Restoring Estuaries– Linking Planning, Science and On-ground Considerations

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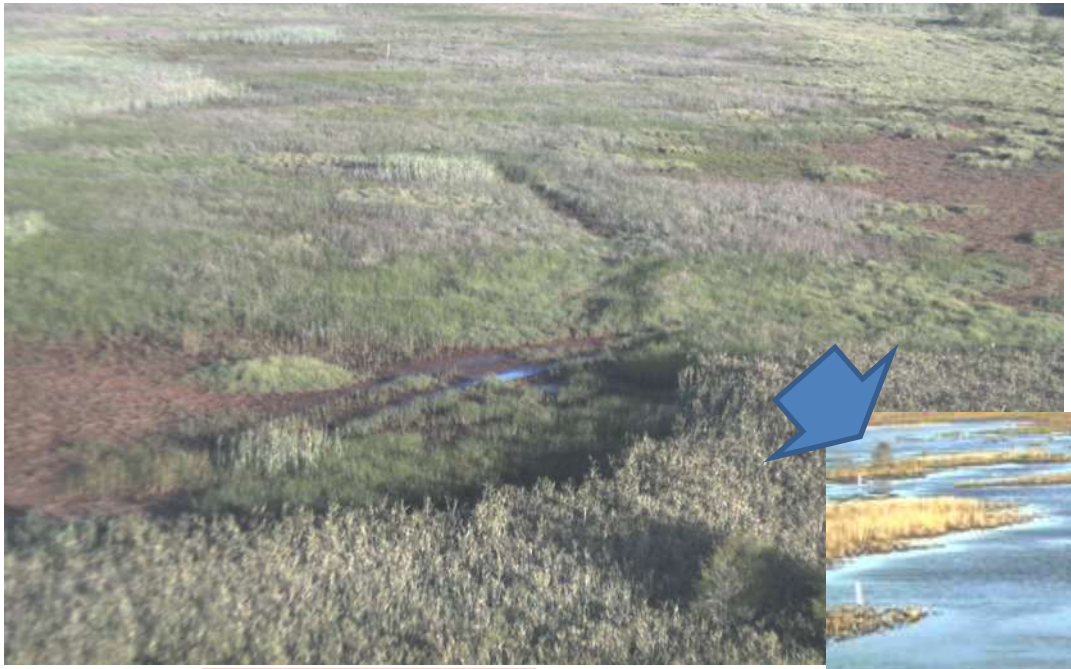
Estuarine Research

Tweed River
Richmond River
Macintyre River
Clarence River
Barwon River
Gwydir River
Namoi River
Macleay River
Castlereagh River
Hastings River
Bogan River
Manning River
Macquarie River
Hunter River
Goulburn River
Hunter River
Lachlan River
Hawkesbury River
Nepean River
Murrumbidgee River
Shoalhaven River
Murray River
Snowy River

Active Projects in NSW



2007 - Existing

2014 – Restored?


LIDAR
Potential groundwater dynamics


Full tidal flushing

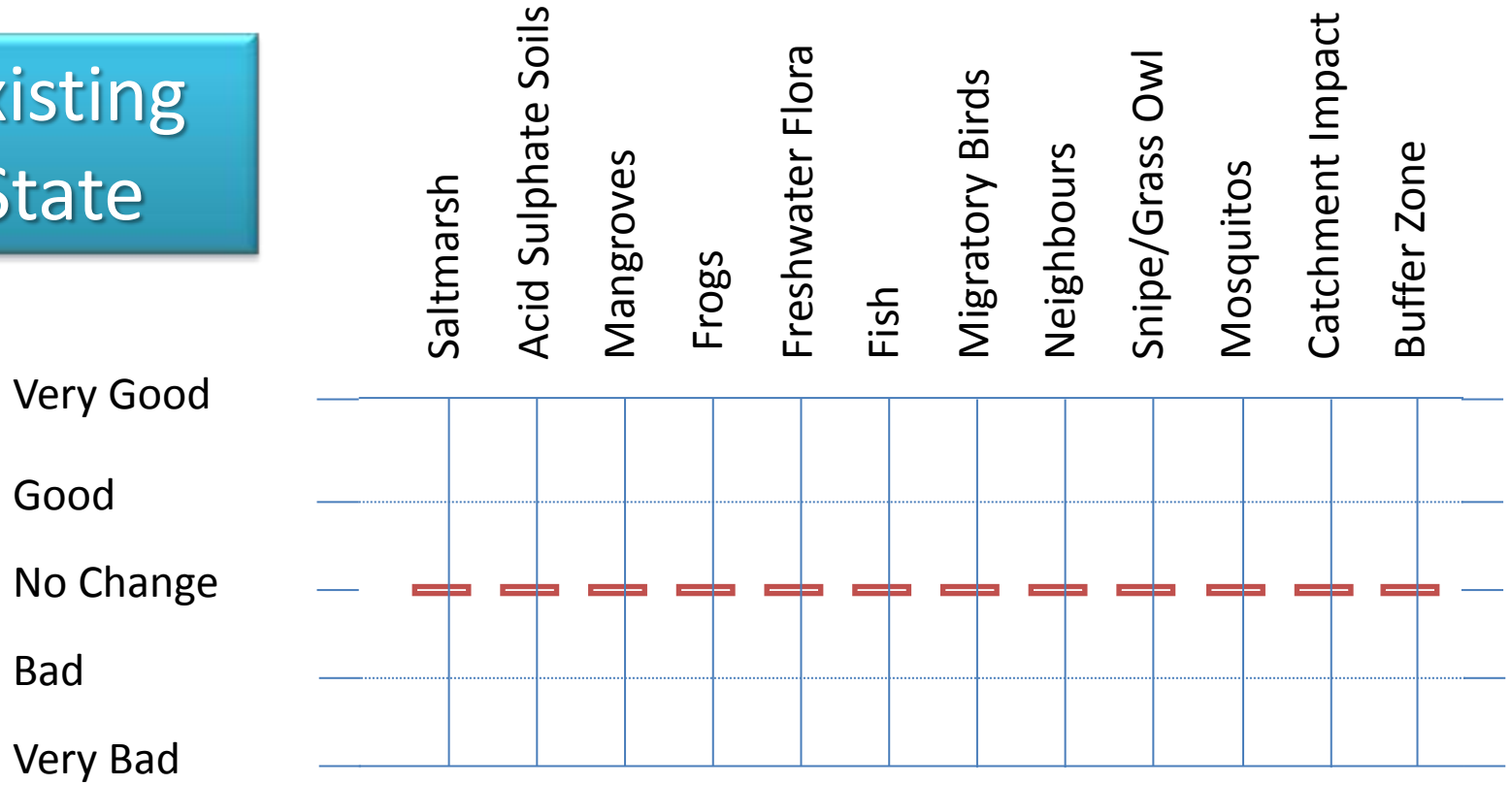

IMAGECATCHER

Restore/Recreate/Rehab/Remediate

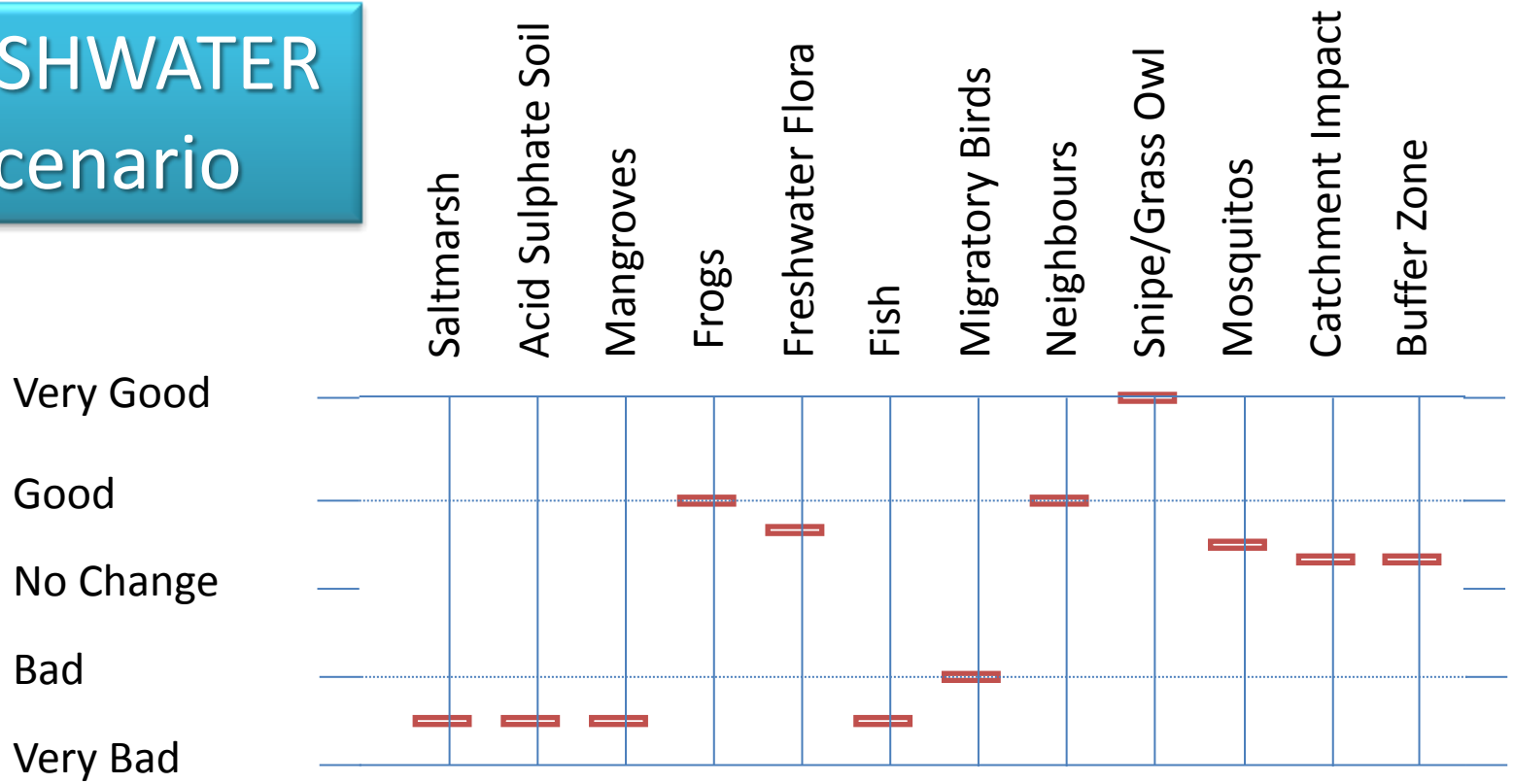
>$100M/a spent with limited understanding of:

- Ecohydraulics
- Hydrology vs Vegetation Linkages
- Geomorphology and carbon cycles
- System values (what is important and why)
- Climate Change impact
- System Feedback Loops

