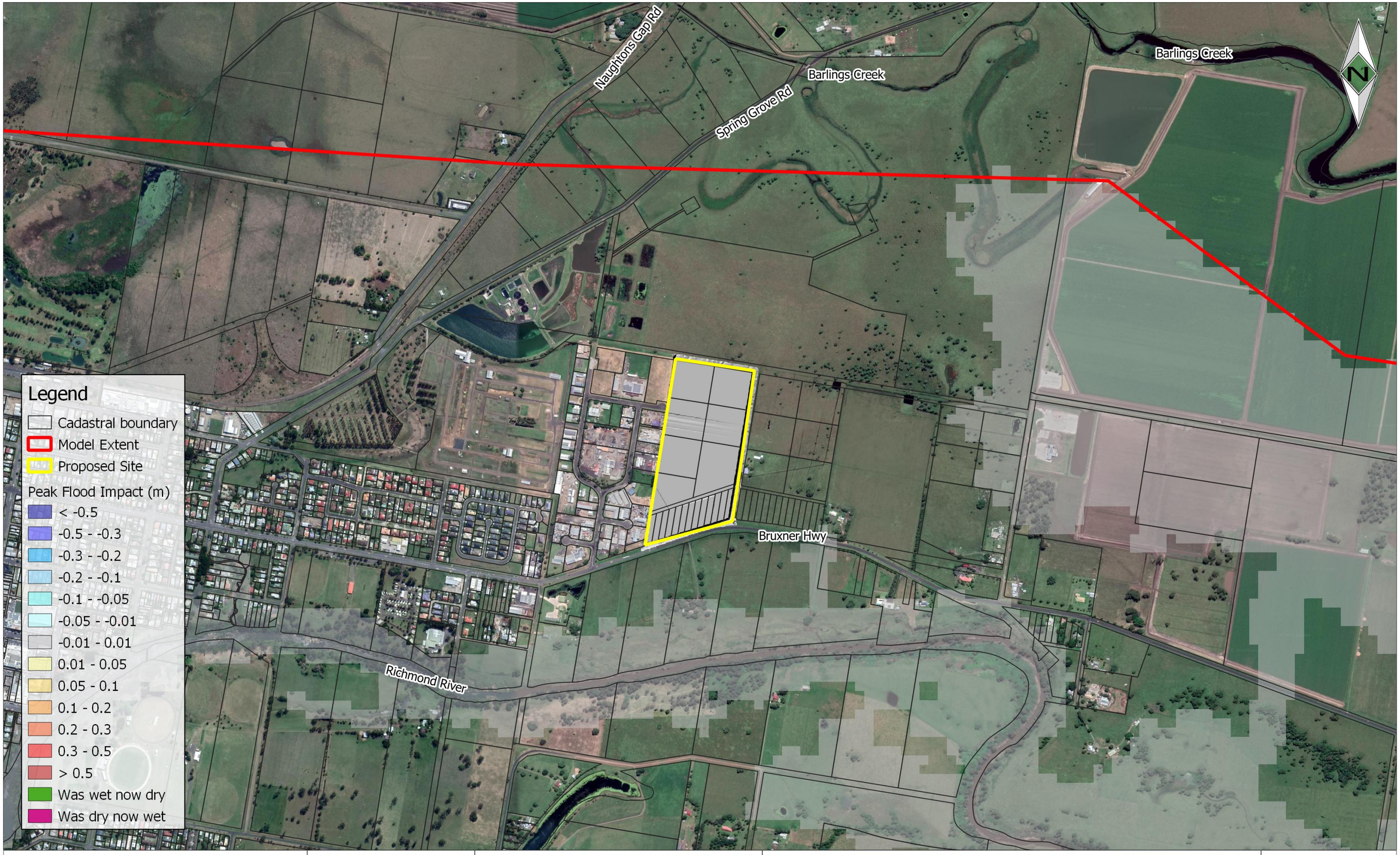
NSW Government (2019). Planning proposal PP_2019_RICHM_002_00 to amend Richmond Valley Local Environmental Plan 2012.

WBM (2002). Casino Floodplain Risk Management Study.

BMT WBM (2010). Richmond River Flood Mapping Study.

