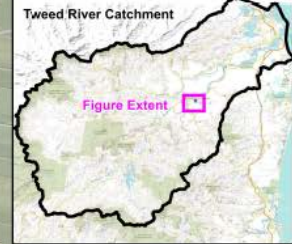
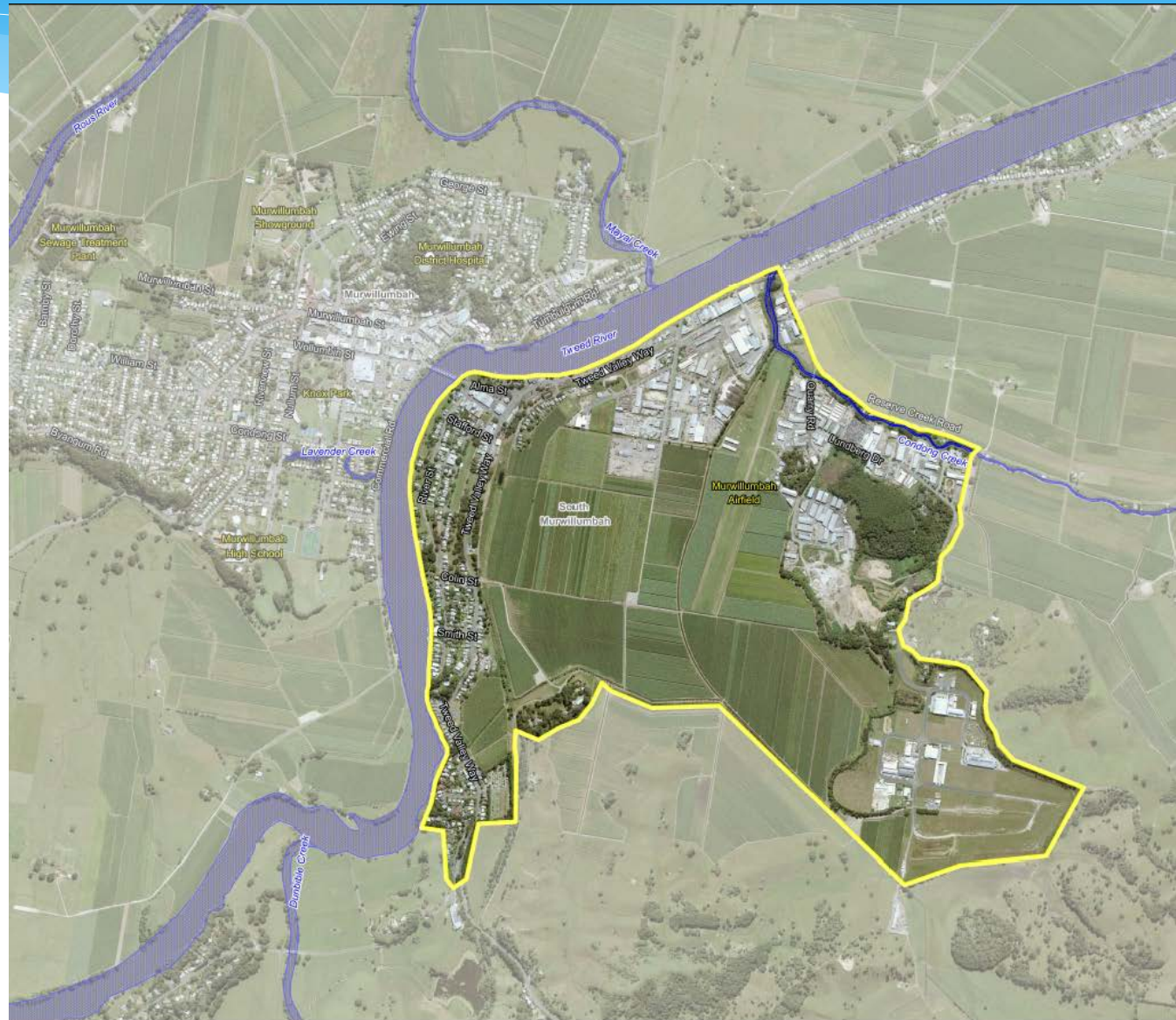



# South Murwillumbah Floodplain Risk Management Study



# Study Area




### LEGEND

 South Murwillumbah Study Area

Notes:  
Aerial photograph date: 2016



**Figure 1:  
South Murwillumbah  
Study Area**

Prepared By:  
 Catchment Simulation Solutions  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig1 - South Murwillumbah Study Area.wor



