

Appendix G

Flood impact consultation information

Woolgoolga to Ballina upgrade

every journey matters

Woolgoolga to Ballina upgrade

Agenda

This presentation includes the following information:

- Project update
- Explanation of key flood related terms
- Flood modelling and objectives
- Summary of design refinements for the floodplain
- Summary of differences in potential flood impacts between the environmental impact statement and detailed design
- Next steps

Pacific Highway upgrade

Overview




Pacific Highway upgrade

Port Macquarie to Coffs Harbour



Woolgoolga to Ballina upgrade

Overview



Woolgoolga to Ballina

- Stage 2 Pimlico to Teven south of Ballina completed May 2016
 - Early enabling works including soft soil work in progress
 - Woolgoolga to Glenugie started construction June 2015
Expected completion 2017
 - Contract awarded to design and build the bridge over the Clarence River at Harwood July 2016
 - Project expected open date 2020

Roads and Maritime Services’ Pacific Highway Office and Pacific Complete are working together to deliver the project.

- 155km of highway upgrade
- \$4.36 billion
- Open to traffic 2020

Project update – Devils Pulpit to the Richmond River

Current early work activities

To prepare for building we are:

- Carrying out soft soil work
- Carrying out foundation treatments
- Upgrading intersections
- Carrying out property and road condition inspections
- Installing nest boxes and clearing vegetation
- Installing fencing
- Carrying out utility relocations
- Building site compounds



Soft soil work – foundation rock being placed

Project update – Coolgardie Road to Pimlico

Current early work activities

To prepare for building we are:

- Soft soil work at Pimlico is complete
- Extending the current compound site; offices, a workshop and other facilities to be built in October
- Installing nest boxes to provide offset habitat for birds and animals
- Continuing geotechnical and ecological surveys
- Preparing for utility relocation



Soft soil work at Pimlico

Project update - design

Upcoming activities

Design has progressed and we are seeking community feedback.

This involves:

- Updating flood modelling and flood focus groups
- Design refinements currently displayed for community comment
- Draft urban design and landscape management plans currently displayed for community comment

Woolgoolga to Ballina upgrade

Key flood related terms

- ARI flood event
- Depth
- Flow velocity (speed)
- **Afflux**
- **Duration of flooding**
- **Flood immunity**
- Floodplain
- Flood direction

Flooding terms

Average Recurrence Interval and critical storm

Average Recurrence Interval

- Average Recurrence Interval – abbreviated to ARI
- EG – 100 ARI is the theoretical flood event with the chance of recurring once every 100 years
- 1% chance of occurring in any given year

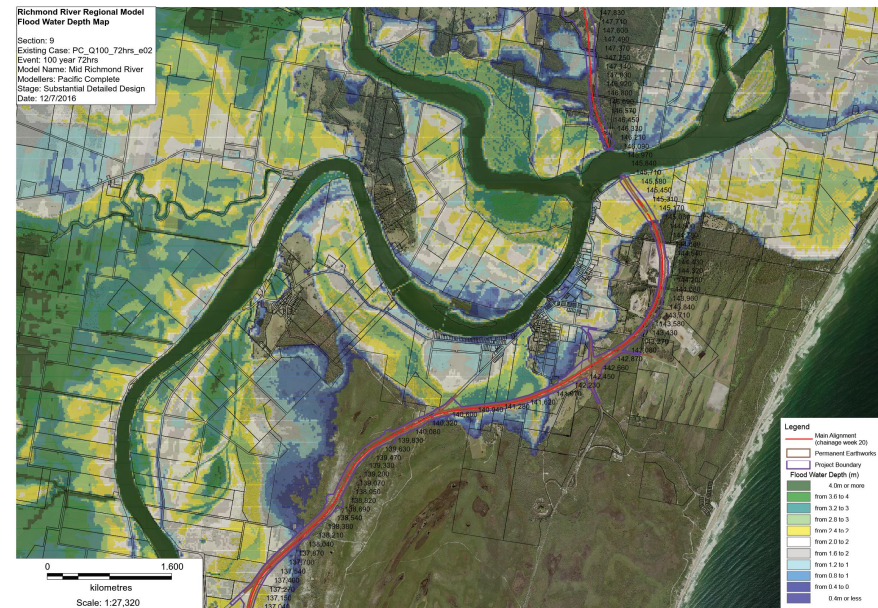
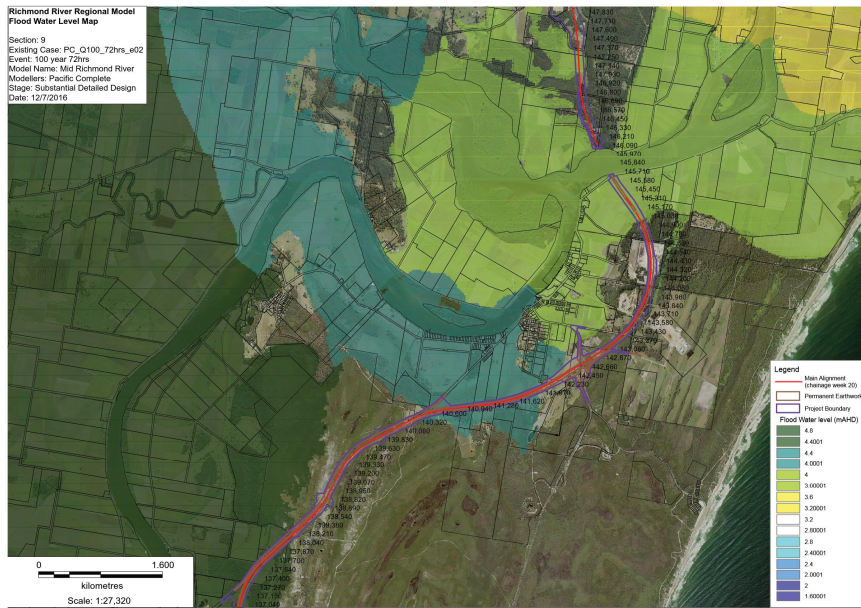
Critical storm

- The critical storm is the storm that produces the highest flood level in the area of interest
- For the Richmond floodplain the critical storm is the 72 hour storm

Flooding terms

100 year ARI Flood Levels and Depths

Example Broadwater (Section 9) Q100 flood level and depth maps

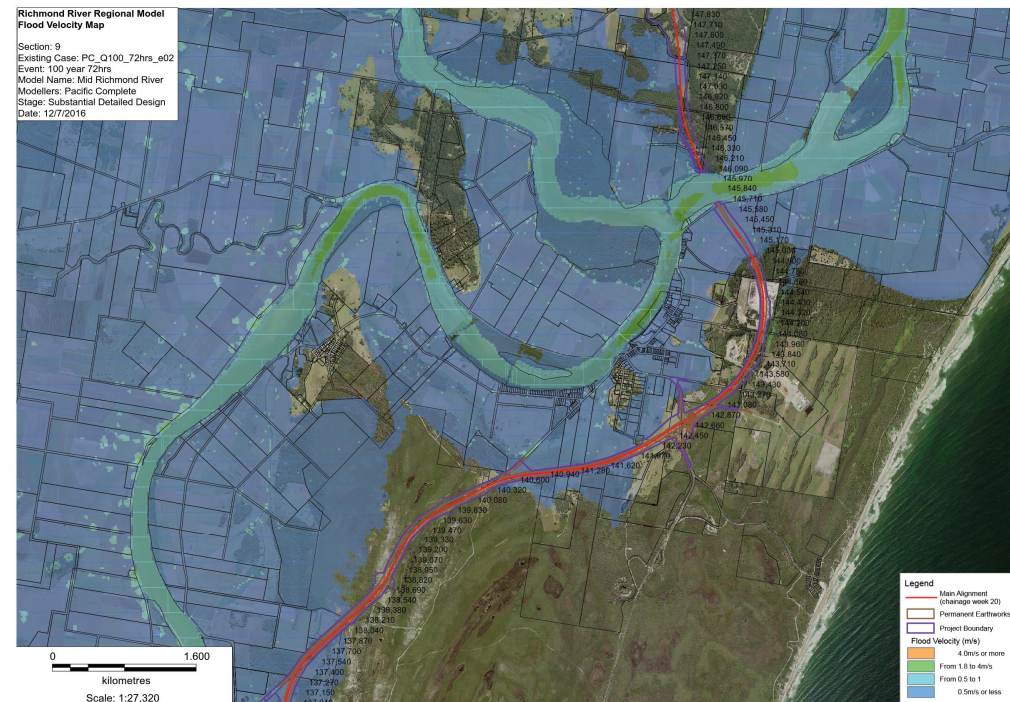


Flooding terms

Flow velocity and direction

- Velocities less than 0.5 metres per second
 - Very gentle, similar to an ingoing or outgoing tide
 - Will transport very fine silt and sand particles
- Velocities between 0.5 - 1.8 metres per second
 - Will transport silt particles
 - At about 1.8 m/s velocity pasture and crop areas may erode
- Velocities in the Richmond River floodplain are generally less than 1 metre per second
- Flow direction also a key focus in the model – floodplain flows are multi-directional and complex

