Water quality and ASS
Ecotoxicology perspective

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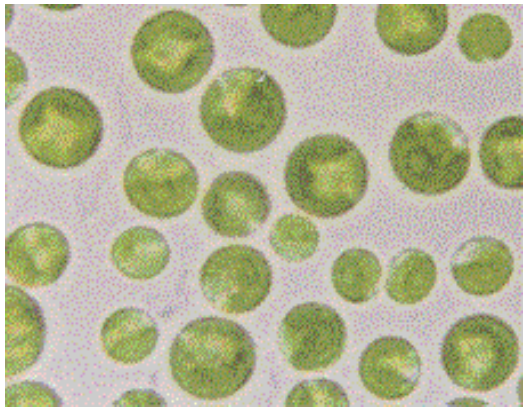
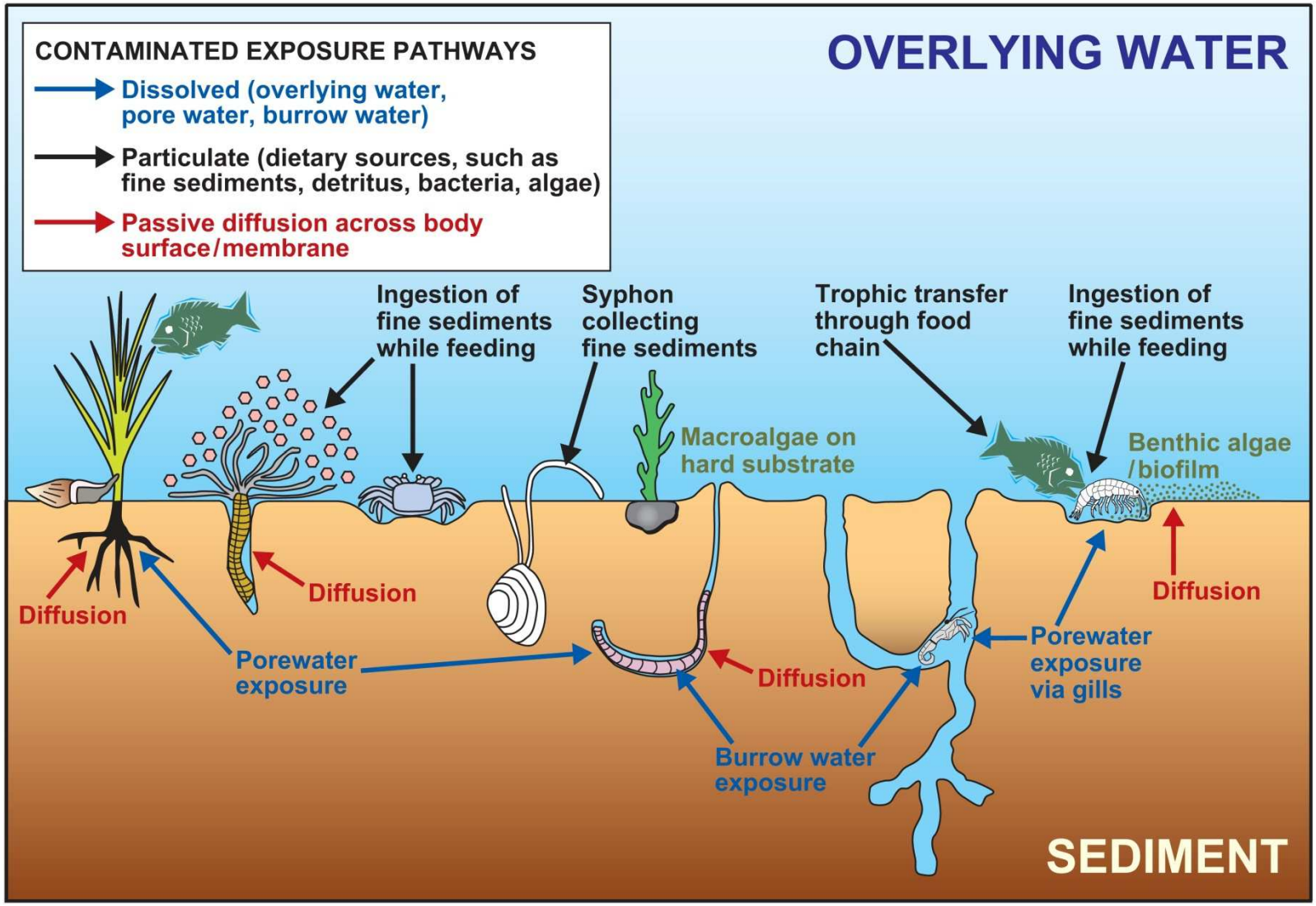
Use of bioindicators

Direct toxicity assessment-surface water

Sites	Microbial	Alga	Water flea	Shrimp	Fish larvae
Dog Lake	LT	NT	LT	NT	NT
Point Strut North	LT	NT	LT	NT	LT
Artificial water	NT	NT	NT	NT	NT