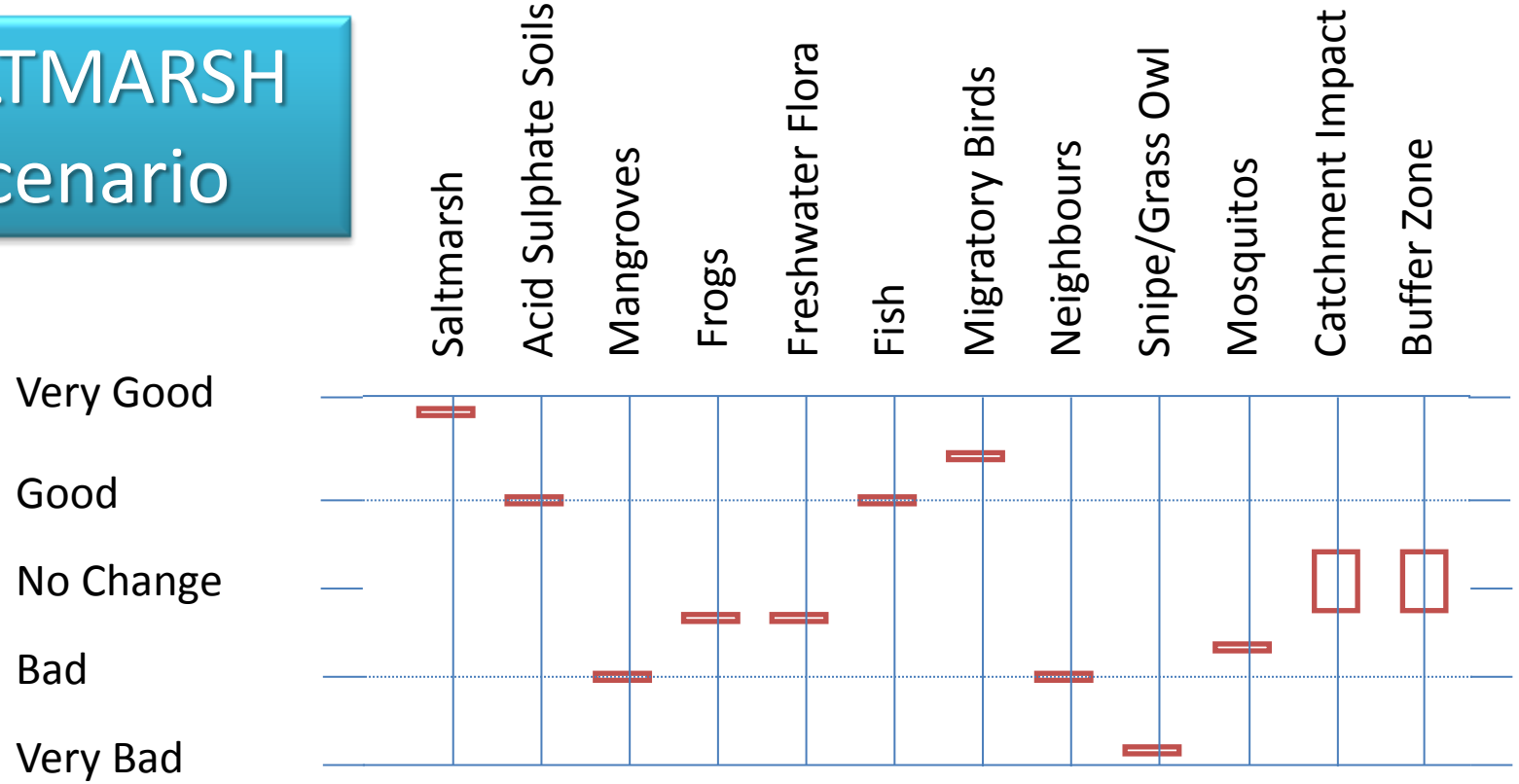
Existing State



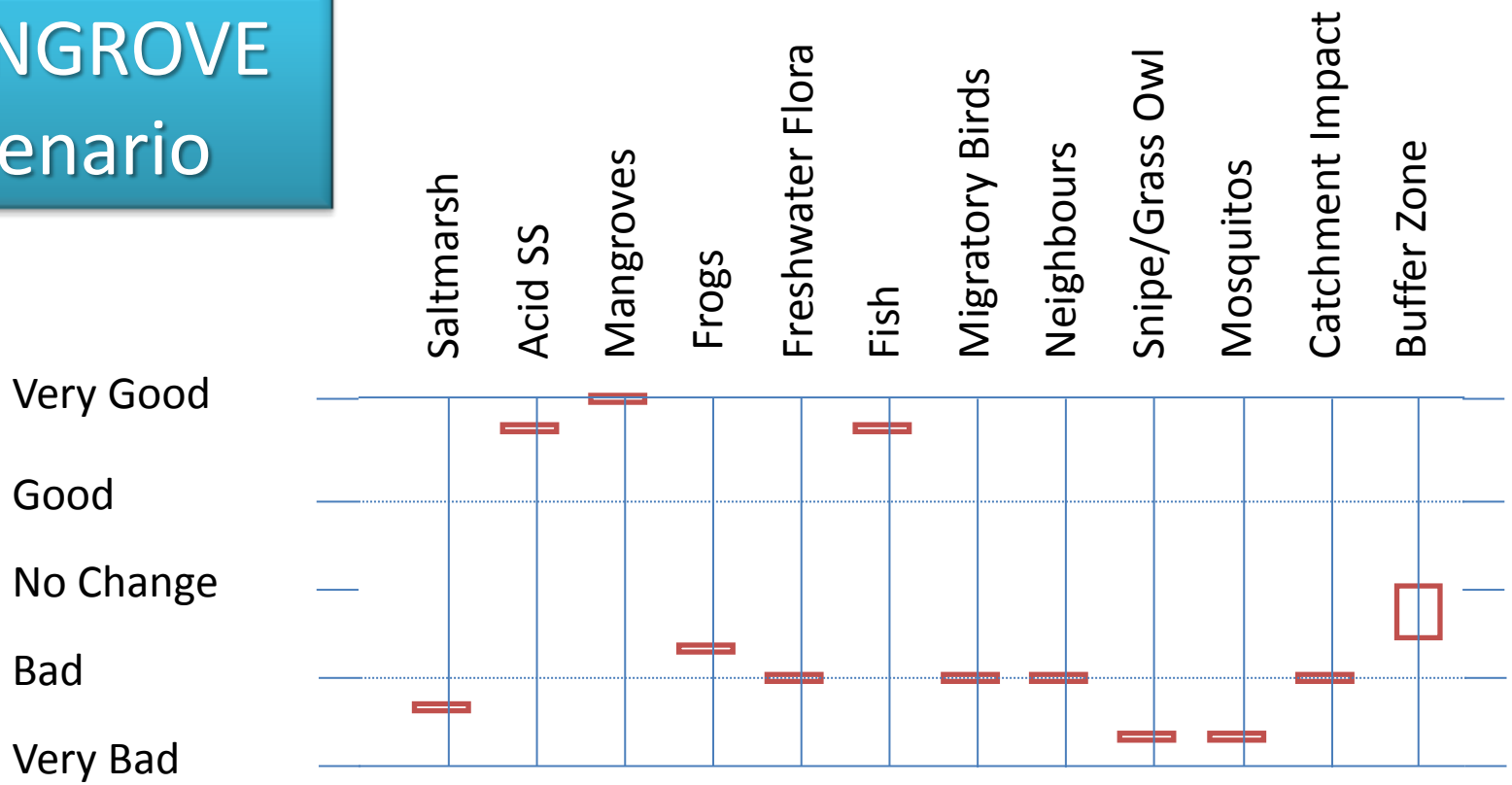
FRESHWATER Scenario



SALTMARSH Scenario

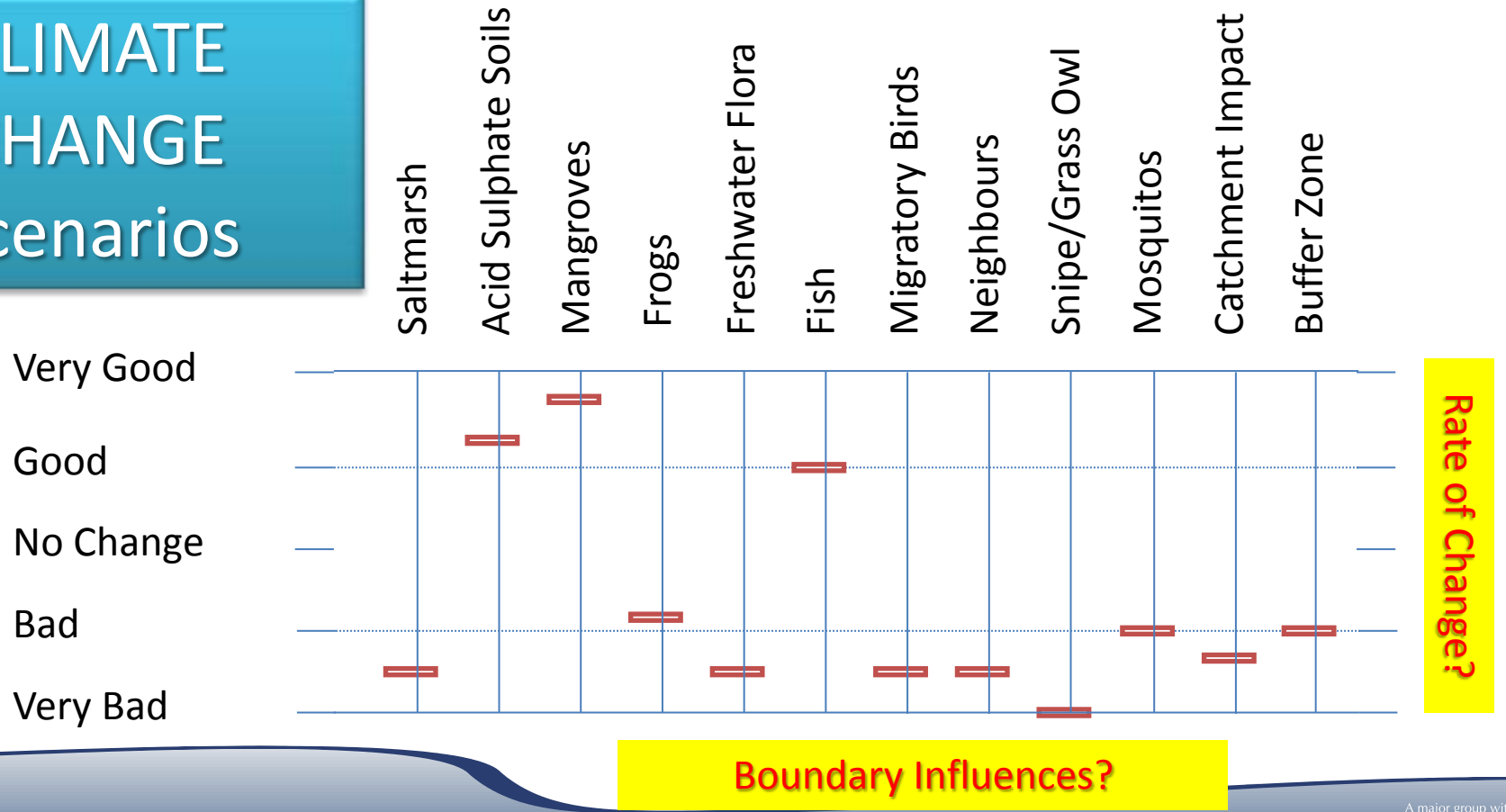


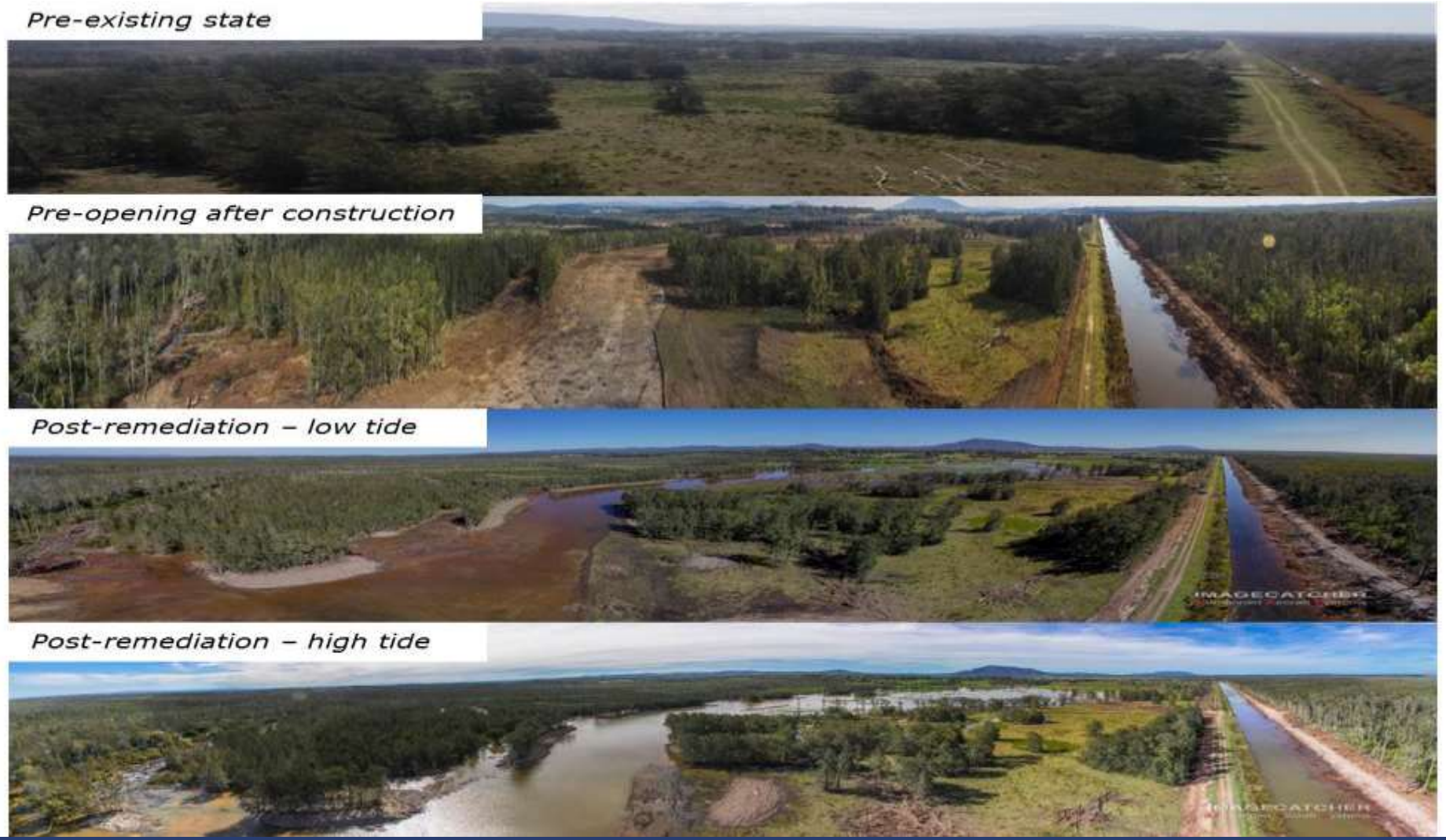
MANGROVE Scenario



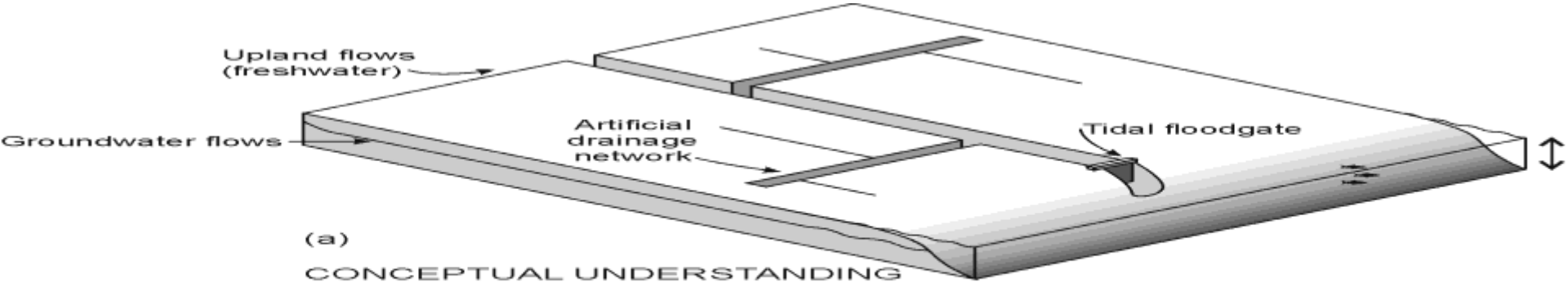
The Dream…

CLIMATE CHANGE Scenarios



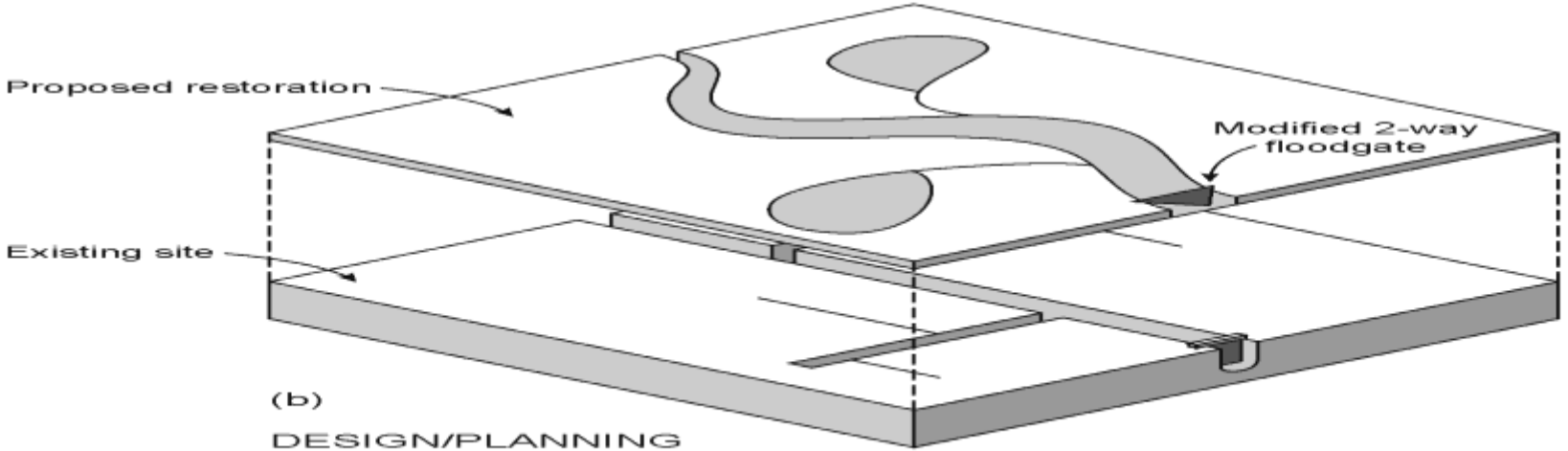

Pre-existing state
Pre-opening after construction
Post-remediation – low tide
Post-remediation – high tide