# Defining the Existing Flooding Problem

# Hydraulic Flood Model

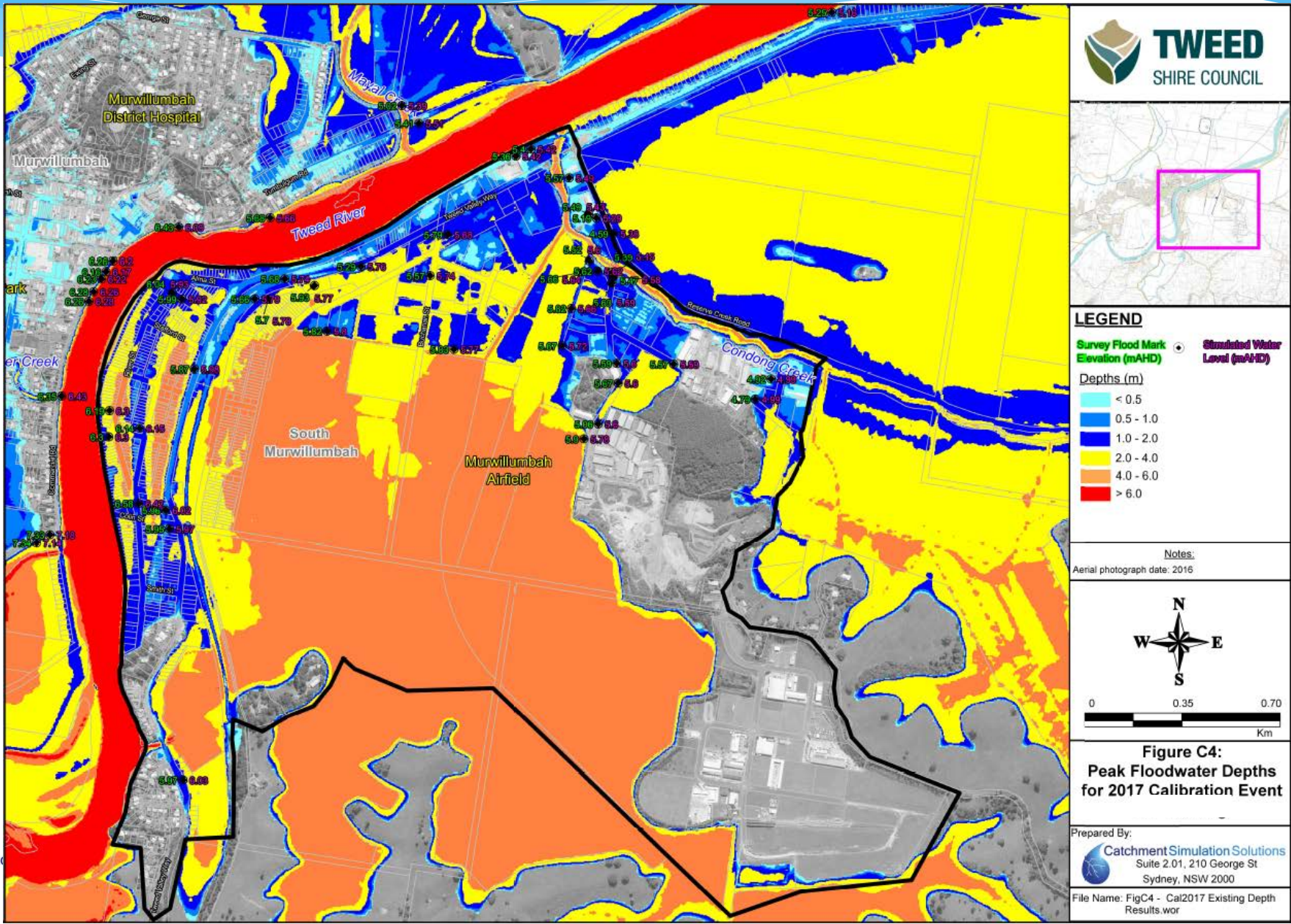
- TUFLOW hydraulic model used for Murwillumbah CBD study updated and expanded for the current study
- New model extends downstream to Tumbulgum
- Takes advantage of new hydrographic survey of the Tweed River collected by OEH

# TUFLOW Model Calibration

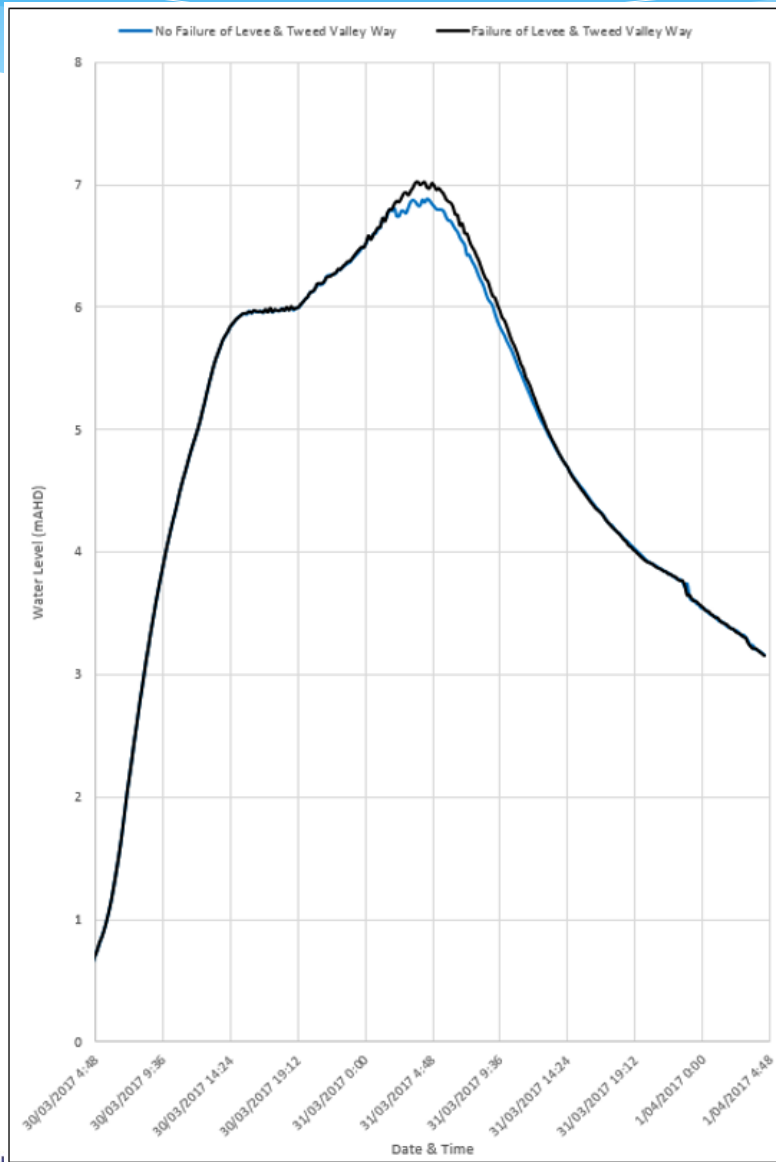
- TUFLOW model was calibrated against following floods
  - 2017
  - 2013
  - 1989
- Difference between surveyed flood levels and simulated flood levels < 0.1 metres



