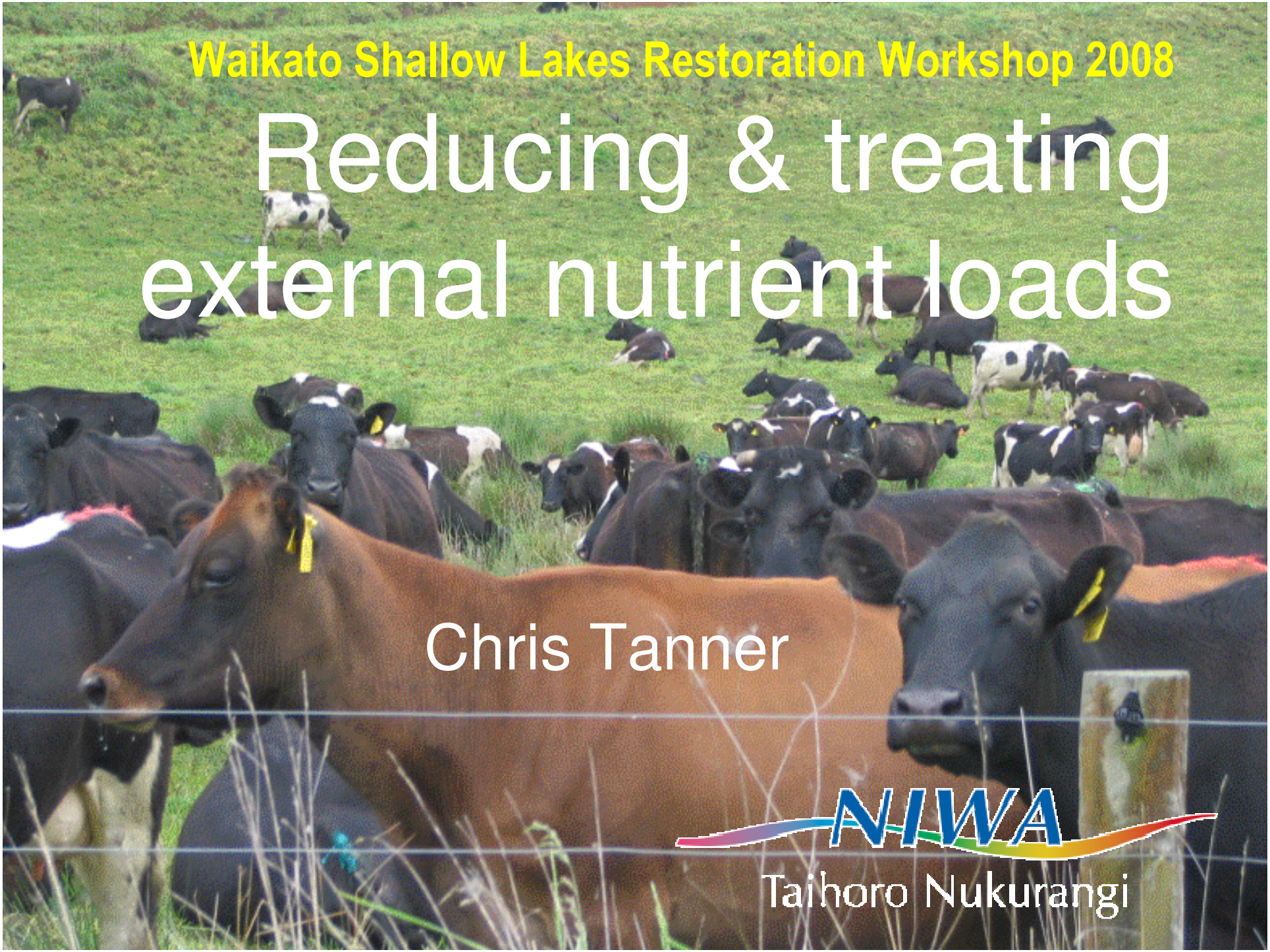
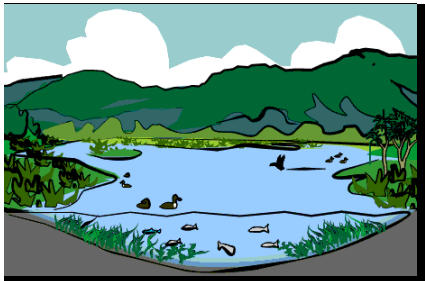


Waikato Shallow Lakes Restoration Workshop 2008

Reducing & treating external nutrient loads

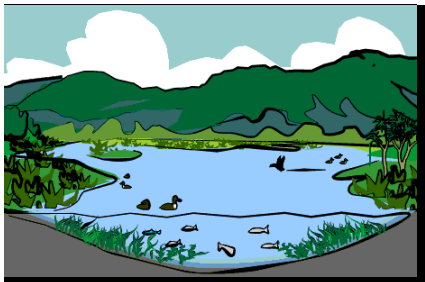
Chris Tanner

NIWA
Taihoro Nukurangi



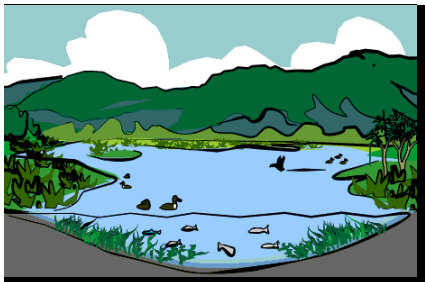
Outline

- Focus on agricultural catchments
- Targeting key pollutant sources and pathways
  - How does water flow through the landscape and enter the lake?
- Source control -Farm BMPs
- Interception and attenuation
  - How & where are water and pollutants generated and transported?
    - Targeting hotspots and priority pathways
  - Key attenuation processes
  - Valuing natural attenuation assets
  - Toolbox of attenuation options



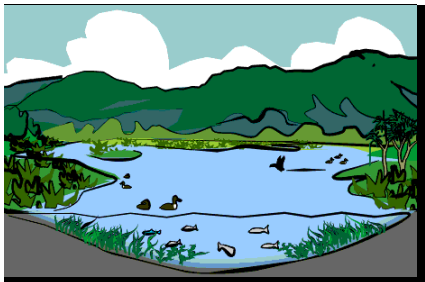
Source control -Farm BMPs

- Effluent management
- Nutrient management
- Grazing management
- Reducing hydrological connectivity



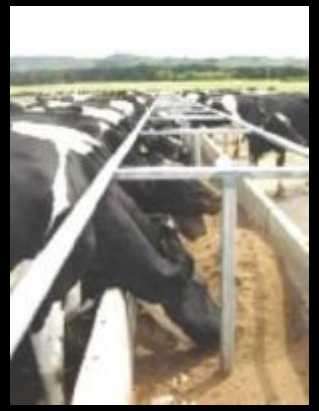
Effluent management

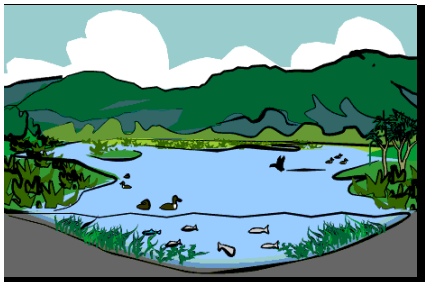
- Land irrigation
  - Proper application rates
    - Appropriate irrigator type/speed
    - Low-rate pod sprinklers (K-line)
  - Deferred irrigation
    - Storage during wet weather
- Improved pond treatment
  - Add constructed wetlands
  - Advanced pond systems