Typical Wetland Projects



(a)

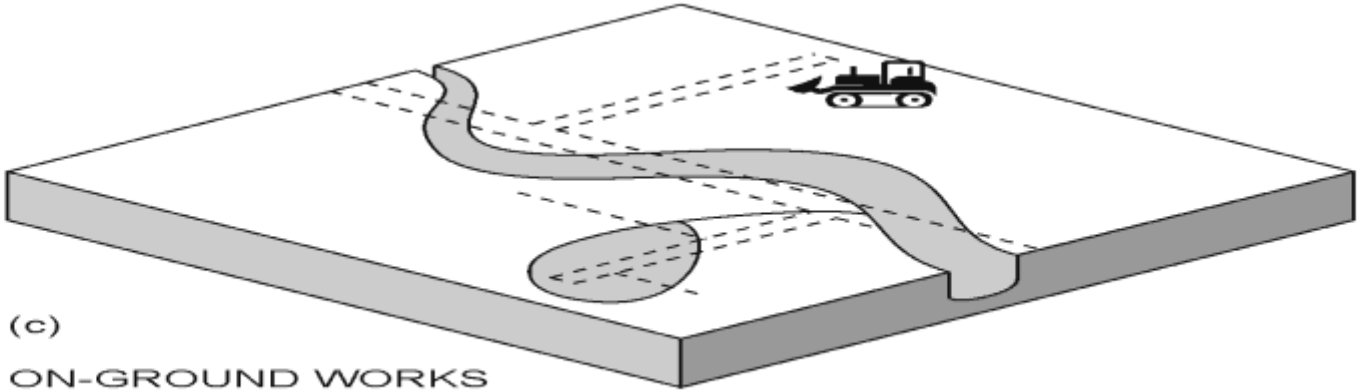
CONCEPTUAL UNDERSTANDING
Understanding existing site constraints and forcing functions
(numerical modelling)



(b)

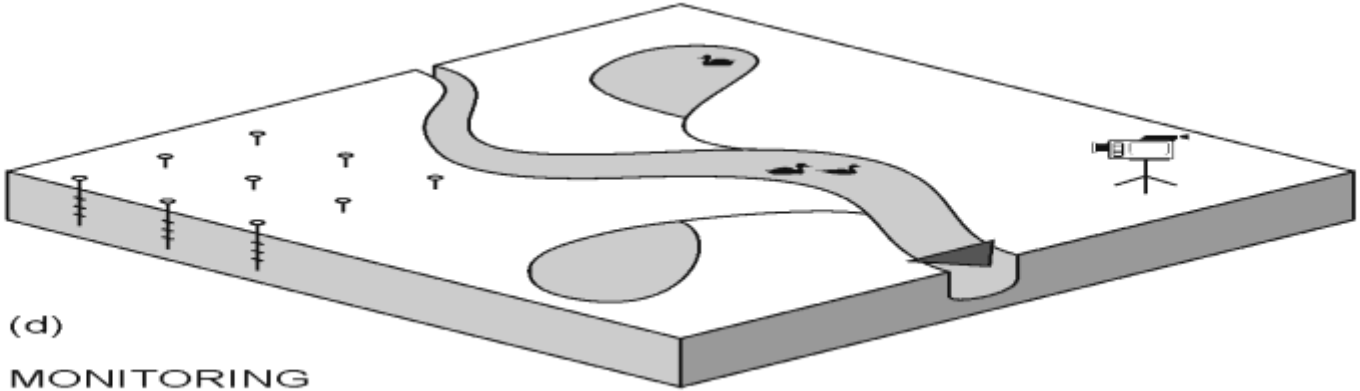
DESIGN/PLANNING
Applying conceptual design against site limitations and project restraints
(floodgate design criteria)

Typical Wetland Projects



(c)

ON-GROUND WORKS
Implements project plan
(modified gate design)



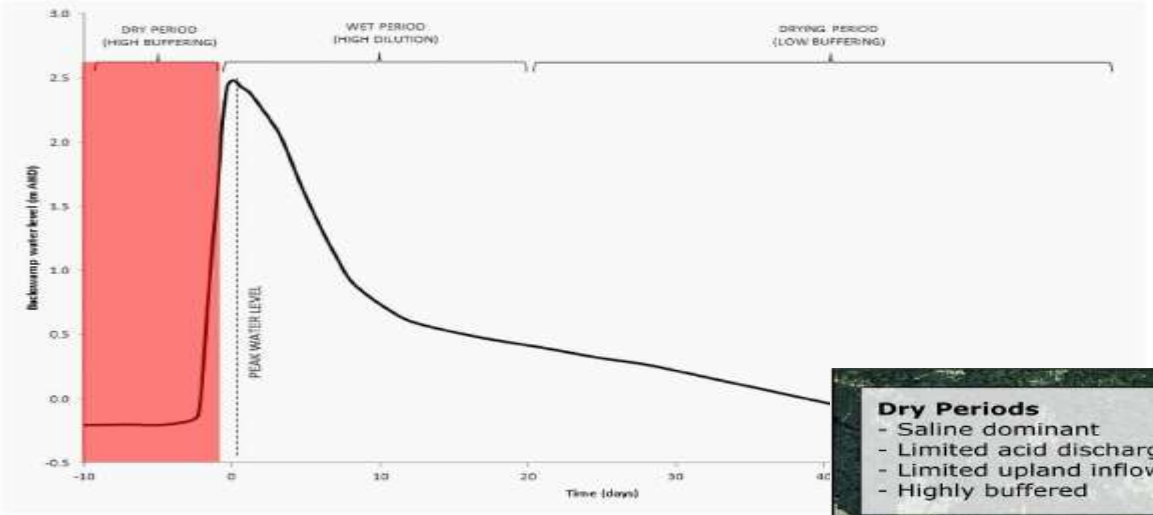
(d)

MONITORING
BACI programme
(importance of mass flux and imaging techniques)

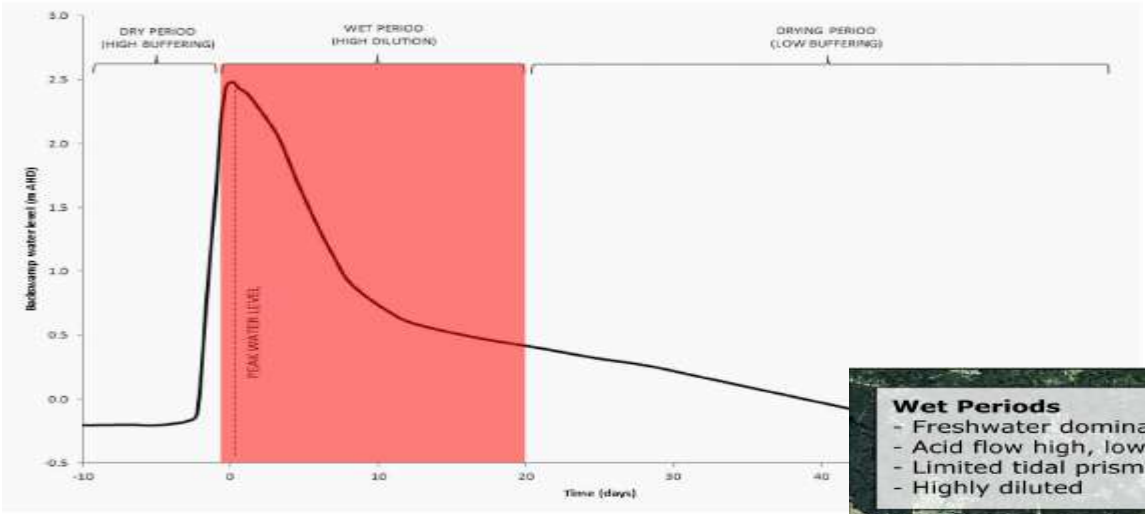
Concept Stage: Lessons

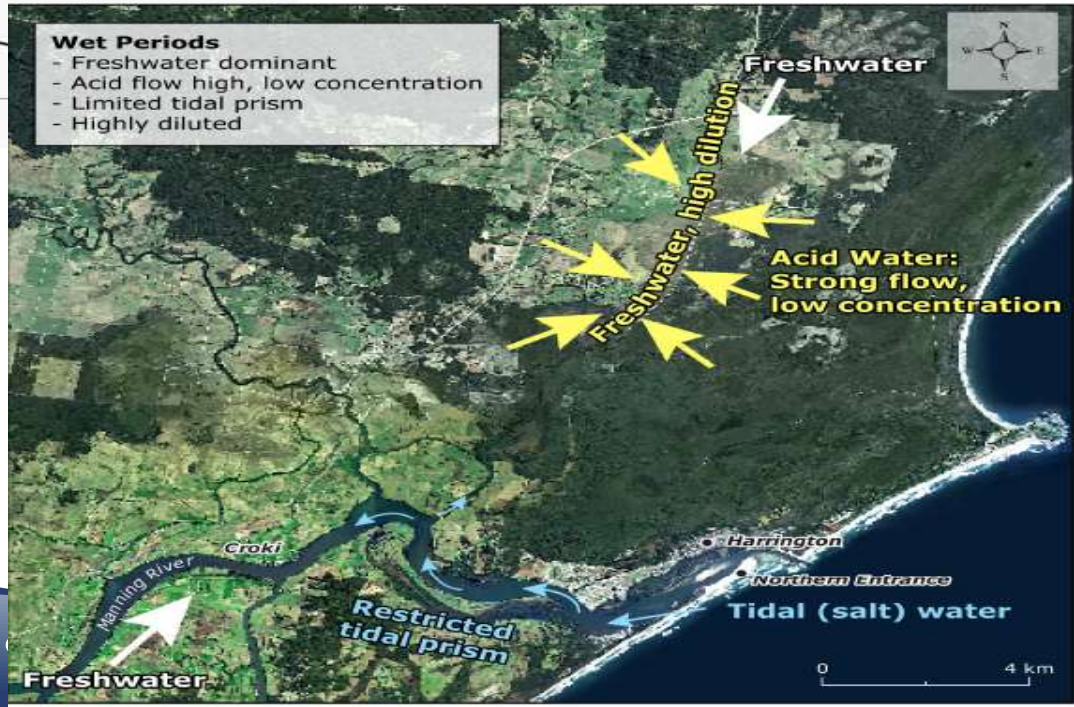
- Move beyond singular outcomes by understanding entire estuary.
- Plan within resilience timeframes.
- Objectively determine the highest priorities.