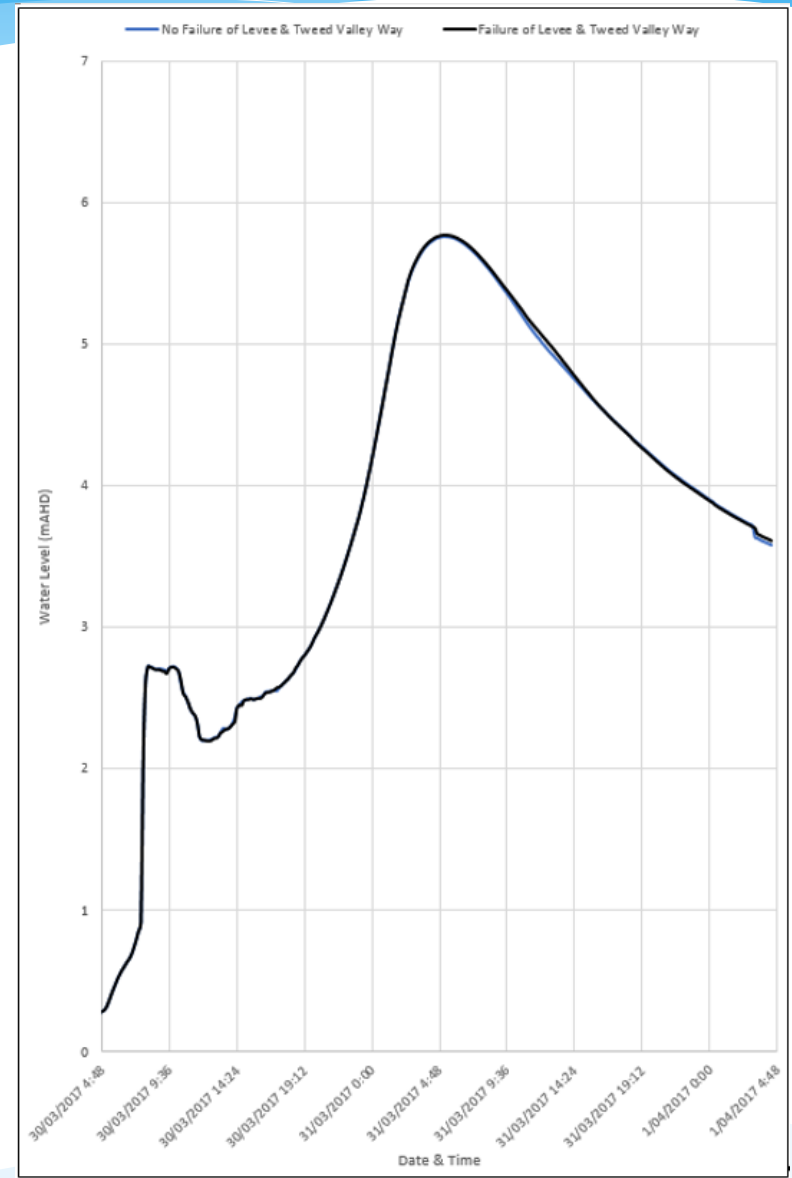
# TUFLOW Model Calibration – 2017 Flood



# TUFLOW Model Calibration – 2017 Flood



Blacks Drain @ Tweed Valley Way



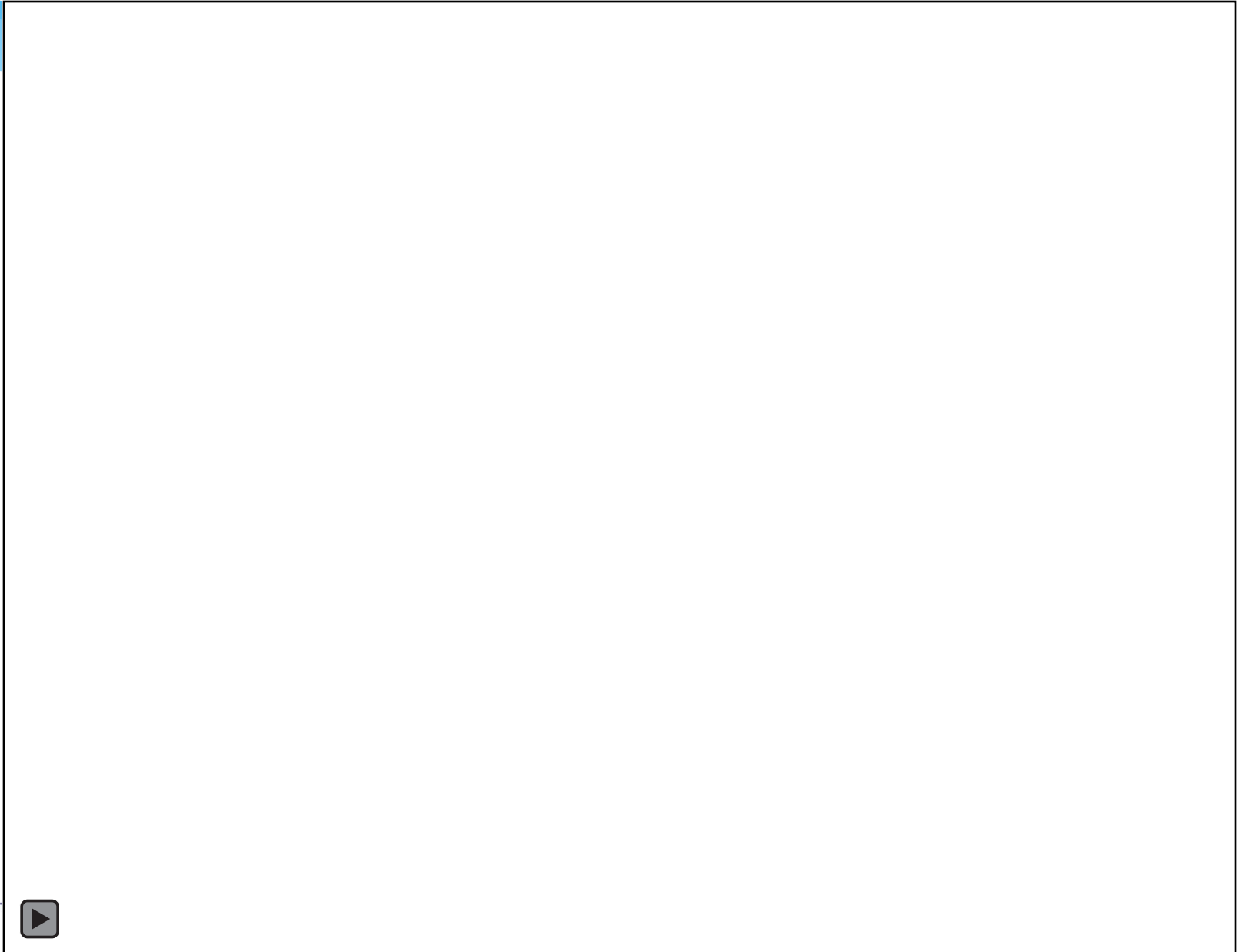
At Murwillumbah Airfield

# Design Flood Simulations

- Design Floods Simulated:
  - 20% AEP
  - 5% AEP
  - 1% AEP
  - 0.2% AEP
- A range of other sensitivity and climate change simulations also completed



# Design Flood Simulations – Animation (1% AEP)



# Design Flood Simulations – Animation (0.2% AEP)



# Flood Damages

Flood	Flood Damages (\$ millions)				
	Residential	Commercial	Industrial	Infrastructure	Total Damages
20% AEP	2.69	0.67	0.05	0.13	3.54
5% AEP	3.33	0.79	0.07	0.16	4.35
1% AEP	7.01	4.04	2.13	1.09	14.3
0.2% AEP	12.6	6.61	4.74	2.00	26.0

- 💧 Average Annual Damage Cost = \$1.4 million
- 💧 Climate change could potentially increase that damage cost by 50%



# Community Consultation

- Questionnaire & brochure distributed to ~800 households & businesses
- 86 questionnaire responses received
- Flood Impacts:
  - 95% had experienced flood impacts
- Emergency Response:
  - 43% would remain at home
  - 27% indicated that they would evacuate
  - 16% were unsure how they would respond
  - The primary reason for remaining at home was for property security and feeling that their house could not be flooded (however, 2/3 of these would be flooded above floor level in a PMF and the above floor flooding depth would typically exceed 4m)

# Community Consultation



# Community Consultation

- Most Favoured Options:
  - SES Local Flood Plan Update
  - Flood Warning System Updates
  - Community Education
  - Flood Evacuation Upgrades
  - Dredging river/creeks
  - New/upgraded flood gates
- Least Favoured Options:
  - New levees
  - Levee raising
  - Voluntary flood proofing
  - Voluntary house raising



# The Existing Flooding Problem...

- Current levee provides < 20% AEP protection
- Inundation of South Murwillumbah first occurs as a result of Alma St overtopping
- During floods up to and including the 1% AEP, Alma St would overtop after ~30 hours. During a 0.2% AEP flood, overtopping would occur after ~15 hours.
- Significant inundations depths are predicted across most of South Murwillumbah during large floods.
- General reluctance to evacuate.



