Managing farm run-off with constructed wetlands

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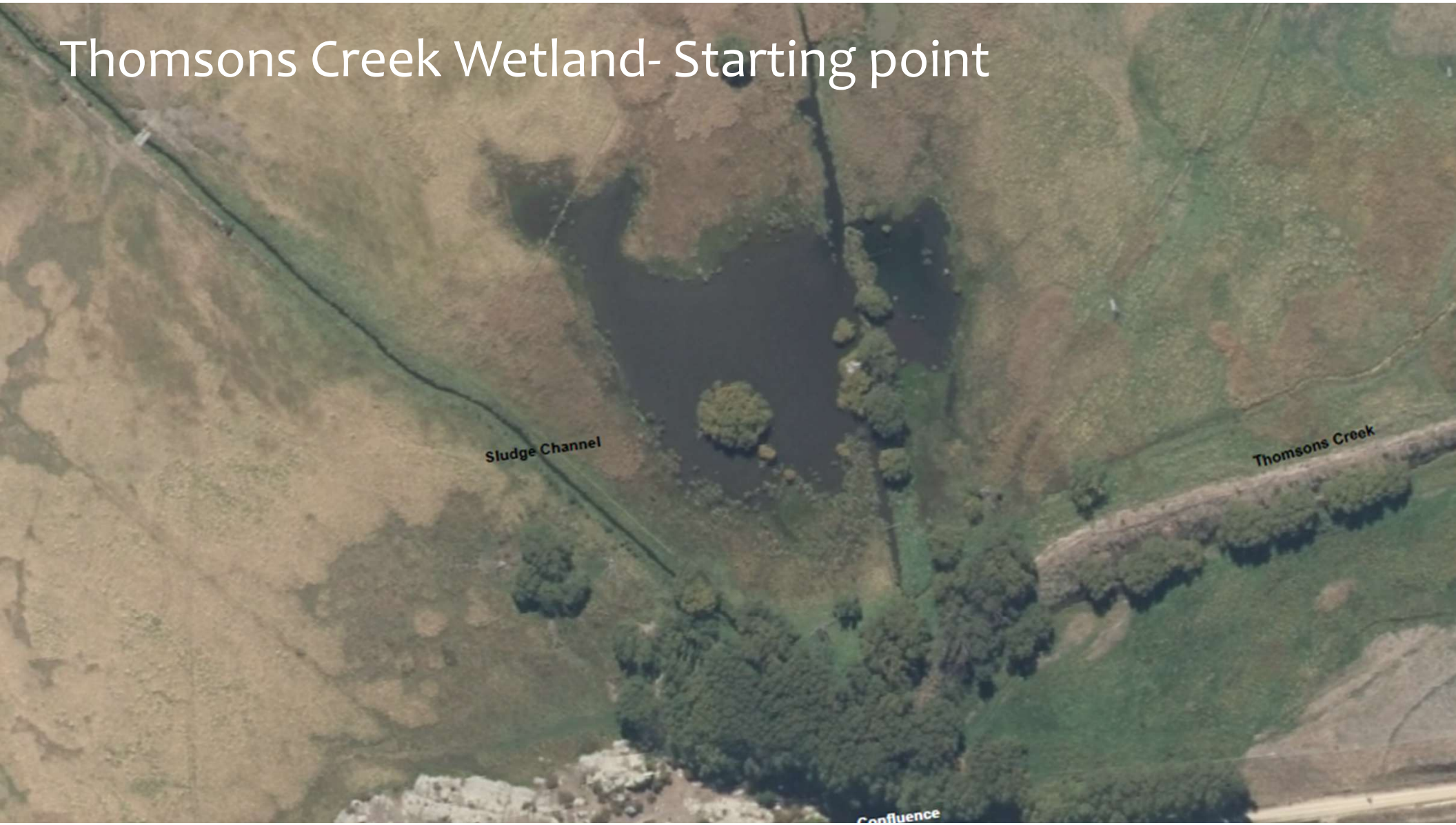
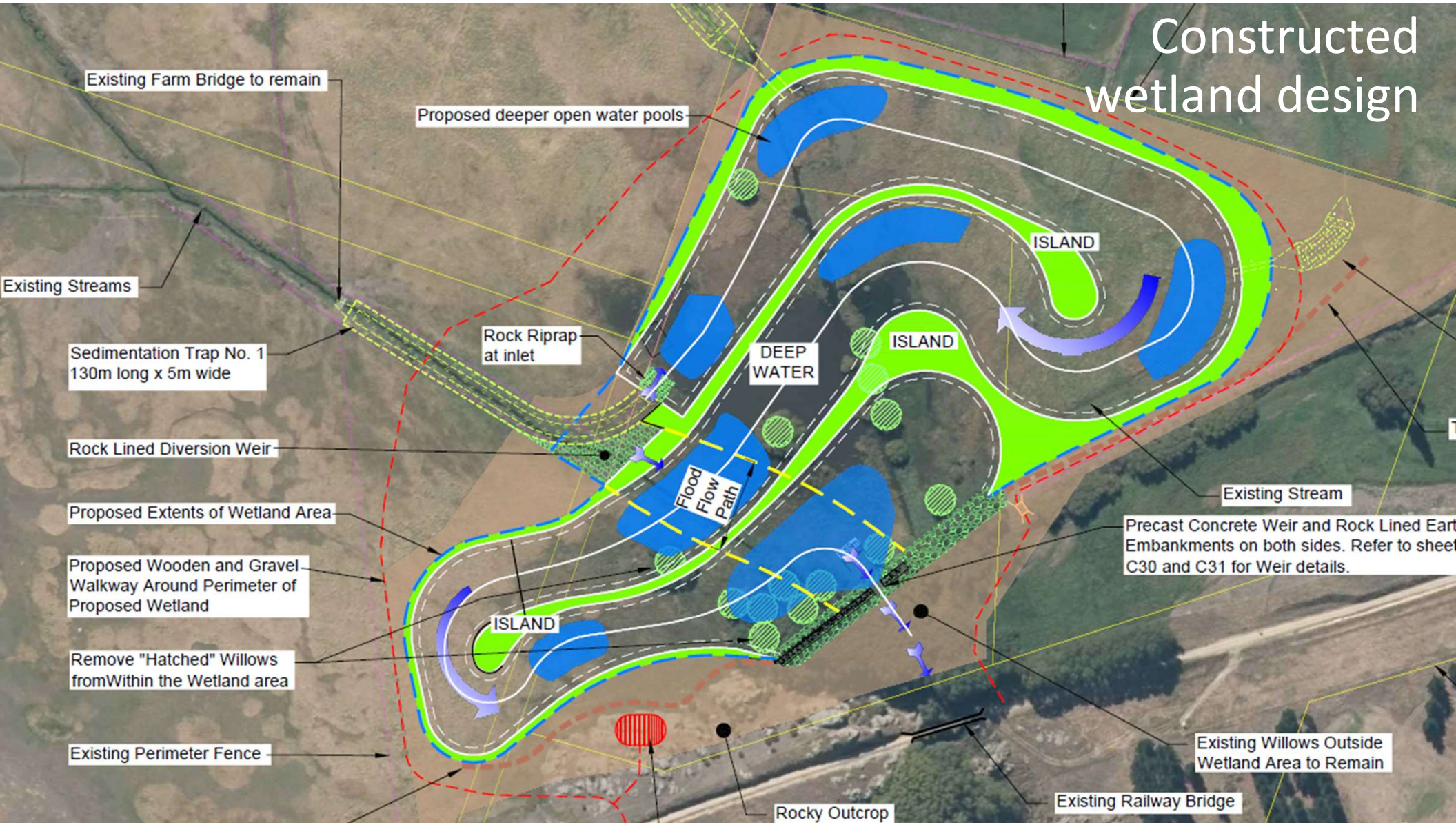
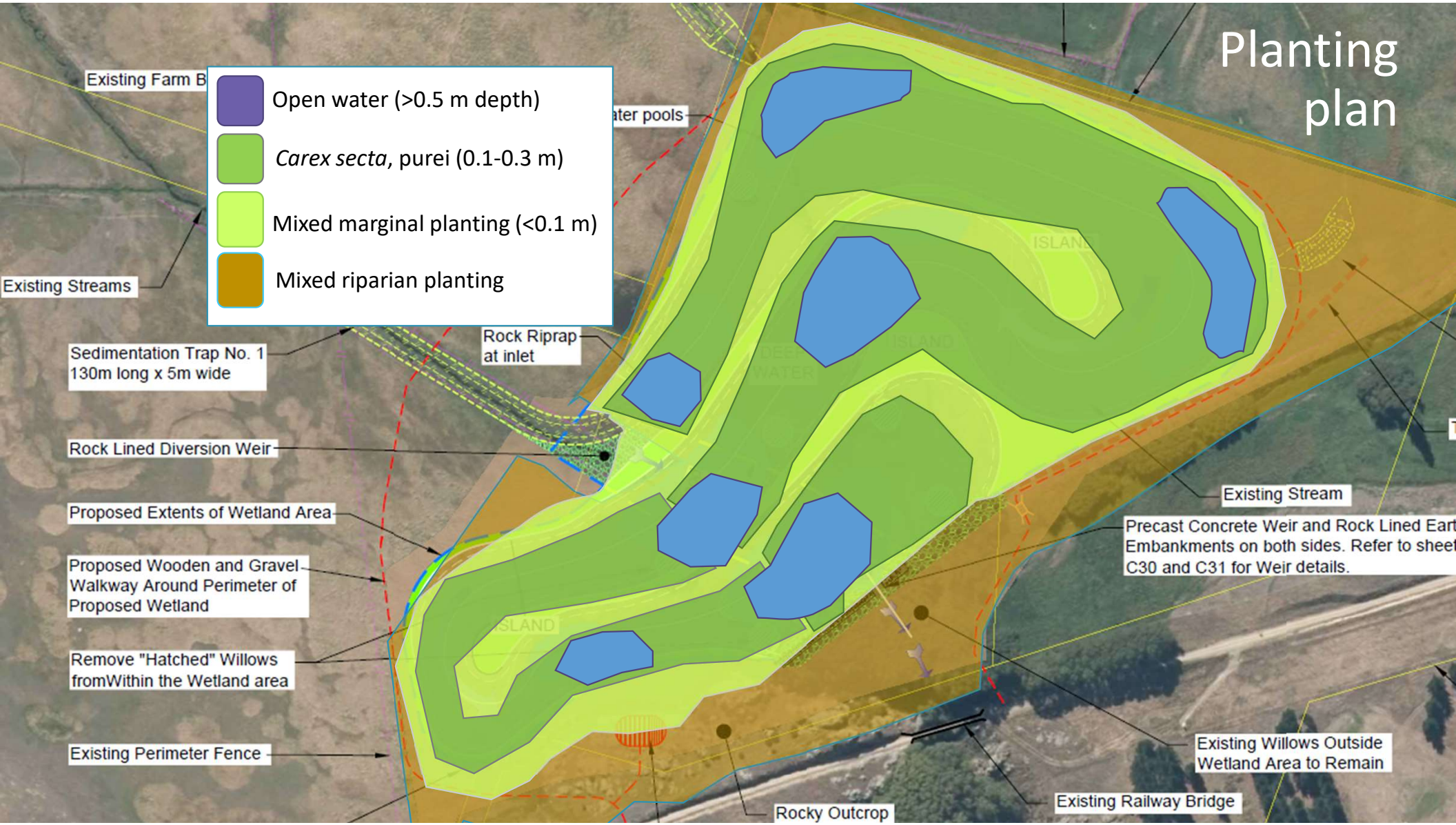
Thomson's Creek Wetland, Omakau, Central Otago
Thomson Project / Otago Catchment Community
September 2023