DRY Conditions

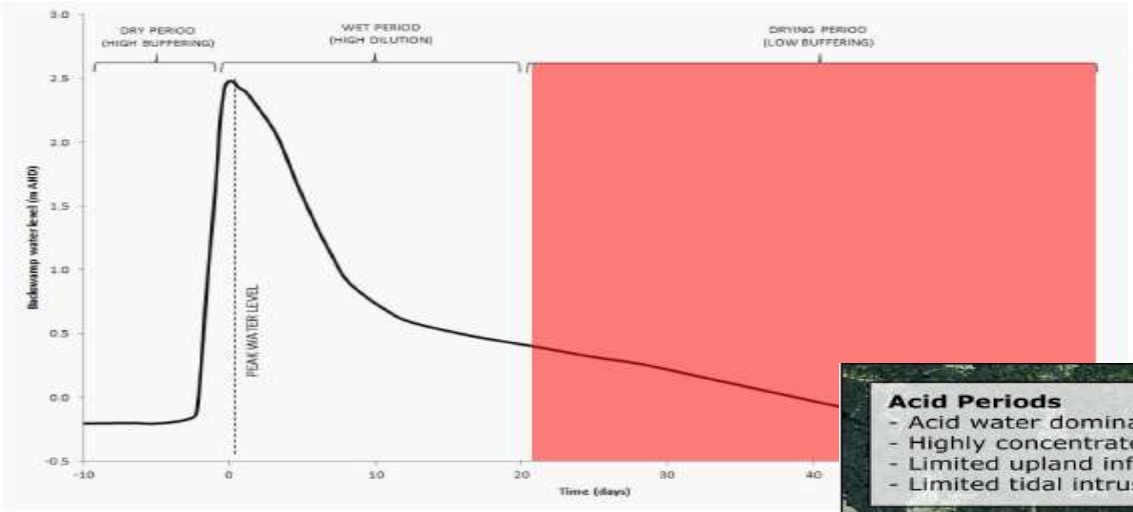


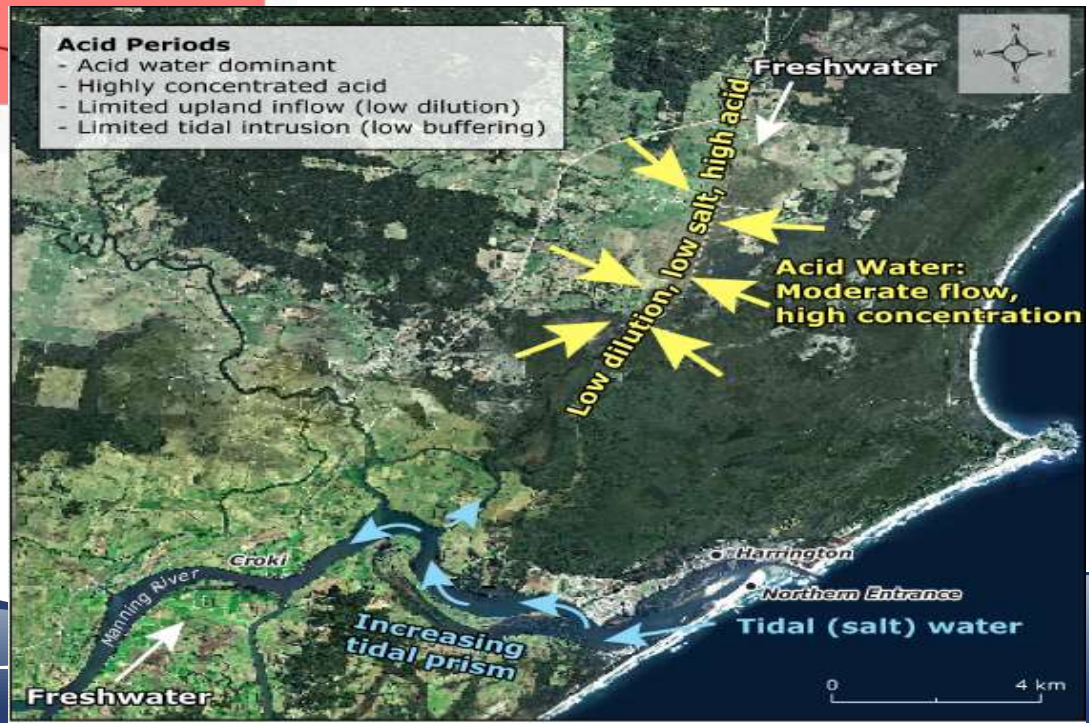
Flood Conditions



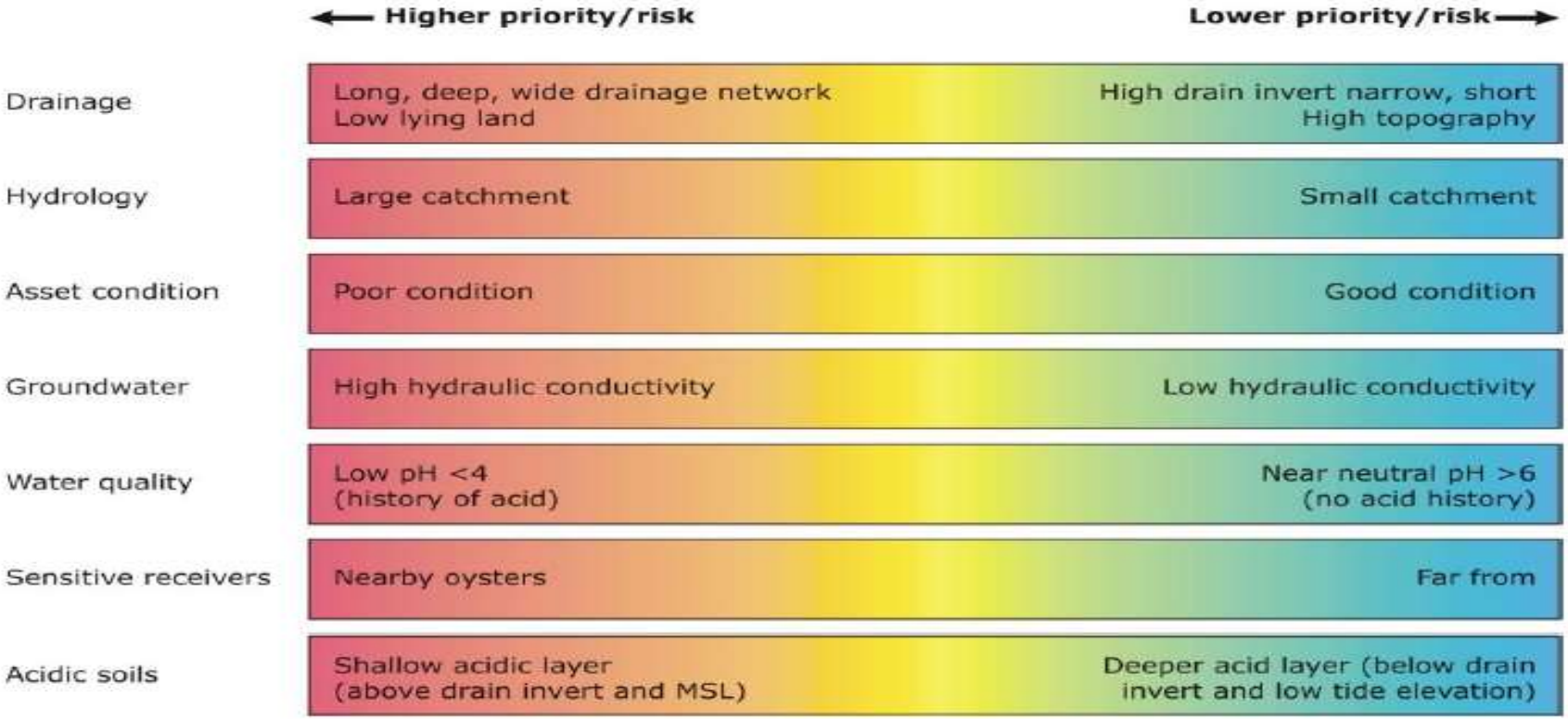


Draining Conditions (Acidic)

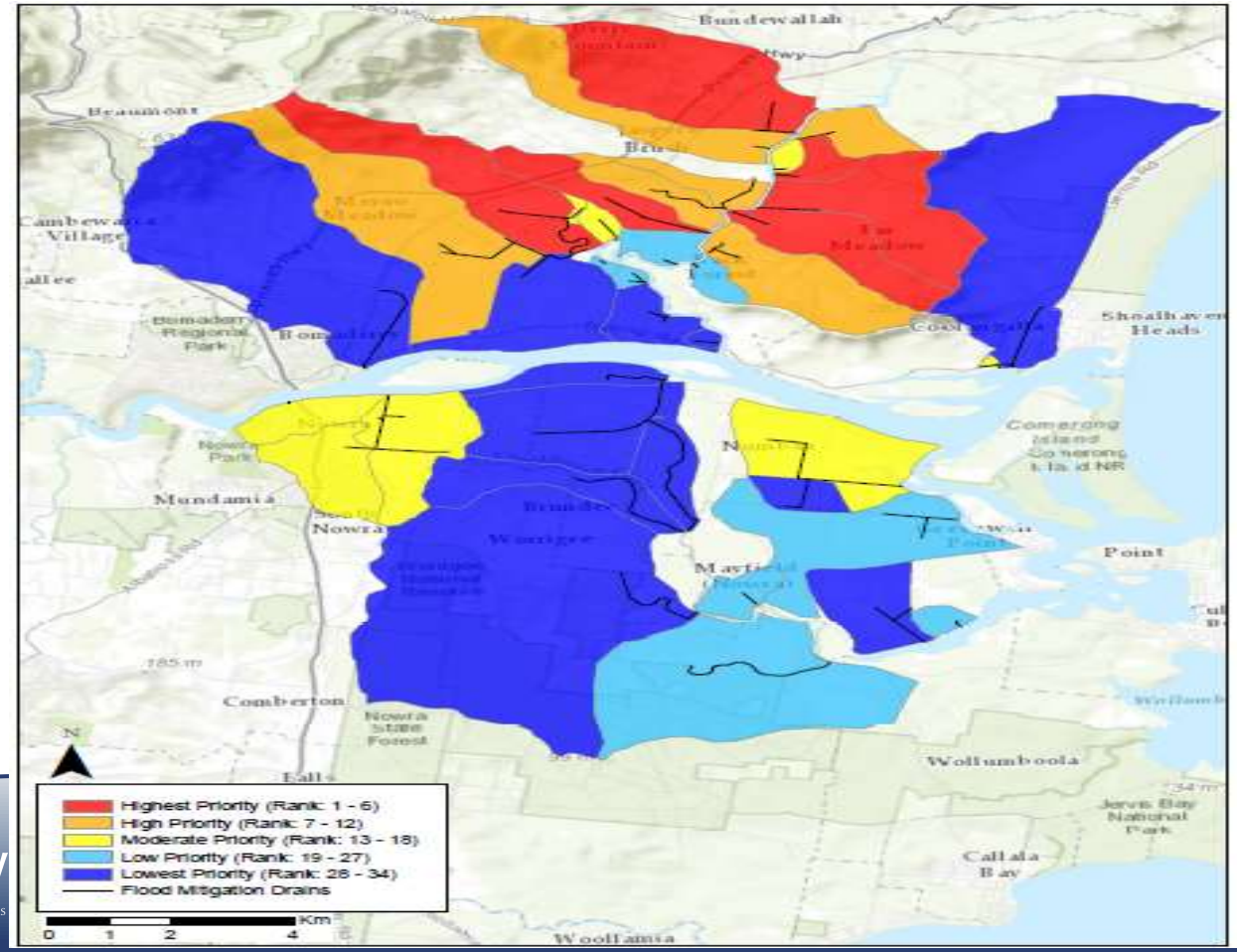




Risk Based Priority Method



Risk Results



Planning/Design Lessons

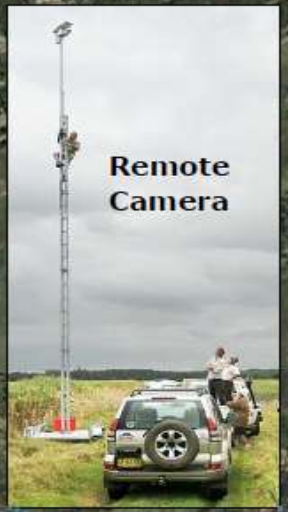
- Overseas methods largely not valid.
- On-ground engineering reduces initial risk but not a long-term solution.
- Pick winnable stages (but avoid zoos).

Case Study: Tomago Wetlands

Restoration of large coastal wetland for habitat offset project.

- Design
- Planning
- On-ground works
- Monitoring

Tomago Wetland Restoration Project



Levees

Stage 3

Hydraulic Structures

Stage 1

Stage 2

SmartGates

SwingGates

Wetland Creation


INUNDATION EXTENT

??


INUNDATION EXTENT

??

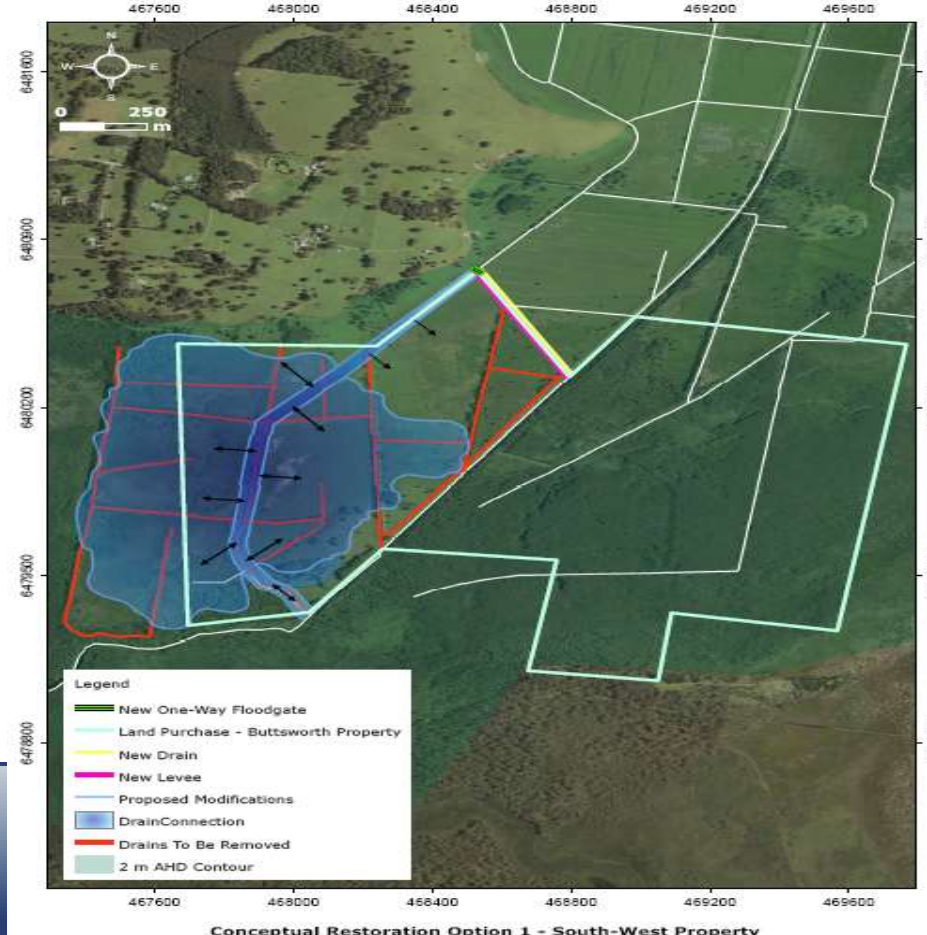

INUNDATION EXTENT

On-ground Controls

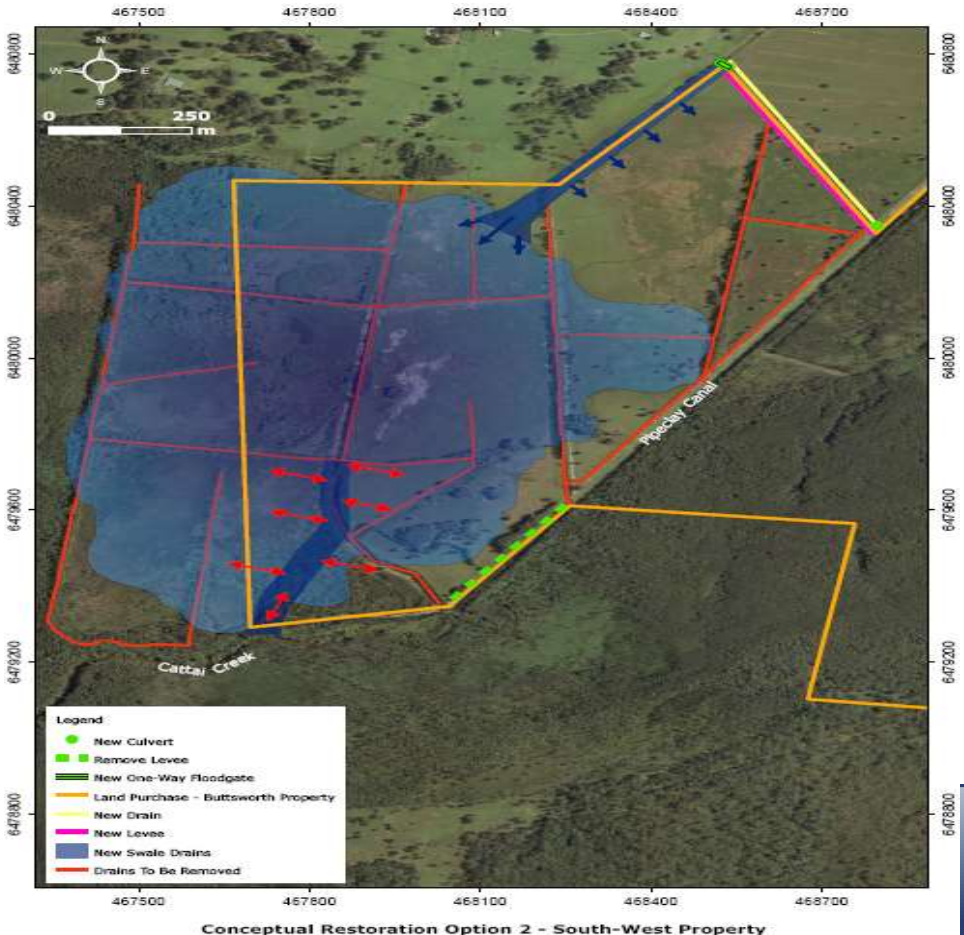
On-ground Works Lessons

- Trial by error is no longer acceptable.
- Trial periods don’t work.