# Potential Flood Risk Management Options

# Mitigation Options – Initial List of Potential Options

Flood Modification Options		Property Modification Options	Response Modification Options
<b>Topographic Modifications</b>	<b>Road, Railway and Bridge Modifications</b>	<b>Residential Property Modifications</b>	<b>Education</b>
<ul style="list-style-type: none"> <li>South Murwillumbah levee modifications</li> </ul>	<ul style="list-style-type: none"> <li>Alma Street modification</li> <li>Remove railway embankment</li> </ul>	<ul style="list-style-type: none"> <li>Voluntary house purchase program</li> <li>Voluntary house raising program</li> </ul>	<ul style="list-style-type: none"> <li>Community education activities</li> </ul>
<ul style="list-style-type: none"> <li>Railway Street flow path</li> </ul>	<ul style="list-style-type: none"> <li>Additional railway culvert/bridge</li> </ul>	<ul style="list-style-type: none"> <li>Voluntary flood proofing</li> </ul>	<b>Private Flood Plans</b>
<ul style="list-style-type: none"> <li>Durrington Street flow path</li> </ul>	<ul style="list-style-type: none"> <li>Additional Murwillumbah bridge opening</li> </ul>	<b>Industrial and Commercial Property Modifications</b>	<ul style="list-style-type: none"> <li>Preparation of residential flood plans</li> </ul>
<ul style="list-style-type: none"> <li>South Murwillumbah high flow bypass</li> </ul>	<ul style="list-style-type: none"> <li>Elevate Tweed Valley Way at Blacks Drain</li> </ul>	<ul style="list-style-type: none"> <li>Temporary flood barriers</li> </ul>	<b>Miscellaneous</b>
<b>Channel Modifications</b>	<b>Condong Creek Modifications</b>	<ul style="list-style-type: none"> <li>Minimum floor level requirement</li> </ul>	<ul style="list-style-type: none"> <li>Local flood plan updates</li> </ul>
<ul style="list-style-type: none"> <li>Dredge Tweed River channel</li> </ul>	<ul style="list-style-type: none"> <li>Modify Condong Creek channel</li> </ul>	<b>Industrial Land Swap</b>	<ul style="list-style-type: none"> <li>Flood warning system upgrades</li> </ul>
<ul style="list-style-type: none"> <li>Blacks Drain modification</li> </ul>	<ul style="list-style-type: none"> <li>Condong Creek High Flow bench</li> <li>High level Condong Creek Outlet</li> </ul>	<ul style="list-style-type: none"> <li>Land swap</li> </ul>	<ul style="list-style-type: none"> <li>Install automated flood barriers</li> </ul>
<b>Lot 4 DP 591604 Quarry Road Modifications</b>	<b>Pump Systems</b>	<b>Planning Modifications</b>	
<ul style="list-style-type: none"> <li>Lot 4 DP 591604 Quarry Road terrain modifications</li> </ul>	<ul style="list-style-type: none"> <li>Pump system behind Floodgate 17L</li> </ul>	<ul style="list-style-type: none"> <li>Lot Consolidation</li> </ul>	
<ul style="list-style-type: none"> <li>Lot 4 DP 591604 Quarry Road terrain and Quarry Road culvert modifications</li> </ul>	<ul style="list-style-type: none"> <li>Pump system behind Blacks Drain floodgate</li> </ul>		

# Potential Mitigation Options – Qualitative Assessment

Potential Flood Modification Options	Evaluation Criteria/Score						
	Change in Flood Levels/Extents	Emergency Response	Technical Feasibility	Environmental Impacts	Economic Feasibility	Community Acceptance	Overall Score
<b>Road, Railway &amp; Bridge Modifications</b>							
Alma Street modification	1	1	-1	0	-1	1	1
Remove railway embankment	1	0	-1	0	0	-1	-1
Additional railway culvert/bridge	1	0	-1	0	-1	1	0
Additional Murwillumbah bridge opening	1	0	-2	0	-2	0	-3
Elevate Tweed Valley Way	0	1	0	0	-1	1	1
<b>Channel Modifications</b>							
Dredge Tweed River channel	1	0	-1	-2	-2	1	-3
<b>Condong Creek Modifications</b>							
Modify Condong Creek channel	0	0	0	1	0	1	2
Condong Creek High Flow bench	1	0	0	0	-1	1	1
High level Condong Creek Outlet	1	0	-1	0	-1	1	0
<b>Lot 4 DP 591604 Quarry Road Modifications</b>							
Lot 4 DP 591604 Quarry Road terrain modifications	1	0	1	0	0	1	3
Lot 4 DP 591604 Quarry Road terrain and Quarry Road culvert modifications	1	1	-1	-1	-1	0	-1

# Mitigation Options – Options Selected for Detailed Assessment

Flood Modification Options		Property Modification Options		Response Modification Options	
<b>Topographic Modifications</b>		<b>Road, Railway and Bridge Modifications</b>		<b>Residential Property Modifications</b>	
<ul style="list-style-type: none"> <li>South Murwillumbah levee modifications</li> </ul>	<ul style="list-style-type: none"> <li>Alma Street modification</li> <li>Remove railway embankment</li> </ul>	<ul style="list-style-type: none"> <li>Voluntary house purchase program</li> <li>Voluntary house raising program</li> </ul>	<ul style="list-style-type: none"> <li>Community education activities</li> </ul>		
<ul style="list-style-type: none"> <li>Railway Street flow path</li> </ul>	<ul style="list-style-type: none"> <li>Additional railway culvert/bridge</li> </ul>	<ul style="list-style-type: none"> <li>Voluntary flood proofing</li> </ul>	<b>Private Flood Plans</b> <ul style="list-style-type: none"> <li>Preparation of residential flood plans</li> </ul>		
<ul style="list-style-type: none"> <li>Durrington Street flow path</li> </ul>	<ul style="list-style-type: none"> <li>Additional Murwillumbah bridge opening</li> </ul>	<b>Industrial and Commercial Property Modifications</b>		<ul style="list-style-type: none"> <li>Preparation of business flood plans</li> </ul>	
<ul style="list-style-type: none"> <li>South Murwillumbah high flow bypass</li> </ul>	<ul style="list-style-type: none"> <li>Elevate Tweed Valley Way at Blacks Drain</li> </ul>	<ul style="list-style-type: none"> <li>Temporary flood barriers</li> </ul>	<b>Miscellaneous</b>		
<b>Channel Modifications</b>		<b>Condong Creek Modifications</b>		<ul style="list-style-type: none"> <li>Local flood plan updates</li> </ul>	
<ul style="list-style-type: none"> <li>Dredge Tweed River channel</li> </ul>	<ul style="list-style-type: none"> <li>Modify Condong Creek channel</li> </ul>	<b>Industrial Land Swap</b>		<ul style="list-style-type: none"> <li>Flood warning system upgrades</li> </ul>	
<ul style="list-style-type: none"> <li>Blacks Drain modification</li> </ul>	<ul style="list-style-type: none"> <li>Condong Creek High Flow bench</li> <li>High level Condong Creek Outlet</li> </ul>	<ul style="list-style-type: none"> <li>Land swap option</li> </ul>	<ul style="list-style-type: none"> <li>Install automated flood barriers</li> </ul>		
<b>Lot 4 DP 591604 Quarry Road Modifications</b>		<b>Pump Systems</b>		<b>Planning Modifications</b>	
<ul style="list-style-type: none"> <li>Lot 4 DP 591604 Quarry Road terrain modifications</li> </ul>	<ul style="list-style-type: none"> <li>Pump system behind Floodgate 17L</li> </ul>	<ul style="list-style-type: none"> <li>Lot Consolidation</li> </ul>			
<ul style="list-style-type: none"> <li>Lot 4 DP 591604 Quarry Road terrain and Quarry Road culvert modifications</li> </ul>	<ul style="list-style-type: none"> <li>Pump system behind Blacks Drain floodgate</li> </ul>				