Grazing & nutrient management

- Nutrient budgeting –soil tests
- Winter-off stock (?)
- Reduce winter fertiliser
- Nitrification inhibitors
  - Applied to pasture (or fed)
- Feed & stand-off pads
- Wintering barns/Herd homes
- Convert to organics (?)
- Reduce grazing & cropping

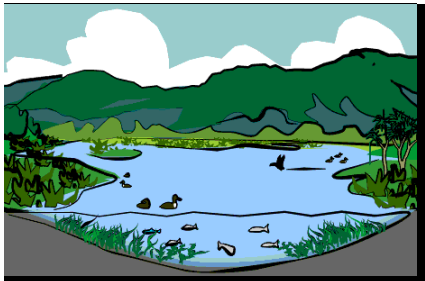




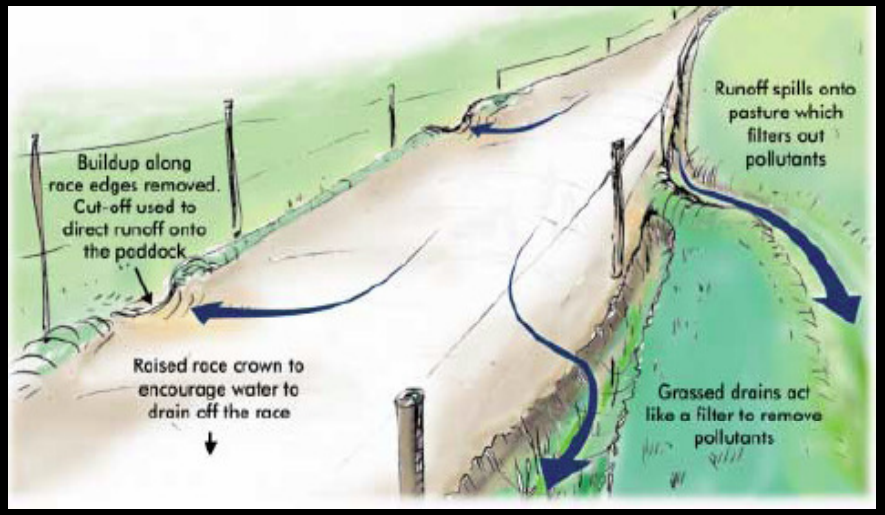
Grazing management & reducing connectivity

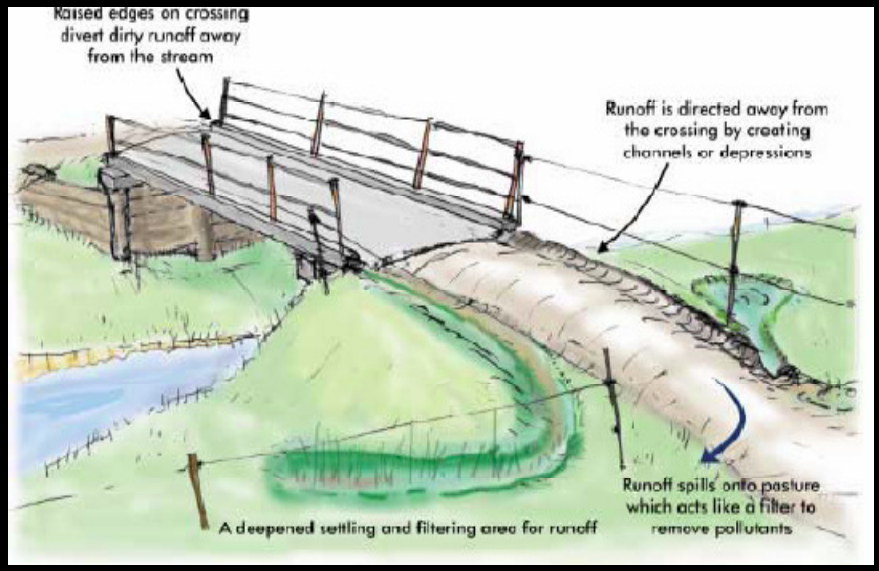
"Put water and shade at the top of the paddock and stock will graze more evenly and put on more weight"

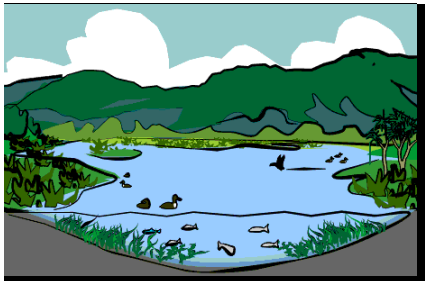
- Livestock exclusion from waterways, wetlands and riparian zones
- Bridges at crossings
- Locating gates, troughs and races away from high run-off risk areas
- Race and track run-off diverted to swales



Race and track run-off diverted to swales

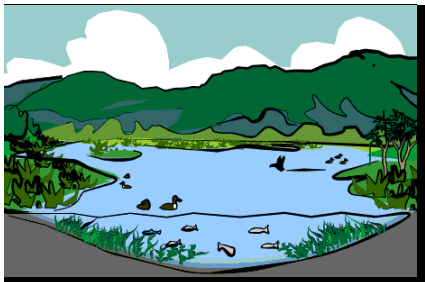






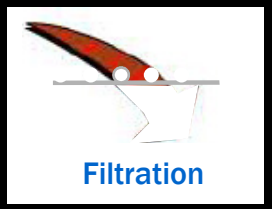
Interception and attenuation

- What is attenuation?
  - permanent loss or temporary storage between generation site and a water body
- Understand how water flows through our landscape
  - Target key pollutant sources and pathways
    - Best bang for buck
  - Identify natural attenuation assets
    - Protect, restore, rehabilitate
  - Identify other interception and attenuation opportunities