Thomsons Creek Wetland- Starting point



Constructed wetland design




Planting plan
Open water (>0.5 m depth)
Carex secta, purei (0.1-0.3 m)
Mixed marginal planting (<0.1 m)
Mixed riparian planting
Existing Farm B
ater pools
Existing Streams
Sedimentation Trap No. 1
130m long x 5m wide
Rock Riprap
at inlet
Rock Lined Diversion Weir
Proposed Extents of Wetland Area
Proposed Wooden and Gravel
Walkway Around Perimeter of
Proposed Wetland
Remove "Hatched" Willows
fromWithin the Wetland area
Existing Perimeter Fence
Existing Stream
Precast Concrete Weir and Rock Lined Eart
Embankments on both sides. Refer to sheet
C30 and C31 for Weir details.
Existing Willows Outside
Wetland Area to Remain
Existing Railway Bridge
Rocky Outcrop


Late Feb 2023


Late March 2023


Late June 2023

How it should look when plants established

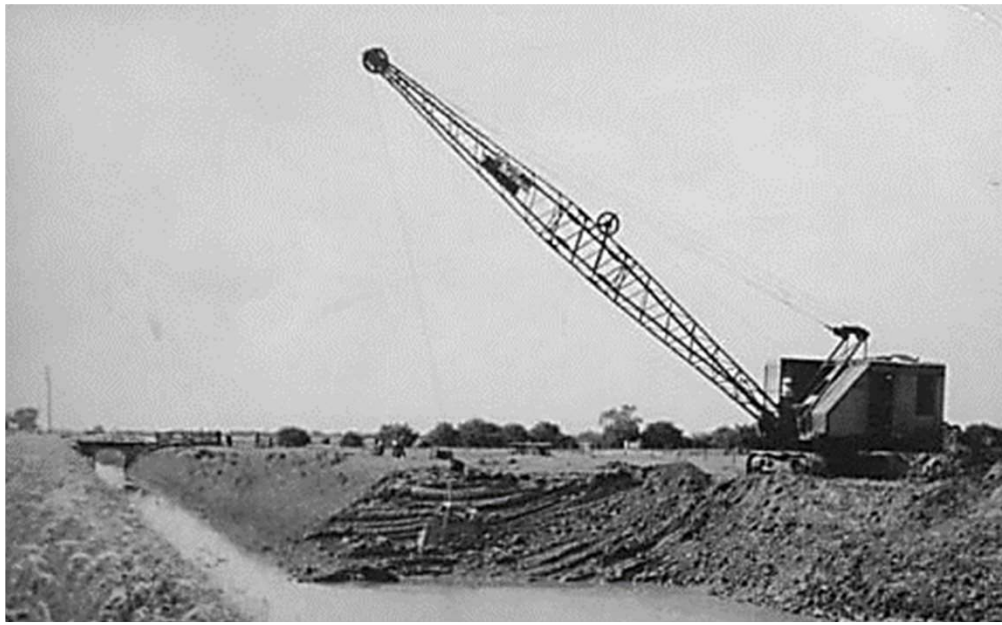
l team
mmunity
t

Managing farm run-off with constructed wetlands

Climate, Freshwater & Ocean Science

Outline:

- Wetlands treated as wastelands
- Wetlands treated as assets
- Constructed wetlands
  - Why
  - How they work
- New guidelines
  - What and how
  - Contaminant removal
- How wetlands can work for farmers



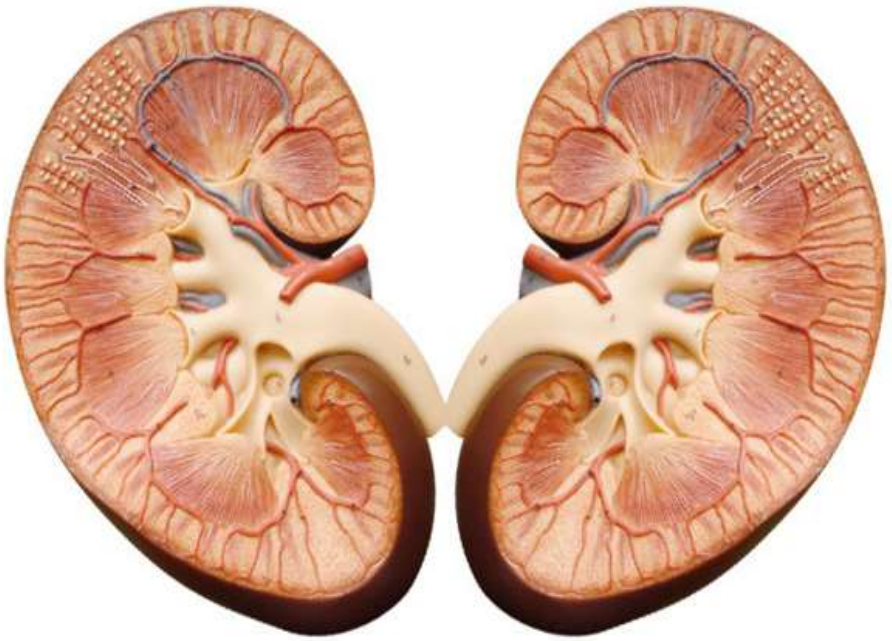

Habitat &
biodiversity


Recreation &
mahinga kai


Cultural resources

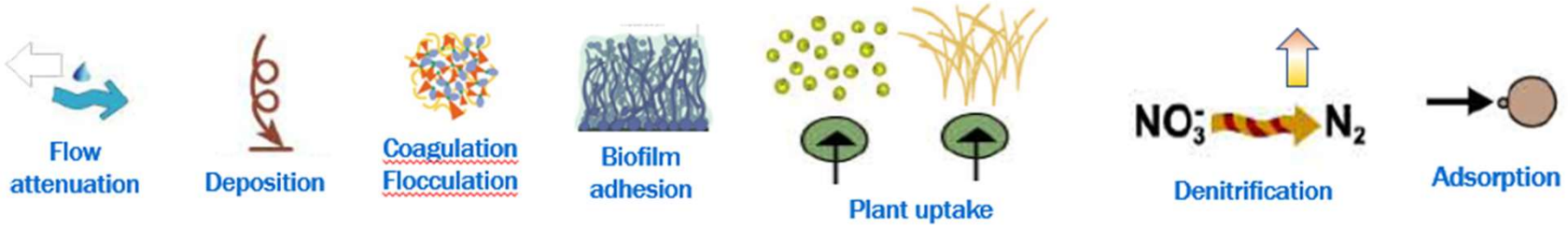
WETLANDS- Kidneys of the landscape

- Interface between land & water
- Buffer storm-flows
- Sustain base-flows
- Filter out
  - Suspended sediment
  - Nutrients
  - other contaminants



Why construct wetlands?