APPENDIX A

Flood Impact Mapping



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ENGENY WATER MANAGEMENT

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Document Set ID: 1575326
Version: 1, Version Date: 27/04/2020

0 270 540 m

Scale in metres (1:12500 @ A3)

Map Projection: Tranverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

Bruxner Highway Development Flood Impact Assessment

5% AEP Peak Flood Impact

Job Number:
M7239_001
Revision: 0
Drawn: JN
Date: 18 /10 /2019

Naughtons Gap Rd

Spring Grove Rd

Barlings Creek

Barlings Creek

N

Bruxner Hwy

Richmond River

Legend

- Cadastral boundary
- Model Extent
- Proposed Site

Peak Flood Impact (m)

- < -0.5
- -0.5 - -0.3
- -0.3 - -0.2
- -0.2 - -0.1
- -0.1 - -0.05
- -0.05 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- > 0.5
- Was wet now dry
- Was dry now wet

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0 270 540 m

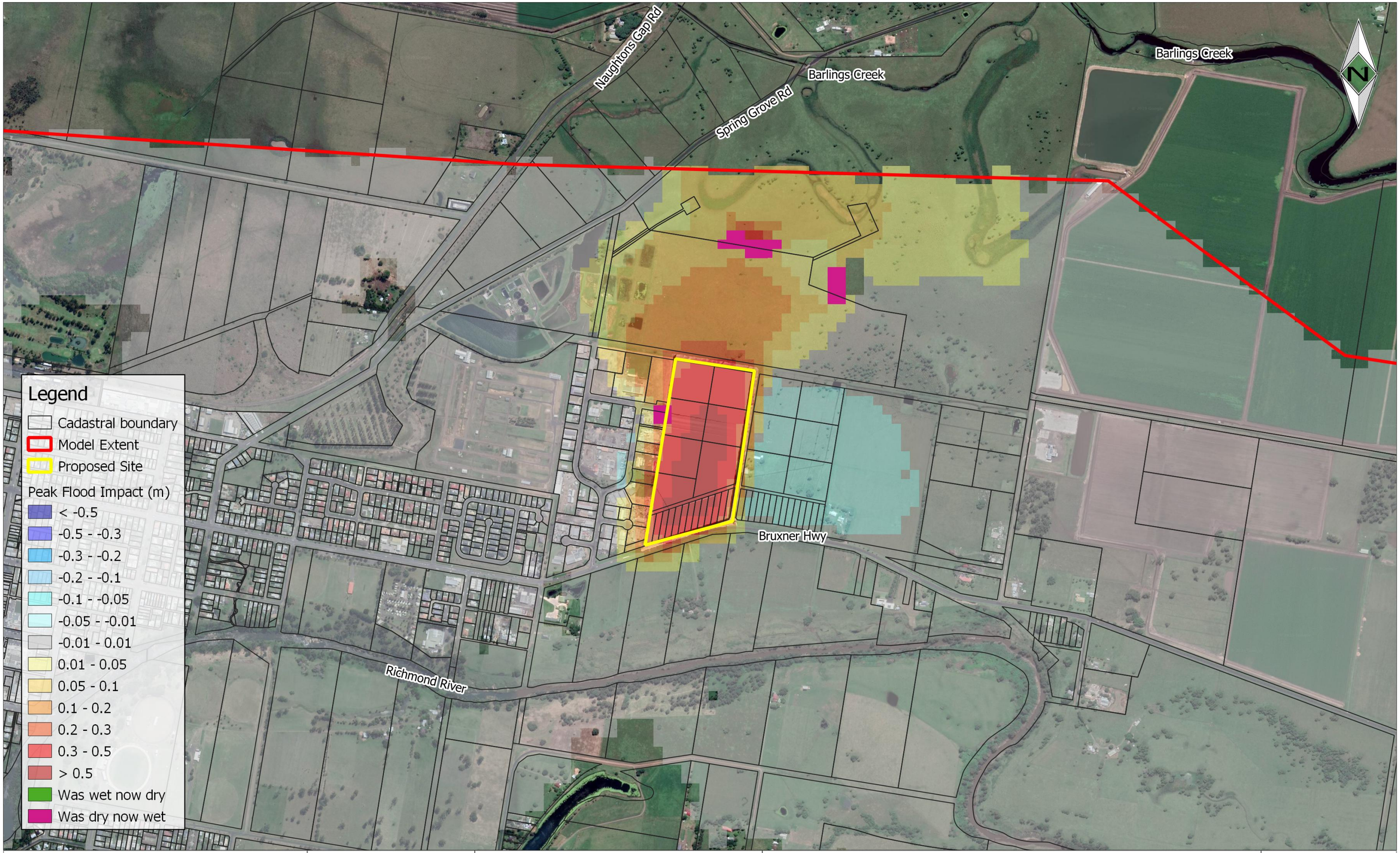
Scale in metres (1:12500 @ A3)