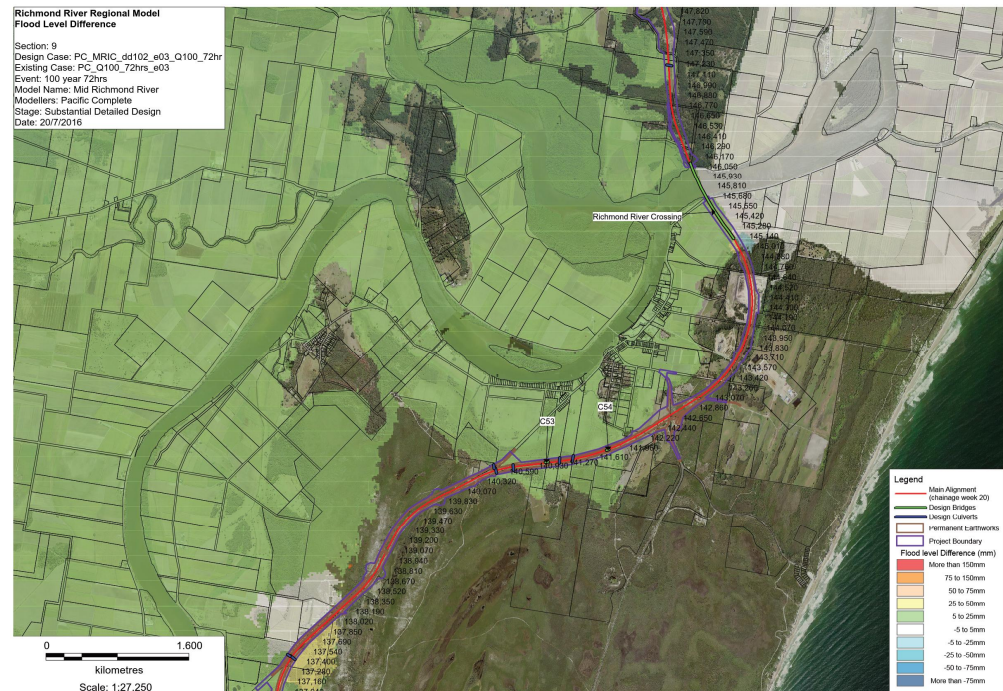
Example Broadwater (Section 9) Q100 flood velocity map



Flooding terms

Afflux

- Afflux is the change in flood level due to change in conditions across the floodplain
- A positive afflux value means an increase in flood level
- A negative afflux value means a decrease in flood level



Flooding terms

Duration of flooding

- Duration of flooding refers to the length of time a particular area is affected by flooding
- 100 year ARI duration of flooding is generally >72 hours across the Richmond floodplain for the critical 72 hour storm
- Time of flooding varies depending on the terrain, local drainage and size of the flood



How does the model work?

- Regional scale model – over 1000 square kilometres
- Calibrated against real flood events
- Runs theoretical ‘design’ events based on averaged observed rainfall patterns
- Run for the 5, 20, 50, 100 and 2000 year ARI events
- Used to:
 - Check flood immunity for the highway upgrade
 - Inform the design of bridges, structures and cross drainage
 - Check against the projects flood management objectives

Flood management objectives

Parameter	Houses and cane farm land	Grazing, forested and other rural lands
Flood levels	< 50 mm increase in flood level up to and including the 100 year ARI flood event	Generally < 250 mm increase with localised increased of up to 400 mm for short duration/ local catchment flooding acceptable over small areas (nominally less than 5 ha) up to the 100 year ARI event
Flood duration	No more than 5 % increase	No more than 10 % increase
Flood velocity	<p>Houses: velocity-depth to remain in the zone of low hazard for children (i.e. < 0.4 m/s) where current velocity-depth are currently low hazard</p> <p>Cane farms: velocities to remain below 1.0 m/s where currently below this figure</p> <p>An increase of not more than 20% where existing velocity is above 1 m/s</p>	<p>Velocities to remain below 1.0 m/s where currently below this figure</p> <p>An increase of not more than 20% where existing velocity is above 1.0 m/s</p>
Flood direction	No change to the direction of watercourses or the direction of flood flows except for constriction in and expansion out of discrete openings (culverts and bridges) and construction diversions	

Recent flood modelling

What has changed?

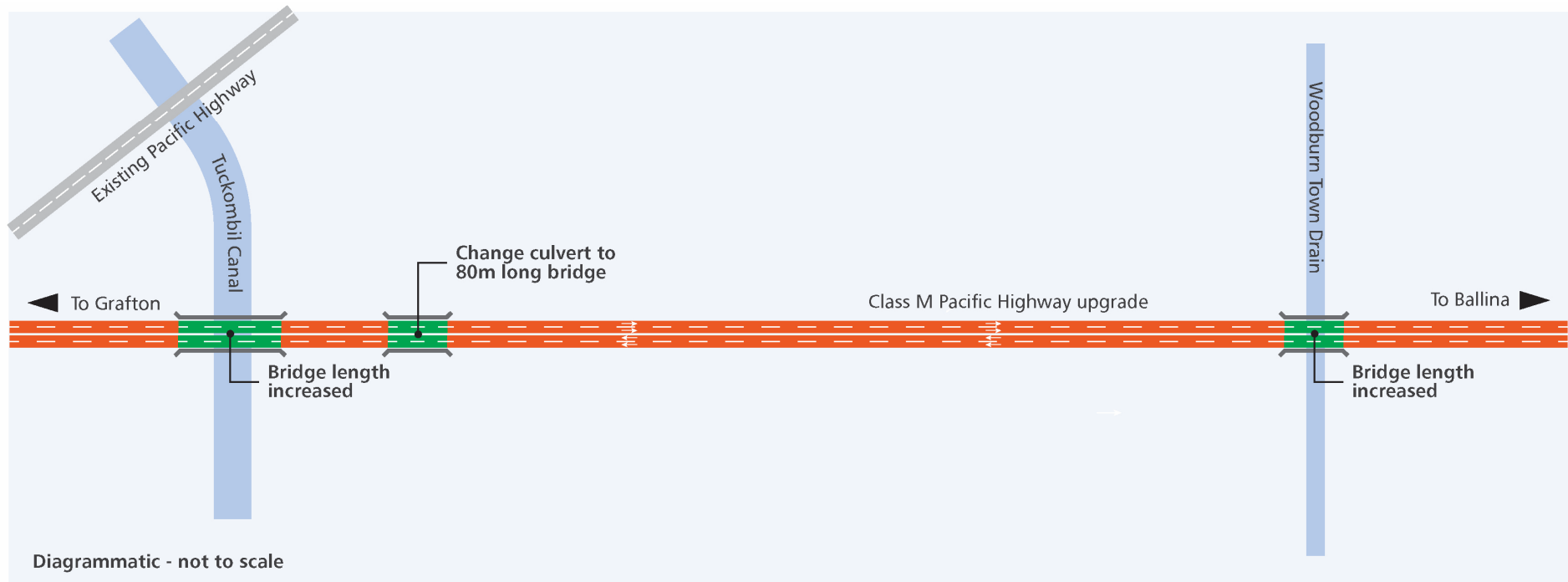
- The base flood model has been updated and improved since the EIS:
 - More recent data
 - Model checked against recent flood event in 2009
- The proposed case flood model has been updated and improved:
 - Latest design of the road embankment, bridges and cross drainage structures
 - Latest design of side roads
 - 102 model iterations to optimise designs and minimise impacts
 - More detailed assessment of changes in flood duration

Design – what has changed?