- Relatively simple nature-based option
- Replicate water “filtration” processes of natural wetlands
- Can remove sediment, nutrients and bugs from farm run-off
- Can often be sited on lower productivity areas of farm
- Enhance on-farm biodiversity, mahinga kai and aesthetics
- Can store carbon and reduce net greenhouse gas emissions




Shane Birchall,
Lake Okaro,
Bay of Plenty


David Hopkins,
Waitotara, South
Taranaki


White family, Tukipo, Hawkes Bay


Gray & Marilyn Baldwin,
Putaruru, Waikato


Raewyn & Tony van Gool,
Waituna, Southland


Donna & Phil Cram, Taranaki

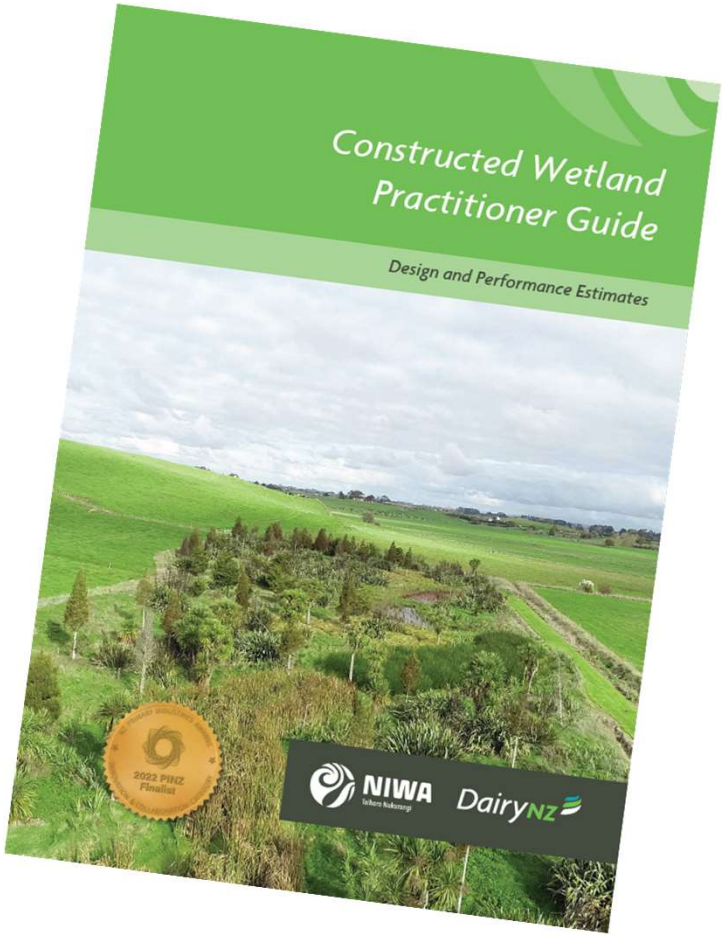

Owl Farm, Waikato


Kaiwaiwai Dairies, Wairarapa


Whangamaire,
Waikato

NEW Constructed Wetland Guide

- NIWA teamed up with DairyNZ to assess performance and develop new guidance to help incentivise uptake
- Robust development process
  - Practitioner Technical Group to inform development and endorse suitability of guidelines
  - Endorsed by most councils, WRA, F&GNZ
- Freely available to download on NIWA and DairyNZ websites



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DairyNZ NIWA Taihoro Nukurangi