Map Projection: Tranverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

Bruxner Highway Development Flood Impact Assessment

1% AEP Peak Flood Impact

Job Number:
M7239_001
Revision: 0
Drawn: JN
Date: 18 /10 /2019



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Document Set ID: 1575326
Version: 1, Version Date: 27/04/2020

0 270 540 m

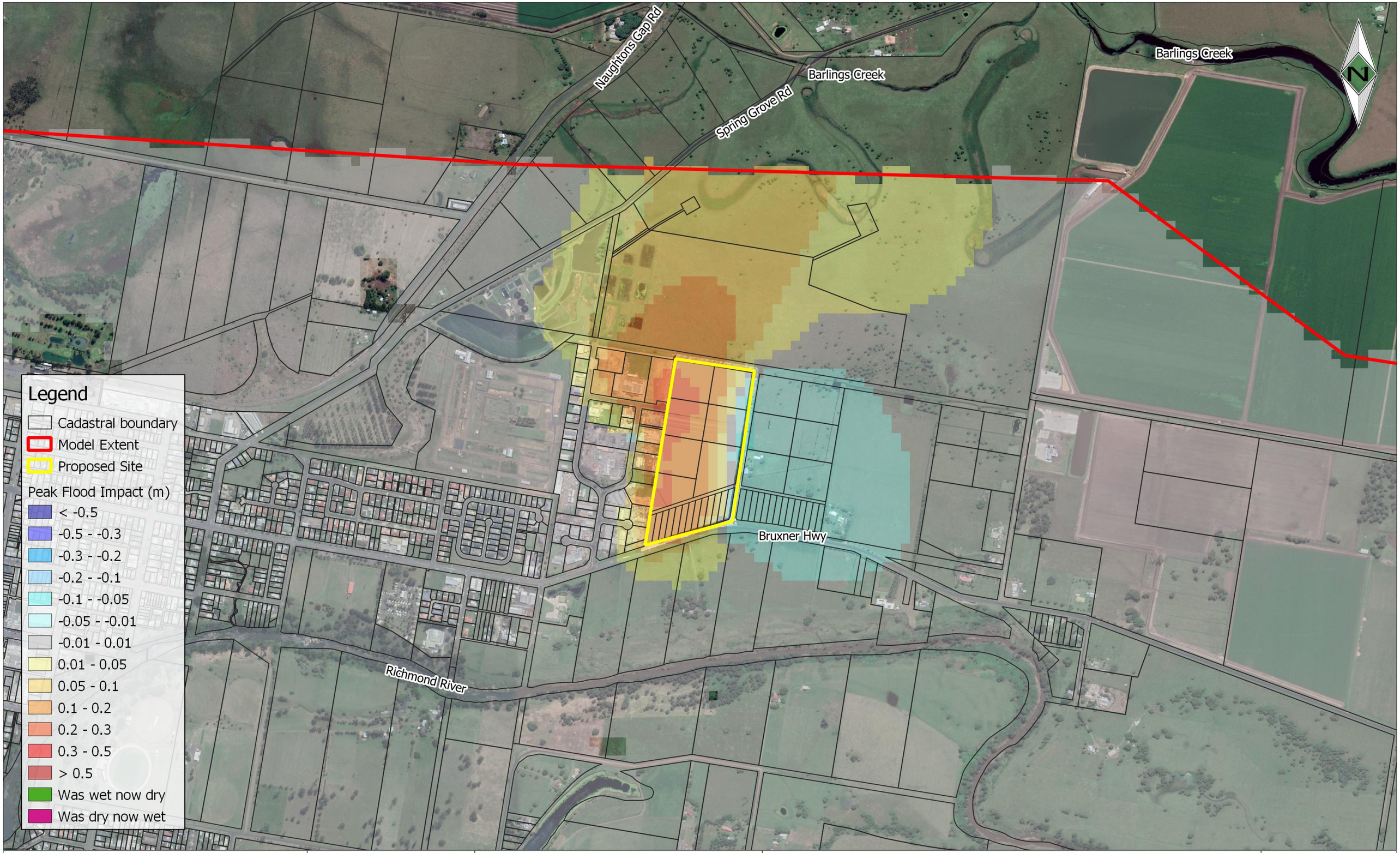
Scale in metres (1:12500 @ A3)

