



murray river  
council

# Barham River Estate Levee Discussion

4 May 2022

# Housekeeping

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- Toilets
- Evacuation
- Recording of session
- Timeline for session
- Representatives

# Outline for the session

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- Community feedback – Sharon Sims (community nominated spokes person)
- Documentation review – Trevor Clark (MRC Floodplain Management Consultant)
- Q & A session
- Where to next – Onisimo Mukodi (MRC Manager Infrastructure Projects)
- Q & A session
- Close – Jack Bond (MRC Director Infrastructure)

# Community feedback

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Sharon Sims

- nominated community spokes person

Covering

- Issues
- Community request to Council

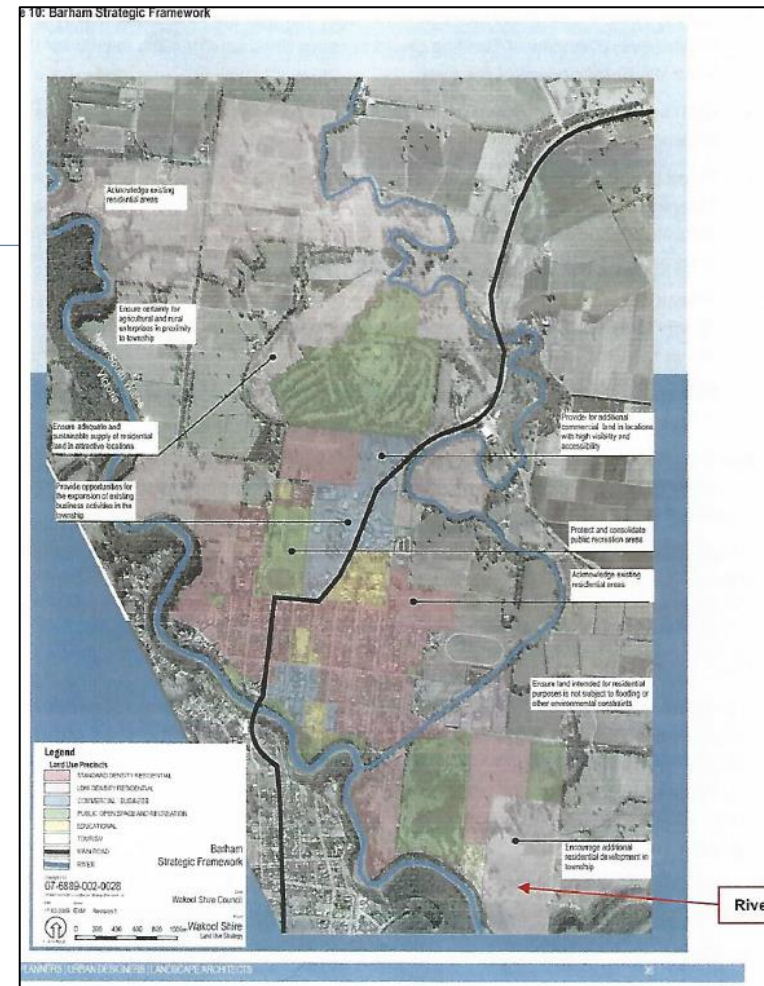
# Trevor Clark – Civil Engineer

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- I worked for consultants Earth Tech Engineering between 1998 and 2008. I undertook project work during this period for the NSW Government Departments of the day on the so-called Stage 1, Stage 2 and Stage 3 Areas of the Edward and Wakool River floodplains culminating in the adopted 2008 Floodplain Management Plans.
- I worked for consultants GHD between 2008 and 2021. I undertook various project work at Barham between 2011 and 2019.
- I am currently working freelance.