Remediation Options: Tidal Wetland Creation

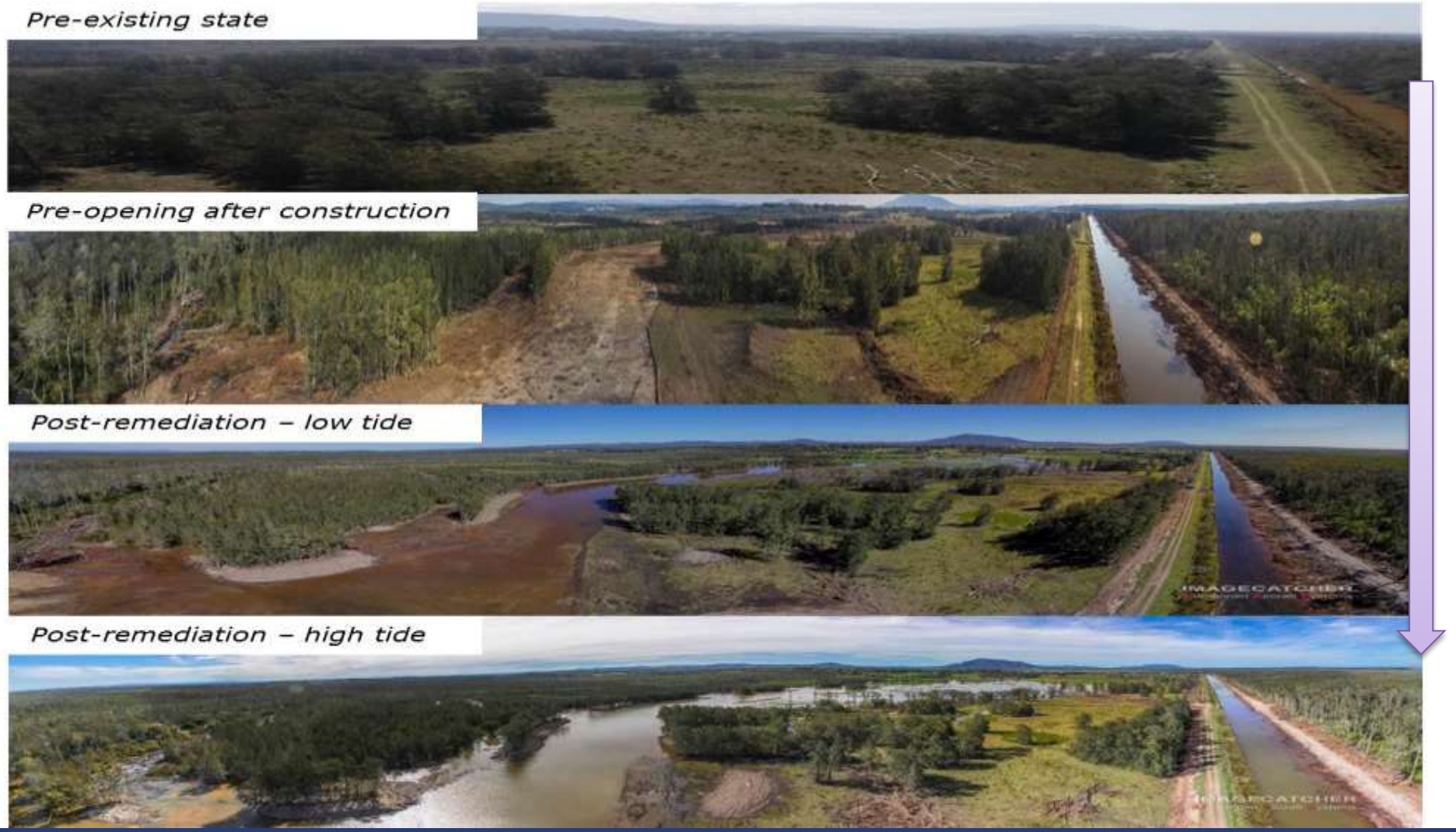


Conceptual Restoration Option 1 - South-West Property



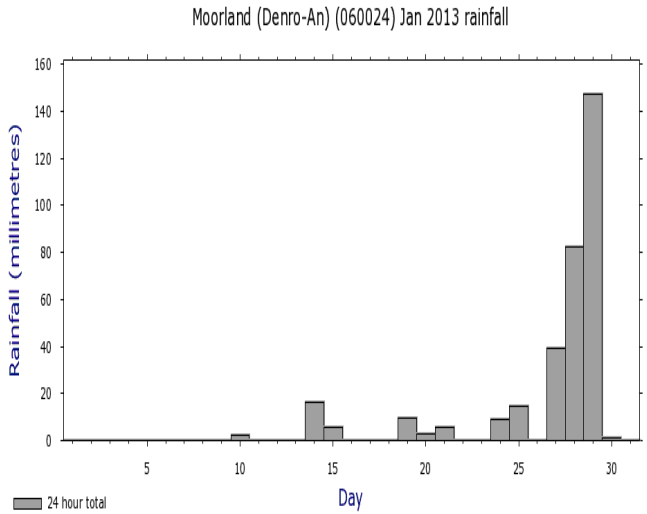
Conceptual Restoration Option 2 - South-West Property

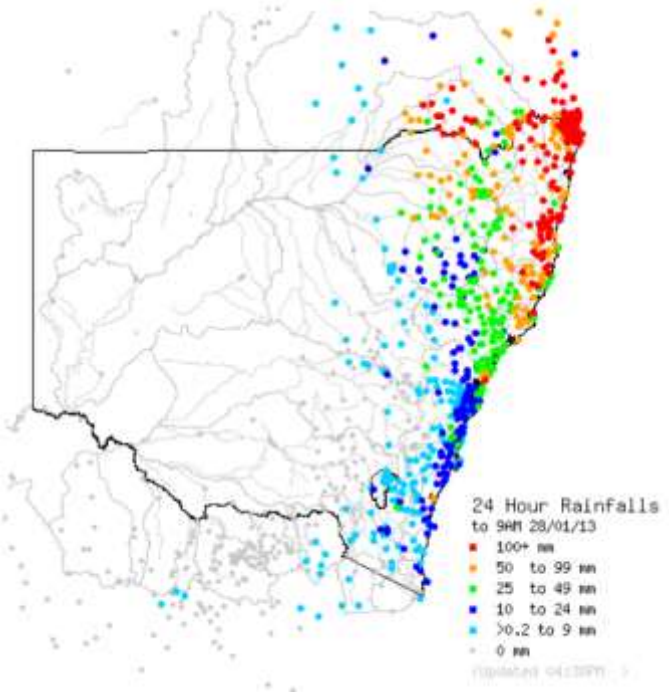
ory


Pre-existing state
Pre-opening after construction
Post-remediation – low tide
Post-remediation – high tide

Monitoring Lessons

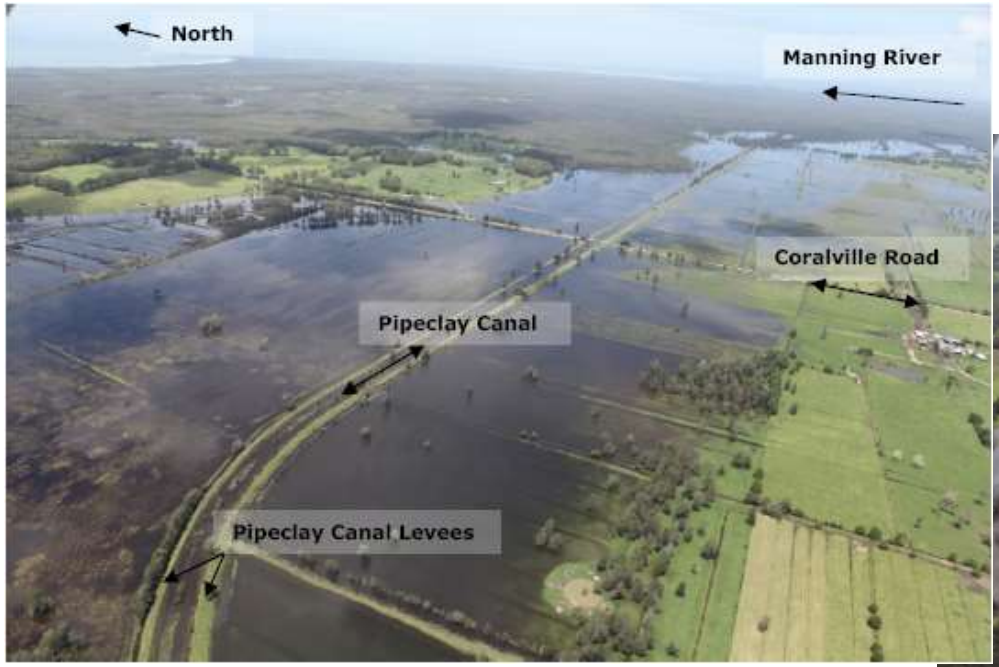
- Concentration is only ½ the story.
- Rehabilitation occurs in spurts.
- Link site results to impacts.



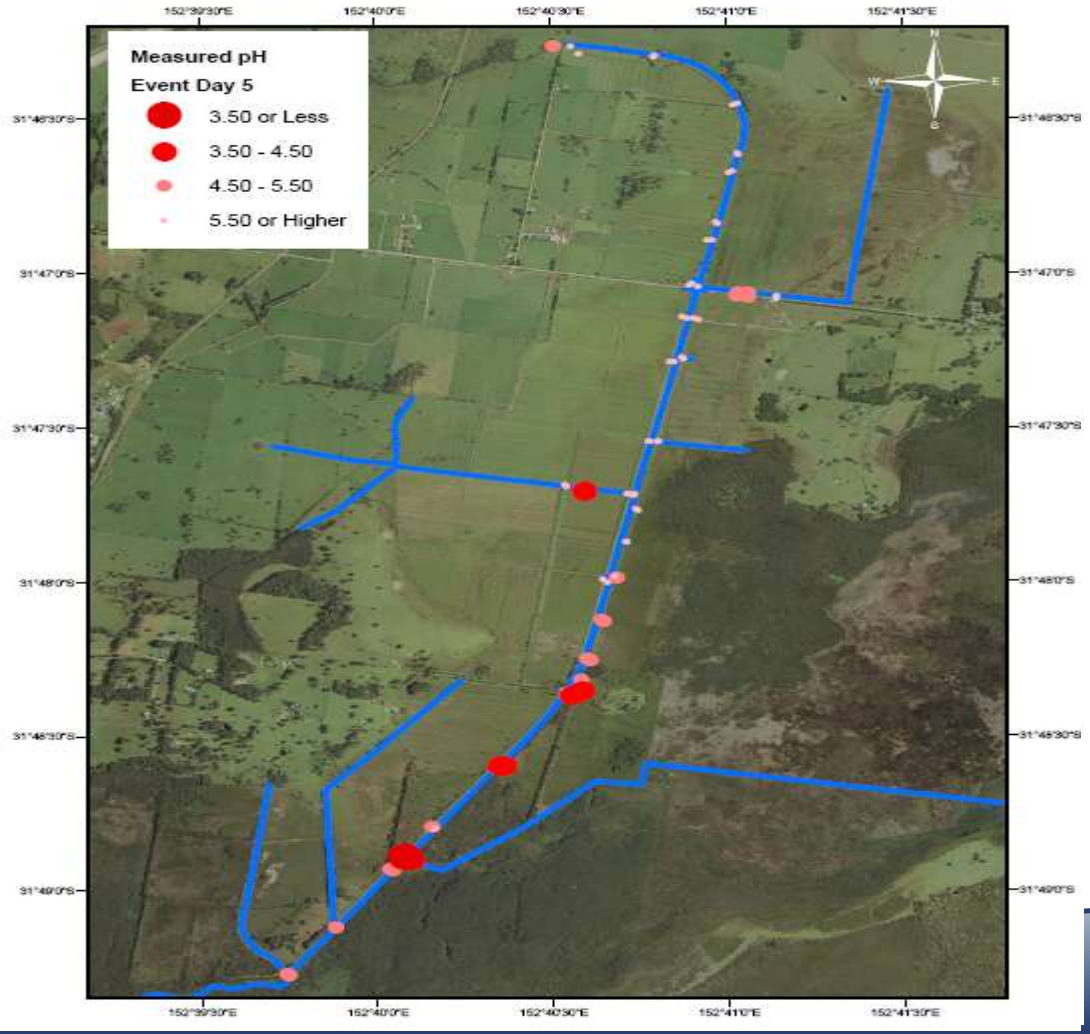


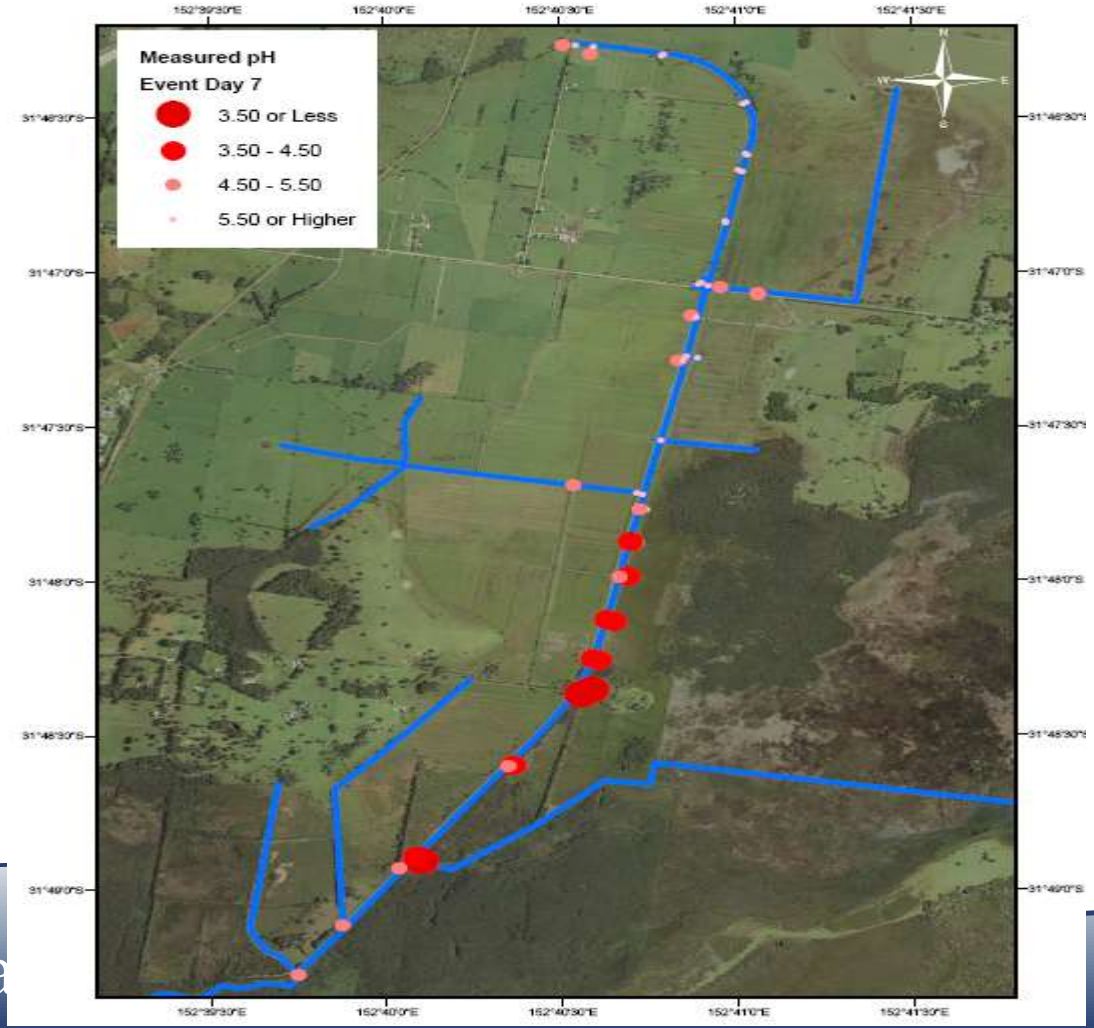
>200 mm of rainfall was recorded at the site in 3 days in late Jan 2013