Map Projection: Tranverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

Bruxner Highway Development Flood Impact Assessment

0.2% AEP Peak Flood Impact

Job Number:
M7239_001
Revision: 0
Drawn: JN
Date: 18 /10 /2019



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Document Set ID: 1575326
Version: 1, Version Date: 27/04/2020

0 270 540 m

Scale in metres (1:12500 @ A3)

Map Projection: Tranverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

Bruxner Highway Development Flood Impact Assessment

PMF Peak Flood Impact

Job Number:
M7239_001
Revision: 0
Drawn: JN
Date: 18 /10 /2019

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Appendix I

RVC Response to Flood Impact Assessment

Nicole Rodda

From: Tony McAteer <tony.mcateer@richmondvalley.nsw.gov.au>
Sent: Tuesday, 3 March 2020 1:15 PM
To: Karina Vikstrom
Cc: Jeff and Chris Imeson; Chris Pickford; Brian Eggins
Subject: RE: Imeson Industrial Flood Modelling - Council Response
Attachments: M7239_001-FIG-001-A-100y Flood Impact-Section-Markup.jpg

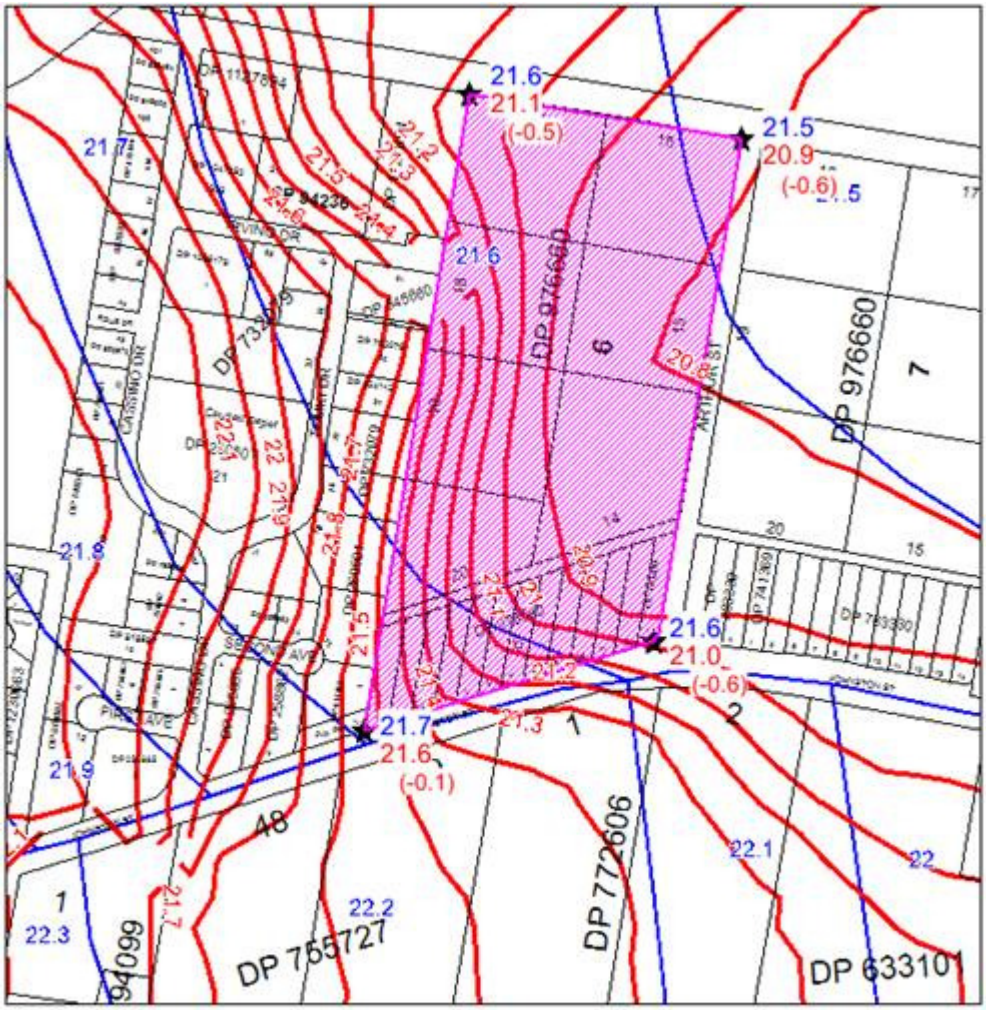
Hi Karina
I have reviewed the Engeny Flood Study for the Imeson land and discussed this with Brian.