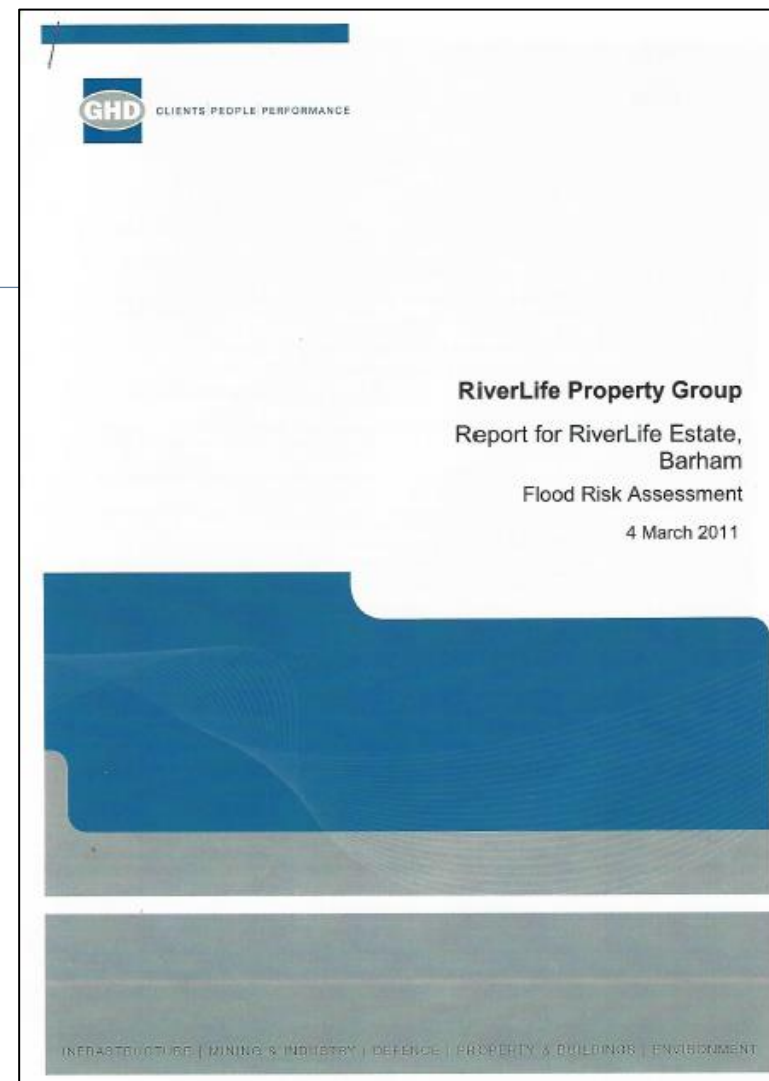
# 2009 / 2010 River Estate beginnings

- The site of the future River Estate was identified in Wakool Shire Council's 2009 Land Use Strategy report as a prospective residential development area
- Council subsequently submitted a rezoning proposal to the NSW Government referral authority, Department of Environment, Climate Change & Water (DECCW) in 2010
- DECC's response in late 2010 was that the rezoning could not be approved without a detailed flood risk assessment for the site and appropriate proposed flood protection measures



# 2011 GHD Flood Risk Assessment Report

- The developers of the estate (RiverLife Property Group) engaged consultant's GHD in 2011 to undertake a flood risk assessment for the site
- Aim of the assessment was to identify what was required in terms of flood protection infrastructure for the site to secure the rezoning of the land to General Residential



# 2011 GHD Assessment

The assessment identified:

- Adjoining Murray River 100 year flood level 78.0 m AHD
- Existing (2011) levee height varies from 77.8 to 78.2 m AHD
- Ground levels within the estate vary from 77.2 to 77.6 m AHD

The NSW Government referral authority, DECCW confirmed to GHD that the existing levee would need to be upgraded to comply with current urban levee design standards in order to be approved by the approval authority.





# 2011 GHD Assessment

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The 2011 assessment proposed that:

- Upgraded levee would be on a new route, skirting around the inside of the treed zones, so as to not impact on native vegetation and provide a buffer between the levee and the river channel
- Levee would be constructed as a ring levee, providing full protection to the site
- The design height of the new levee to be at the 1 in 100 year flood level plus the level of freeboard required by the NSW Government approval authority and Council
- DECCW indicated to GHD in discussions that the Department would most likely specify 0.6 m freeboard as a condition of the rezoning approval
- DECCW advised GHD that the levee would need to be constructed in accordance with the techniques and materials appropriate for urban standard levees