- Bridge Lengths have been increased across Richmond River Floodplain
- A new floodplain bridge has been introduced on northern bank of Tuckmobil Canal
- Culverts have been changed to bridges in many locations due to Environmental and/or constructability reasons
- Road Alignment design has been optimised to reduce embankment heights where possible
- Achieved flood immunity objective of 20 year ARI flood immunity across the Richmond River floodplain

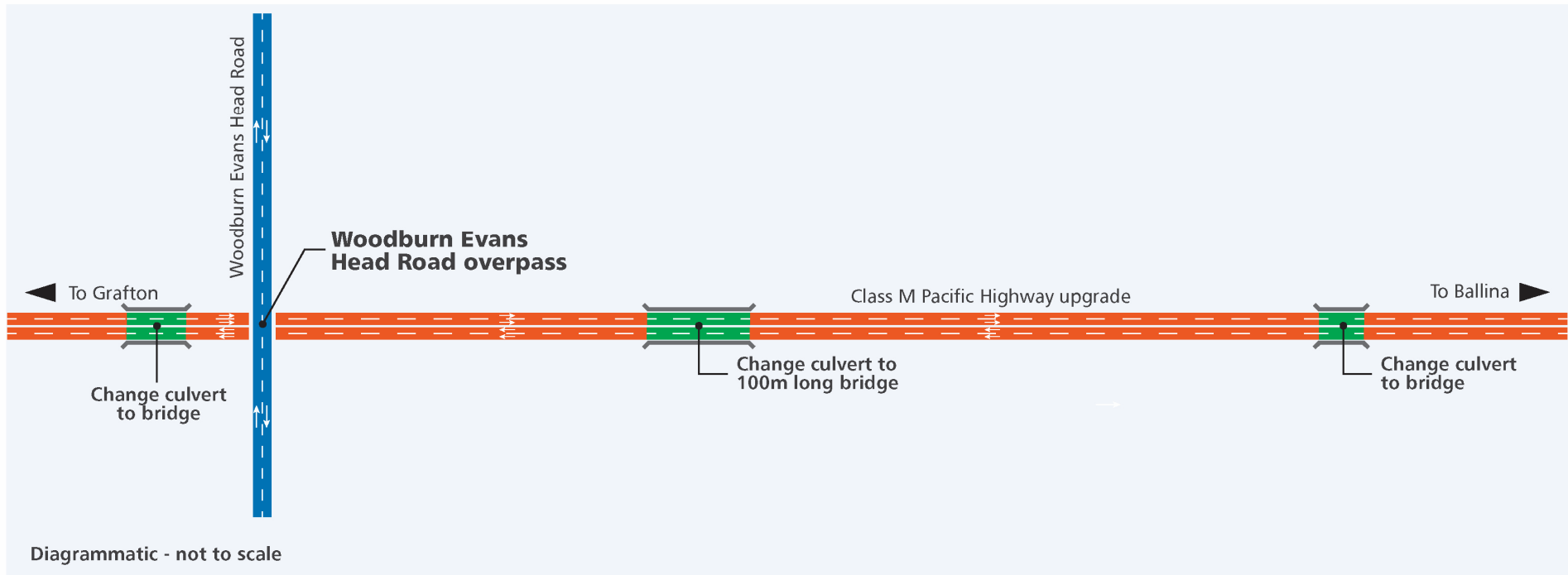
Design – what has changed?

Changes to structures in the floodplain – Tuckombil Canal to Woodburn Evans Head Road



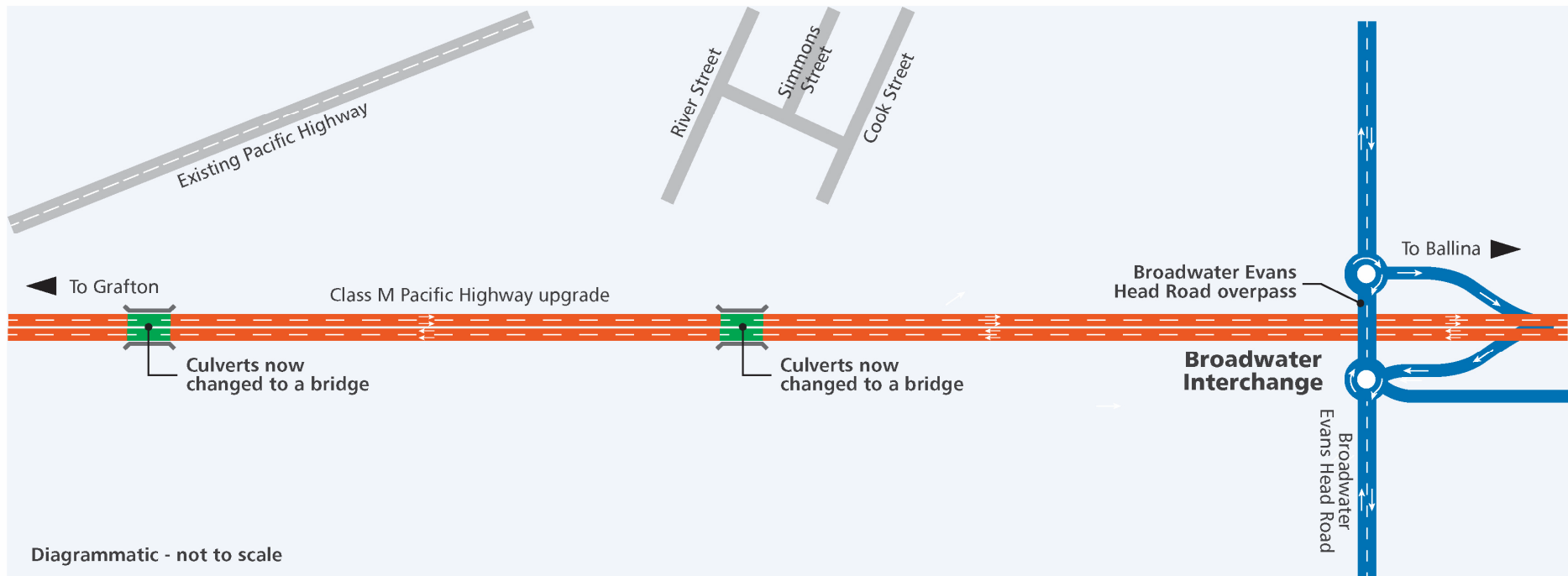
Design – what has changed?

Changes to structures in the floodplain –Woodburn Evans Head Road to McDonalds Creek



Design – what has changed?