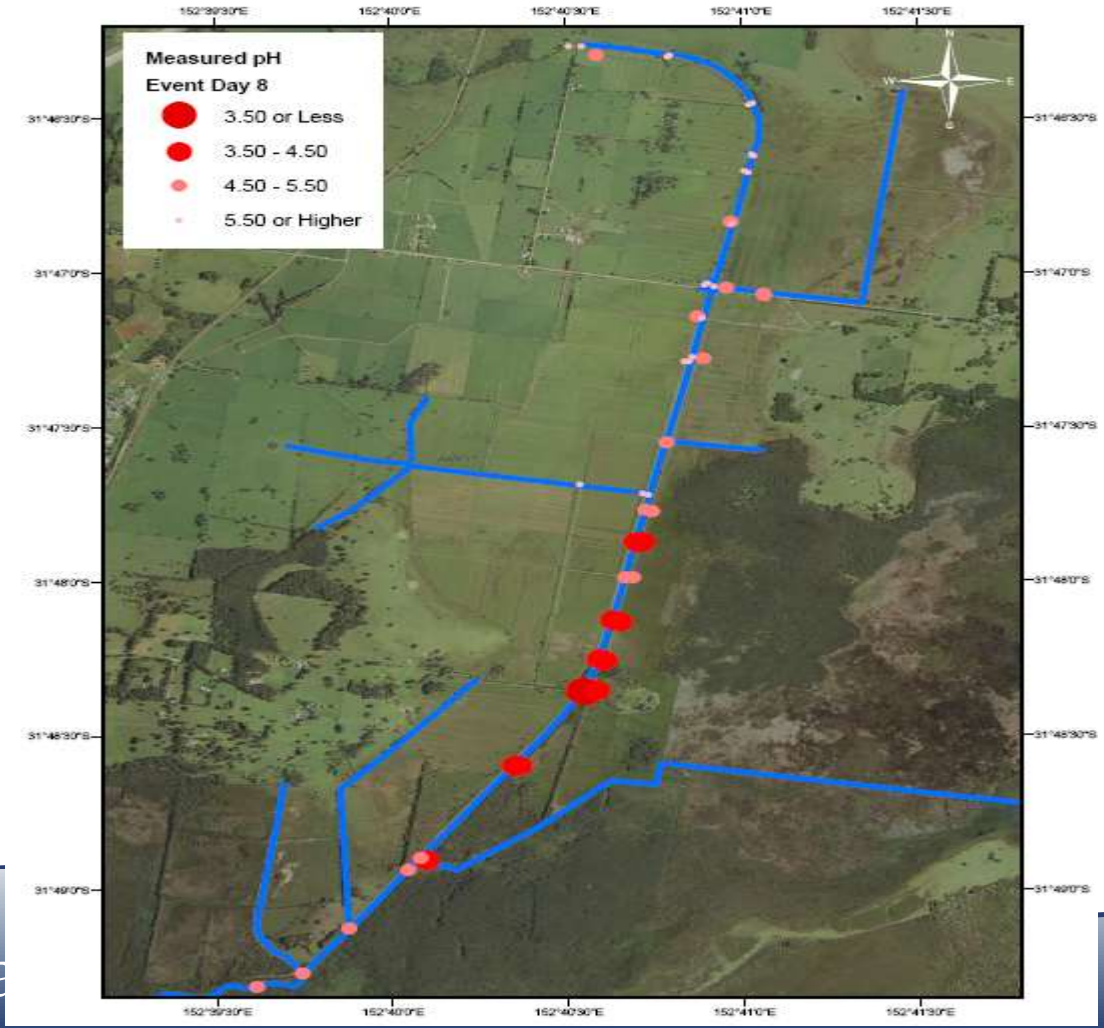
Wet Conditions: Jan-Feb 2013

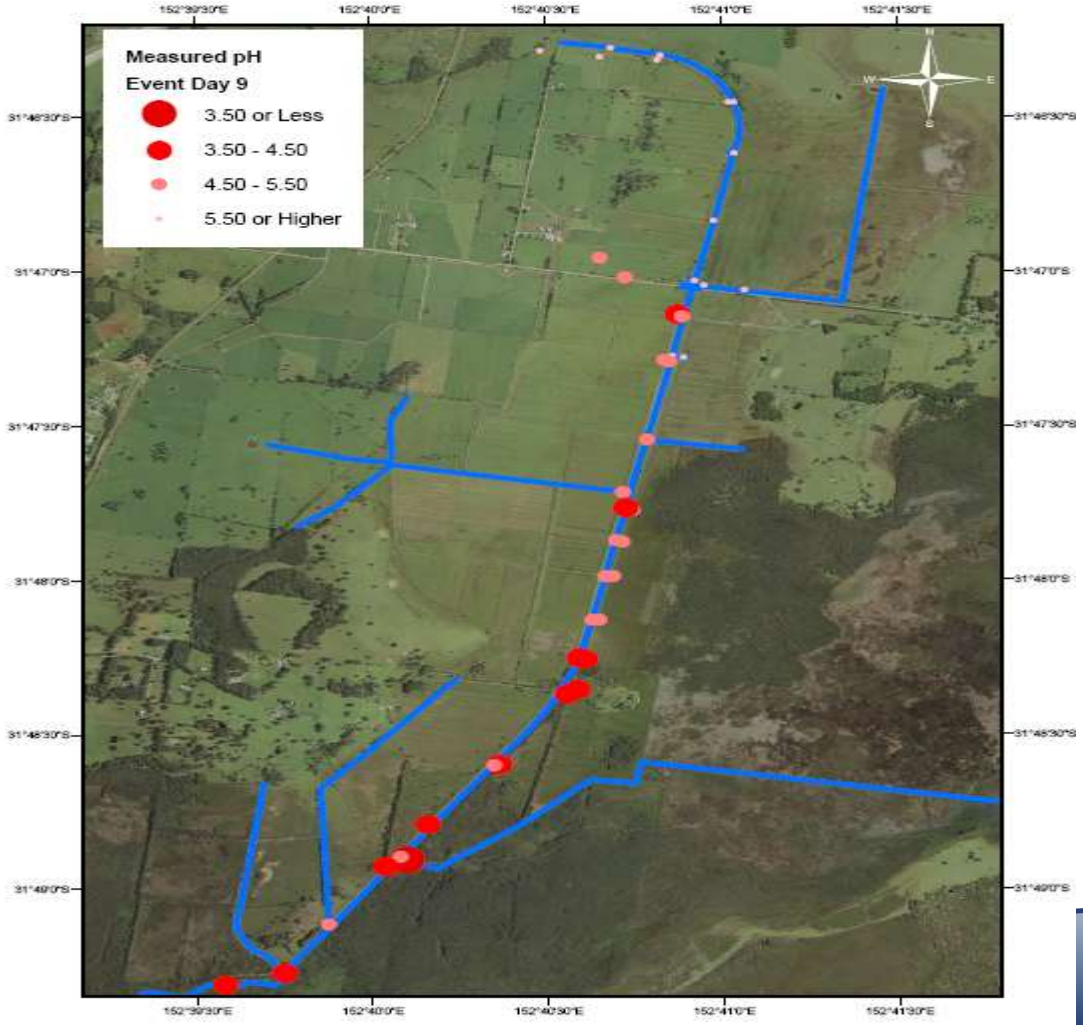


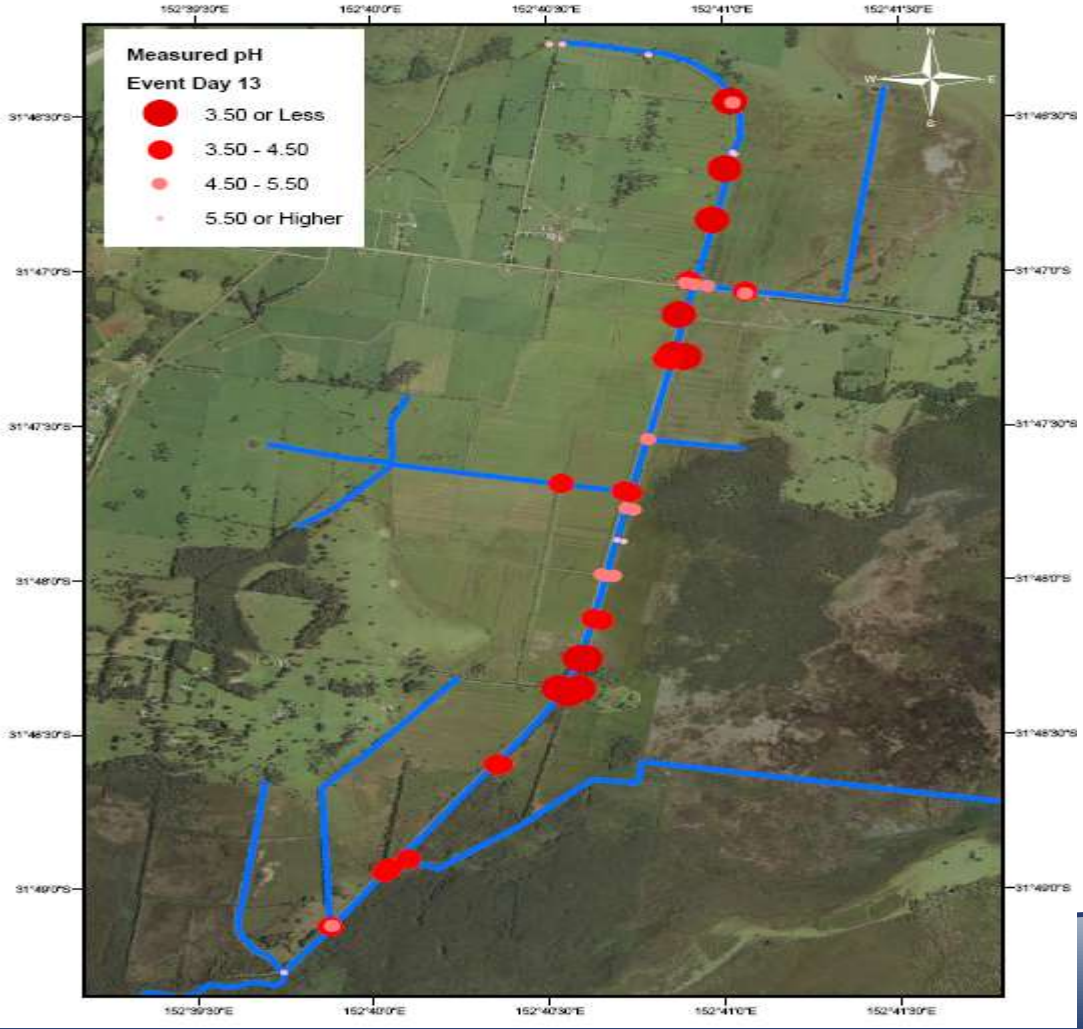
On-ground Impacts

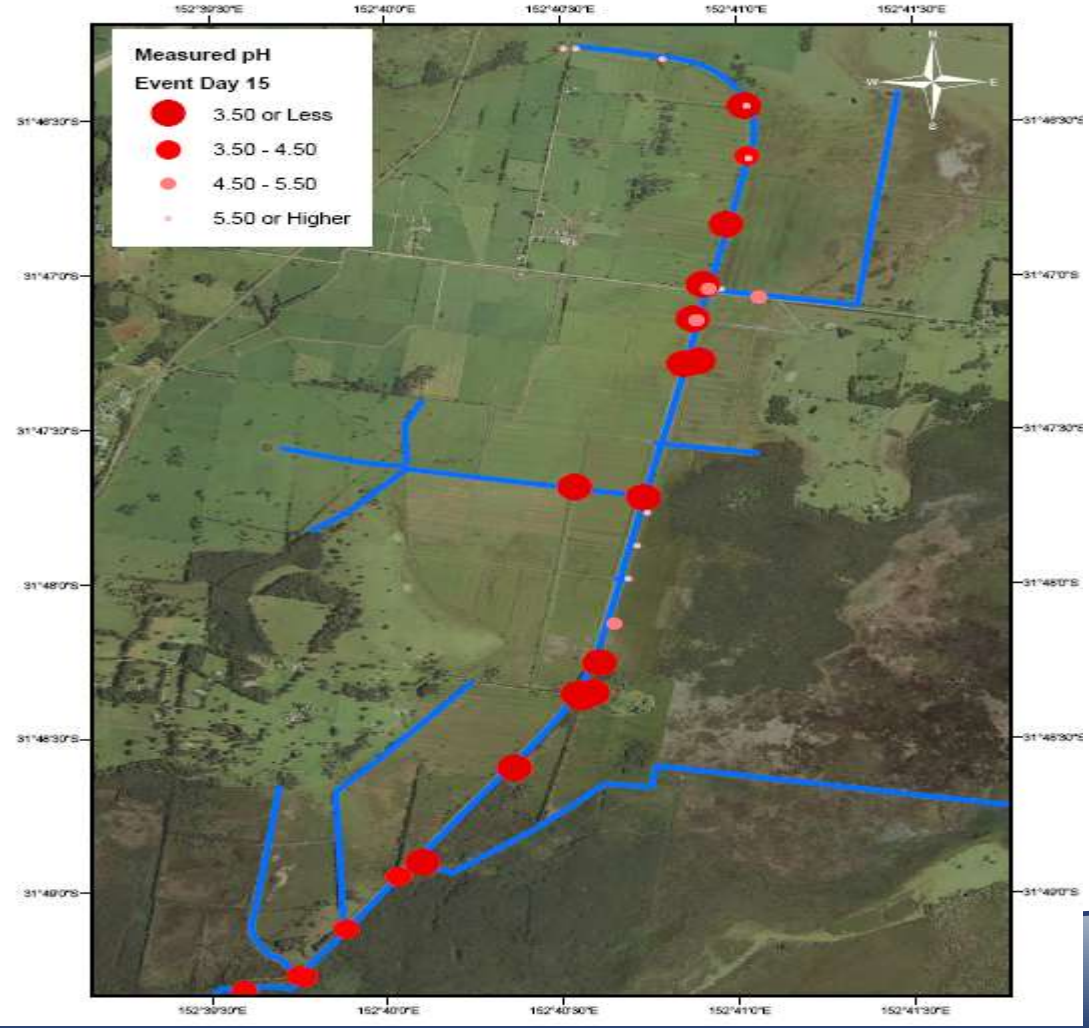

Measured pH
Event Day 5
3.50 or Less
3.50 - 4.50
4.50 - 5.50
5.50 or Higher
152°39'30"E
152°40'0"E
152°40'30"E
152°41'0"E
152°41'30"E
31°46'30"S
31°47'0"S
31°47'30"S
31°48'0"S
31°48'30"S
31°49'0"S
N
W
E
S