# 2012

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- The rezoning of the subject land was approved by the NSW Government approval authority subject to conditions
- One of the approval conditions required that a new flood protection levee be constructed appropriately – with the required freeboard, materials and construction methods

# 2013/ 2014 Barham Flood Study

- Project initiated by Council in 2013 – Murray River Flood Study for Barham, Murray Downs and Tooleybuc townships
- Hydraulic modelling – 1 in 100 year flood and other smaller and larger flood events
- Resultant Murray River design 1 in 100 year flood level directly opposite the River Estate site – varies 77.9 to 78.1 m AHD



**Wakool Shire Council**

Barham Flood Study  
Final Report

October 2014

## 2014 – Construction of Levee

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- The River Estate levee was constructed during 2014 as part of the estate infrastructure works

# 2016 – As-constructed survey of levee

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- In January 2016, Council initiated a survey to identify the constructed height of the River Estate Levee
- The survey identified that the constructed height of the levee varied between 78.1 and 78.3 m AHD

# October 2016 – Flood Event

- In October 2016, the Murray River peaked at 6.08 m at the Barham gauge
- This was the highest flood level recorded at Barham since October 1993 (6.10 m)
- Comparisons of a photo taken near the peak with survey data indicates that the peak 2016 flood level was approximately 77.8 m AHD opposite the River Estate levee. This is in good agreement with the GHD modelled flood levels



# 2016/ 2017 Barham Floodplain Risk Management Study & Plan

- This Council project followed on from the 2014 Flood Study project
- The adopted January 2017 Floodplain Risk Management Plan proposes a progressive levee upgrade strategy for Barham township to upgrade the existing levees to meet current urban levee standards
- Plan proposes a preliminary design freeboard for all levees at Barham of 0.6 metre
- The levee upgrade includes the River Estate Levee given its freeboard does not meet the necessary freeboard requirement for urban levee
- Plan also nominates the need for a Structural Integrity Audit for all the existing levees, including the River Estate Levee



# 2018/2019 Levee Structural Integrity Audit

- The Structural Integrity Audit was the first step in the implementation of the Barham Floodplain Risk Management Plan.
- The audit was undertaken by consultants GHD. Audit report is dated March 2019.
- Audit of the existing levees at Barham included the River Estate Levee
- Borehole samples within the River Estate Levee obtained in January 2019. Laboratory tests completed using the borehole samples.
- Audit concluded that there is a high probability of leakage through the River Estate Levee bank structure during a flood event and subsequent internal erosion due to the dispersive and poorly compacted nature of the levee fill material. Other issues – levee freeboard 0.1 to 0.3m, likely to be a poor bond between the levee embankment fill and the foundation.



**Murray River Council**  
Barham Levee Structural Integrity Audit  
Final Report  
March 2019



# 2019 Levee Options Assessment

- In light of the Structural Integrity Audit outcomes a review of the levee upgrade strategy for Barham was undertaken by consultants GHD.
- Design freeboard assessment – recommends that 0.5 metre be adopted for all Barham levees including River Estate Levee
- Upgrade of the River Estate Levee is assigned a High priority by the report given the ongoing development within the Estate (i.e. the longer it is delayed, the more disturbance there will be to existing development when it is upgraded).
- Report documents an assessment of upgrade options for River Estate Levee.
- Preferred option involves the construction of a raised impervious earthfill zone on the river side of the existing levee on the basis that it minimises the capital costs for the upgrade and limits the disturbance to the existing developed lots by restricting the works to the river side of the levee.



**Murray River Council**

Barham Levee Options Assessment

Updated Draft Final Report

September 2019

# 2022 Levee Upgrade – Detailed Design

- In early 2022, Council engaged consultants Dryside Engineering to prepare detailed designs for the River Estate Levee upgrade
- Feature survey and geotechnical site investigations completed
- Community consultation sessions held as ‘drop in sessions’ on 23 and 24 March 2022.
- Independent review of design freeboard completed – concludes that 0.5 metre is appropriate
- Adopted option for the levee upgrade selected after considering six alternative options