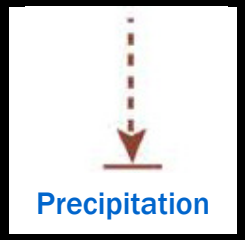


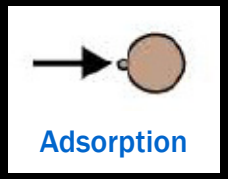
Attenuation processes

Permanent loss or temporary storage between generation site and a water body

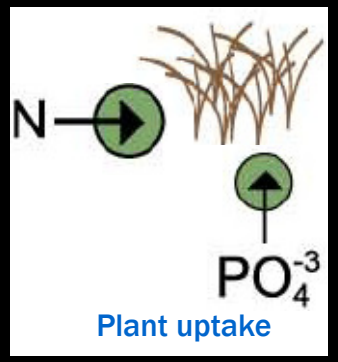


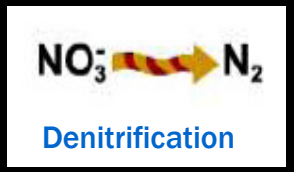
physical

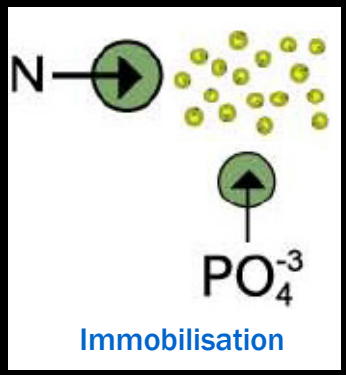




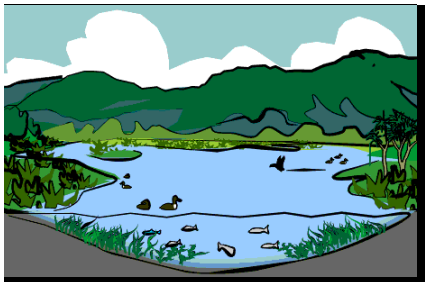
chemical



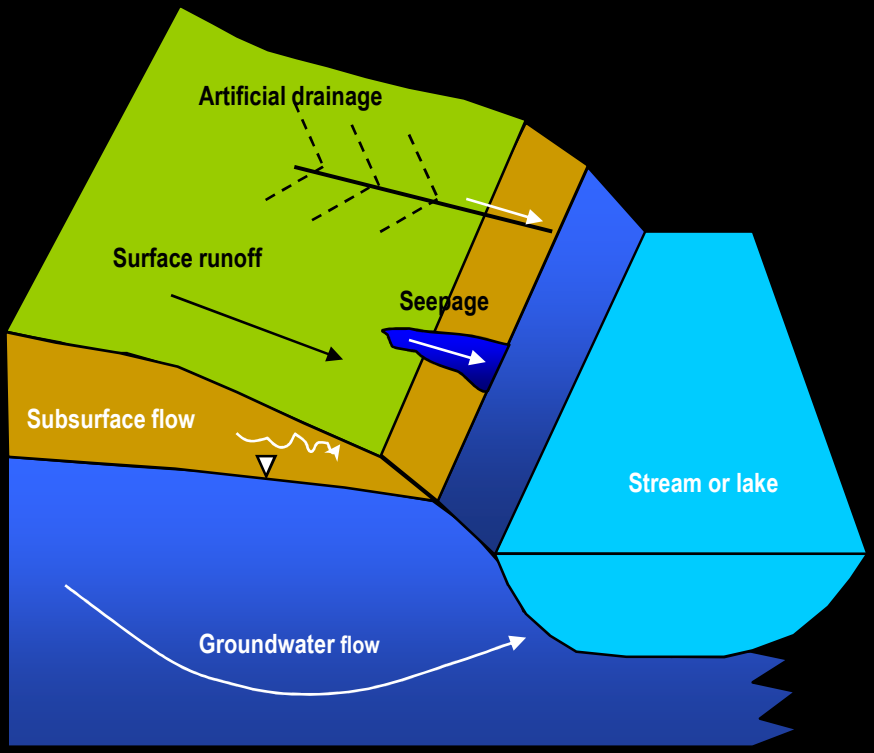




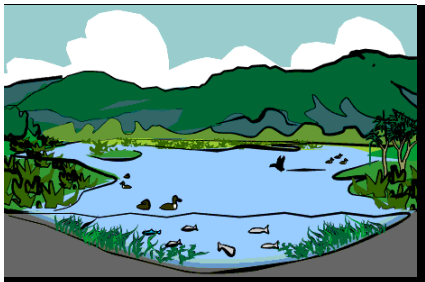
biological



What are main runoff pathways?

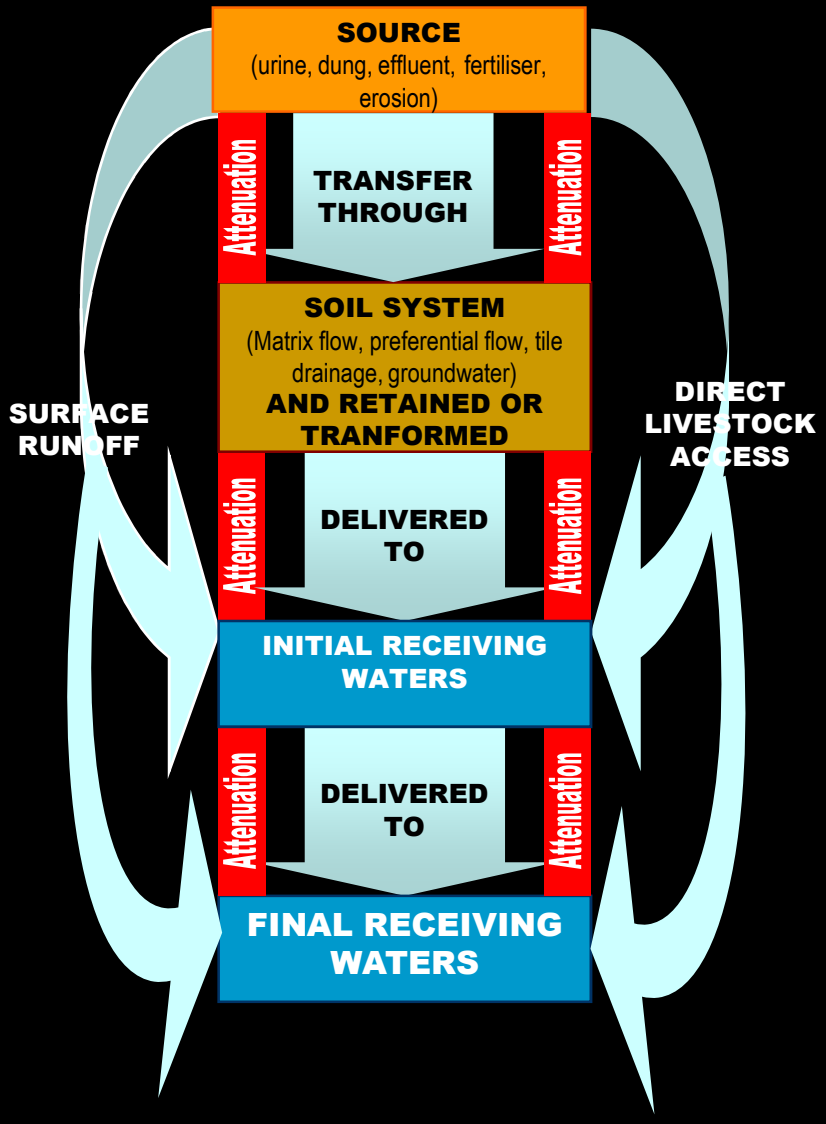


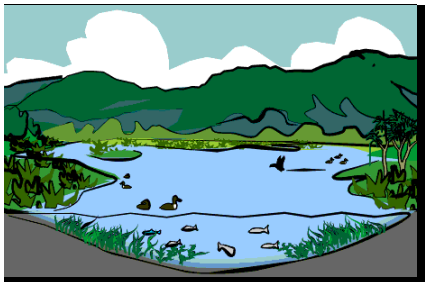
- surface runoff
  - infiltration excess
  - saturation excess
- subsurface
  - groundwater
  - seepage
  - matrix flow – slow
  - preferential flow – fast e.g. tile drains



Where can I intercept them?