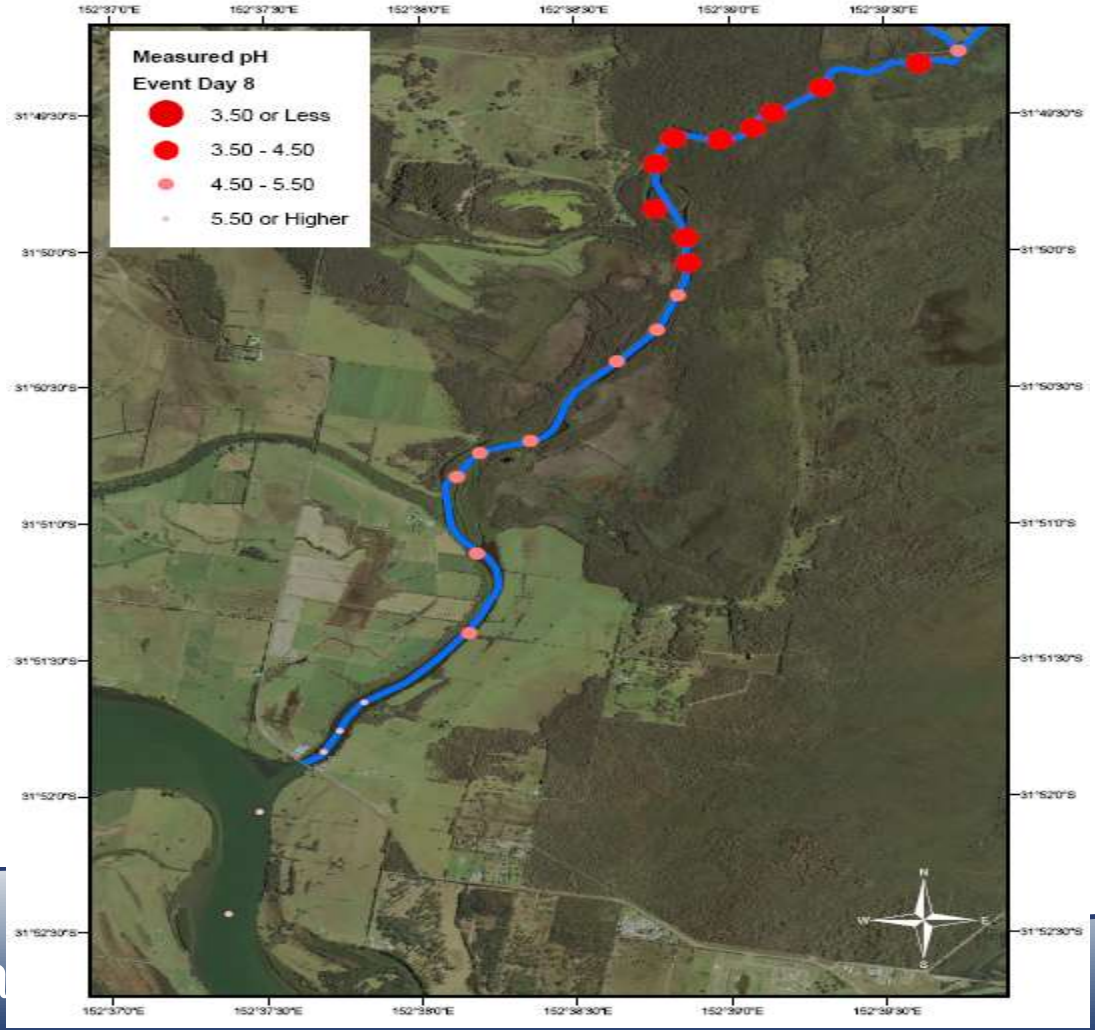

Measured pH
Event Day 7
3.50 or Less
3.50 - 4.50
4.50 - 5.50
5.50 or Higher
152°39'30"E
152°40'0"E
152°40'30"E
152°41'0"E
152°41'30"E
31°46'30"S
31°47'0"S
31°47'30"S
31°48'0"S
31°48'30"S
31°49'0"S
N
W
E
S


Measured pH
Event Day 8
3.50 or Less
3.50 - 4.50
4.50 - 5.50
5.50 or Higher
152°39'30"E
152°40'0"E
152°40'30"E
152°41'0"E
152°41'30"E
31°46'30"S
31°47'0"S
31°47'30"S
31°48'0"S
31°48'30"S
31°49'0"S
N
W
E


Measured pH
Event Day 9
3.50 or Less
3.50 - 4.50
4.50 - 5.50
5.50 or Higher
152°39'30"E
152°40'0"E
152°40'30"E
152°41'0"E
152°41'30"E
31°46'30"S
31°47'0"S
31°47'30"S
31°48'0"S
31°48'30"S
31°49'0"S
N
W
E
S


Measured pH
Event Day 13
3.50 or Less
3.50 - 4.50
4.50 - 5.50
5.50 or Higher
152°39'30"E
152°40'0"E
152°40'30"E
152°41'0"E
152°41'30"E
31°46'30"S
31°47'0"S
31°47'30"S
31°48'0"S
31°48'30"S
31°49'0"S
N
W
E
S


Measured pH
Event Day 15
3.50 or Less
3.50 - 4.50
4.50 - 5.50
5.50 or Higher
152°39'30"E
152°40'0"E
152°40'30"E
152°41'0"E
152°41'30"E
31°48'30"S
31°47'0"S
31°47'30"S
31°48'0"S
31°48'30"S
31°49'0"S
N
S
E
W


Measured pH
Event Day 8
3.50 or Less
3.50 - 4.50
4.50 - 5.50
5.50 or Higher
152°37'0"E
152°37'30"E
152°38'0"E
152°38'30"E
152°39'0"E
152°39'30"E
31°49'30"S
31°50'0"S
31°50'30"S
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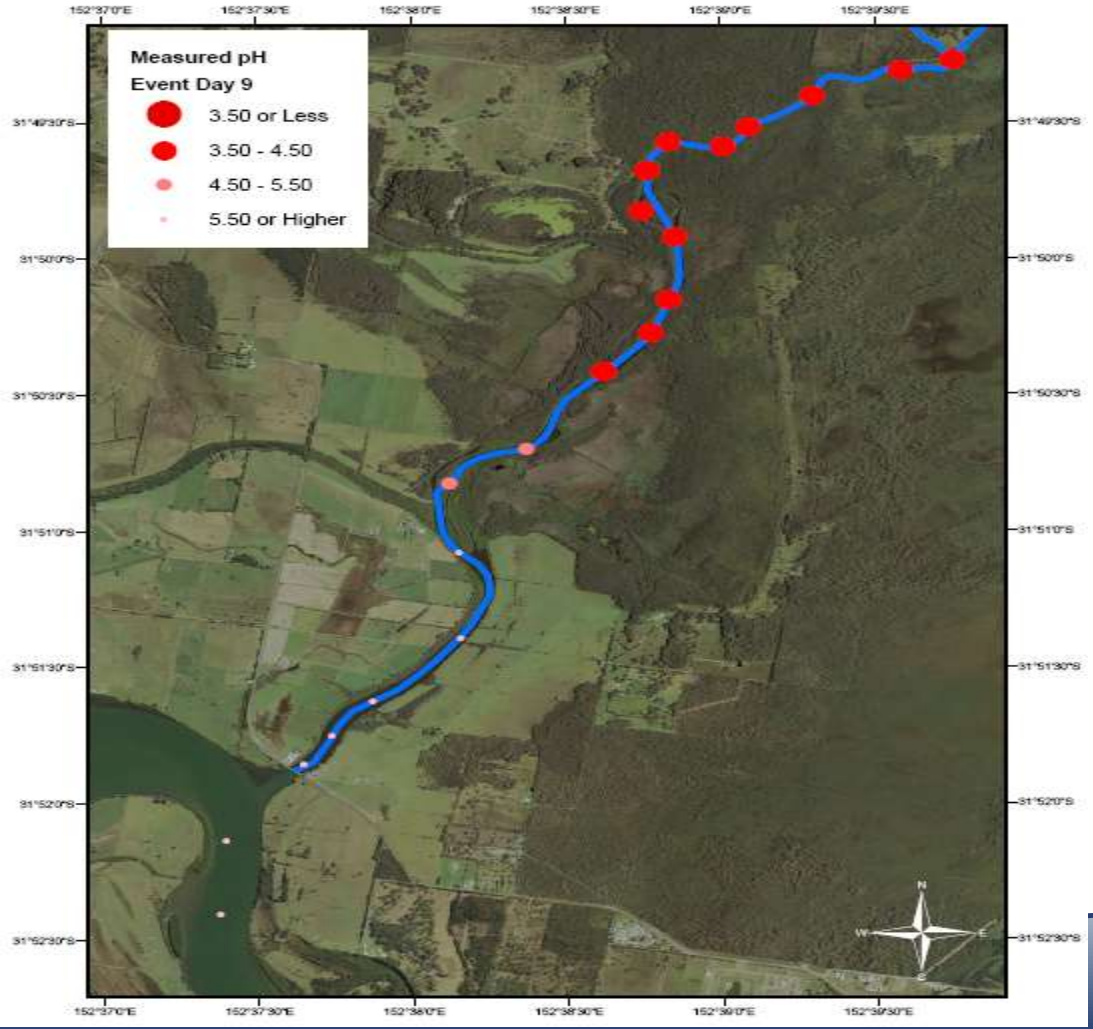
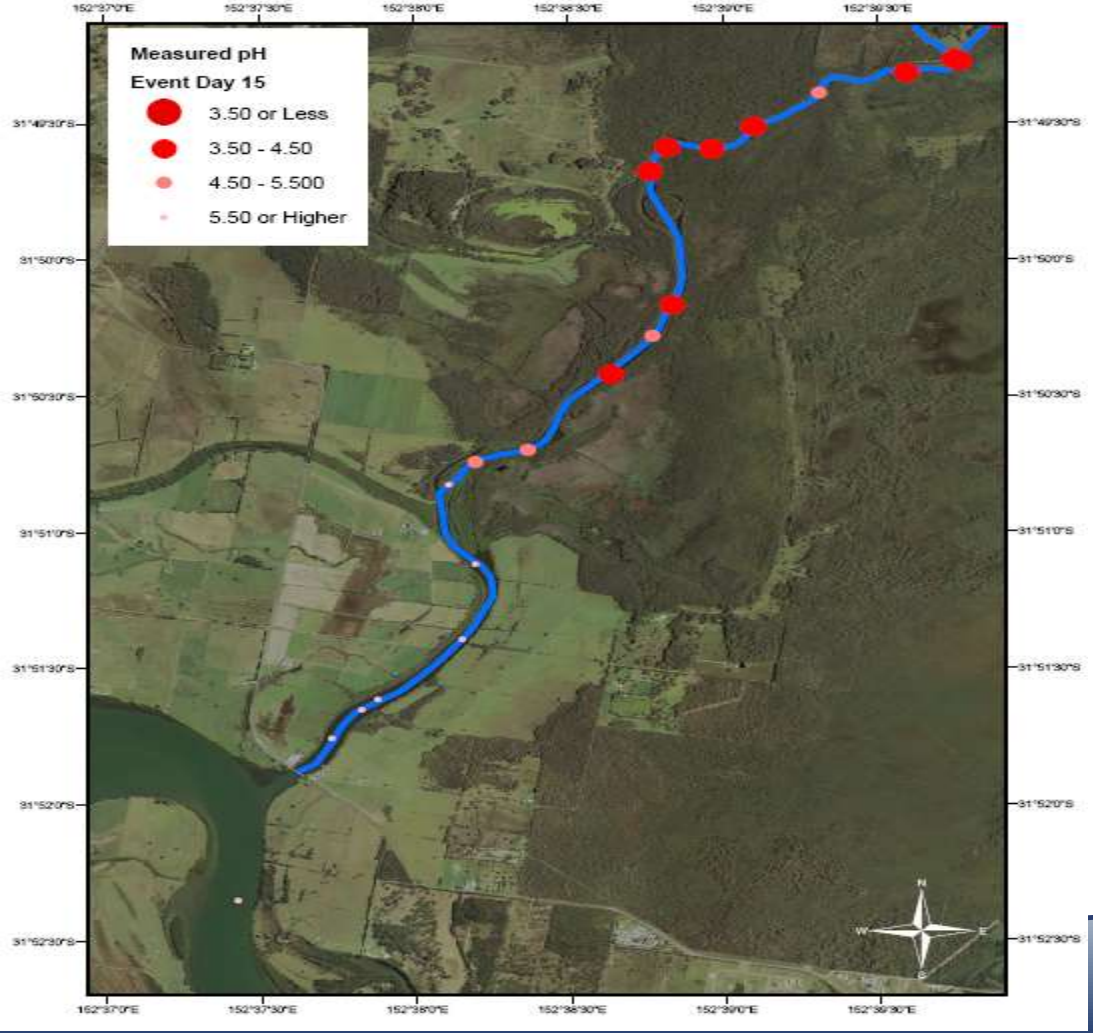
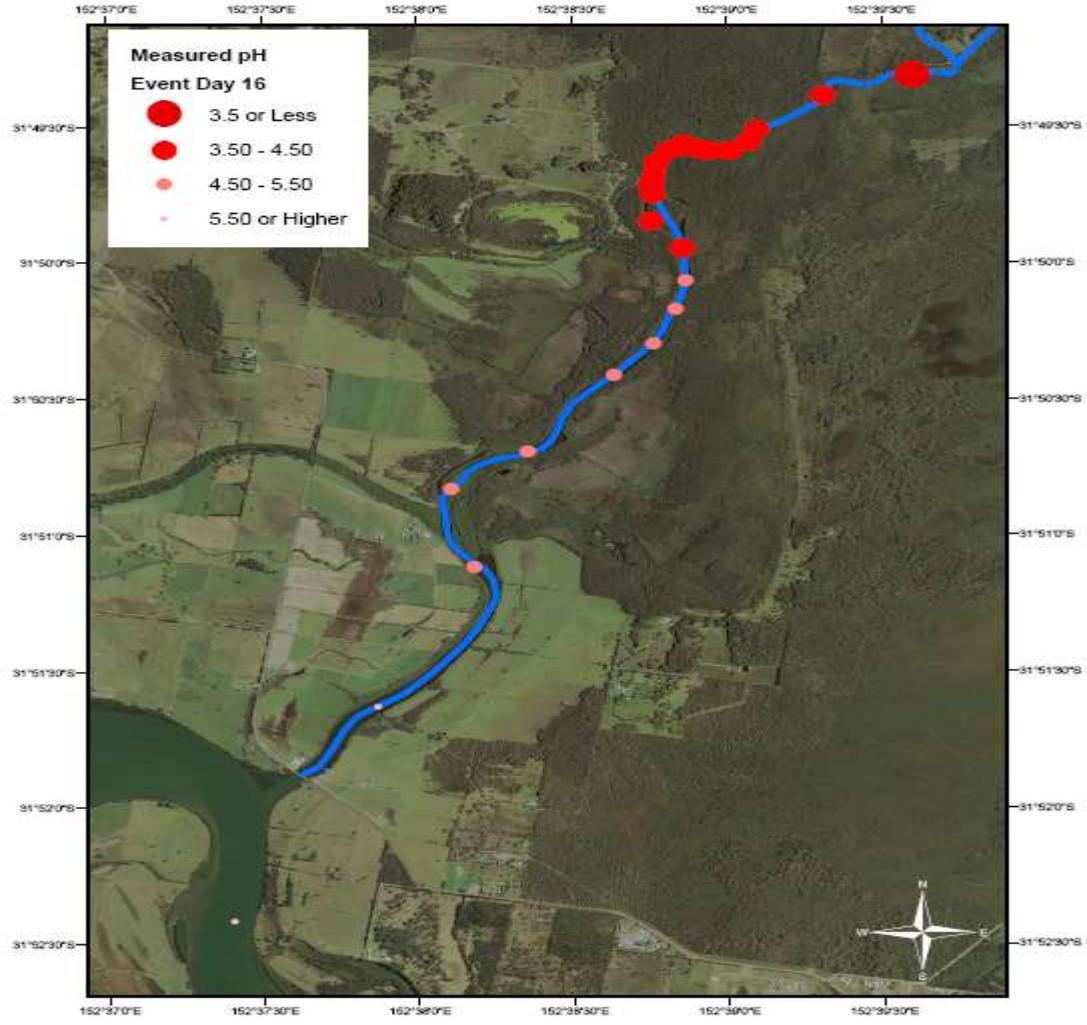
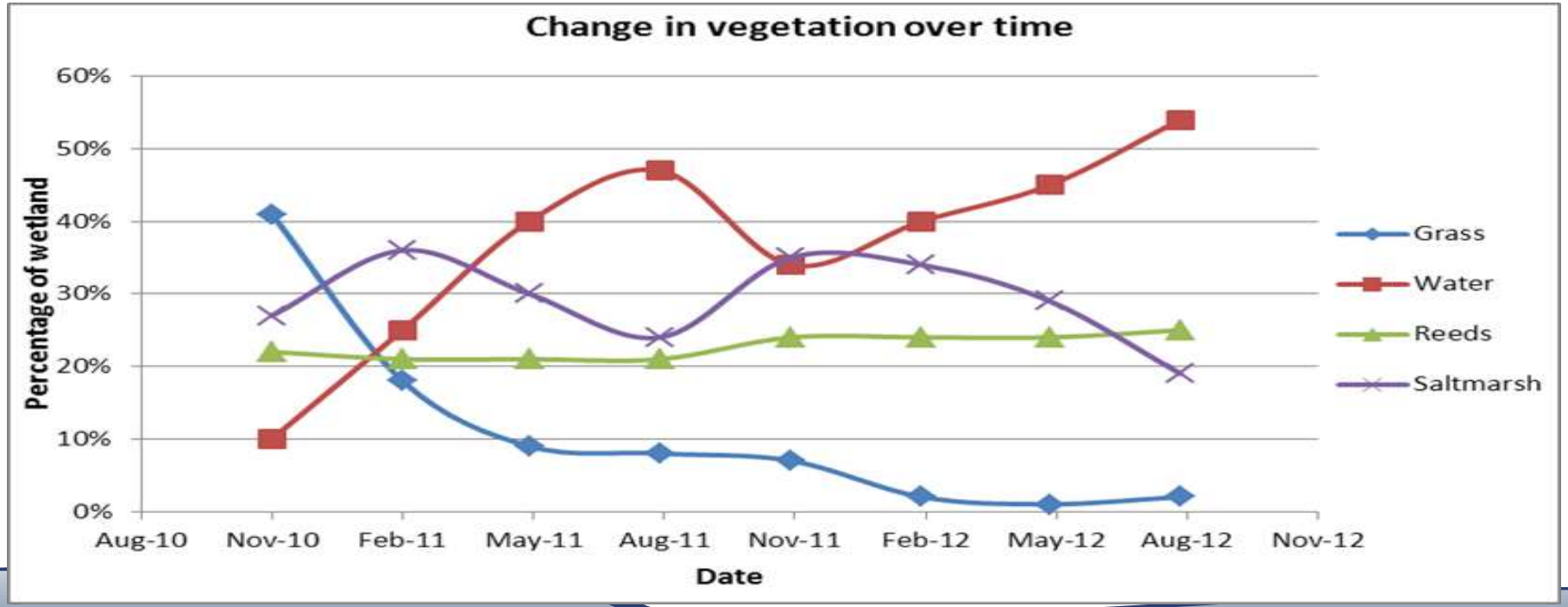
31°51'30"S
31°52'0"S
31°52'30"S
N
W
E
S