SURFACE-FLOW CONSTRUCTED WETLANDS

Key contaminant removal processes

Adsorption

Solar inactivation

Coagulation Flocculation

Biofilm adhesion

Flow attenuation

Deposition

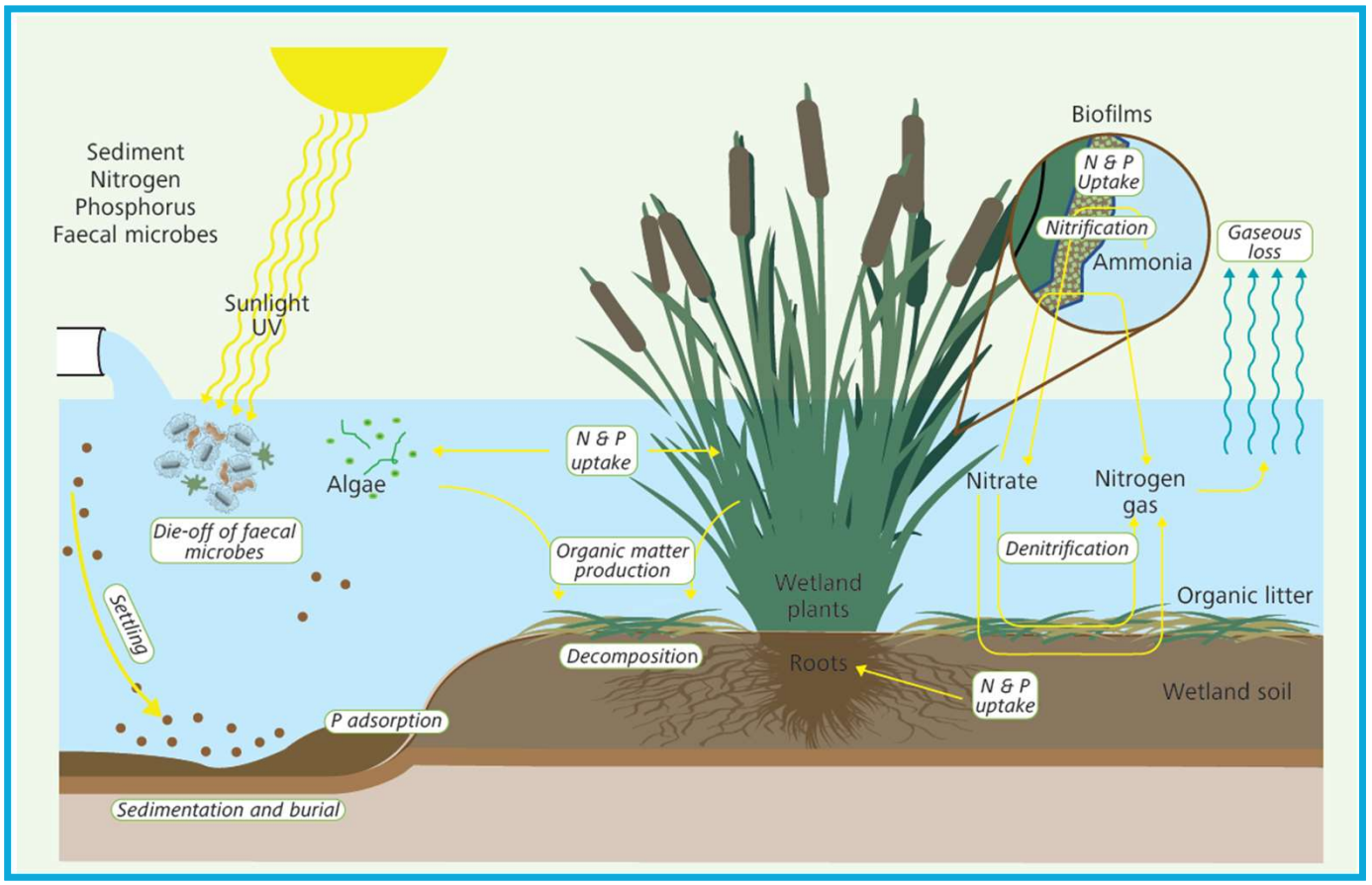
Infiltration

Plant uptake

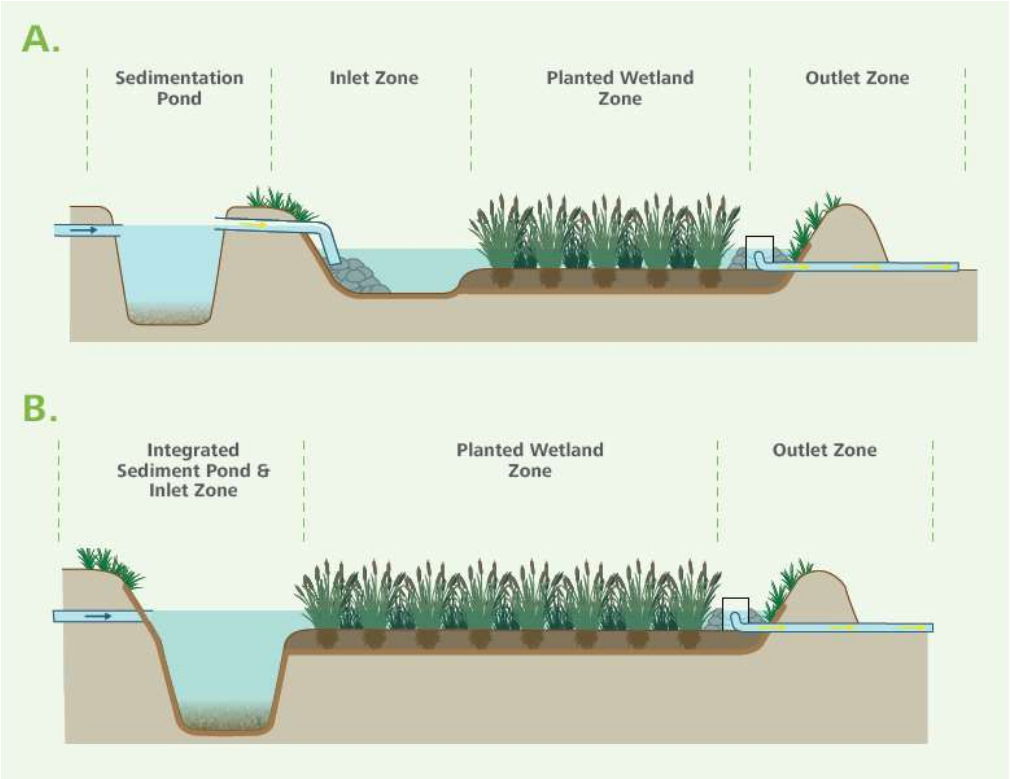
$NO_3^- \rightarrow N_2$

Denitrification

Litter/peat accumulation



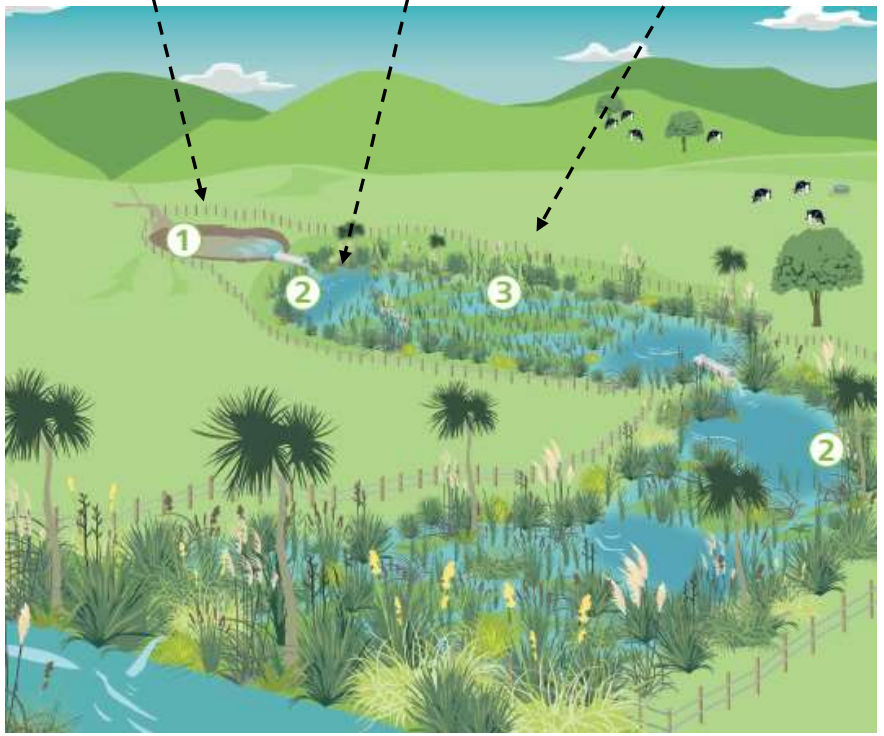
Wetland design



1. Initial sedimentation pond

2. Open water zones to disperse flow

3. 70% shallow vegetated zones



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Vegetation

- Plant selection
- Planting and weed management

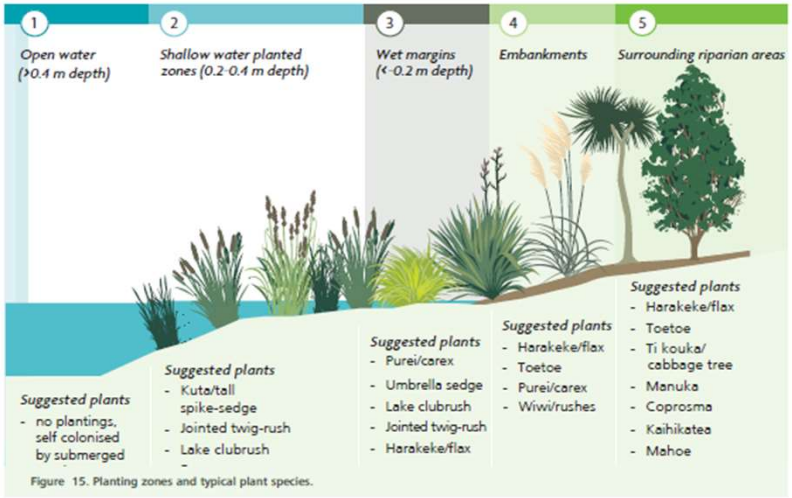
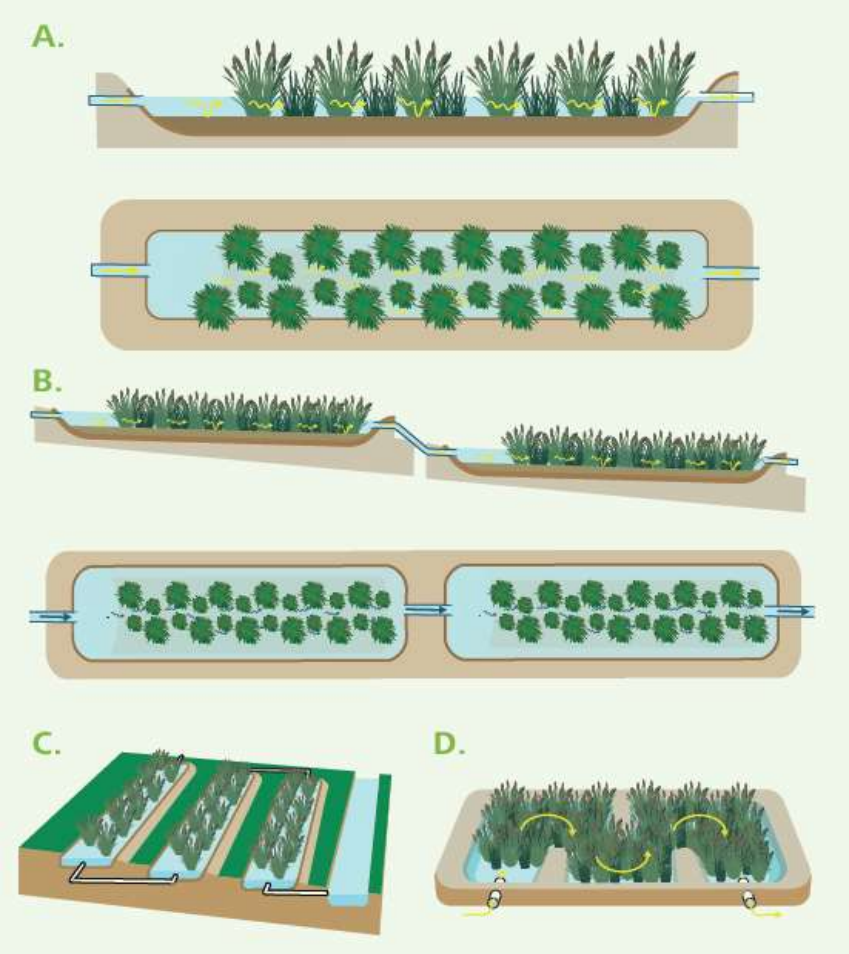


Figure 15. Planting zones and typical plant species.