- Opportunities
  - close to source
  - along pathways
  - bottom of catchment
- Ease of interception
  - drains > wetland > surface runoff > subsurface runoff > groundwater





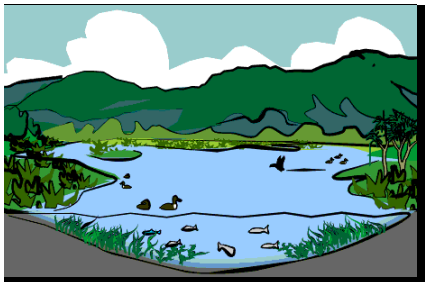
Key interception & attenuation options

Attenuation tool	Intercepted flowpath(s)	Scale(s)	Likely applicability	Target pollutants	Landscape fit	Knowledge level	Efficacy	Cost
Grass filter strip	surface runoff (sheet flow)	paddock	M	SS, P, N, bugs	L	M	M-L	$
Riparian buffer	surface runoff (sheet flow) + subsurface flow	paddock	H	SS, P, N	U	H	L	$$
Vegetated or partially-vegetated drains	surface runoff + subsurface flows in surface drains	paddock, farm	M	SS, N, P	U	L	M	$-$$
Managed or controlled drainage	s						M-L	$
Sediment traps, dams and ponds	s s						H	$$
Aquatic plant/algae uptake and harvesting	s						M-L	$$$
Natural seepage wetlands	s						M-H	$
Floodplain wetlands	floods	farm, catchment	H-L	SS, P, N	U/L	L	M-L	$-$$$
Constructed wetlands	stream flow, tile drain flow, surface drains	paddock, farm, catchment	M	SS, N	U	H	M	$$-$$$
Floating wetlands	streams, ponds, lakes	catchment	L	N, P	L	M-L	M	$$$
Permeable reactive filters	1. subsurface flow, surface drains, tile drains 2. subsurface drains (WCF)	paddock	M-L	N	L	M	H	$$
Reactive materials	1. stream flow 2. tile drains 3. natural, facilitated and constructed wetlands 4. surface runoff 5. soils, or porous filters for tile or surface drain flows	1. catchment 2. paddock 3. paddock, farm, catchment 4. paddock 5. paddock	M-L	P, (zeolite also K and NH_4)	L	L	M-L	$$-$$$ (close to material source)

http://www.niwascience.co.nz/ncwr/tools

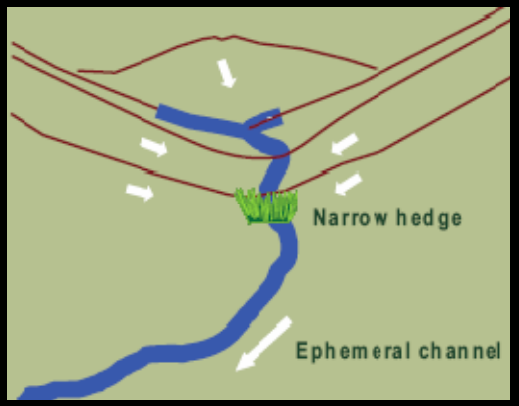
then look for:

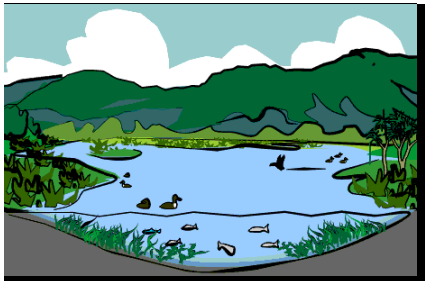
Pastoral 21: Stocktake of diffuse pollution attenuation tools



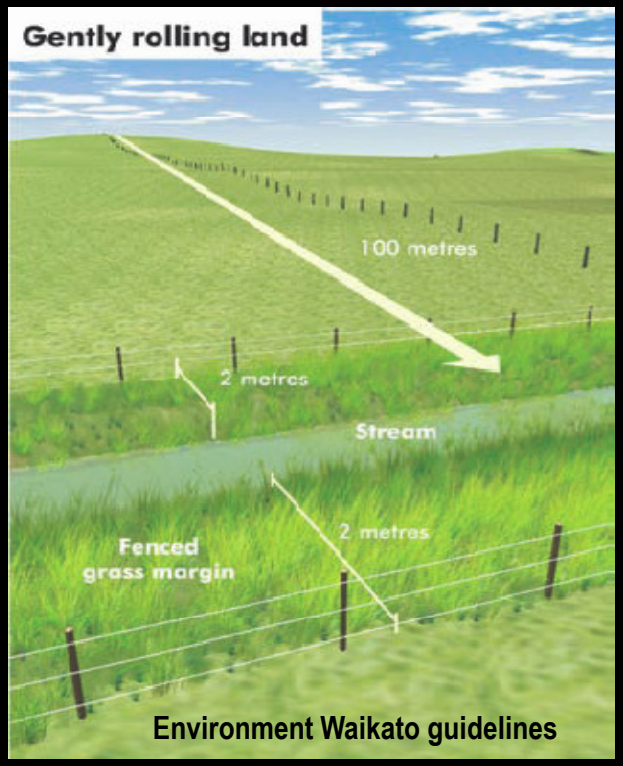
Filter strips

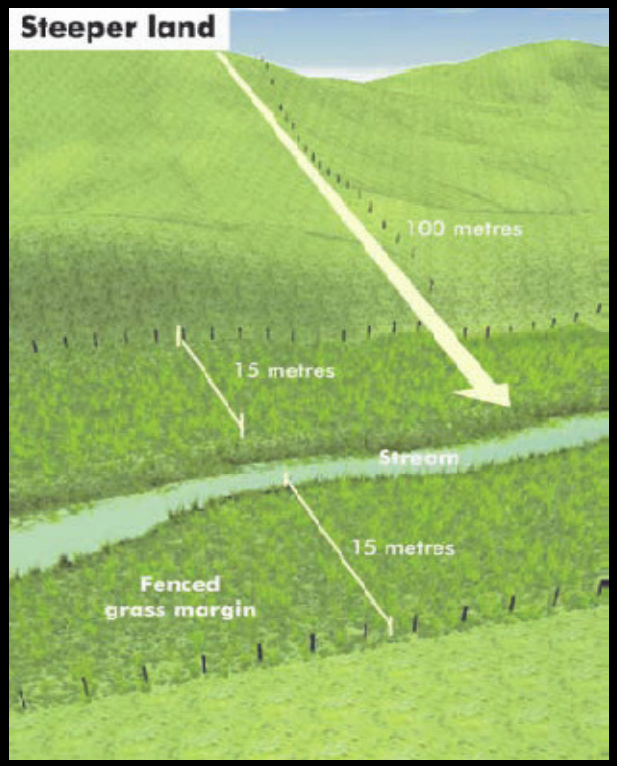
- Grass filter strips
  - Managed band of dense grass
  - Focus = Surface run-off
    - Deposition, infiltration, filtering
      - >80% removal SS & particulate N & P
      - > 50% removal dissolved N & P
    - Channelised-flow -Grass hedges