# 2022 Levee Upgrade Design

- Design height – 0.5 m above 1 in 100 year flood level – this will vary from 0.2 to 0.4 m above the existing levee
- Reconstruction of the levee – includes 2.0 m deep cut-off trench
- Levee material to be lime stabilised to allow use of locally sourced material (lime stabilisation addresses the dispersive and erodible nature of the local material)
- Cost estimate - \$1.5 million

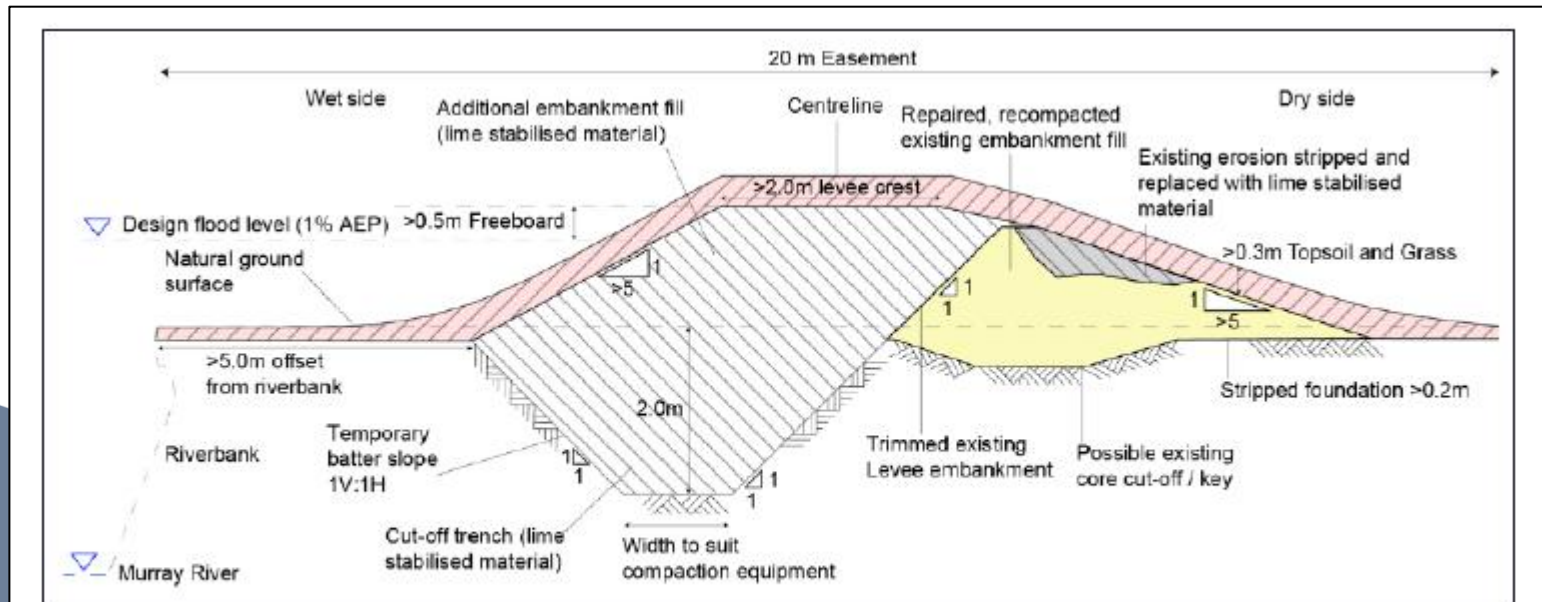


Figure 5-1 Proposed Levee Design based on Geotechnical Investigation

# Benefits of River Estate Levee Upgrade

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The River Estate Levee upgrade will provide the following benefits:

- Mitigate the risk of future flooding within the Estate
- Reduce flood insurance premiums for properties within the Estate
- Increase the valuations of properties within the Estate.

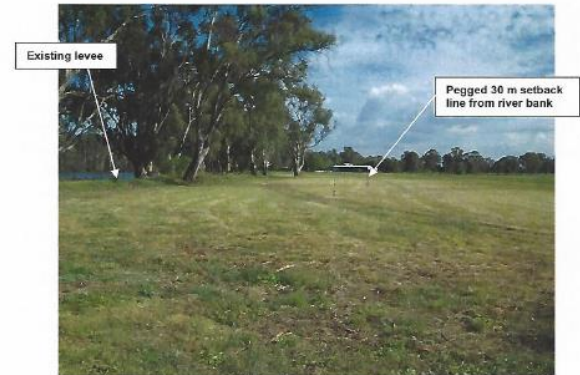
# Q&A - Why is the River Estate Levee needed at all?