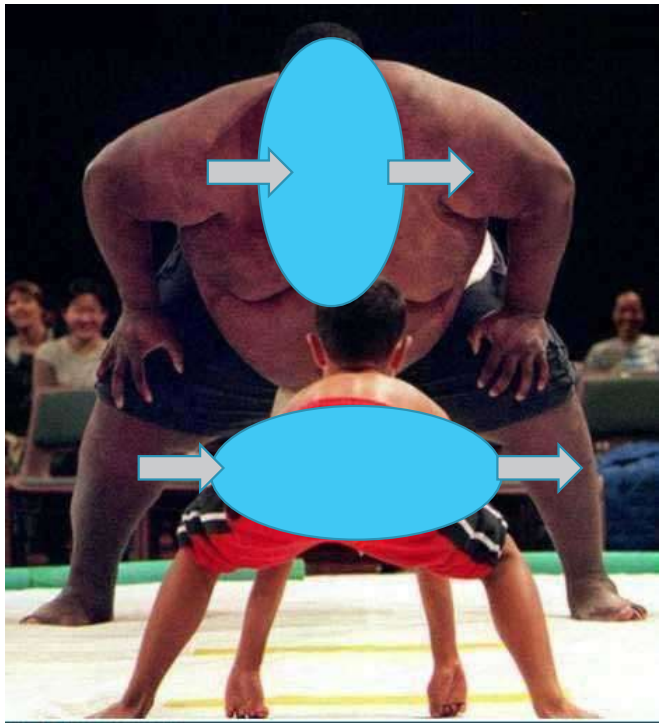
Guidance

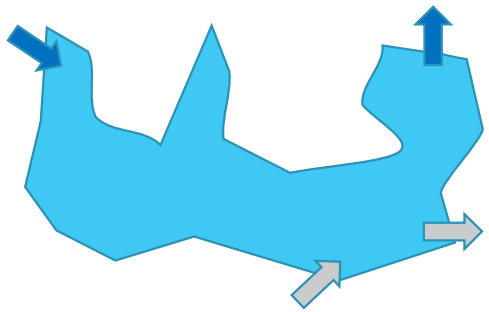
- Size
- Flow paths intercepted
- Shape and arrangement
- Sediment pond
- In-let/out-let structure
- Embankments
- Maintenance
- Costings
- Case-studies



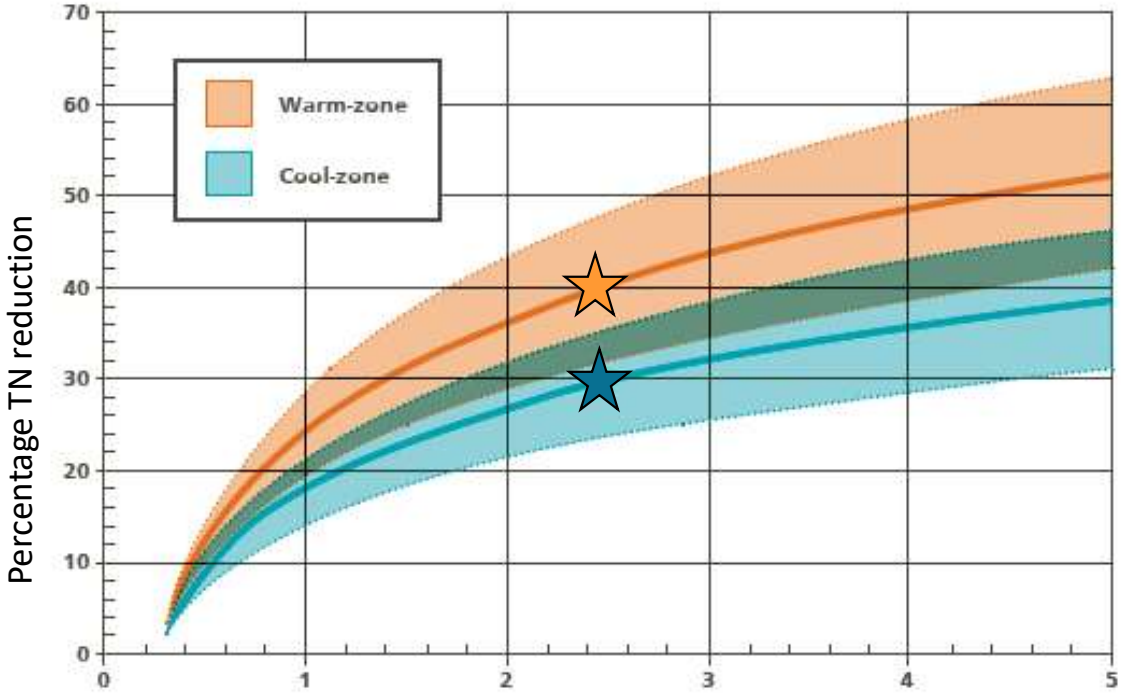
Size matters !

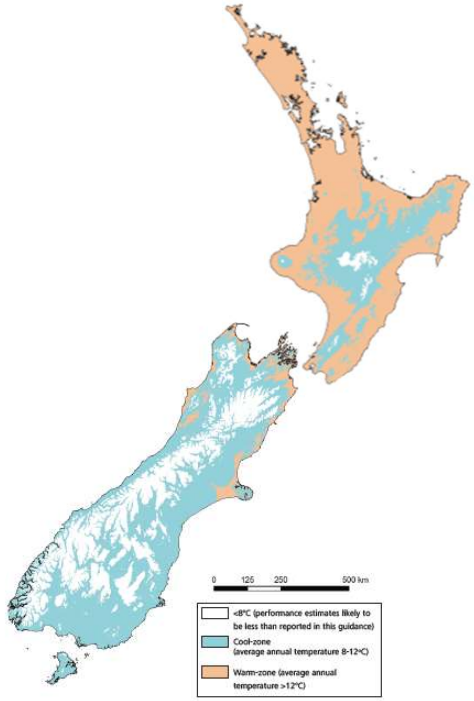
- Wetland WQ performance related to size
- Also location and design
  - Proportion of flow intercepted
  - Flow variability
  - Shape / Hydraulic efficiency
  - Plant cover
  - Temperature