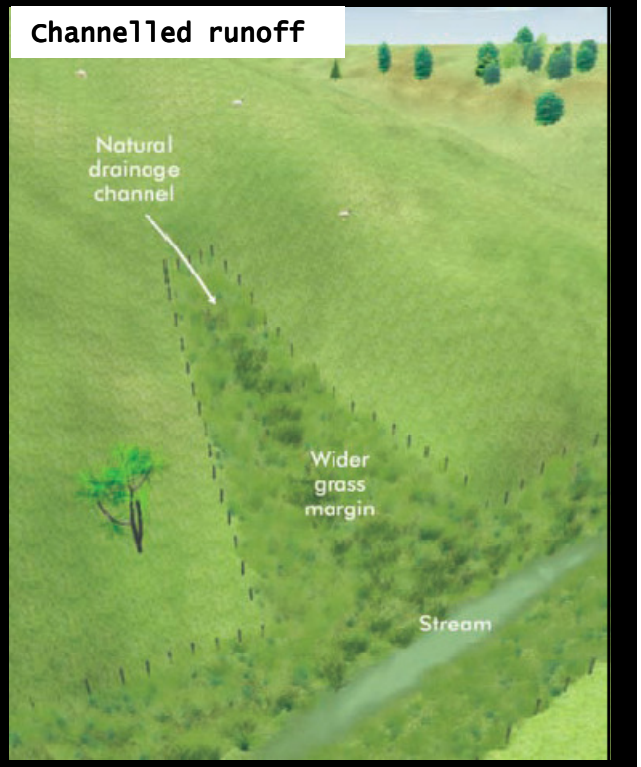


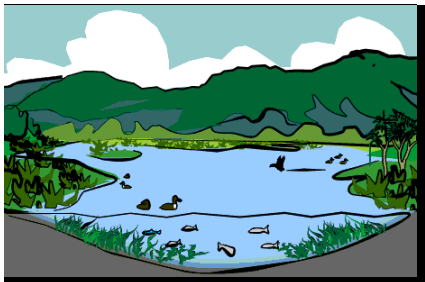


General grass filter guidelines



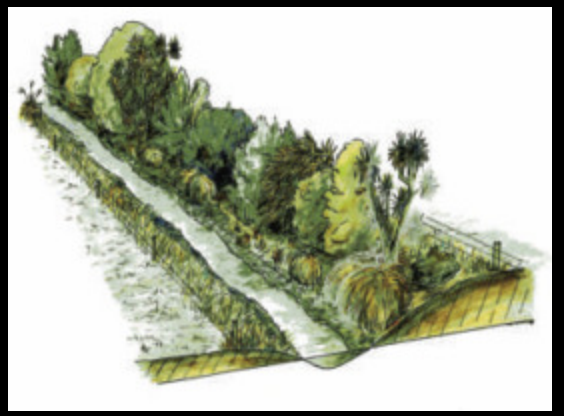


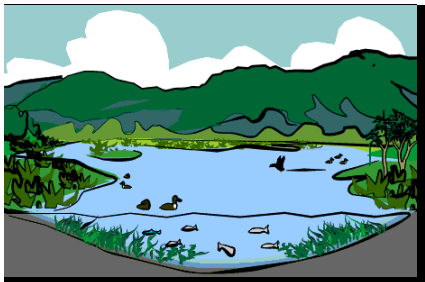




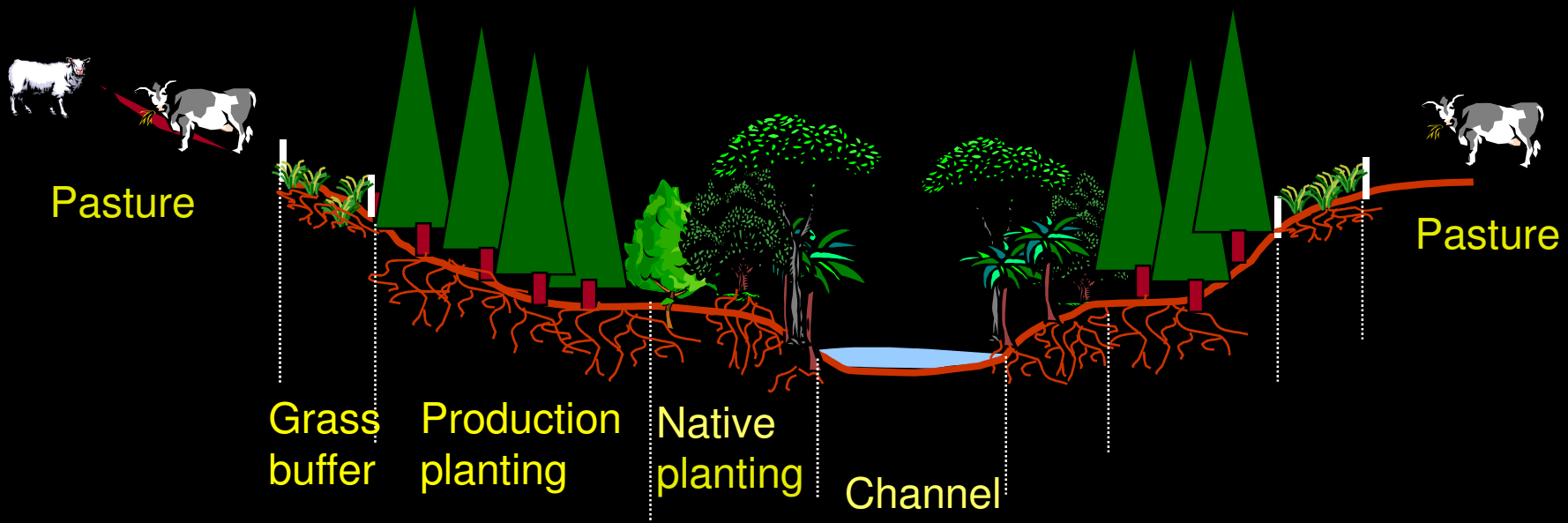
Riparian buffer

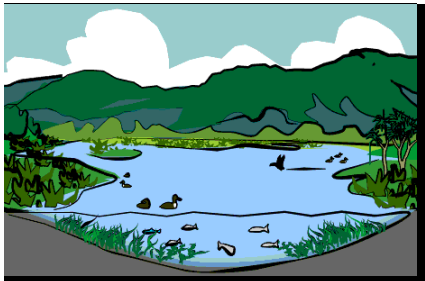
- Managed band of shrubs & trees along streambank
- Surface & shallow subsurface-flow
  - Deposition, infiltration, filtering
  - Plant uptake
  - Denitrification
  - Adsorption
- Streambank protection
  - Biodiverstiy
  - Shading
  - Landscape aesthetics