The levee was an approval condition imposed on the rezoning of the land occupied by the River Estate.

The rationale for the need for the levee was that:

- The previous levee opposite the River Estate was not an urban standard levee due to its limited height and structural deficiencies
- The estimated 100 year flood level in 2011 of 78.0 m AHD was higher than ground levels within the estate and also higher than parts of the 2011 existing rural levee.



Photograph 1 Riparian vegetation zone adjoining Murray River - view north west towards old homestead and Barham Lakes Caravan Park



Photograph 2 View looking west towards riparian vegetation and river on the site's western boundary

# Q&A - Is the levee design 100 year flood level correct?

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The 100 year flood level was estimated to be 78.0 m AHD in 2011.

The 2014 Flood Study modelling places the 100 year flood levels at 78.06 m AHD at the upstream most point of the site and 77.91 m AHD at the downstream most point of the site.

In October 2016, flood levels peaked at 6.08 m at the Barham gauge, 0.12 m below the 100 year flood level. A comparison of photographs of the 2016 flood near its peak with survey data indicates that the 2016 flood peaked at approximately 77.8 m AHD opposite the River Estate. Adding 0.12 m to this height results in a flood level which is in good agreement with the 2014 study modelled 100 year flood levels.

# Q&A - Is the levee 0.5 metre design freeboard needed?

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Freeboard is a mandatory design height allowance which aims to account for uncertainties in the estimation of flood levels, wind generated waves, local disturbance / turbulence, levee settlement and climate change effects.

The 0.5 m adopted for the Barham levees is at the lower end of the freeboard typically adopted for urban levees. Levees at Moama and Swan Hill have a 0.6 m design freeboard.



# Q&A - Is the need for a structural upgrade of the levee justified?

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All of the levees at Barham were subject to a structural integrity audit in 2018/19.

Geotechnical borehole samples taken from the River Estate Levee and subject to laboratory testing identified that the structural integrity did not meet the urban levee standards and that a structural upgrade of the levee was needed to address the deficiencies (details provided in March 2019 GHD report).

Geotechnical consultants engaged by Dryside Engineering (Senversa) in early 2022 reviewed the previous GHD geotechnical work. This review confirmed the River Estate Levee to be in need of a structural upgrade (details provided in April 2022 Dryside Engineering report).

Council has a duty of care to ensure that the levee can perform its intended function during a flood. Council therefore has an obligation to upgrade the condition of the levee to ensure it can perform its intended design function for the community.



# Q&A - What will be the consequences if the River Estate Levee fails / breaches?

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The consequences will vary depending on the circumstances (river flood level at time of failure, where the failure occurs).

Floodwater will enter the Estate through the breach opening in the levee. Floodwater will continue to flow into the Estate until the flood/water level within the Estate is at the same height as river flood level at the breach point.

Assuming a breach close the upstream point and the river flood level to be at the 100 year level, the water level within the estate will rise to 78.06 m AHD. The lowest ground levels within the estate based on pre-development survey were at approx. 77.2 m AHD (south eastern corner). The maximum depth of flooding would therefore reach 0.86 metre for this scenario. The average depth of flooding within the estate would be closer to 0.6 metre.

# Q&A - Why has the upgrade of the River Estate Levee been assigned the highest priority?

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The River Estate Levee was a condition of approval assigned to the rezoning of the Estate site to General Residential. Council will be responsible if the levee is found to fail due to reasons associated with it not being constructed to an urban standard.

The 2019 Structural Integrity Audit identified that the River Estate Levee is not up to urban standards. Council is therefore compelled to take action to bring the levee up to standard, from an obligation to protect those properties within the levee, and an obligation to meet its own local government responsibilities.