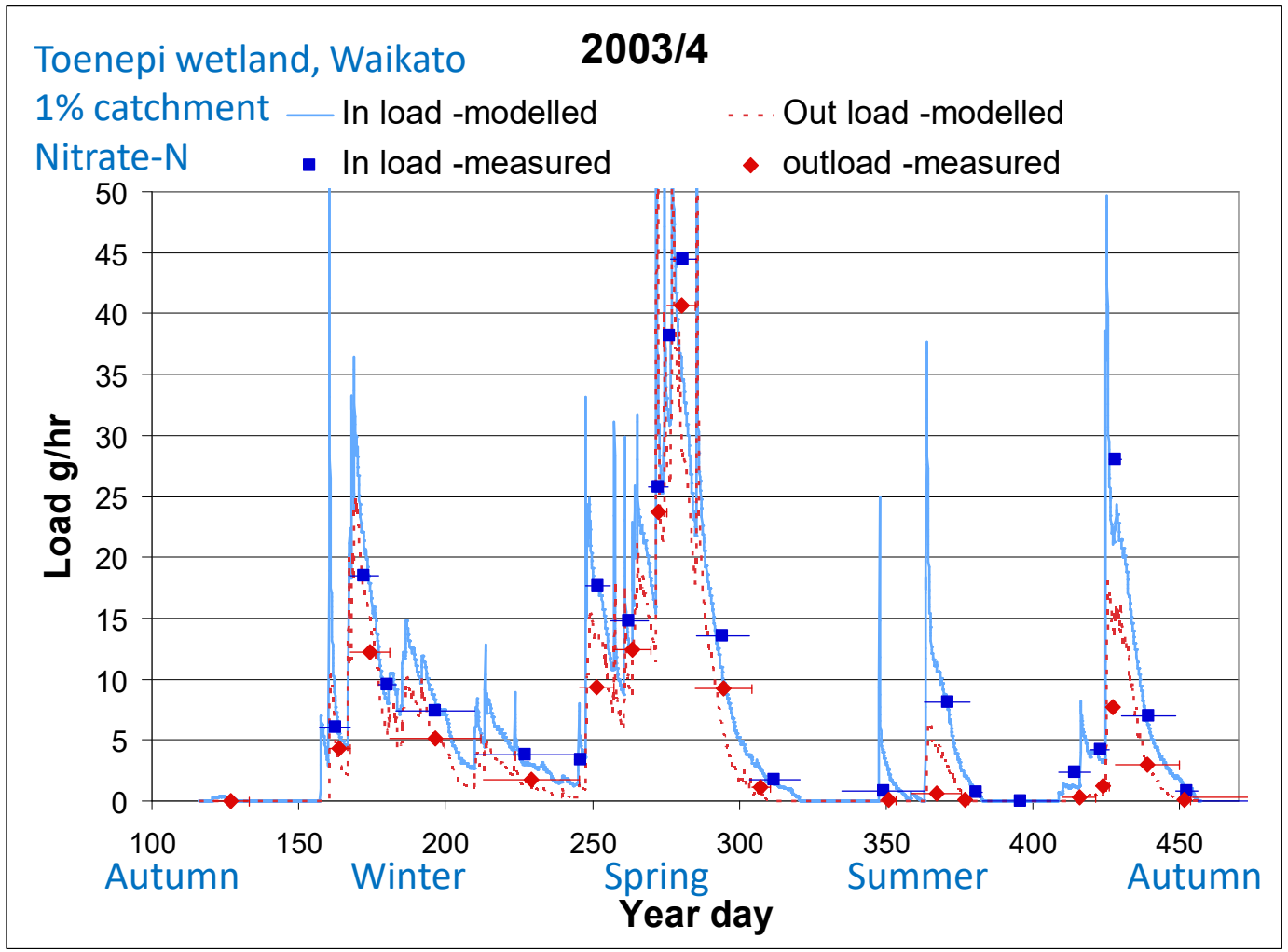
Performance estimates - Nitrogen





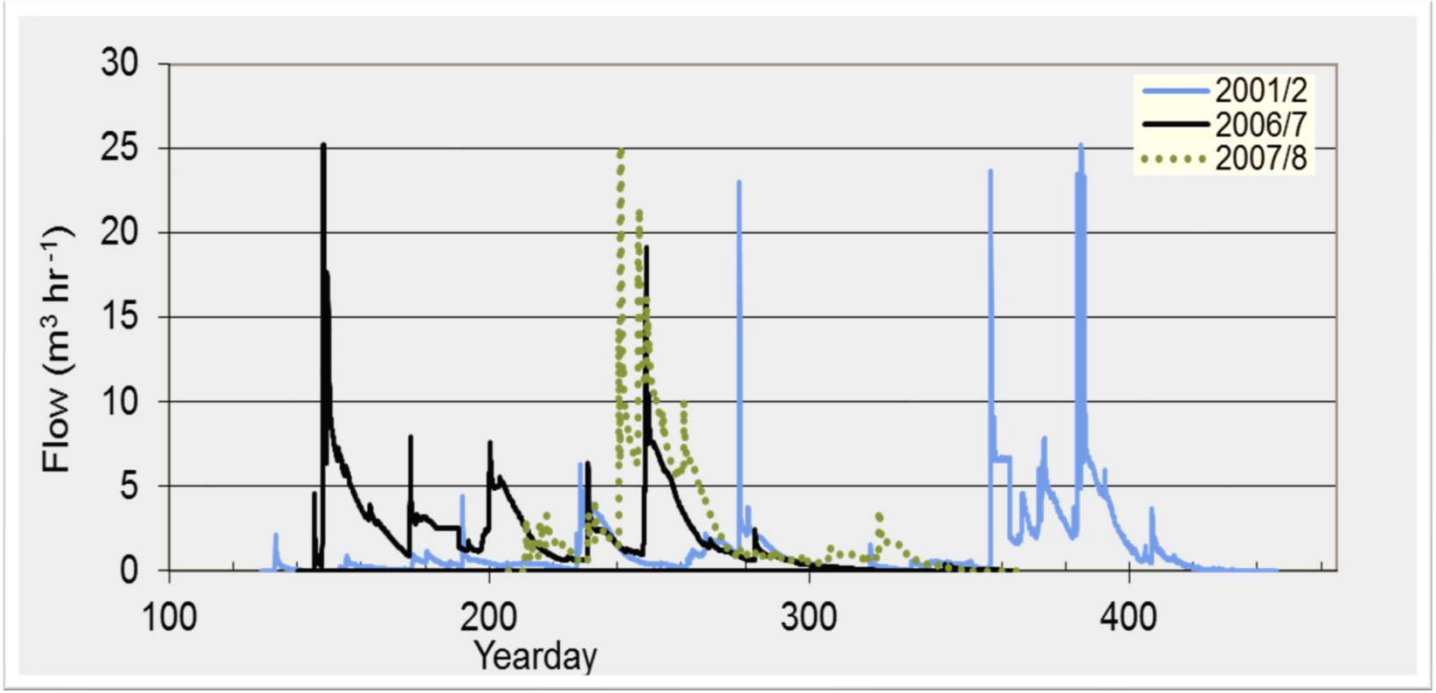
Assume normal NZ pastoral farming practices, climate conditions and flat to rolling landscapes

- Treatment varies with changing inflows & concentrations (=load)
- Performance will vary each year



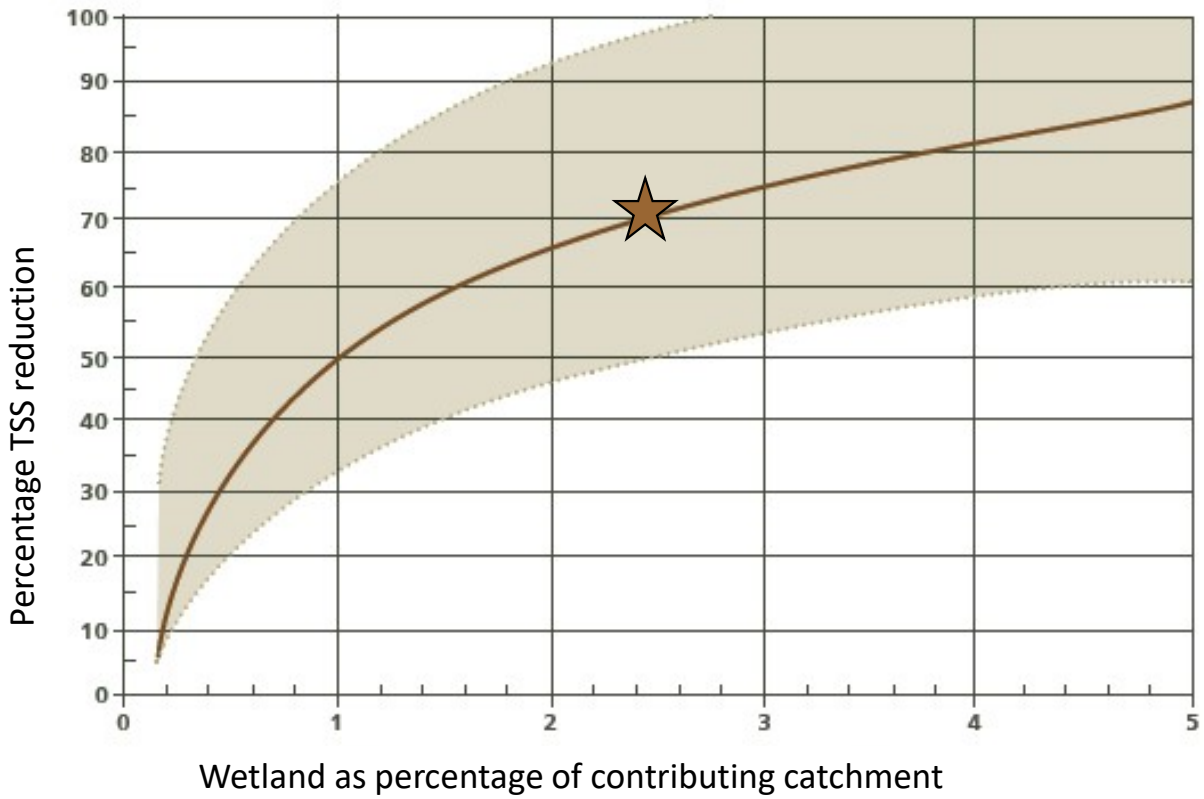
Tanner & Kadlec (2013). *Ecological Engineering* 56: 79-88

Farm run-off and drainage varies markedly from year to year - Wetland performance will vary with it



Example from Toenepi, Waikato

Performance estimates – Suspended sediment



Estimates limited to catchments with soils <35% clay

Assume normal NZ pastoral farming practices, climate conditions and flat to rolling landscapes