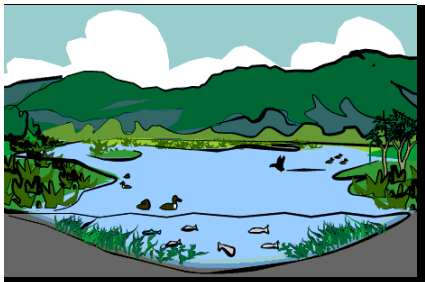


Combination riparian buffer (Rolls Royce)

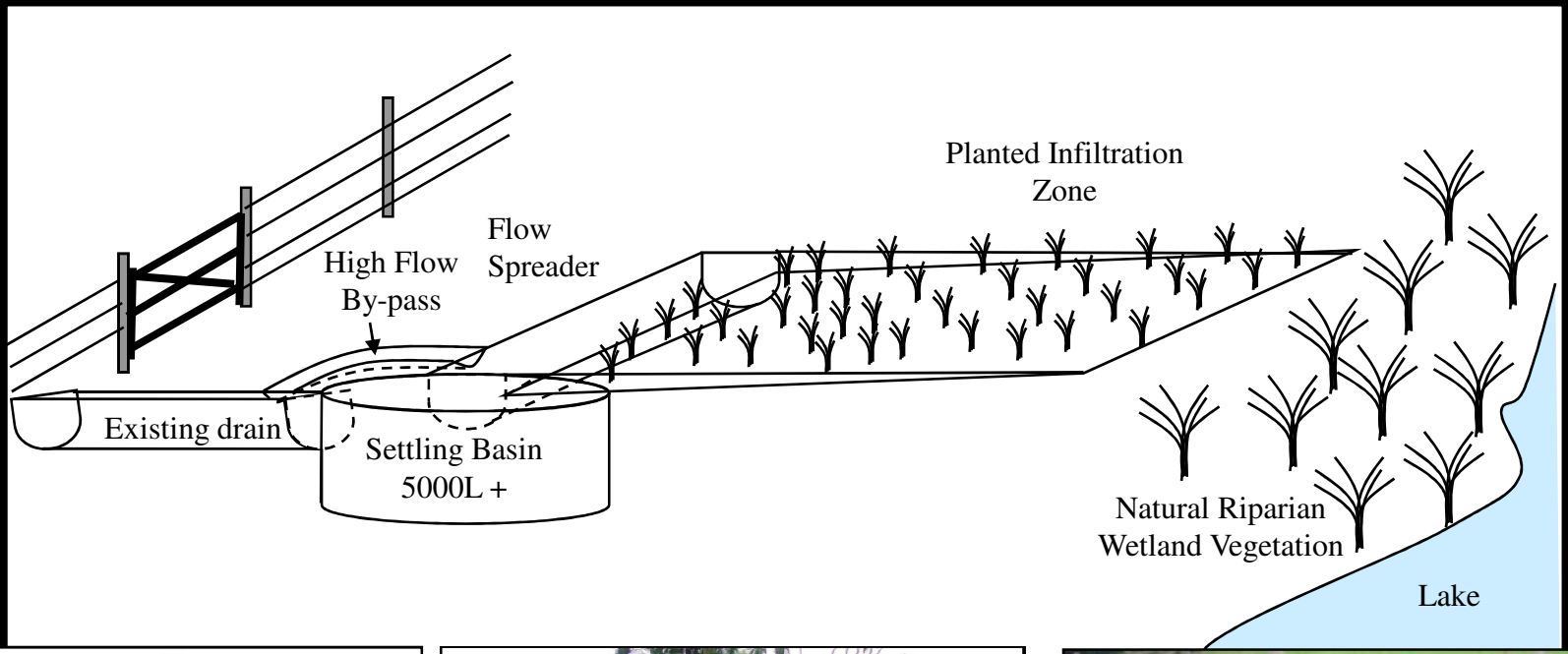


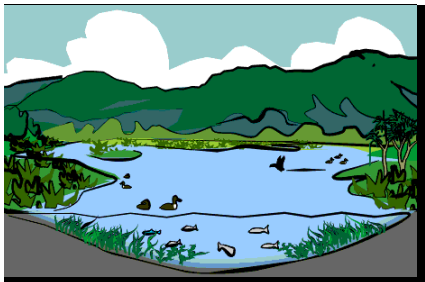


Rotopiko Lakes



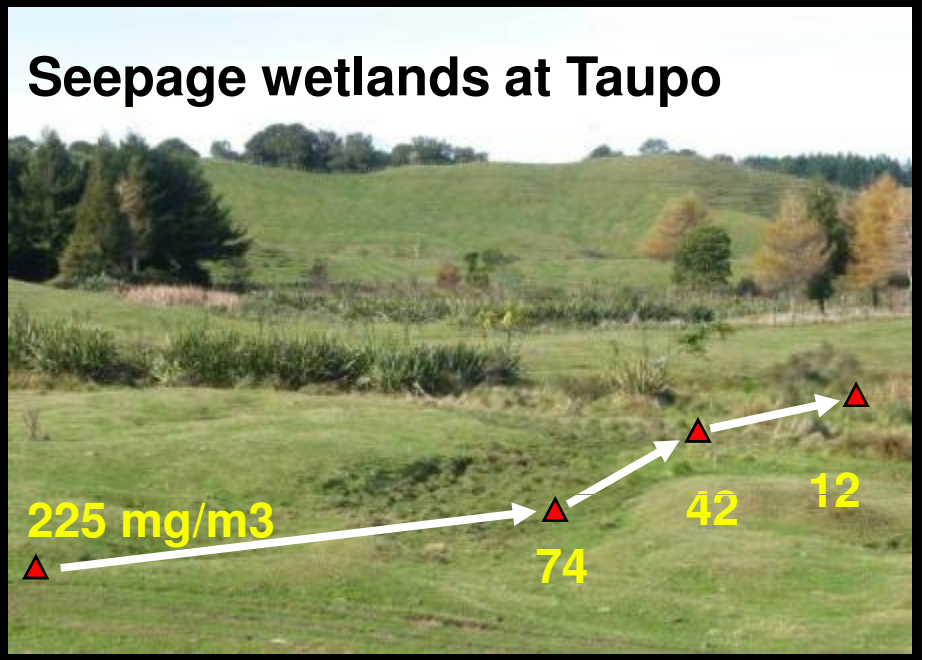
Riparian reconnection

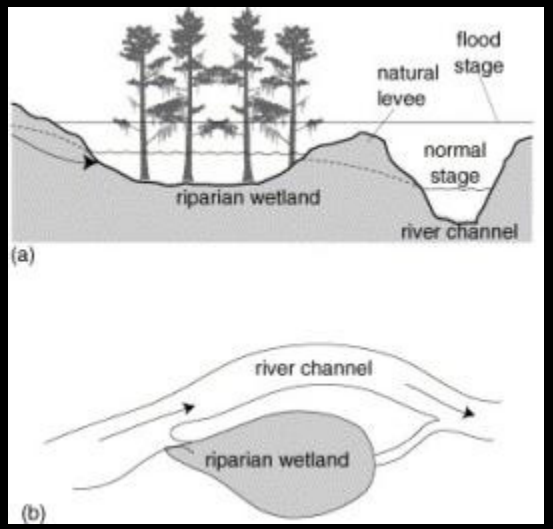


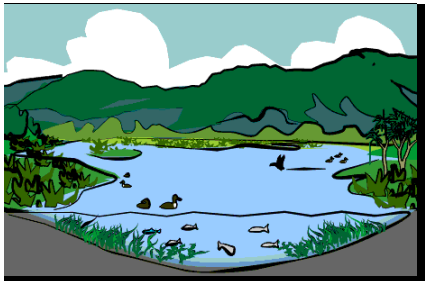


Natural wetlands

- Seepage wetlands
  - Denitrification
  - Nutrient uptake
  - Deposition
  - Adsorption
- Riverine wetlands
  - Flood attenuation