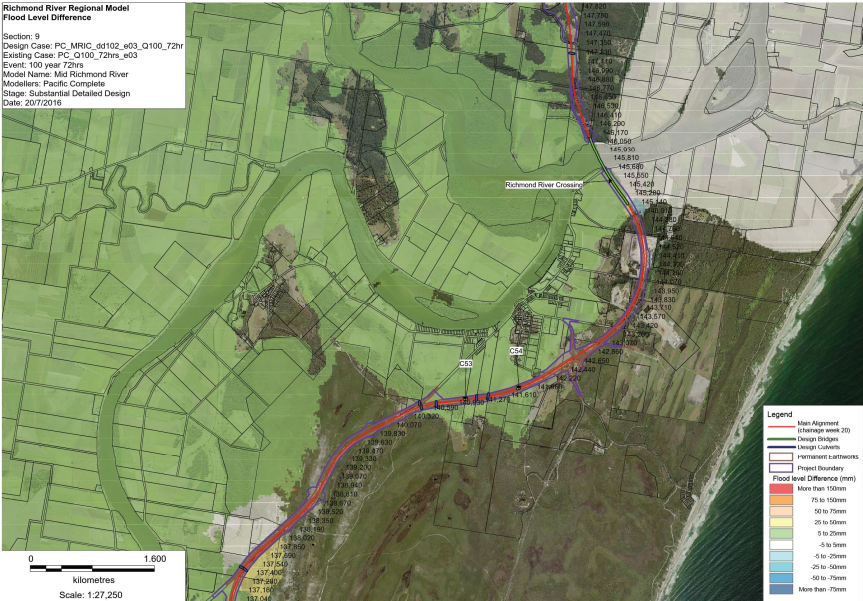
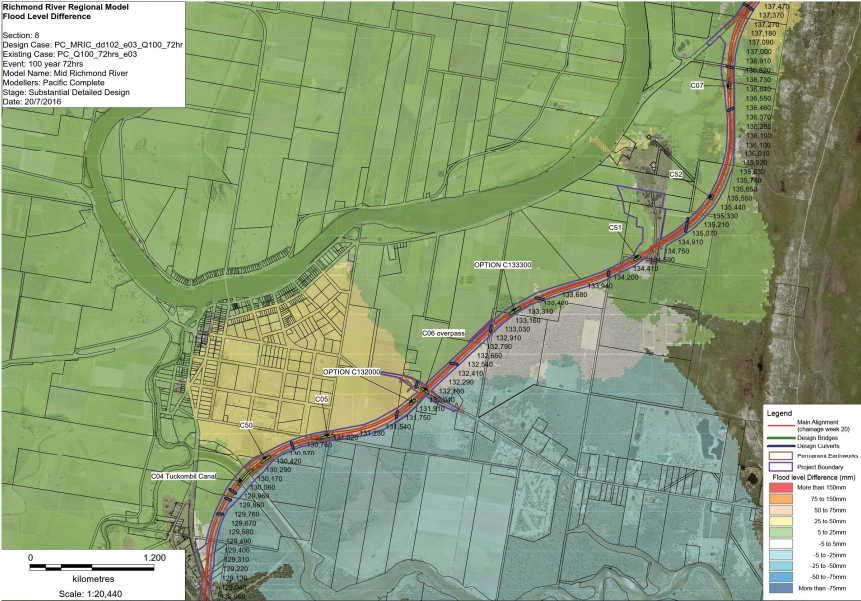
Changes to structures in the floodplain – Montis Gully to Broadwater Evans Head Road



Outcomes of flooding assessment

Afflux – changes in flood level

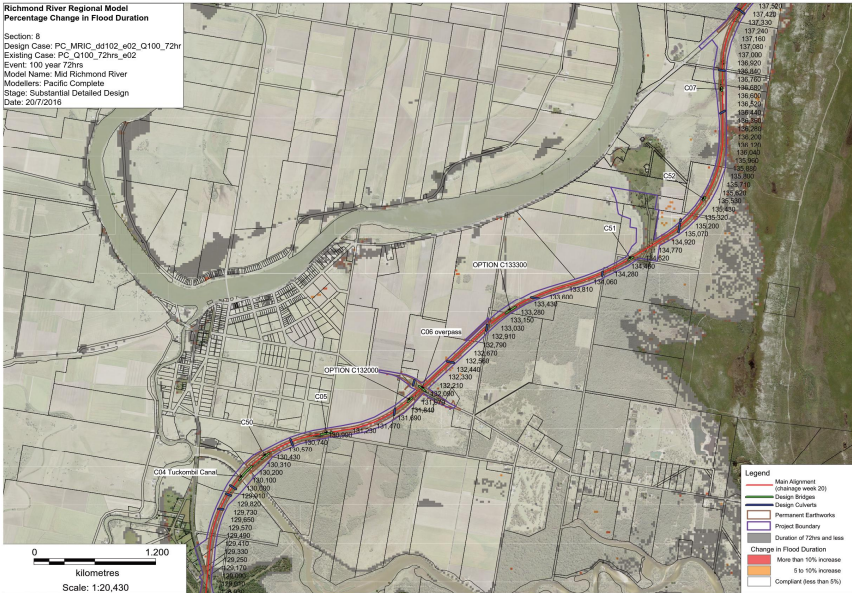
Example Woodburn (Section 8) and Broadwater (Section 9) Q100 afflux maps



Outcomes of flooding assessment

Duration of flooding

Example Woodburn (Section 8) and Broadwater (Section 9) Q100 duration change maps



Outcomes of flooding assessment

Summary

- Flood modelling is a work in progress
- Design and flood model currently at around 85% completion
- Generally meet flood management objectives
- One-on-one consultation with landowners where flood management objectives cannot be achieved

Independent verification

- Modelling has been independently reviewed and checked
- Roads and Maritime has engaged an independent hydrologist, Mark Babister

Next steps

- Ongoing consultation with landowners and the community
- Finalise flood modelling
- Detailed design
- Urban Design and Landscape Plan

- Email: W2B@pacificcomplete.com.au
- Phone: 1800 778 900
- Visit: www.rms.nsw.gov.au/W2B



Thank you

Operations and Maintenance Review Group – Flooding in Richmond regional and local catchments

Woolgoolga to Ballina Pacific Highway upgrade

20 May 2020



Transport
for NSW

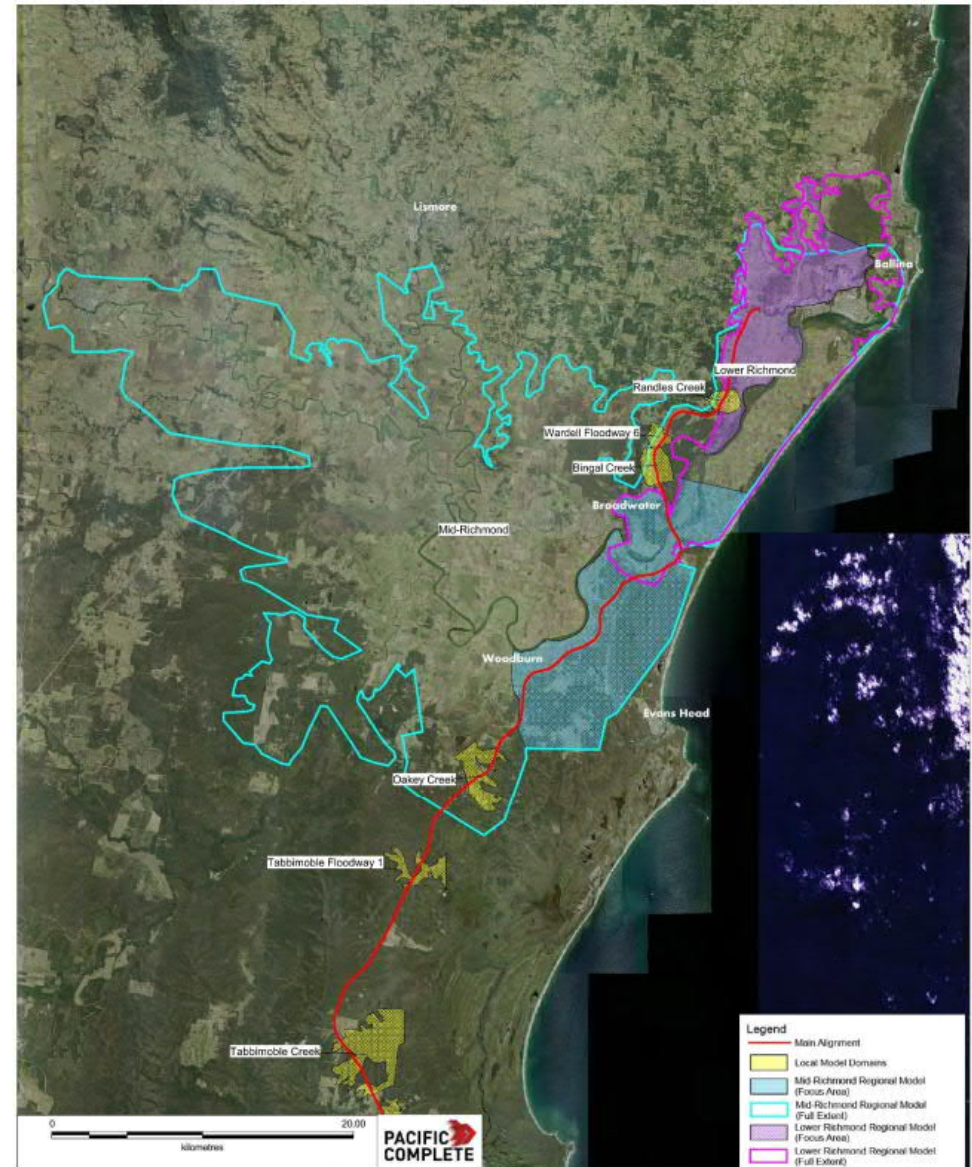
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COMPLETE**