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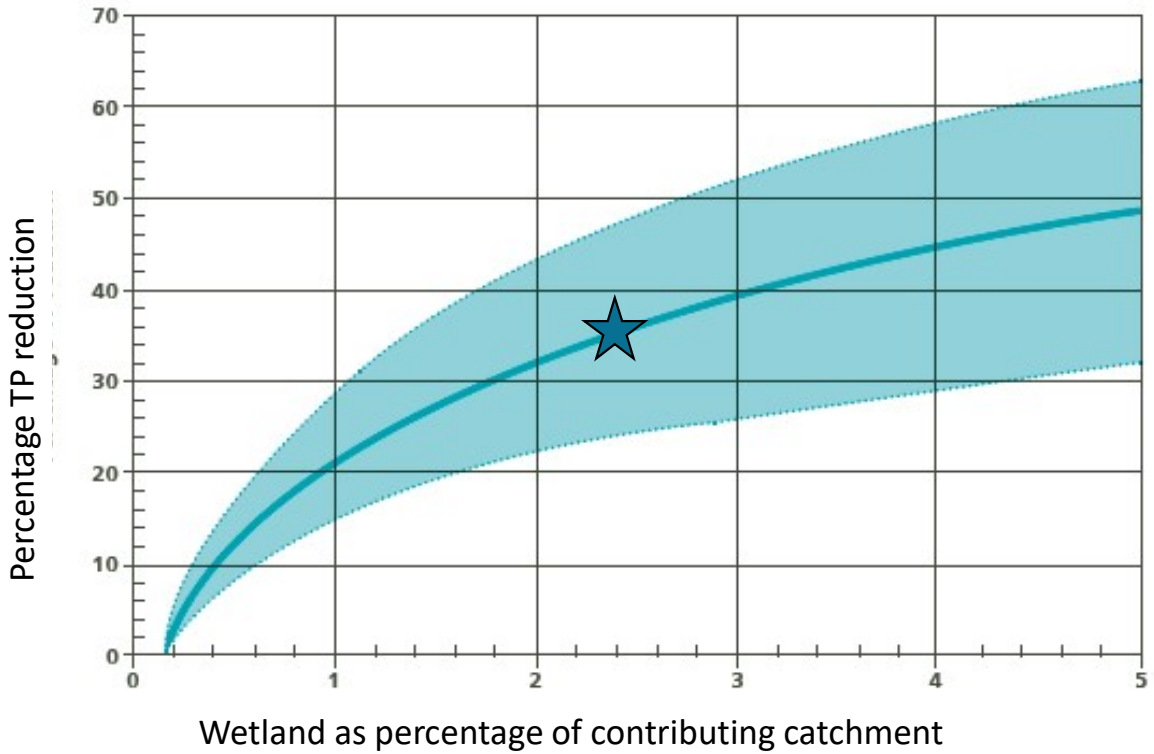
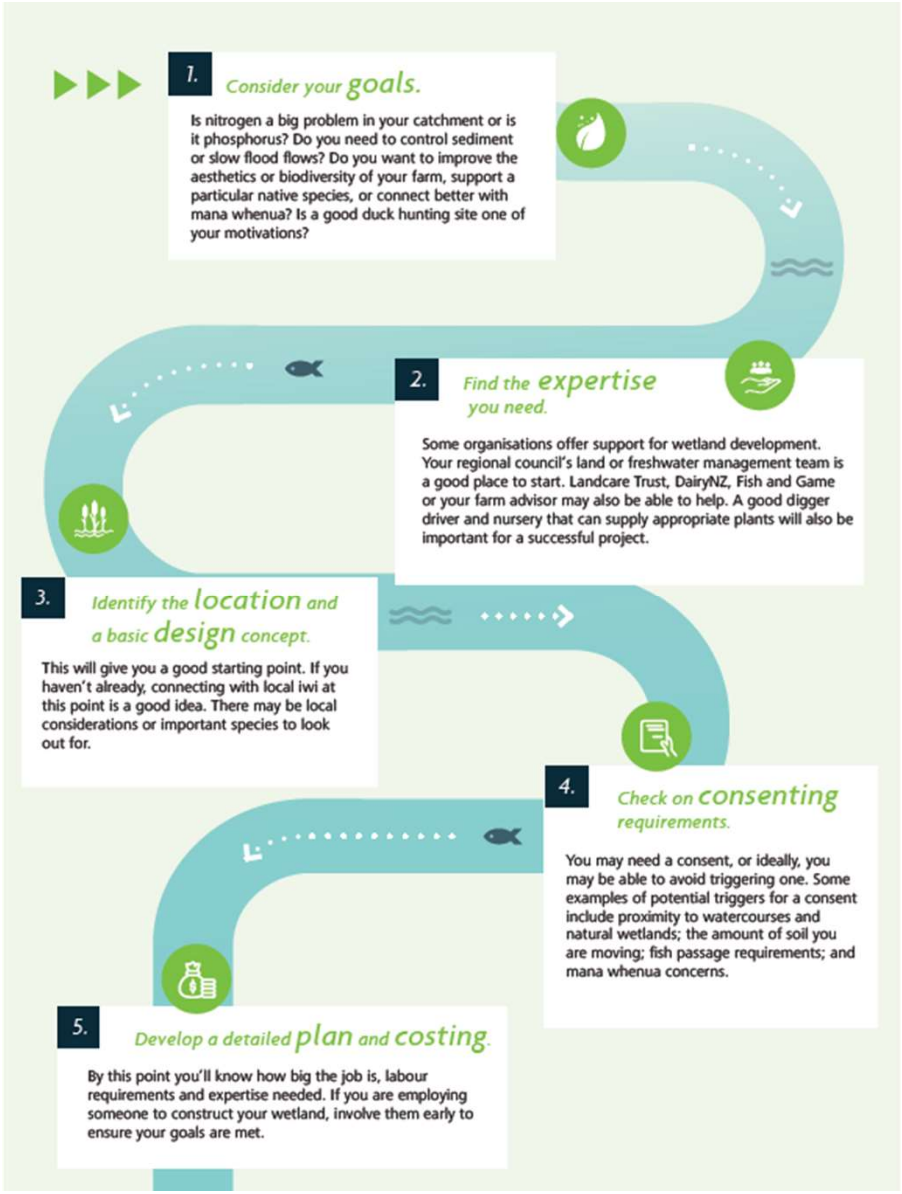
Performance estimates – Phosphorus



- *Estimates limited to wetlands receiving mainly particulate-associated P with soil clay content <35%*
- *Work continuing to identify ways to enhance retention of dissolved P*

Assume normal NZ pastoral farming practices, climate conditions and flat to rolling landscapes

Steps to develop a constructed wetland



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Maintenance needs

Constructed wetland:


Remove sediment from pond


Maintain ~70% vegetation


Maintain embankments- plant with riparian species

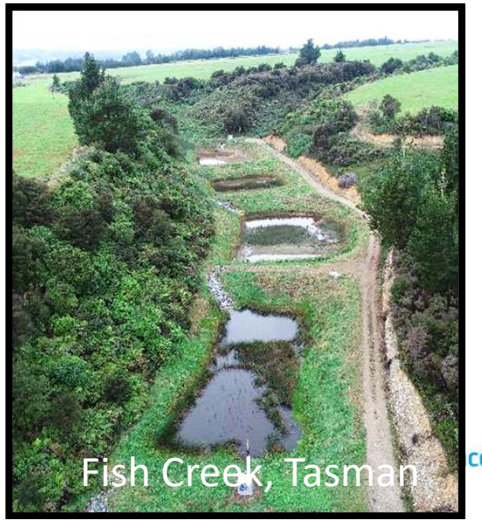

Keep inlets & outlets clear


Manage weeds, particularly during establishment


Maintain fences

CONSTRUCTED WETLAND MONITORING & DEMONSTRATION NETWORK

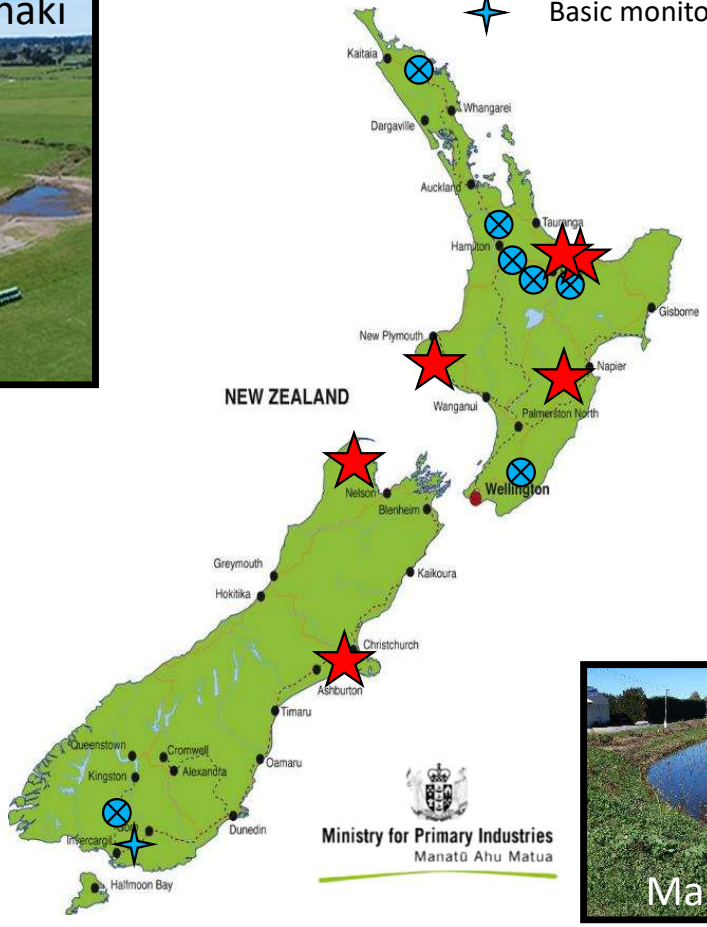
Building the evidence base



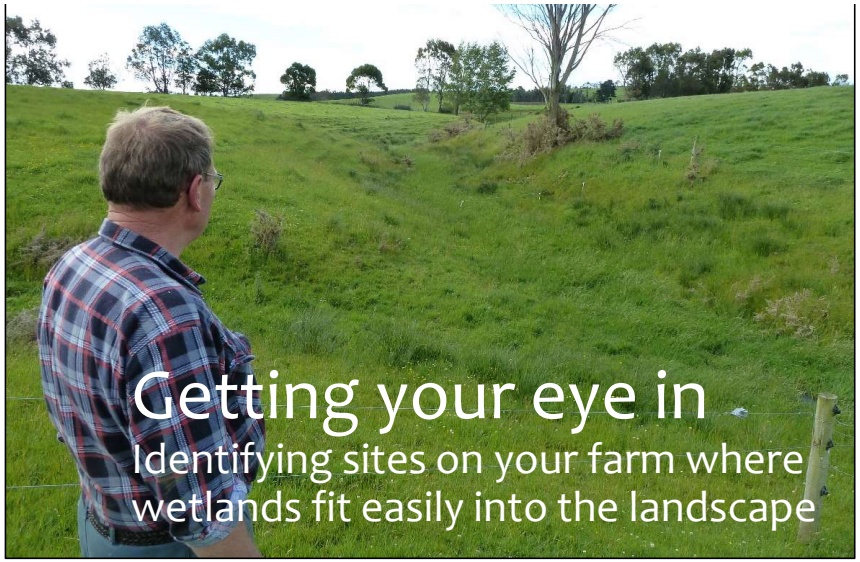
NEW monitoring sites

Previously monitored

Basic monitoring



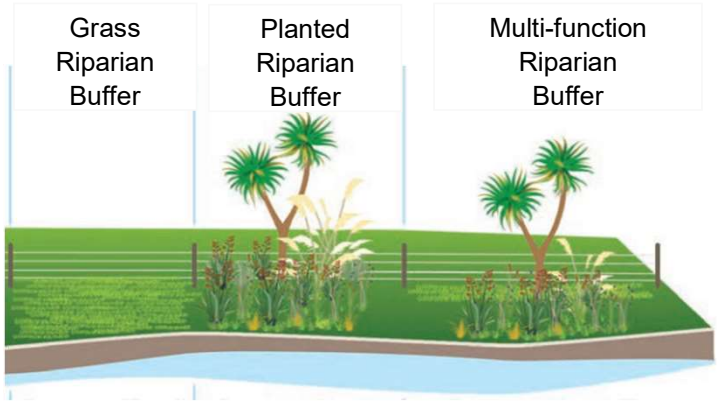
Small wetlands work too


Getting your eye in
Identifying sites on your farm where wetlands fit easily into the landscape

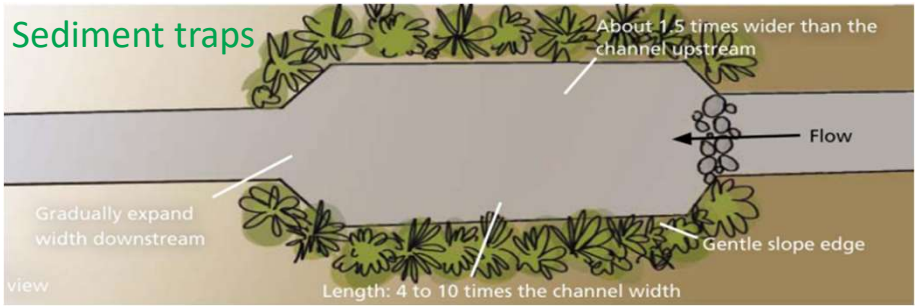
Other edge-of-field and waterway mitigation options to consider

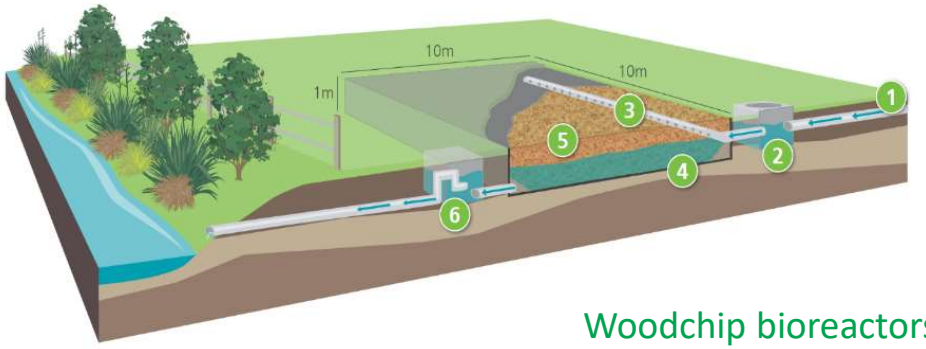
FANS

Riparian buffers



Sediment traps





Woodchip bioreactors

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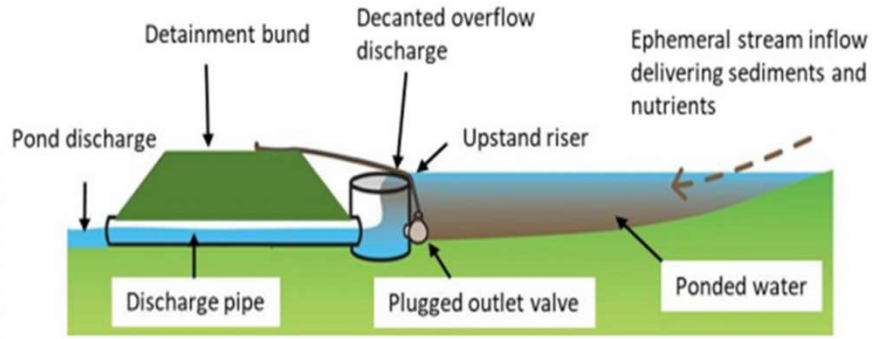
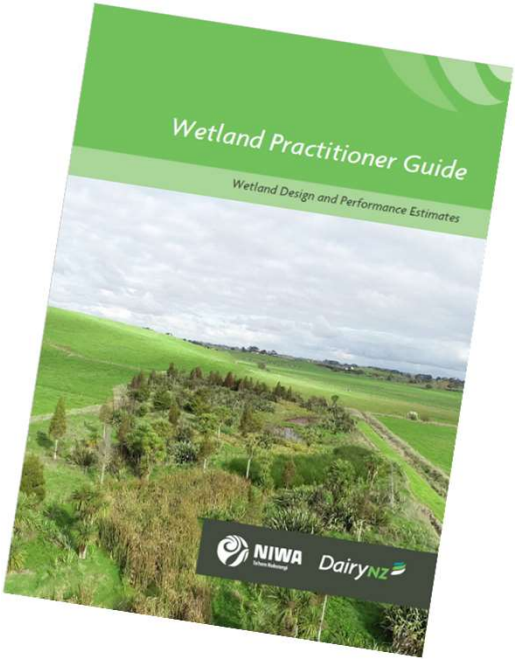
Detainment bunds



Conclusions: Wetlands as mitigation assets

Check out the guidelines!

- New nutrient management tool for farmers
  - Performance estimates can be used for nutrient budgeting and farm plans
- Strengths
  - Multiple contaminants and flow paths, robust, low maintenance
  - Biodiversity and aesthetics
- #1 On-farm management of soils, nutrients & grazing
- #2 protect and rehabilitate existing wetlands
- #3 construct wetlands (or apply other mitigations)
  - 1-5% of catchment area in wetlands
  - Focus on key contaminant flow paths
  - Maximise performance through good design & implementation



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Thanks to:

- Thompson's Project and Otago Catchments Community; Manuherikia CG
- MfE for funding the Thompsons Creek Wetland as an exemplar demonstration project
- Pete, the farmer who provided the land
- Nicola McGrouther for co-ordination and project management
- Matt Hickey and ORC for providing flow estimates and WQ data for the catchment
- Brendan Sheehan for engineering design, and supervision
- Contractors for making it happen in very challenging conditions
- Jo Wakelin for supervising plant supply and planting
- Many others and the amazing local community that has got behind the project

- More broadly for supporting work on constructed wetlands for management of agricultural run-off
  - Farmers who have provided support and access to their land
  - LMOs and many other partners for assistance with field trials & monitoring
  - Funding from MBIE, the dairy industry, regional councils, WRA and MPI
  - DairyNZ who have assisted with funding and development of the practical guidelines
    - Practitioner Technical Advisory Group

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