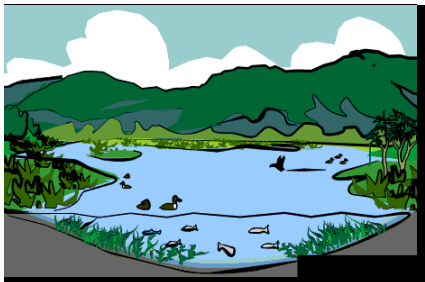




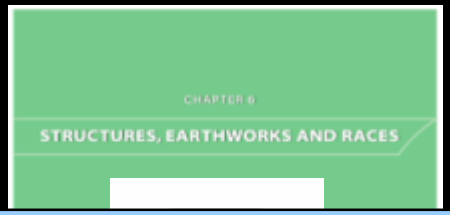


Constructed wetlands

- Drainage systems
- Flow confluences
- Bottom of catchment
  - 1-5% of catchment
  - Removal of 30- 70% of N, SS & PP



Interception of farm drainage



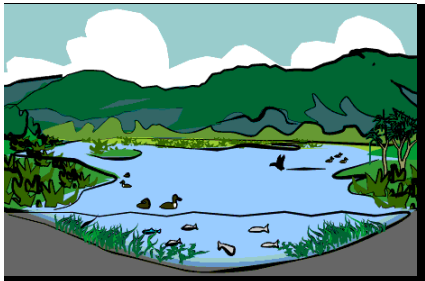
View from above

Subsurface drain

Fenceline

Subsurface drain

Stream



Lake Okaro wetlands

Main north-western stream inflow

Storm bypass channel

Lakeside wetland

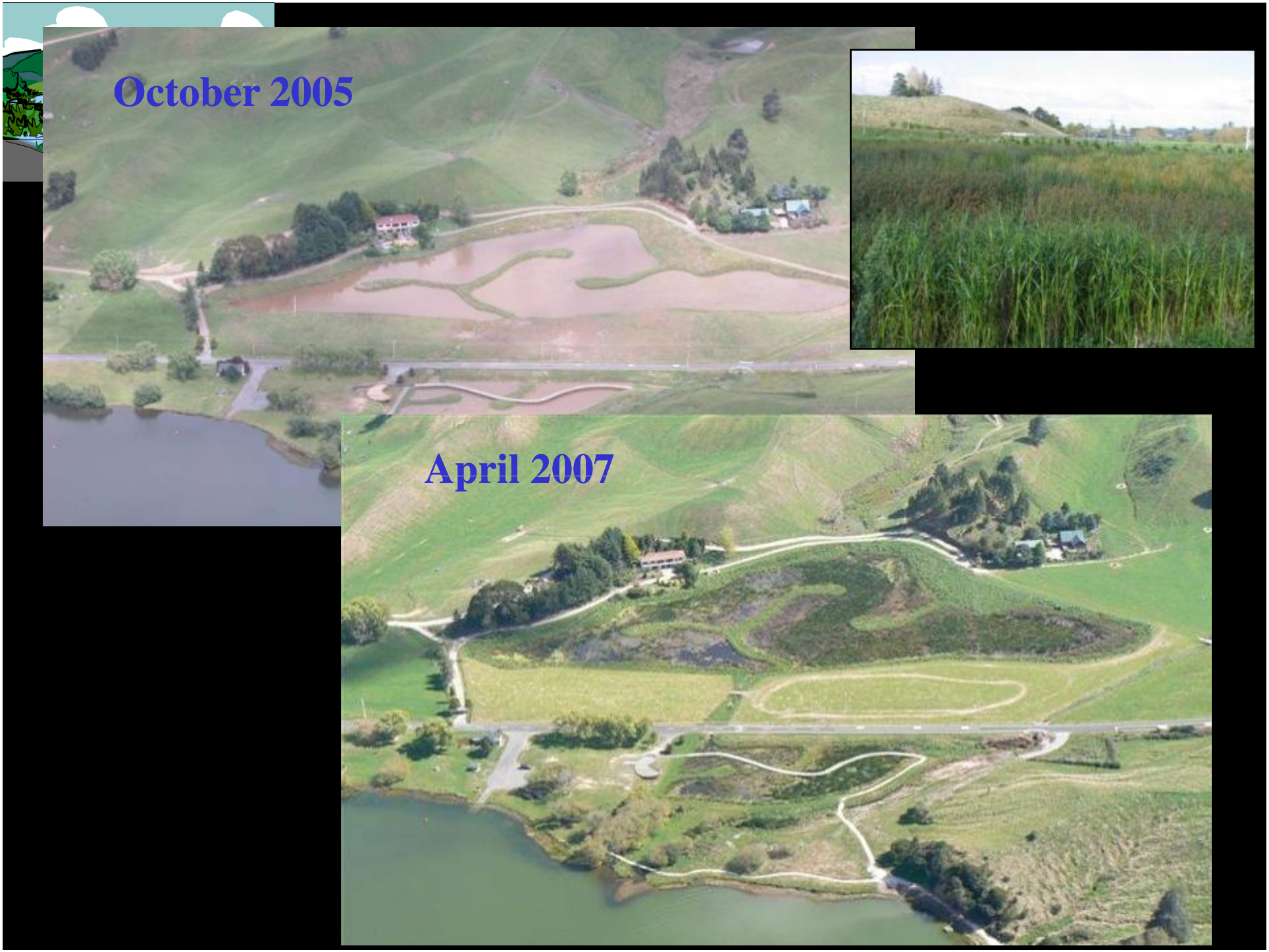
Lake Okaro

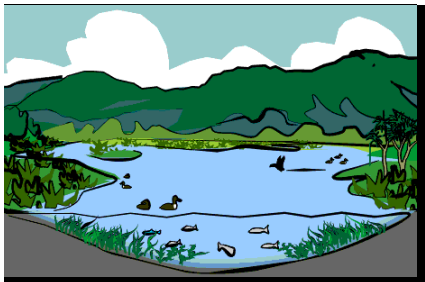
Stream weir

Farm wetland

Secondary western stream inflow

Farm drain inflow

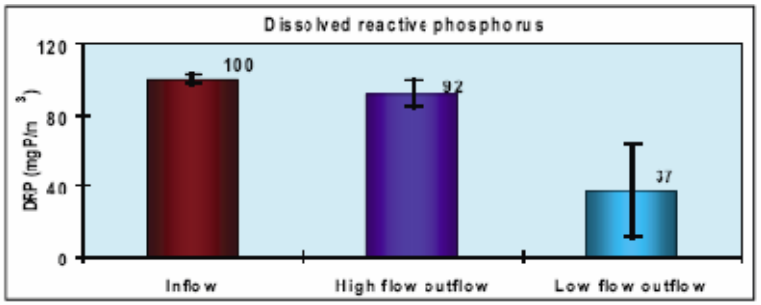

October 2005
April 2007

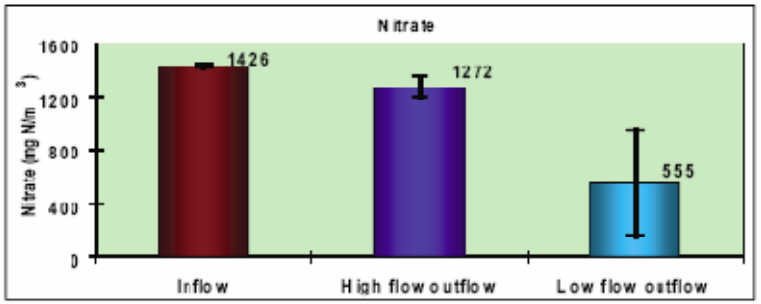


Aquatic plant harvesting

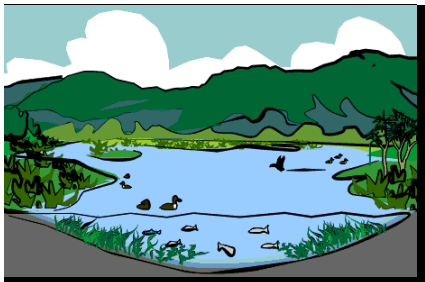
- Harvest to maintain active uptake
- Water cress
  - Potential markets

Preliminary Results



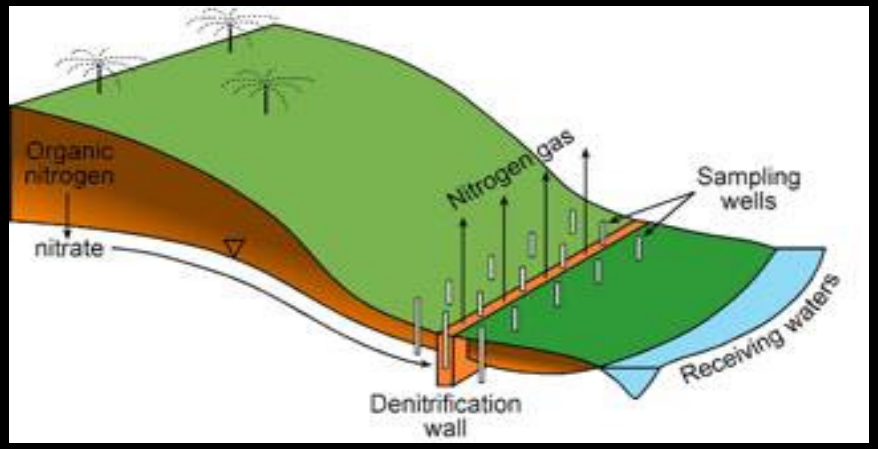