Agenda

- Overview of W2B floodplain setting
- Flood management design criteria – highway and local road flood immunity
- Flood management design criteria – impacts on adjacent land
- Project flood models
- Design outcomes - highway and local road flood immunity
- Design outcomes - flood impacts on adjacent land
- Flood risk datasets available and example flood maps
- Q&A

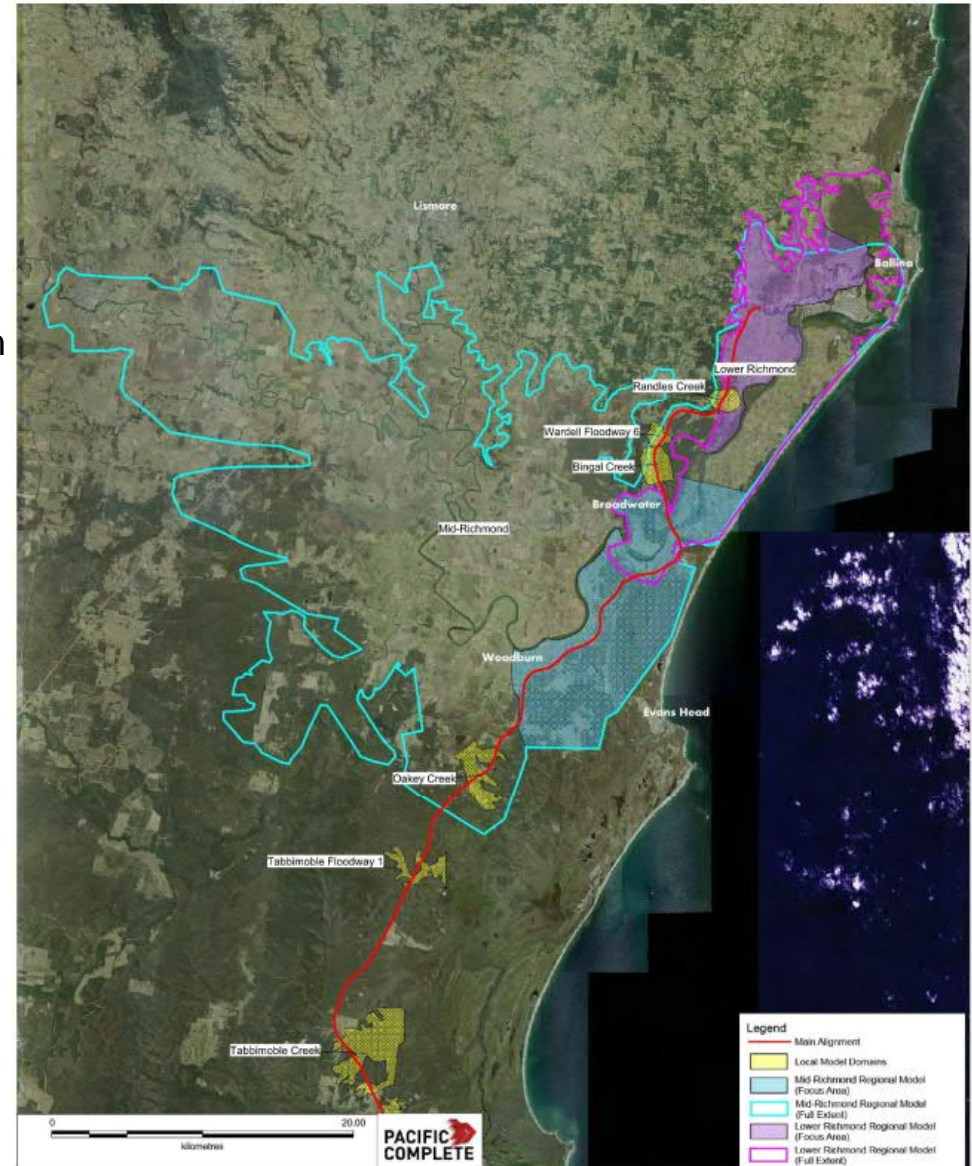
Overview of W2B floodplain setting

- Richmond Regional Floodplain
 - Very large catchment extending from Border Ranges and Richmond Ranges to coast (6,900 sq km)
 - Experiences large scale long duration flooding with long warning times
 - Pacific Highway and connecting access roads provide key access into and out of the regional floodplain during major events
- Local floodplains
 - Devils Pulpit to Trustums Hill
 - Tabbimoble Floodway 1
 - Oakey Creek
 - Richmond River to Coolgardie Road
 - Bingle Creek
 - Wardell Floodway 6
 - Randles Creek
- Separate and independent floodplains at highway location
- Shorter duration flooding with shorter warning times, more susceptible to flash flooding



Flood management design criteria – highway and local road flood immunity

- Highway:
 - 5% AEP / 20 year ARI in the regional floodplain
 - 1% AEP / 100 year ARI in local floodplains
- Service roads: current or better flood immunity
- Local and property access: current or better flood immunity