There are a couple of things to note that might help with your explanation of flood impacts in the Planning Proposal.

Flood Models
The subject land is within a region of overlap for the Casino (1999) and the Richmond River (2010) Flood Models-

- Casino Flood Model (1999) is a 1D/2D model based on a 20 metre grid (a smaller grid = higher resolution flood information and the ability to pick up smaller changes in terrain). This model has been specifically calibrated for flood conditions flowing through the Casino township, but lacks Climate Change considerations
- Richmond River Flood Model (2010) is a 1D/2D model based on a 60 metre grid and includes climate change considerations. However, the model lacks accurate calibration through Casino township, and its larger grid, which is perfectly suitable for large expansive flat flood plains, provides less accuracy for highly complex terrain as might be expected through Casino.

Comparing the 2 models for the subject land
Engeny's report explains why it has been necessary to use the Richmond River Model, over the Casino Model (page 4), but failed to provide an overview/comparison of the base case outputs from both models as they apply to the subject land. As can be seen in the figure below, each model behaves differently over the land. Each contour shown is at a 0.1m interval for the Flood Planning Level (FPL = 1% AEP flood event plus 500mm freeboard) with the Casino Model in Blue and the Richmond River Model in Red.
I have placed markers in each corner of the land (ê) and labelled them with the FPLs (and difference) for the Casino and Richmond River models. The Casino Model clearly has higher predicted flood levels for the land and should be relied upon as the conservative level for future filling, given its calibration for the Casino area and its smaller grid size, implying higher accuracy.



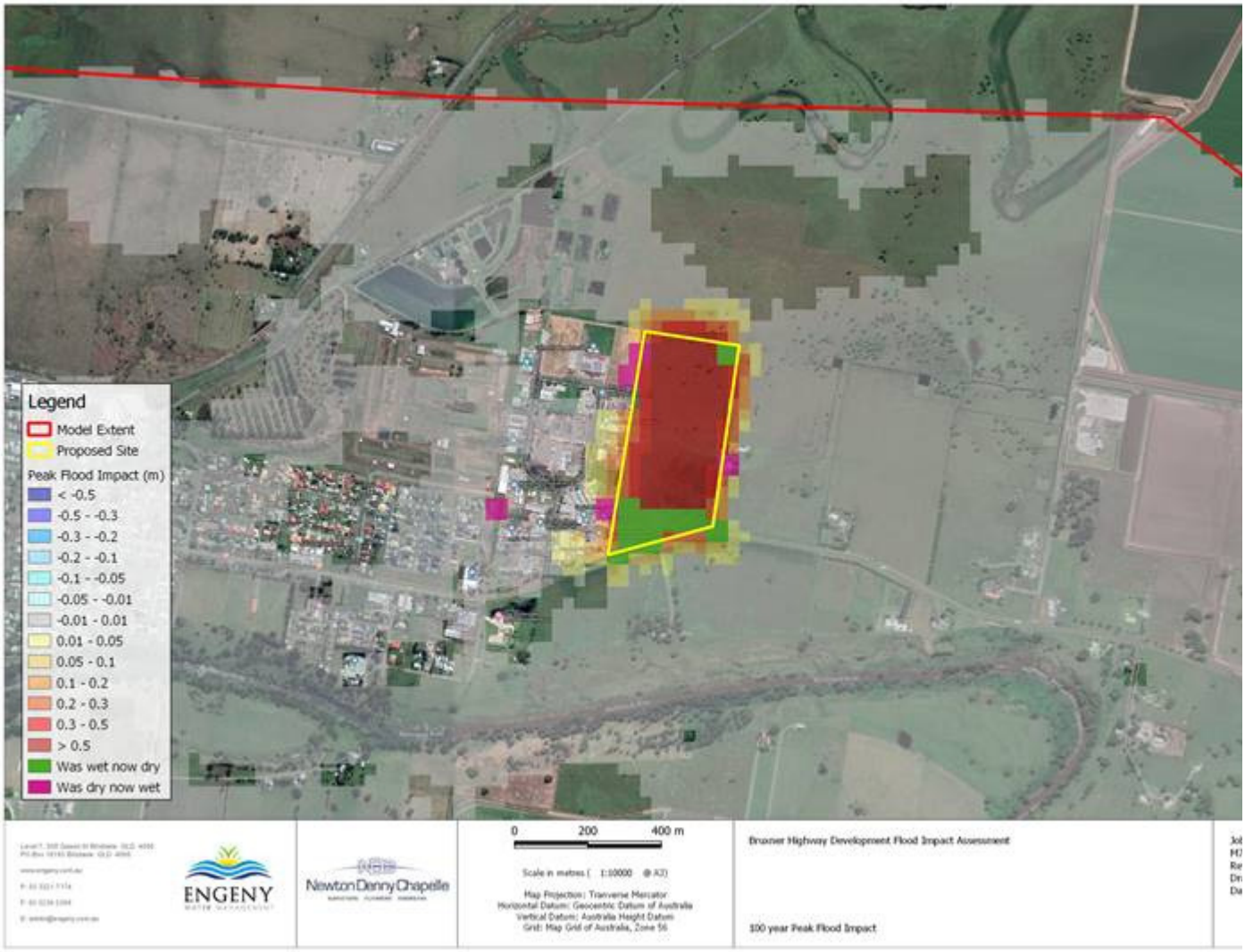
Minimum Habitable Flood Levels (Flood Planning Level or FPL) (being a 1 in 100 year ARI Flood Event plus 500mm freeboard) - levels shown are to AHD