The upgrade works will significantly disrupt the already developed properties within the Estate which back onto the levee. If the upgrade works are deferred, this will lead to more disruption as more lots are occupied. The sooner the upgrade works are completed, the better in this respect.

# Q&A - Why is the 2022 detailed design arrangement different to the 2019 concept design arrangement?

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The levee upgrade design arrangement proposed by Dryside Engineering has been selected on the basis that it will provide the most structurally sound levee, minimising the risk of any further issues.

The alternative of adopting a modified approach to minimise costs and disruption impacts such as the 2019 concept design has been discarded on the basis that it runs the risk that there may be further problems after the upgrade.

The worst possible outcome would be to proceed with a costly and disruptive upgrade and still end up with a levee that has ongoing problems.

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# Questions???

# Where to next?

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- Onisimo Mukodi
  - MRC Manager Infrastructure Projects

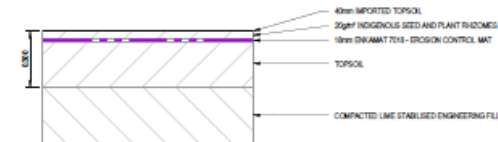
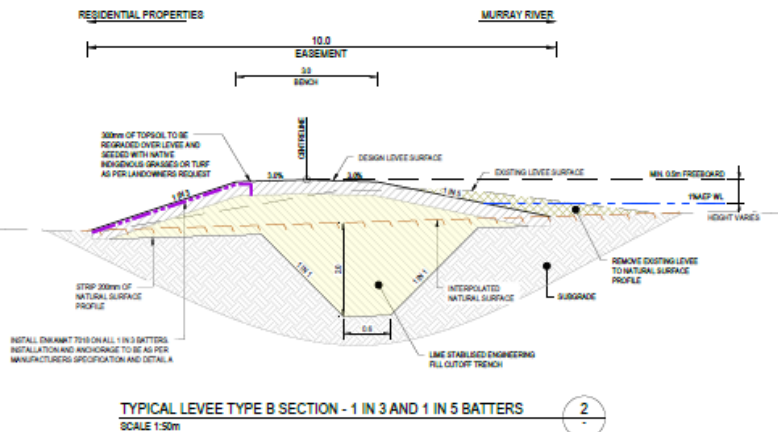
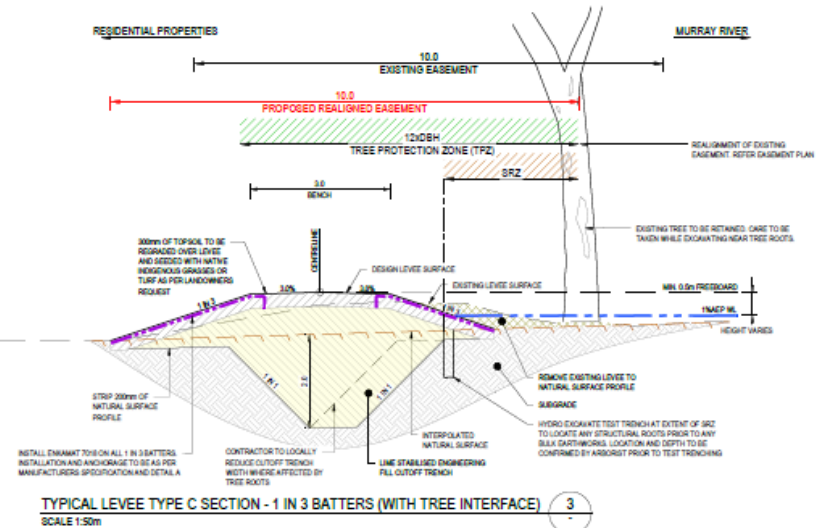
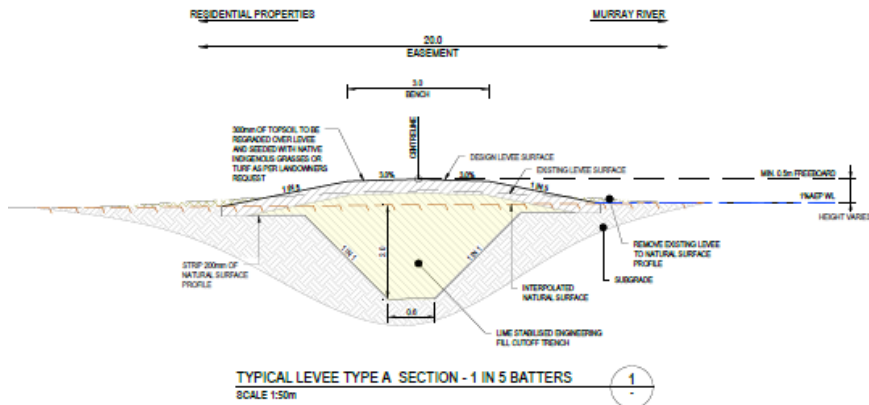
# Barham Floodplain Management Program