# Mitigation Options – Flood Modification Options



- Elevate Tweed Valley Way

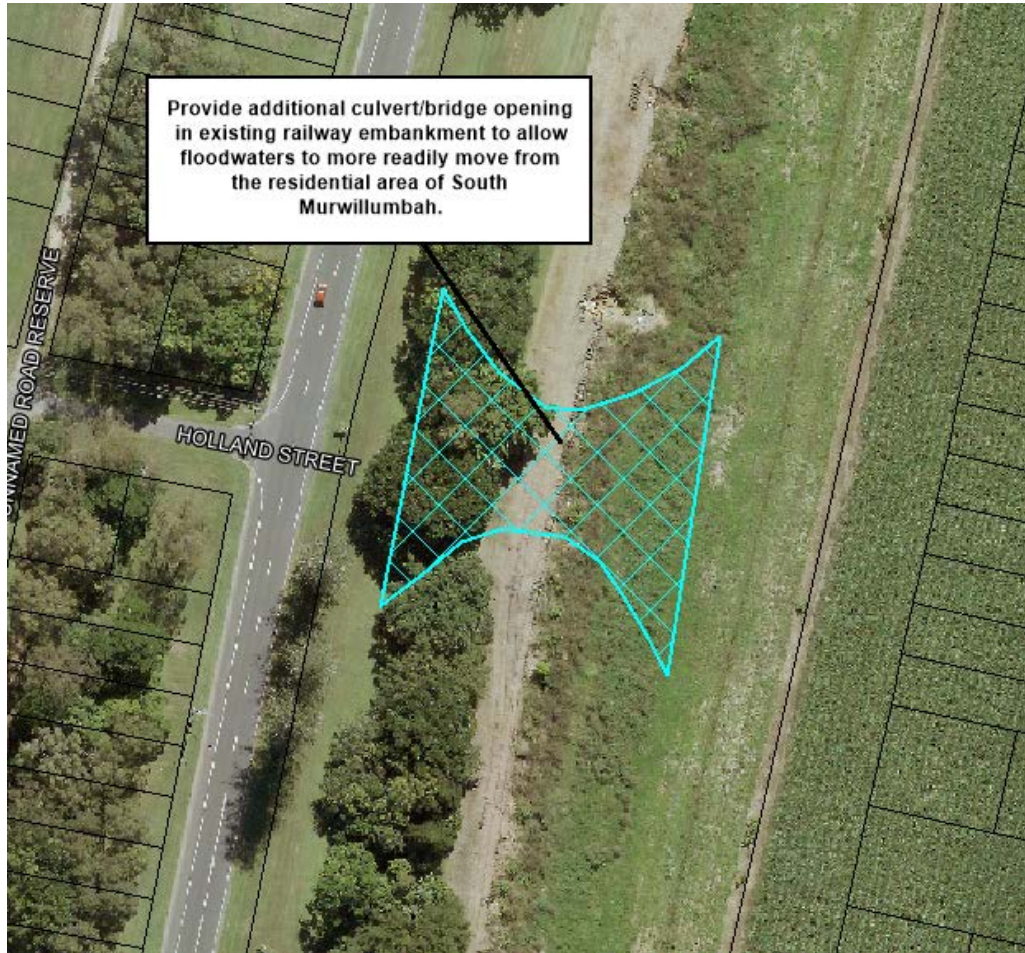


# Mitigation Options – Flood Modification Options

- South Murwillumbah high flow bypass



# Mitigation Options – Flood Modification Options



- Additional “opening” in railway line



# Mitigation Options – Flood Modification Options



- Alma Street modification

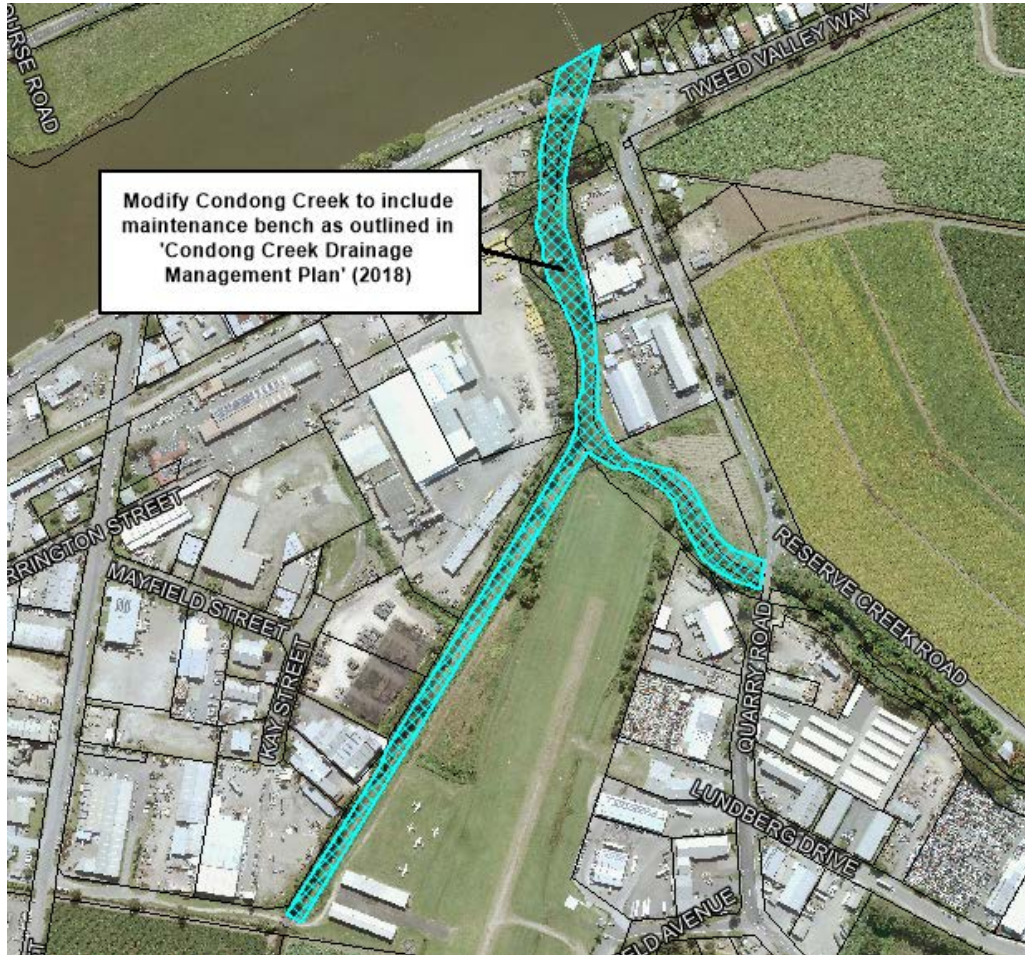
# Mitigation Options – Flood Modification Options