Measured pH
Event Day 9
3.50 or Less
3.50 - 4.50
4.50 - 5.50
5.50 or Higher
152°37'0"E
152°37'30"E
152°38'0"E
152°38'30"E
152°39'0"E
152°39'30"E
31°49'30"S
31°50'0"S
31°50'30"S
31°51'0"S
31°51'30"S
31°52'0"S
31°52'30"S
N
W
E
S


Measured pH
Event Day 15
3.50 or Less
3.50 - 4.50
4.50 - 5.500
5.50 or Higher
152°37'0"E
152°37'30"E
152°38'0"E
152°38'30"E
152°39'0"E
152°39'30"E
31°49'30"S
31°50'0"S
31°50'30"S
31°51'0"S
31°51'30"S
31°52'0"S
31°52'30"S
N
W
E
S


Measured pH
Event Day 16
3.5 or Less
3.50 - 4.50
4.50 - 5.50
5.50 or Higher
152°37'0"E
152°37'30"E
152°38'0"E
152°38'30"E
152°39'0"E
152°39'30"E
31°49'30"S
31°50'0"S
31°50'30"S
31°51'0"S
31°51'30"S
31°52'0"S
31°52'30"S
N
W
E
S

Response to Restoration

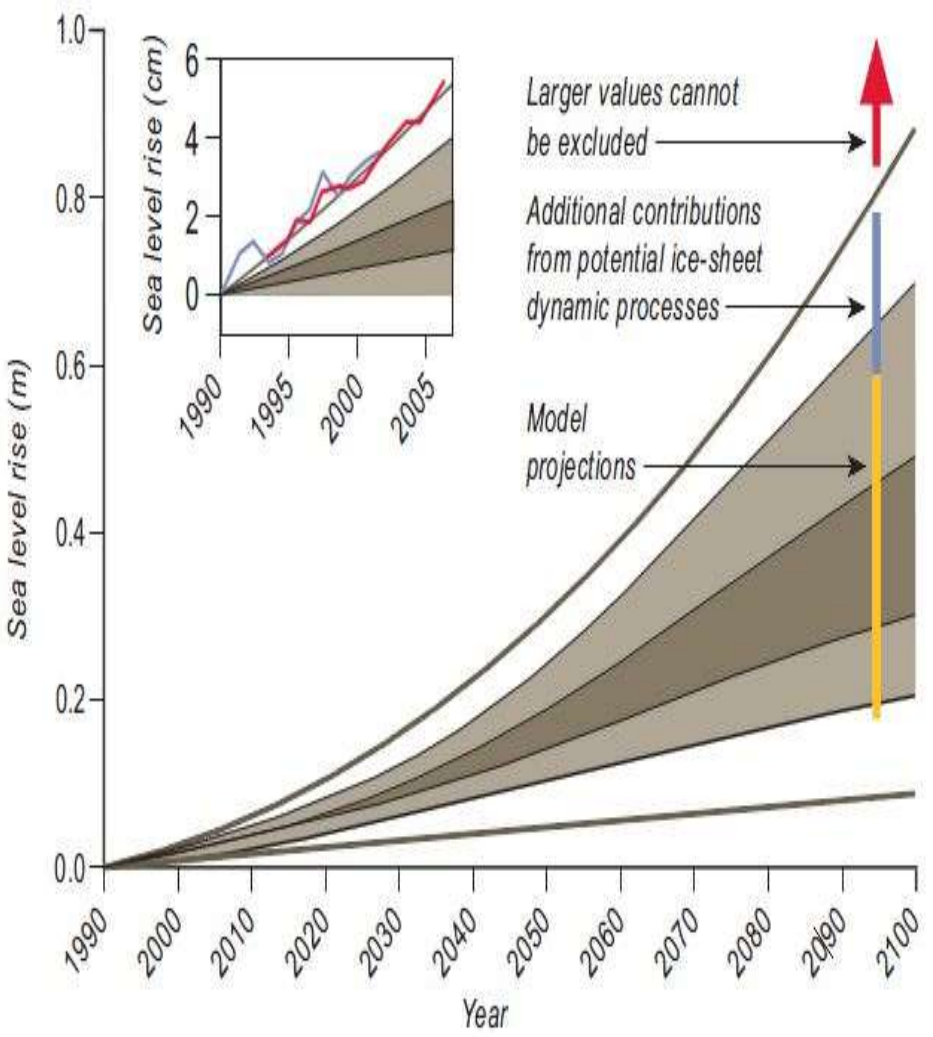


Things to note…

- Lets not wait for a catastrophe, its already bad enough (death by 1000 cuts).
- Existing scientific method is flawed.
- CC impact is caused by rate of change.

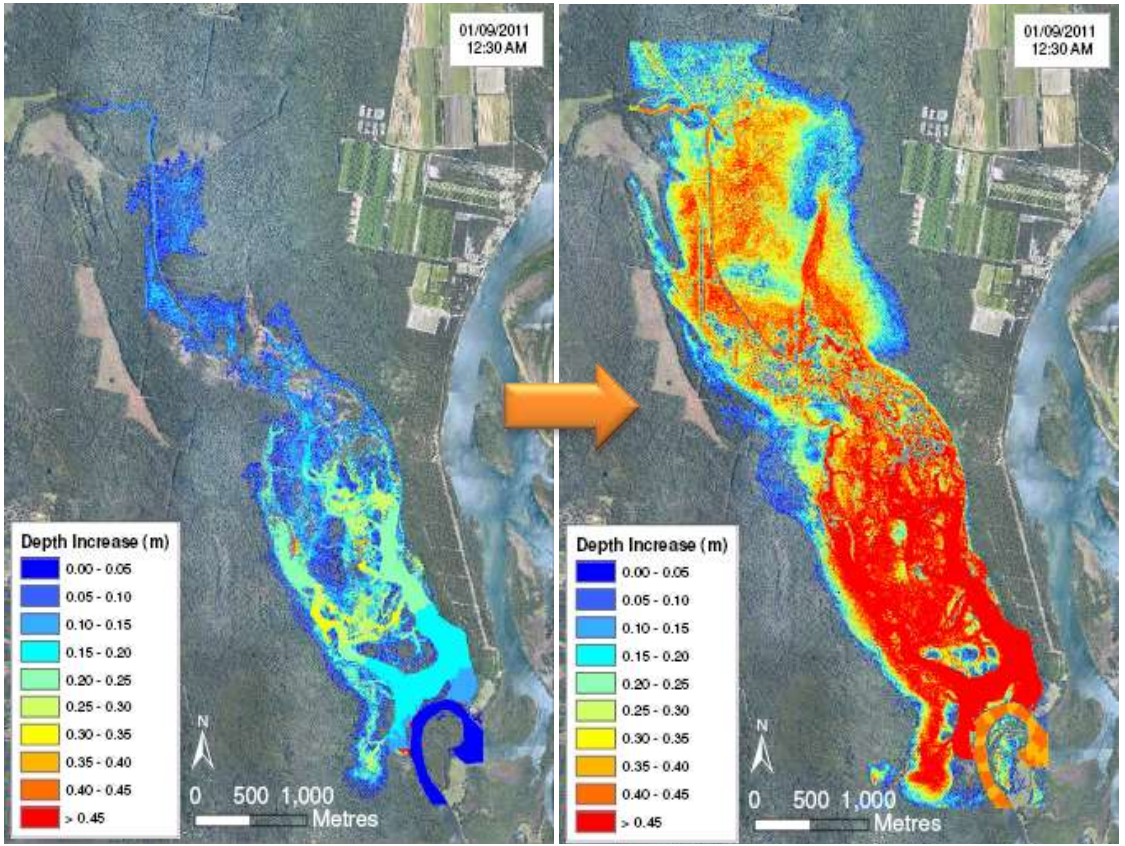
Climate Change

- System dynamics are in balance.
- SLR Rate is not linear!
- When SLR exceeds deposition system failure occurs.
- Rate of change is key



But then…

- Scientific method has to be adjusted to integrate various rate changes…
- BACI to b-FAcI ?
  - Where is the site headed towards?
  - Are there any controls?



Tomago Aluminium Smelter
Existing Port 'A' Zone
22ha Offset
Lot 1001
"Rice Paddy"
(Big Pond offset)
HUNTER RIVER
Lot 1002
Hunter Wetlands National Park
0 0.25 0.5 1 1.5 2 km


Proposed Vegetation Management Area
Rice Paddy Zone
Bund Islands
Culverts
Main Channel
Lagoon 1
Lagoon 2
Lagoon 3
Lagoon 4
Lagoon 5
Existing Levee

Thanks…

- WRL Staff
- OEH's Parks and Wildlife Division
- Councils (Shoalhaven, GTCC)
- Students (Lisa Granqvist)
- NSW DPI - Fisheries
- Habitat Action Grants
- Various LLS
- Commonwealth
- Plus many others…

But…

- Animation Link