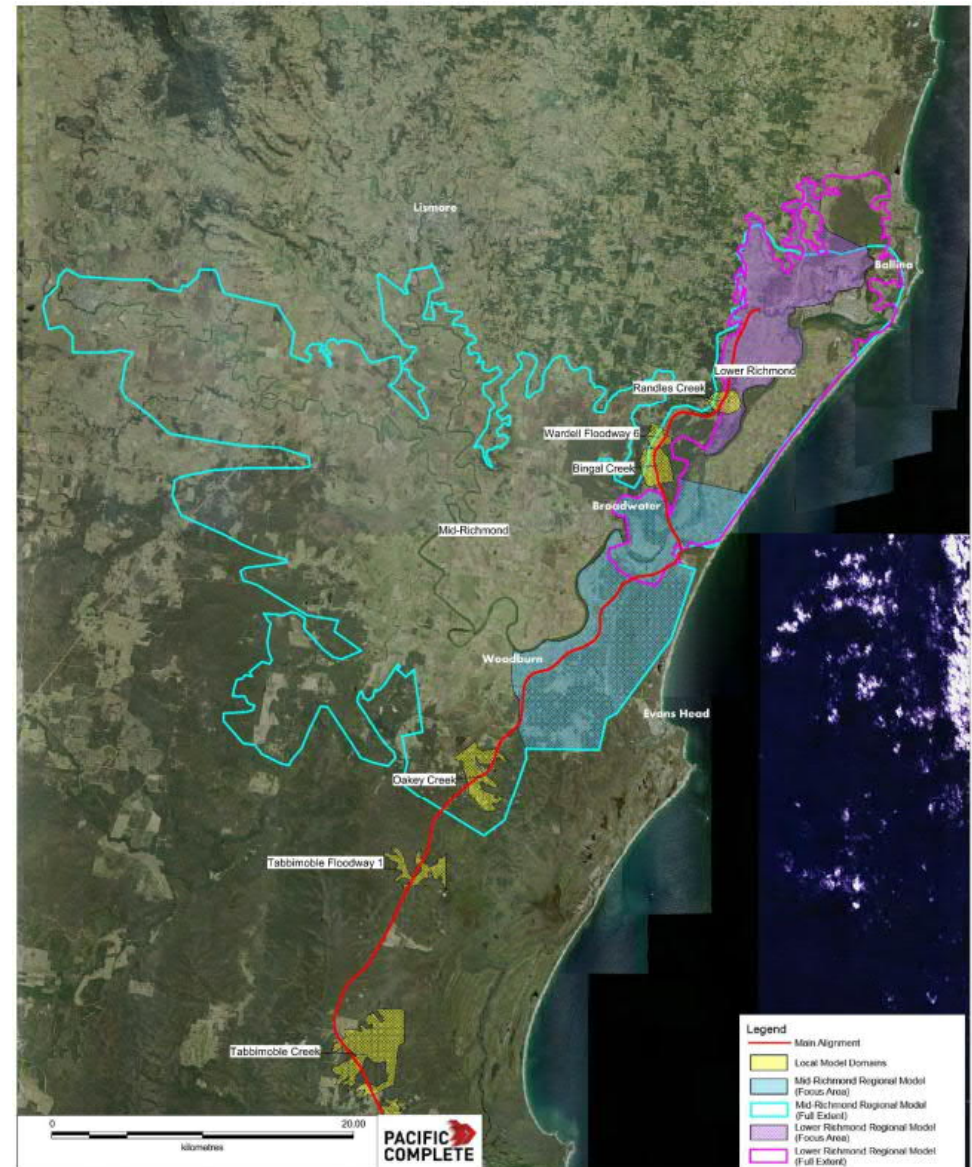


Flood management design criteria – impacts on adjacent land

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Flood direction	No change to the direction of watercourses or the direction of flood flows except for constriction in and expansion out of discrete openings (culverts and bridges) and construction diversions	

Project flood models

- Richmond Regional Floodplain
 - Suite of models originally developed by Richmond River County Council, Richmond Valley Council and Ballina Shire Council:
 - Bespoke hydrological models based on flood frequency analysis - unmodified
 - TUFLOW hydraulic models - updated by Pacific Complete to represent new highway
- Local floodplains
 - Devils Pulpit to Trustums Hill
 - New RAFTS hydrological models and TUFLOW hydraulic models for:
 - Tabbimoble Floodway 1
 - Oakey Creek
 - Richmond River to Coolgardie Road
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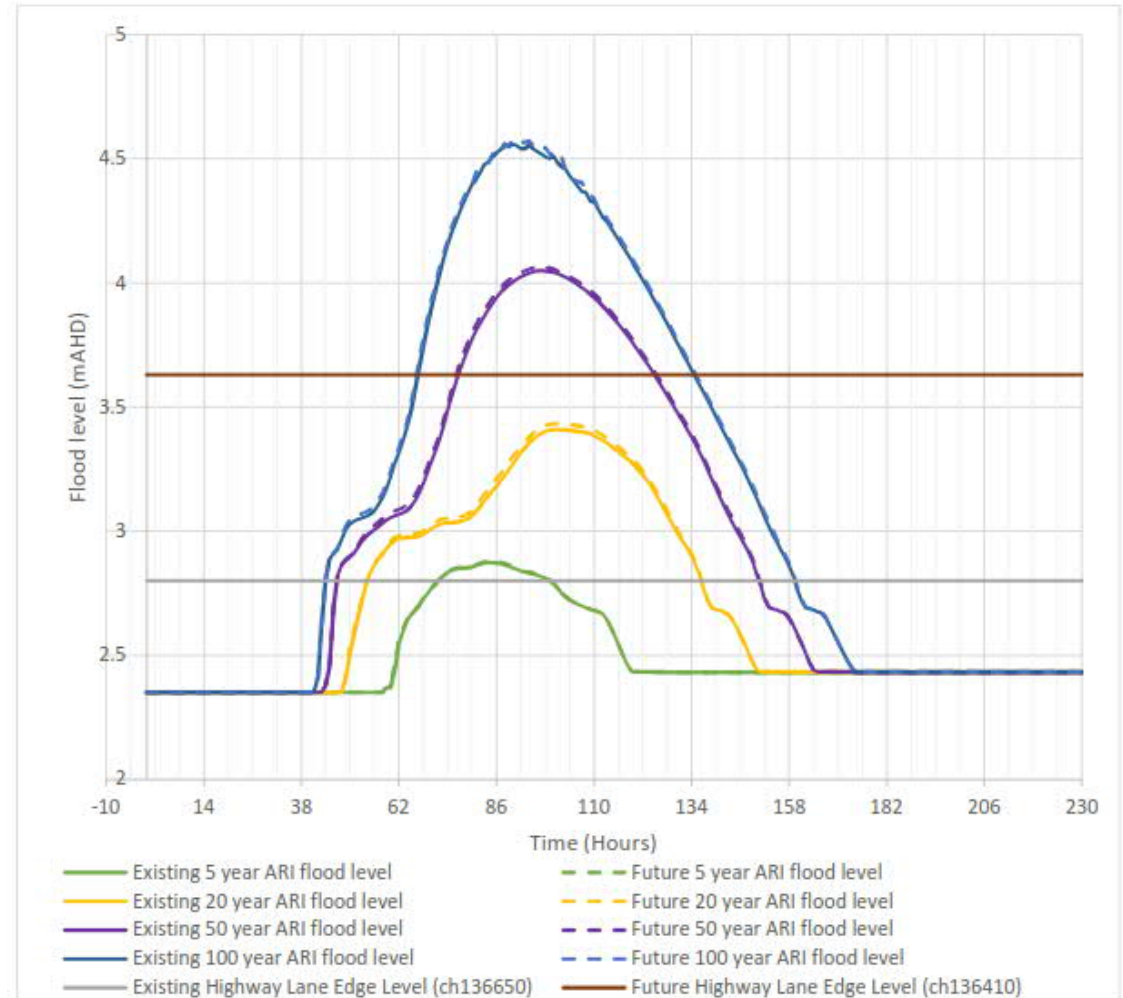


Design outcomes – highway and local road flood immunity

- Flood immunity criteria have been achieved
 - 20 year ARI in regional floodplain
 - 100 year ARI everywhere else
- Upgraded highway will provide more efficient and reliable flood evacuation routes due to improved flood immunity
- Upgraded highway will have shorter closure times during major floods (>20 year ARI)
- No impacts on service and local roads – current immunity maintained or improved upon
- Considerable improvement on old highway flood immunity at key hotspots
 - Between Woodburn and Broadwater: current flood immunity of 5 to 10 year ARI event and < 5 year ARI immunity in localised sections
 - North of Broadwater: overtops at 5 year ARI event between Broadwater and intersection with Boundary Creek Road
 - Road closures of several days to weeks experienced in previous major events
 - These sections on the corresponding new/upgraded highway now have 20 year ARI flood immunity

Design outcomes – highway and local road flood immunity

- Example: Lowest part of old highway between Woodburn and Broadwater
 - Old highway inundation / closure times:
 - 5 year ARI: 25 hours
 - 20 year ARI: 3 days
 - 50 to 100 year ARI: 5 days
 - New / upgraded highway inundation / closure times:
 - 5 year ARI: no flooding
 - 20 year ARI: no flooding
 - 50 to 100 year ARI: 3 days