Casino Flood Study (1999)

Richmond River Study (2010)

Engeny's Conclusion

The Engeny Study reports in its conclusion (page 9) that the 1% flood (and 0.2% & PMF floods) will potentially have adverse impacts of 600mm (and 350mm & 200mm, respectively) outside the property boundary. To support this conclusion the figure labelled *1% AEP Peak Flood Impact* has been provided in Appendix A (reproduced below).



My initial thought on these reported offsite impacts is that +600mm in flood height is unacceptable. This is especially given when gauged against the Roads and Maritime Service (RMS) Flood Management Objectives for the Pacific Highway upgrade, where acceptable offsite impacts are capped at up to +50mm in an urban area and up to +250mm for rural areas. However, I don't believe it is a bad as it appears in the figure.

Crowded and complex Figure

Notwithstanding the predicted offsite impacts, the above figure is crowded with information and hard to interpret given it overlays the change in flood level with additional colouring to represent grid cells that "was wet now dry" and "was dry now wet".

When we met on 21 Nov 2019 it was agreed that NDC would ask Engeny to separate these layers into 2 separate maps for clearer viewing. However, I understand Engeny claim there is no masking of information in the figure. In an email to Karina dated 5/12/2019, Engeny explained the figure represents an increase in flood height (not depth). As such filling of the land will increase the flood height and show as red on the map. The depth of flood may not have changed. It would have been beneficial had Engeny also issued a figure showing change in depth and velocity.

The 60m grid doesn't help with interpreting the figure either and most likely contributed towards Engeny's conclusions.

Other things like the "was dry now wet" cell at the end of Walsh Place is just wrong. This land has always been considered low lying (and affected by flood). It was partially filled in 2017 but this wouldn't show up on the 2010 DEM model.

Are the Impacts as bad as reported by Engeny?

Engeny's email of 5 December 2019 contains a cross section which I believe is more useful than anything else Engeny has provided in its report. I have extracted the images from the email and added notes to the cross section.