- Durrington Street flow path

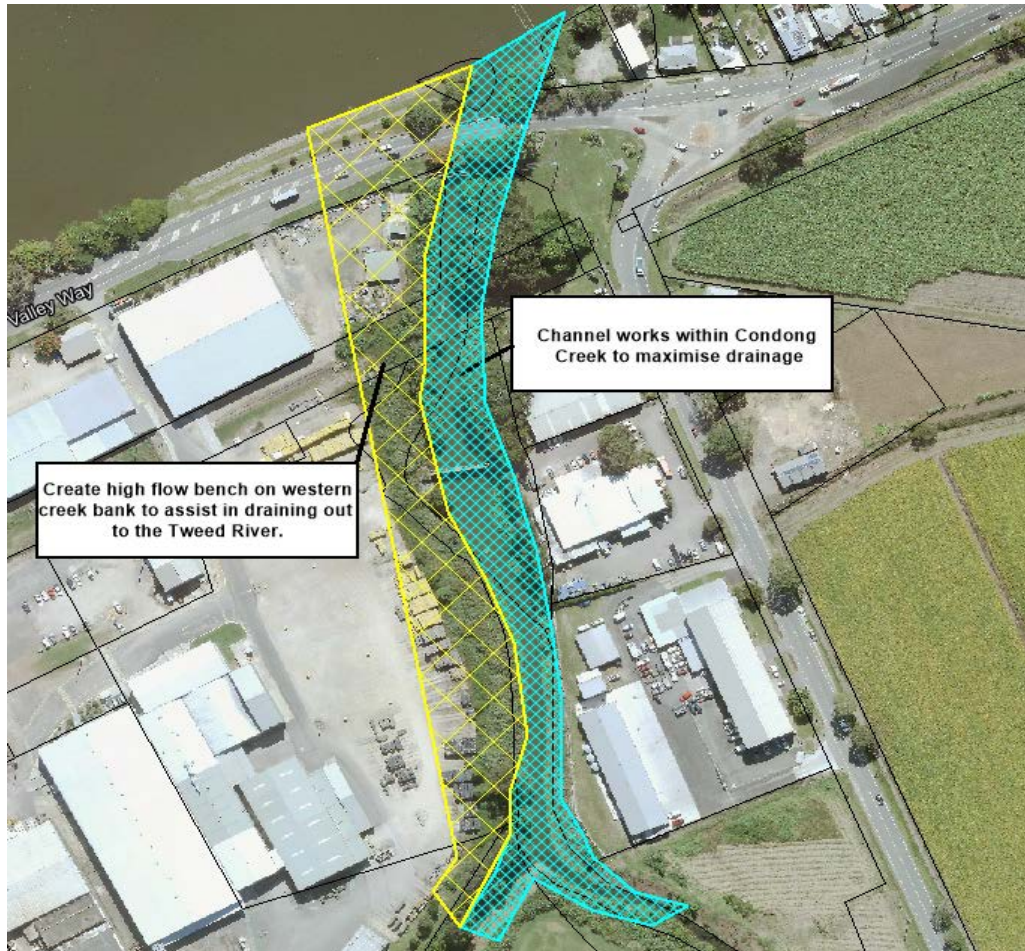


# Mitigation Options – Flood Modification Options



- Modify Condong Creek channel

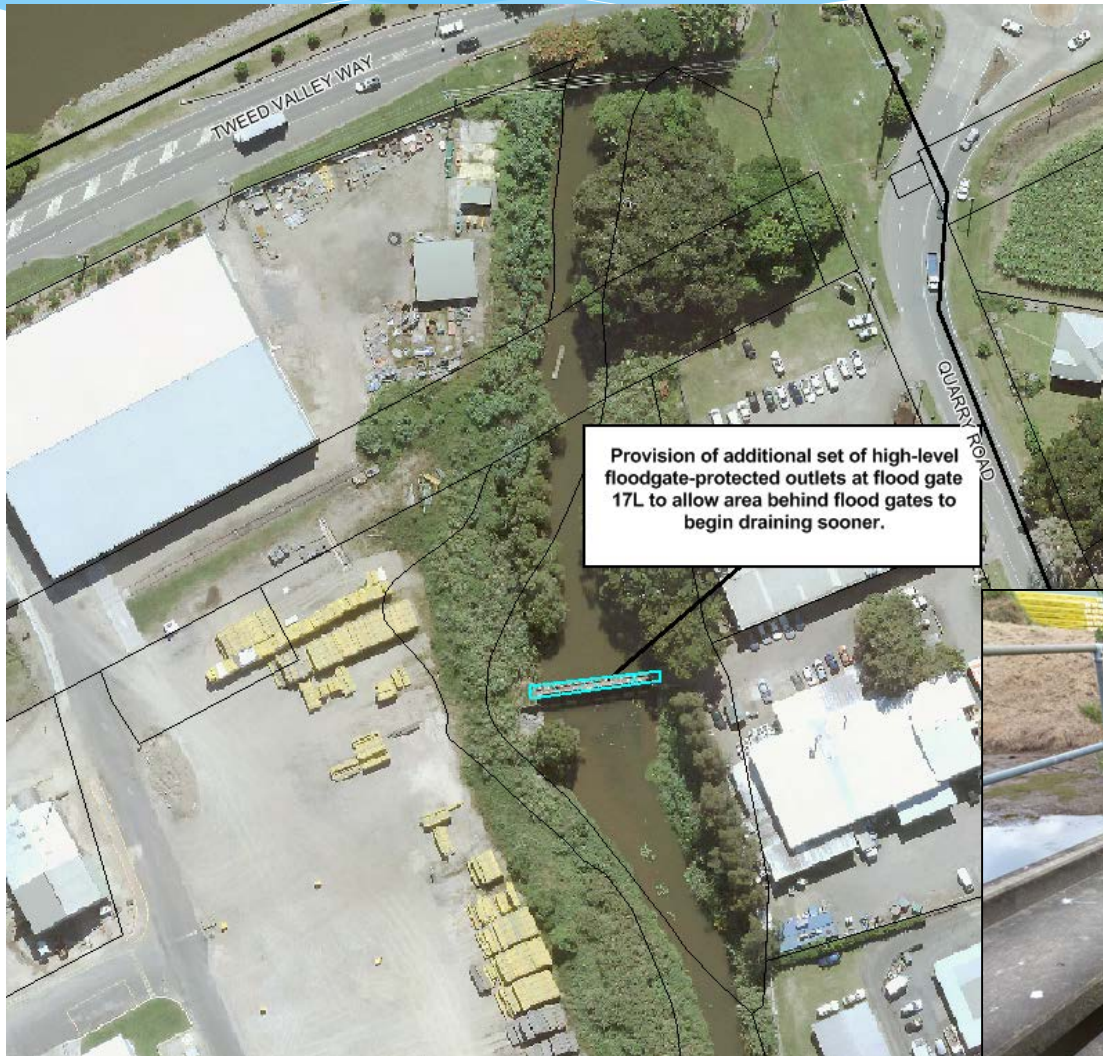
# Mitigation Options – Flood Modification Options



- Condong Creek High Flow bench



# Mitigation Options – Flood Modification Options



- High level Condong Creek Flood Gate Outlet





# Mitigation Options – Flood Modification Options

## Lot 4 591604 Quarry Road Terrain Modifications





# Mitigation Options – Flood Modification Options



- Blacks Drain Modifications

# Mitigation Options – Flood Modification Options

- It's likely that we will also need to look at combinations of options

# Mitigation Options – Property Modification Options

- Voluntary house purchase program
  - Review of Council's existing voluntary house purchase program
- Temporary Flood Barriers
  - Temporary flood barriers that will reduce the potential for ingress of floodwaters into commercial properties
- Industrial Land Swap
  - Relocation of industrial properties and lowering of ground elevation across critical flood zone lots.
- Lot Consolidation
  - Consolidation of multiple lots into a single lot to reduce potential for intensification of development



# Mitigation Options – Response Modification Options

- **Community education activities**
  - Various community education activities to increase flood awareness and allow residents and business owners to be more self-sufficient during future floods
- **Preparation of Residential/Business Flood Plans**
  - Preparation of flood plans to identify actions to be taken before, during and after a flood
- **Local Flood Plan Updates**
  - Update SES local flood plan to take advantage of updated flood information generated as part of the current study
- **Flood Warning System Upgrade**
  - Updates to existing flood warning system to improve the dissemination of flood information

# Next Steps

- Undertake a detailed assessment of flood mitigation options (e.g., cost estimate, revised damages estimates, hydraulic assessment)
- Distribute questionnaire to obtain community feedback on potential options
- Outcomes of options evaluation will be presented in draft floodplain risk management study report (mid-December)



# Committee Feedback

- Any questions or comments?
- Happy with options selected for detailed assessment?
- Are there other options that have not been considered?