Design outcomes – flood impacts on adjacent land

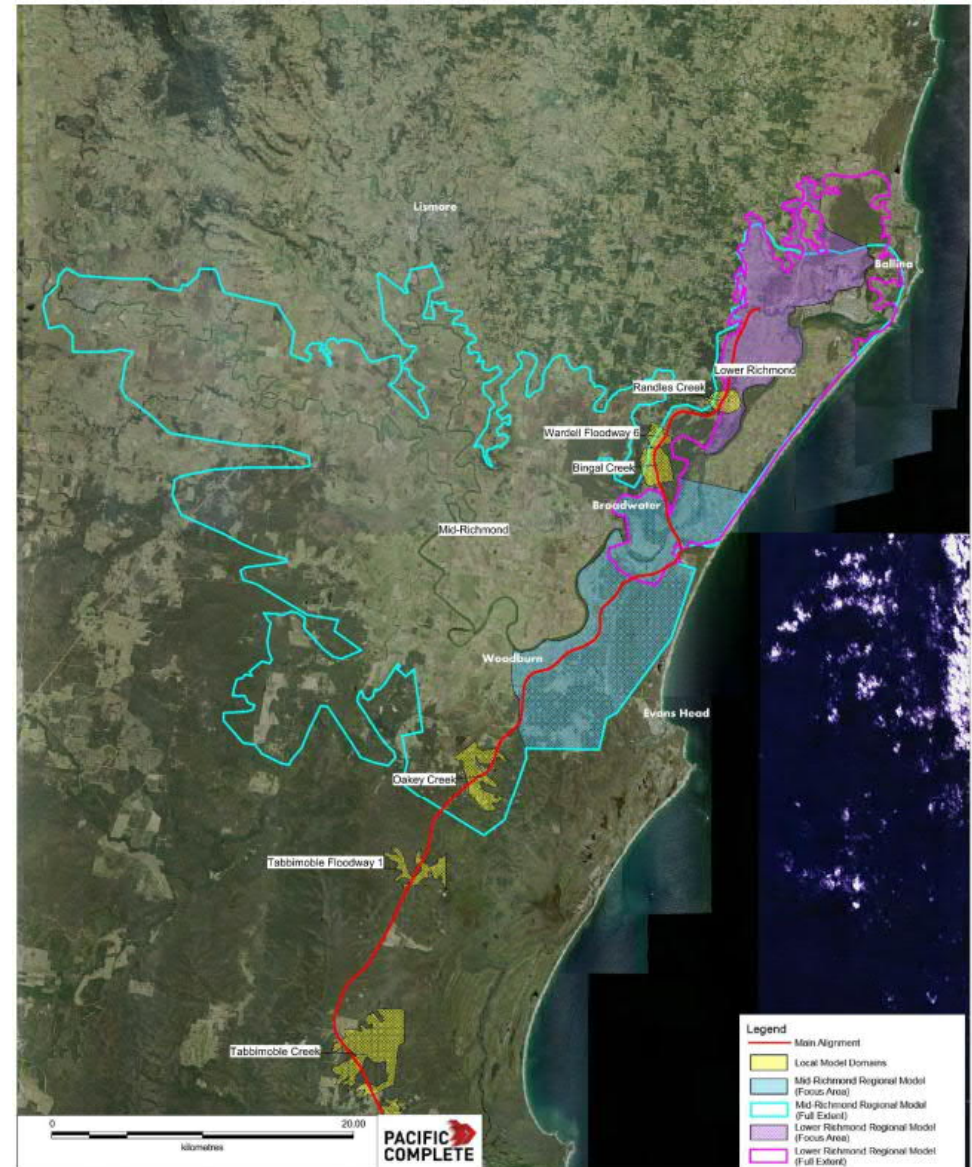
- Minimal changes to all flooding parameters
 - Level
 - Velocity
 - Duration
 - Hazard
 - Flow direction
- Compliance with Flood Management Objectives (FMOs) achieved for the majority of the project corridor
- Some unavoidable departures from FMOs
 - Generally low risk impacts
 - Agreements obtained through the landowner consultation process
 - At property mitigation measures implemented in some cases
- Impact assessment documented in Project Hydrological Mitigation Reports (<https://pacifichighway.nsw.gov.au/woolgo-olga-to-ballina-upgrade-hydrological-mitigation-report-devils-pulpit-to-ballina-april-2017>)



Example: 20 year ARI regional floodplain flood level impact map

Flood risk datasets available

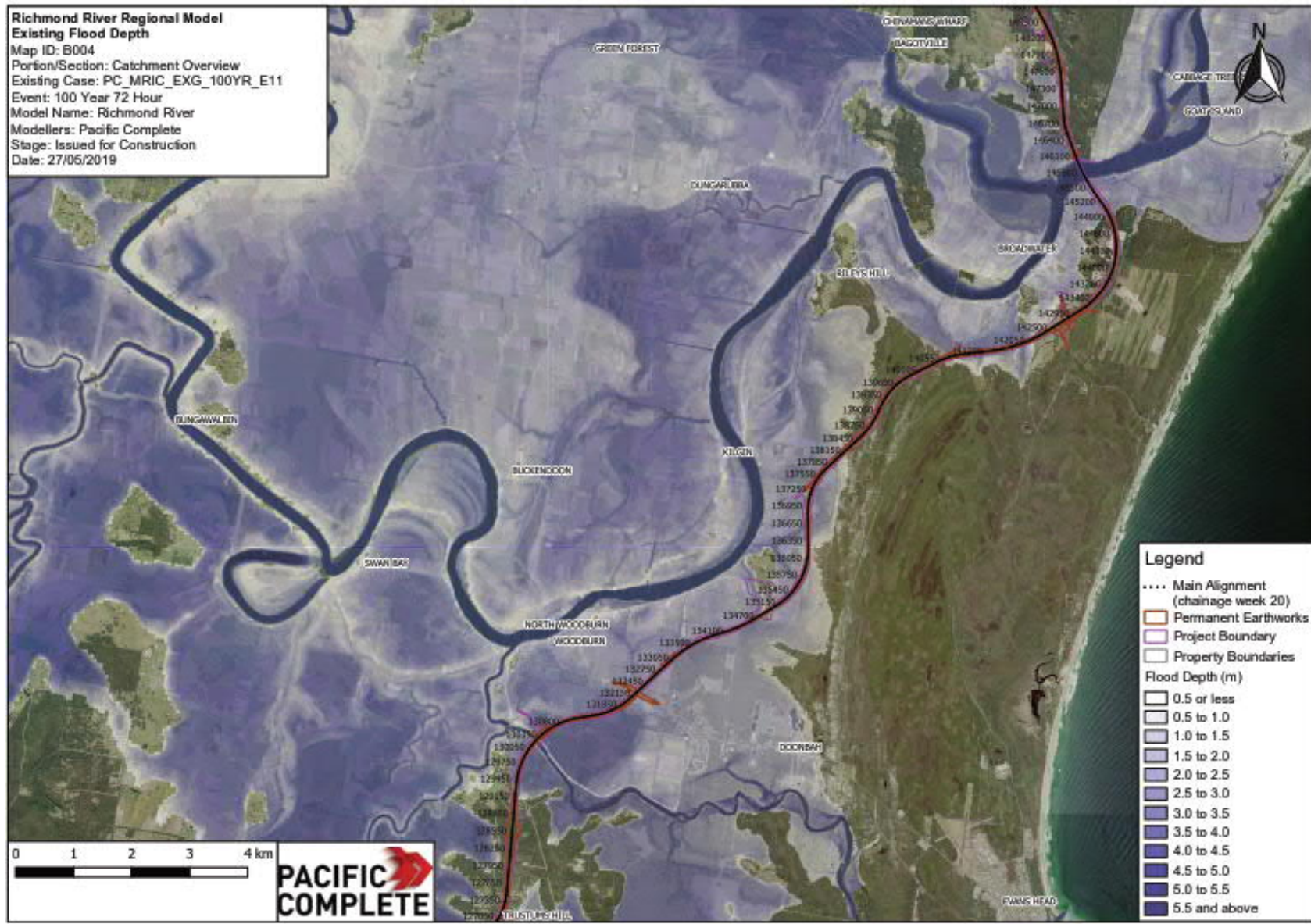
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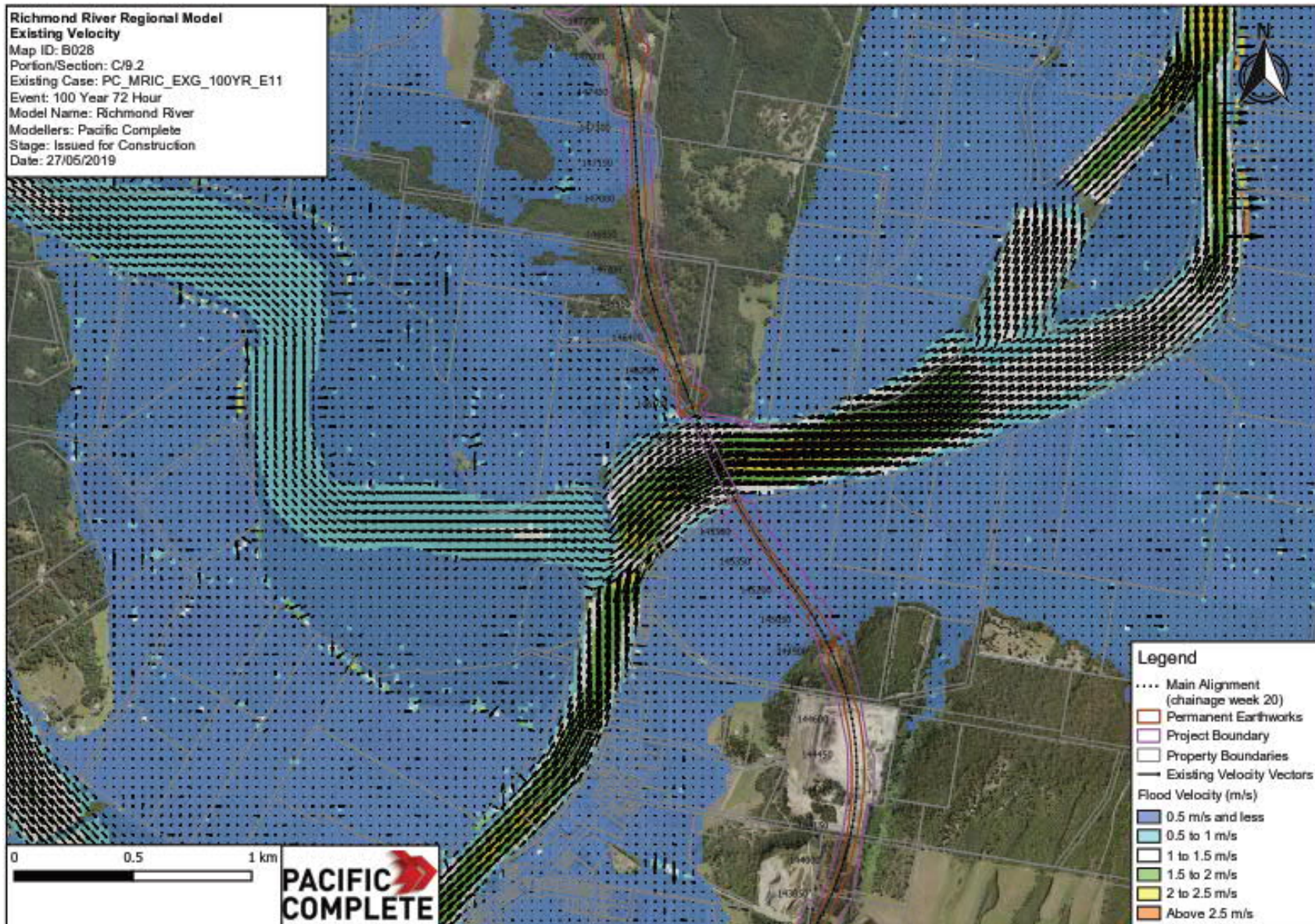
Flood risk datasets available