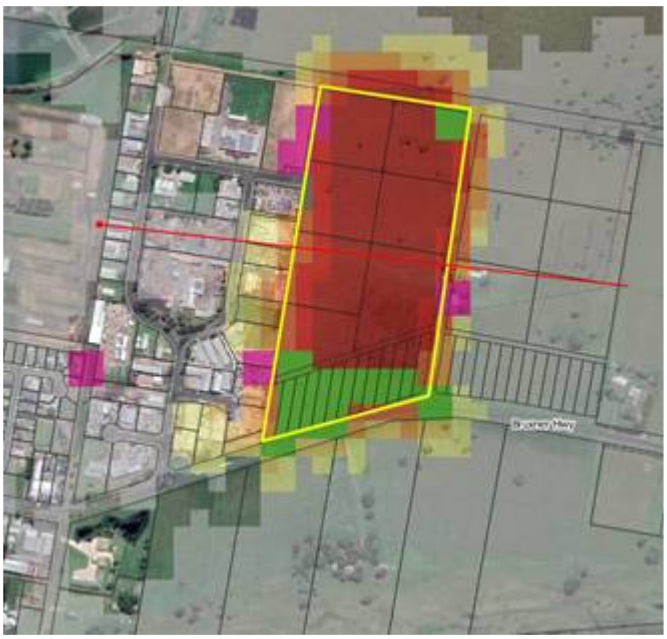
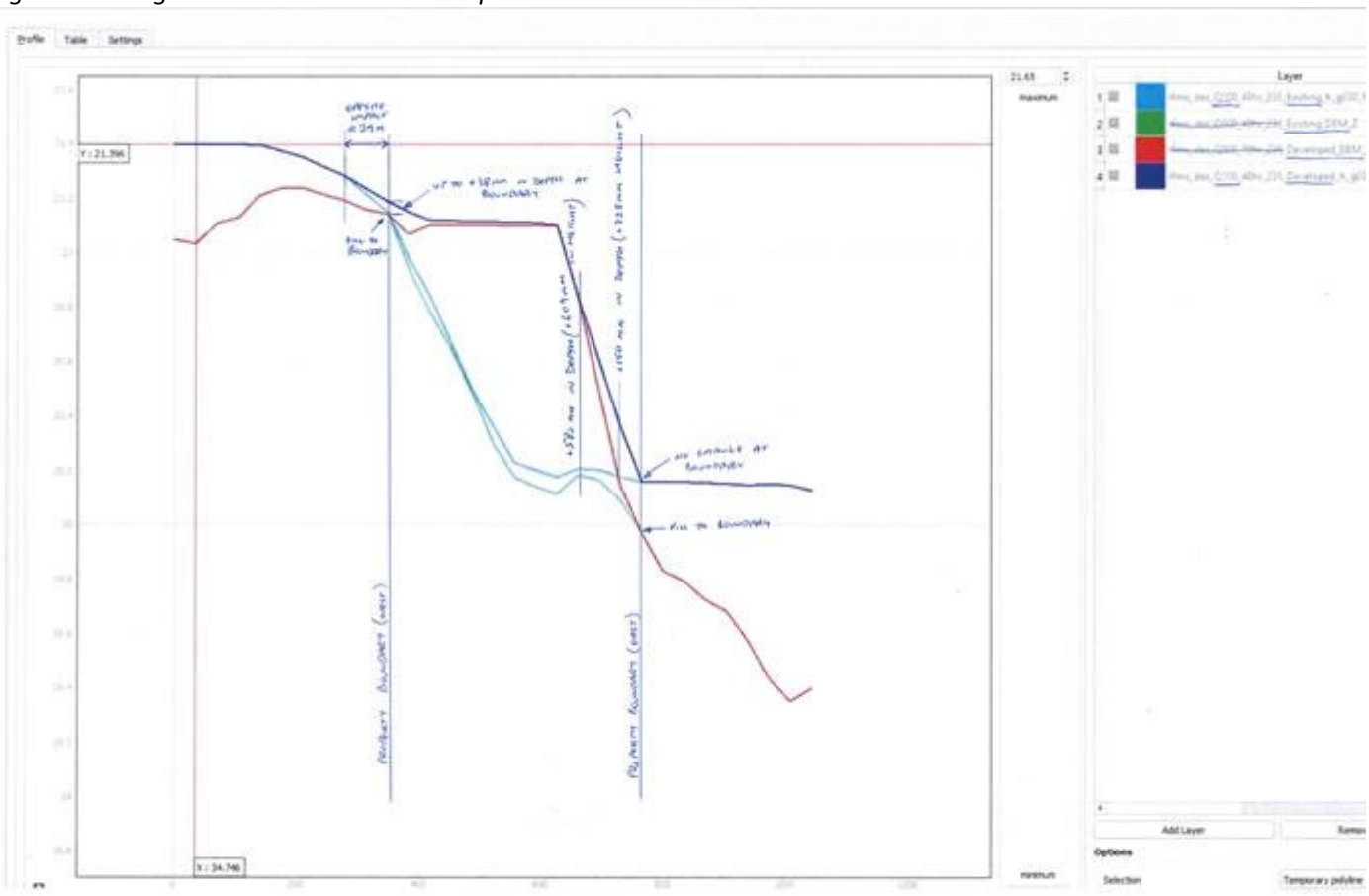