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- Design for upgrade for upgrade of River Estate Levee – 2022
- Grant application for upgrade of River Estate Levee (NSW Floodplain Management Grants) – 2022
- Procurement and Construction for upgrade of River Estate Levee – 2023/2024
- Grant application upgrade of Jamieson Avenue Levee 2024
- Construction for Upgrade of Jamieson Avenue Levee 2025/26



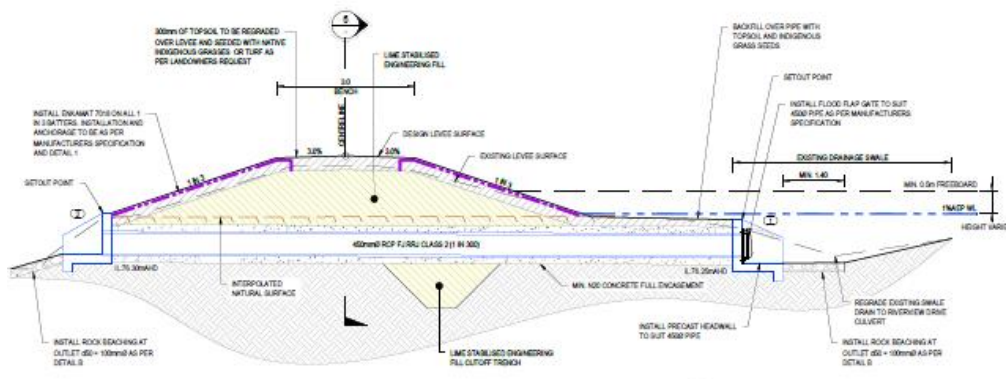
# Snippets of River Estate Levee Design



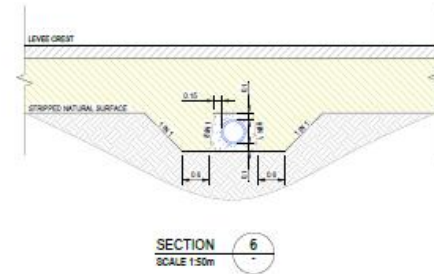
**ENKAMAT 7018 - LEVEE BANK TREATMENT DETAIL**  
SCALE: NTS



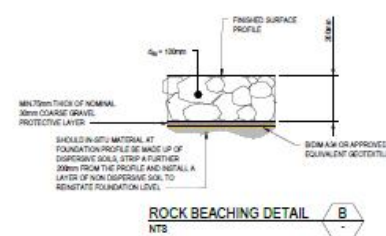
# Snippets of River Estate Levee Design



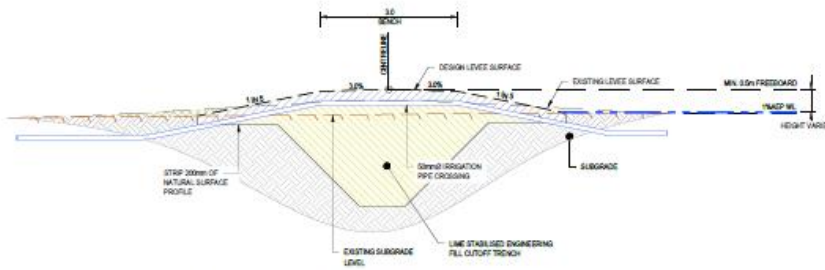
**TYPICAL UNDERGROUND PIPELINE SECTION**  
SCALE 1:50m  
NOTE: DETAIL TAKEN FROM VIC DELWP - LEVEE MANAGEMENT GUIDELINES FIGURE C-2 - PIPE CROSSING UNDER A LEVEE (CONCRETE FULLY ENCASED)