- Hydraulic models include full hydraulic representation of highway upgrade (including bridges and drainage systems)
- The 'design case' in the project flood models is now the new 'existing conditions' with the upgrade in place
- Project flood reports have 'existing conditions' (old pre-upgrade conditions) and 'design case' (new upgrade conditions) flood maps
- Flood model results include key 'design case' flood risk parameters that can be mapped and incorporated into emergency response plans:
 - Extent
 - Level
 - Depth
 - Velocity
 - Duration
 - Hazard
 - Wet/dry areas and sections of road
- Large datasets (up to terrabytes of data with all results files) – would need to be provided on hard drives

Flood risk datasets available – example flood extent and depth map



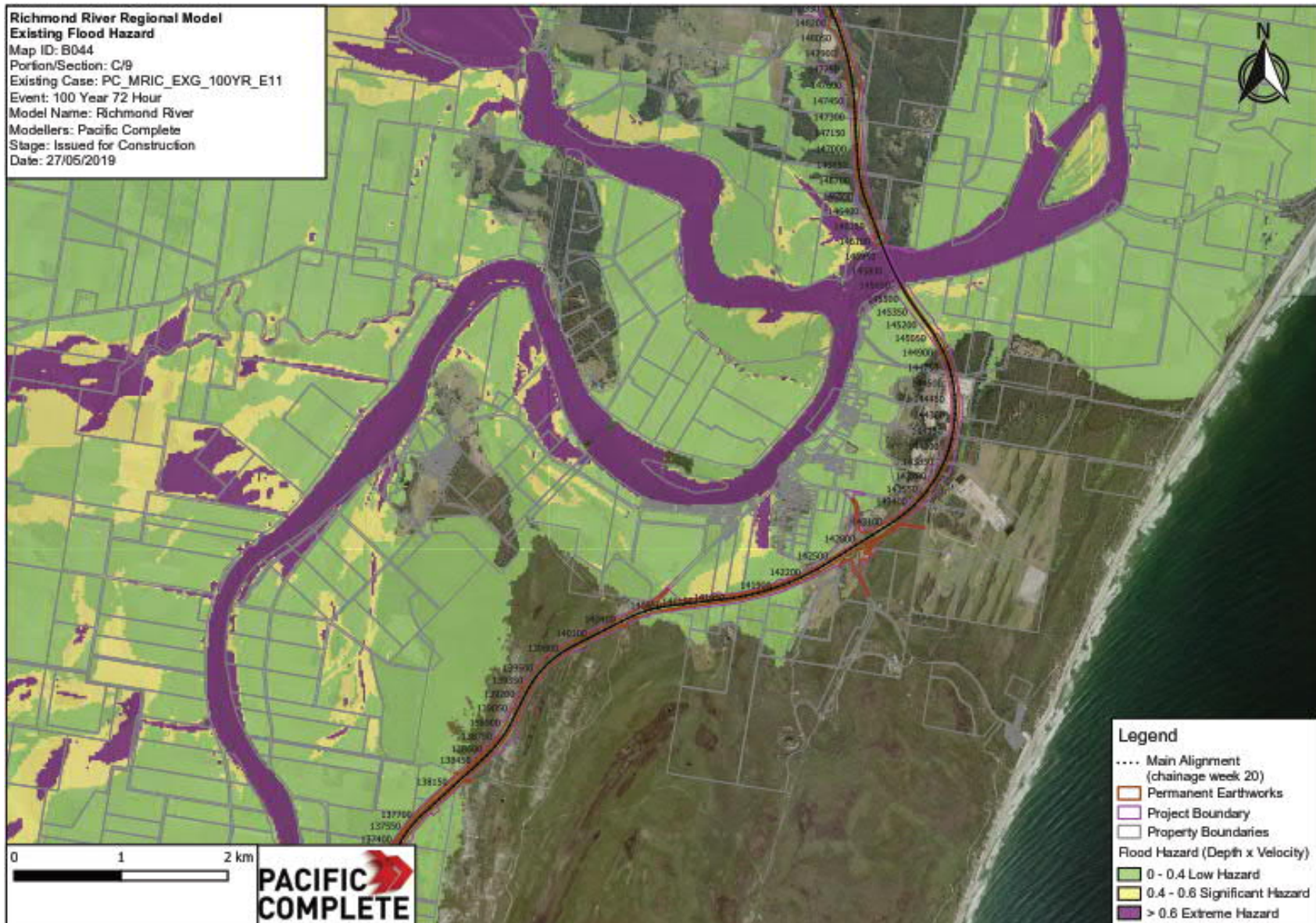
Flood risk datasets available – example flood velocity map



Flood risk datasets available – example flood duration map



Flood risk datasets available – example flood hazard map



Thanks for listening

Q&A