Figure showing the 1% AEP Peak Flood Impact with a cross section



Cross Section showing existing DEM (green line) + proposed DEM (red line) and 1% flood scenarios (base case-blue line & post development case-navy)

In my mark-up of the cross section, I have assumed the development will only be filling the subject land and thus used this to gauge the location of the subject property boundaries on the cross section. I then measured the offsite

impacts at these boundaries and found they are negligible; below the RMS objectives; and far less than predicted by Engeny. For example within the existing industrial estate water is drawn down (the blue line) as it cascades over a drop in terrain and into the subject land (along its western boundary). The post development scenario sees less draw down of water (up to 50 metres inside the existing industrial estate) thus resulting in an approximately +34mm increase in flood depth and height at the western boundary. On the eastern boundary I is see no offsite impacts.

The largest increases in flood height (or depth) are all within the subject property boundaries. Within 16 metres of the eastern boundary there is a flood height increase of 228mm (and an increase in flood depth of 150mm), and 50 metres inside the eastern boundary there is a flood height increase of 609mm (and an increase in flood depth of 580mm). Both of these are located on the eastern fill embankment.

Would I expect a 600mm increase in flood height as a result of the proposed development?
Put simply, No.
Most of the predicted flood impacts are along the boundary of the subject land. On the leeward side of the flood you would expect a lowering in flood depth as the fill obstructs flow of water through the site. On the western boundary (adjacent to the existing industrial estate) it would be inconceivable to think there would be an increased flood height of 600mm, especially given flood depth through the industrial estate is negligible. As such I believe the errors have arisen from the 60m grid projecting increased flood heights within the boundaries of the subject land (resulting from it being fill about 900mm) out into the adjoining properties and thus showing as an increased offsite flood height.

In conclusion
I'm not a Flood Engineer and the above findings are my own observations as a Town Planner. However, I'm critical of the conclusions of Engeny and its failure to provide an explanation for the excessive modelled offsite impacts, other than the Richmond River Model isn't up to scratch.

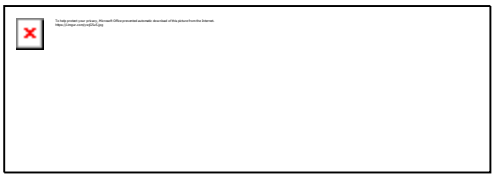
There may be a whole host of reasons why the modelling has shown increased offsite flood height impacts, from model calibration issues to "glass walling" edge of model effects, but I suspect the main reason is the 60m grid has picked up increased flood height (not depth) levels from within the proposed estate (as a result of it being filled approximately 900mm) and projected these beyond the property boundary.

The cross section provided by Engeny on 5 December 2019 is probably to best gauge of potential offsite impacts, and it shows the leading edge might see an increase of 34mm (as filling up to this boundary will result in less draw down of flood water), and the leeward edge as having no offsite changes. Obviously, this is just one cross section but it clearly demonstrates that offsite impacts are not as significant as reported by Engeny.

I hope this helps with your update of the Planning Proposal. Give me a call if you need clarification.

Regards

Tony McAteer
Coordinator Planning Services
Richmond Valley Council | Locked Bag 10, CASINO NSW 2470
T: 02 6660 0276 | F: 02 6660 1300 | M: 0447 455 341
E: tony.mcateer@richmondvalley.nsw.gov.au | http://richmondvalley.nsw.gov.au



#ECMBODY
#QAP DEFAULT
#NOREG

From: Karina Vikstrom <kvikstrom@newtondennychapelle.com.au>
Sent: Thursday, 20 February 2020 3:48 PM
To: Tony McAteer <tony.mcateer@richmondvalley.nsw.gov.au>

Cc: Jeff and Chris Imeson <imesons@hotmail.com>; Chris Pickford <cpickford@newtondennychapelle.com.au>
Subject: Imeson Industrial Flood Modelling

Hi Tony,

Further to our meeting on Monday concerning the above matter, can you please confirm Council's requirements with respect to incorporation of the assessment into the Planning Proposal.

As you are aware, the report identifies potential offsite impacts in the vicinity of the fill pad, but then goes on to say that the underlying model is flawed and so the results may not be accurate. I am therefore having difficulty incorporating the report into the 'standard' Planning Proposal template.

Your clear direction on this matter will be appreciated.

Regards

Karina

Karina Vikstrom

Town Planner

Newton Denny Chapelle
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