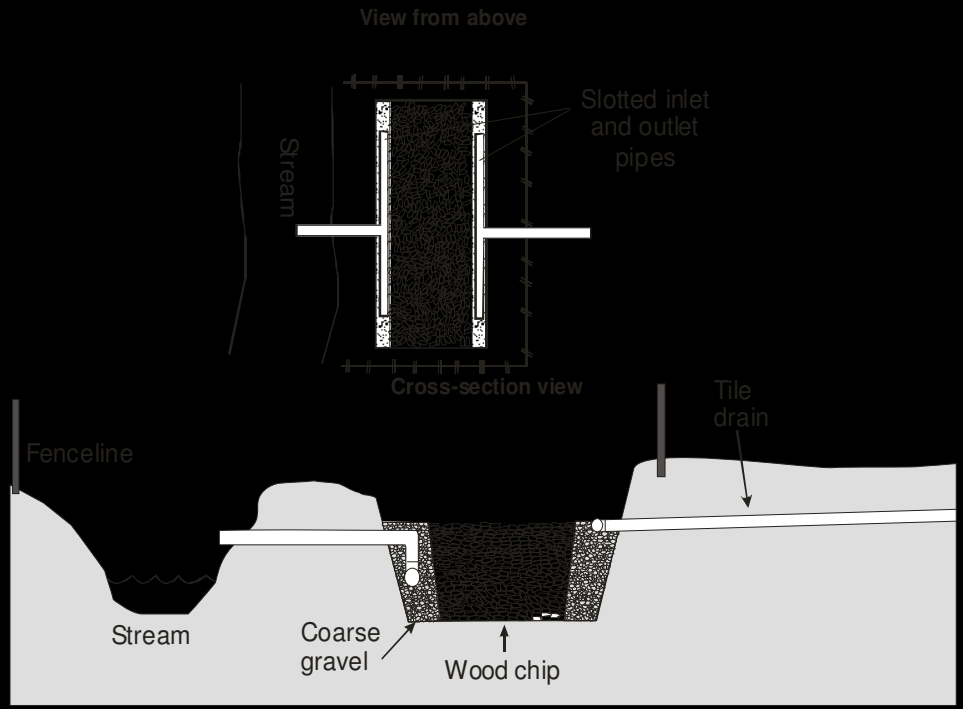
Mean nitrate and disssolved reactive phosphorus concentrations for the inflow and outflows (n = 5).

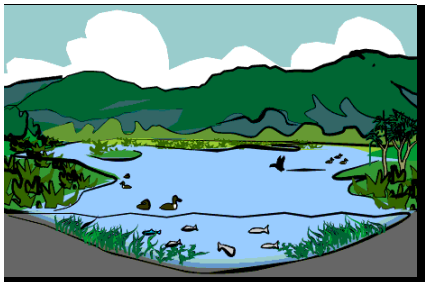


Reactive materials/filters

- Treatment walls
  - Sawdust incorporated in soil
- Porous reactive filters
  - Woodchip or bark
  - P-sorbing media
- Additives to wetland and riparian soils



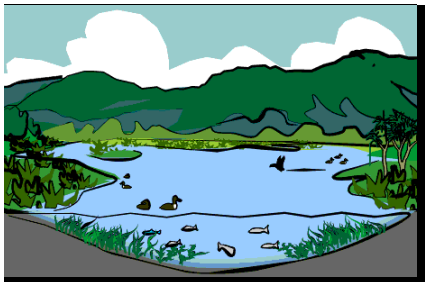




Reducing external nutrient loads

- Selecting the right tool for the job
  1. set catchment targets
  2. understand how water moves through catchment
     – prioritise flowpaths
  3. promote appropriate farming BMPs
  4. safeguard existing wetlands –attenuation assets
  5. evaluate relevance & cost-effectiveness of additional attenuation tools –look for multiple benefits


http://www.niwascience.co.nz/ncwr/tools
then look for:
Pastoral 21: Stocktake of diffuse pollution attenuation tools
Thanks
NIWA
Taihoro Nukurangi



Putting it all together