**SECTION 6**  
SCALE 1:50m



**ROCK BEACHING DETAIL**  
NTS



**TYPICAL CROSSING PIPELINE SECTION**  
SCALE 1:50m  
NOTE:  
• DETAIL TAKEN FROM VIC DELWP - LEVEE MANAGEMENT GUIDELINES, FIGURE C-1 - PIPE CROSSING THROUGH LEVEE CREST  
• ALL PRIVATE PROPERTY IRRIGATION CONNECTIONS TO RIVER TO BE CONSTRUCTED AS PER TYPICAL SECTION ABOVE

## ROCK LINING SPECIFICATION

### ROCK SELECTION

- THE SELECTION OF ROCK SHALL COMPLY WITH THESE NOTES, TABLES AND DRAWINGS HEREIN. THIS REQUIREMENT APPLIES TO BOTH IMPORTED ROCK AND IN-SITU ROCK
- INDIVIDUAL ROCKS SHALL BE FREE FROM CRACKS AND CLEANING PLANES, SCAMS AND DEFECTS WHICH WOULD RESULT IN THE BREAKDOWN OF ROCK IN WATER ENVIRONMENTS
- NOMINAL ROCK SHALL COMPLY TO THE FOLLOWING CRITERIA
  - ROCKS SHALL BE ROUND, ANGULAR, DURABLE AND RESISTANT TO WEATHERING
  - ROCKS ARE TO BE HARD AND SOUND ROCK WITH SHARP EDGES. SOUND AND WEATHERED ROCK IS SIGNIFICANTLY LESS STABLE THAN ANGULAR FRACTURED ROCK
  - NO ROCK SIZE SHOULD HAVE A DIMENSION RATIO OF EXCEEDING 2 TIMES ITS BREADTH AND OR THICKNESS
  - ROCK SHOULD NOT BE SINGLE SIZES AND INSTEAD BE A WELL GRADED MIXTURE OF SELECTED SIZES THAT ALL INTERSTICES ARE FILLED WITH ROCKS OF PROGRESSIVELY SMALLER SIZE
  - THE MAXIMUM ROCK SIZE SHALL NOT EXCEED 2 TIMES THE 50% ROCK SIZE

### ROCK INSTALLATION

- ROCKS SHALL BE WEDGED AND LOCKED TOGETHER SUCH THAT THEY ARE UNABLE TO SHIFT OR MOVE
- INSTALLATION OF ROCKS SHALL BE DONE THROUGH PLACEMENT AND NOT DROPPED OR ROLLED. UNSUITABLE INSTALLATION TECHNIQUES CAN DAMAGE THE ROCK, PROMOTE SEGREGATION OF THE VARIOUS GRADES OF ROCK AND PRODUCE FINES WHICH SUBJECT THE WATERWAY TO FINES CONTAMINATION

### BACKING MATERIAL

- THE ROCK IS TO BE INSTALLED ON A BACKING (BEDDING) LAYER OF FILTER ROCK AND GEOTEXTILE FILTER CLOTH
- THE GEOTEXTILE FILTER CLOTH IS TO BE OF SUFFICIENT STRENGTH (MIN BEAM AND) AND INSTALLED WITH SUITABLE OVERLAP TO WITHSTAND PLACEMENT OF THE ROCK
- IF THE NATURAL SURFACE AT FOUNDATION LEVEL IS DISPERSIVE THEN PRIOR TO PLACEMENT OF THE FILTER CLOTH THE DISPERSED SAND MUST FIRST BE FURTHER STRIPPED OF MIN 300mm OF MATERIAL AND REPLACED WITH A LAYER OF NON-DISPERSIVE SOIL

# Snippets of River Estate Levee Design



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# Questions & General Discussion

# Close

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- Thank you for attending
- An outcomes summary from tonight's session will be forwarded to next week.
- We will be available for the next 30min to answer any additional questions you may have.