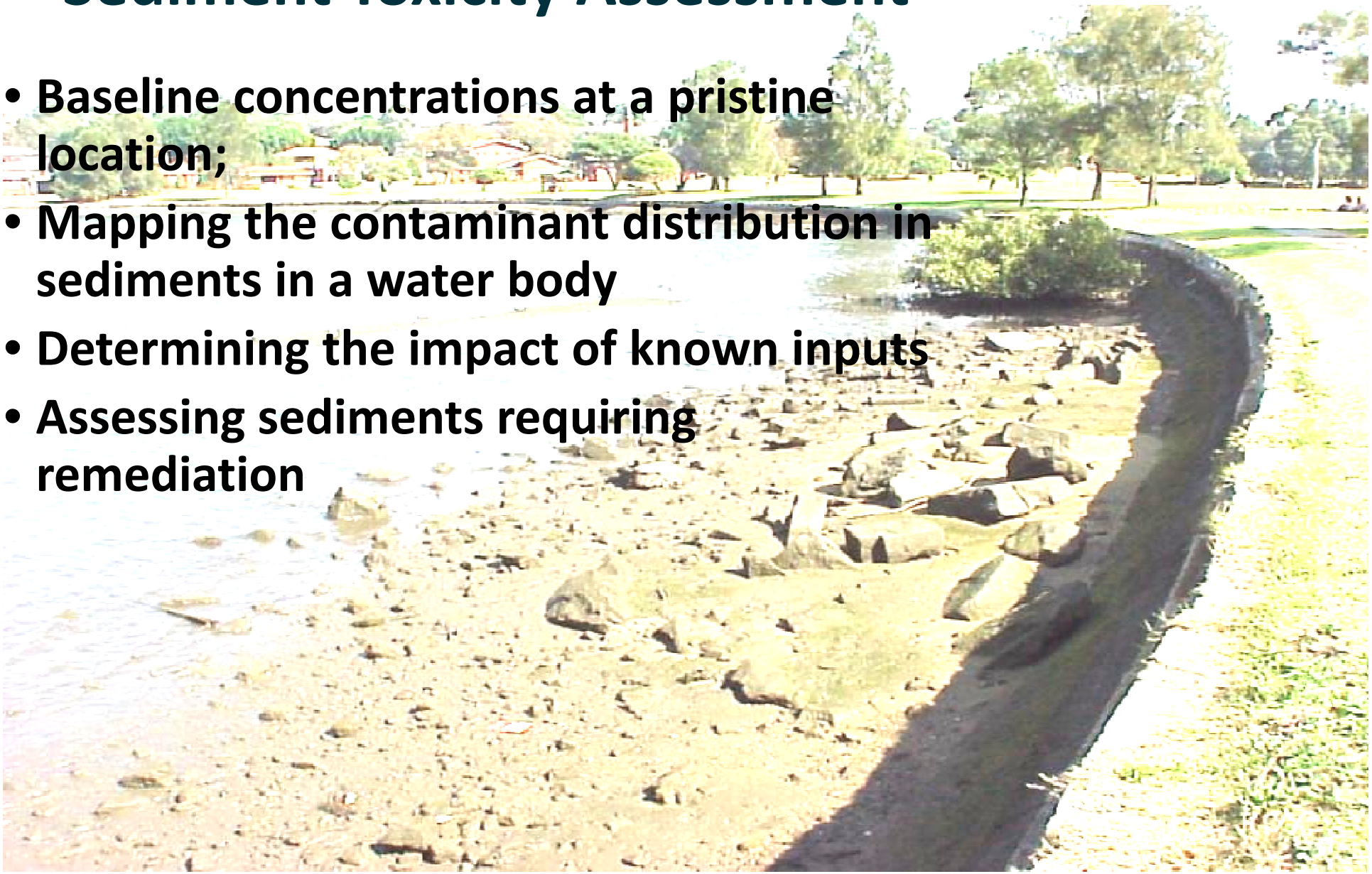
NT: No toxicity	LT: Low toxicity NOEC >60%	T: Moderate to high toxicity NOEC 60-10%	HT- very high toxicity NOEC <10%



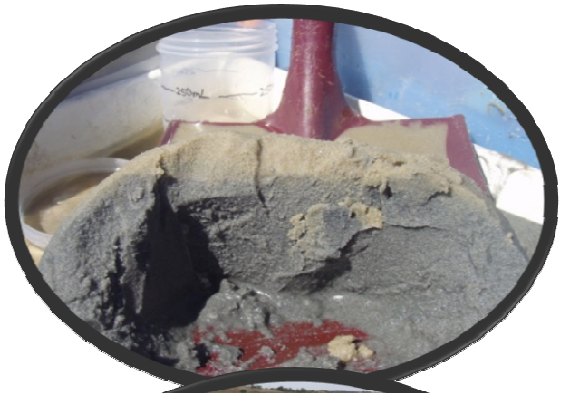

CONTAMINATED EXPOSURE PATHWAYS
Dissolved (overlying water, pore water, burrow water)
Particulate (dietary sources, such as fine sediments, detritus, bacteria, algae)
Passive diffusion across body surface/membrane
OVERLYING WATER
Ingestion of fine sediments while feeding
Syphon collecting fine sediments
Trophic transfer through food chain
Ingestion of fine sediments while feeding
Macroalgae on hard substrate
Benthic algae /biofilm
Diffusion
Diffusion
Diffusion
Diffusion
Porewater exposure
Porewater exposure via gills
Burrow water exposure
SEDIMENT

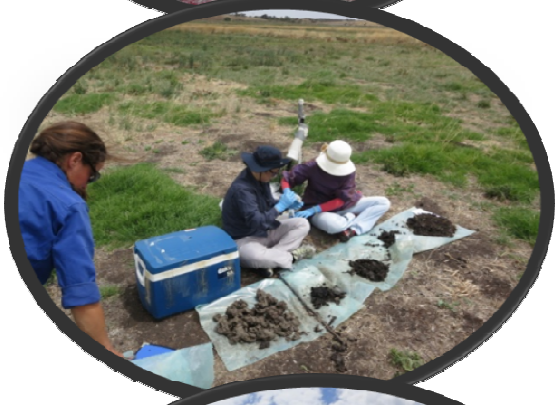
Sediment Toxicity Assessment

- Baseline concentrations at a pristine location;
- Mapping the contaminant distribution in sediments in a water body
- Determining the impact of known inputs
- Assessing sediments requiring remediation

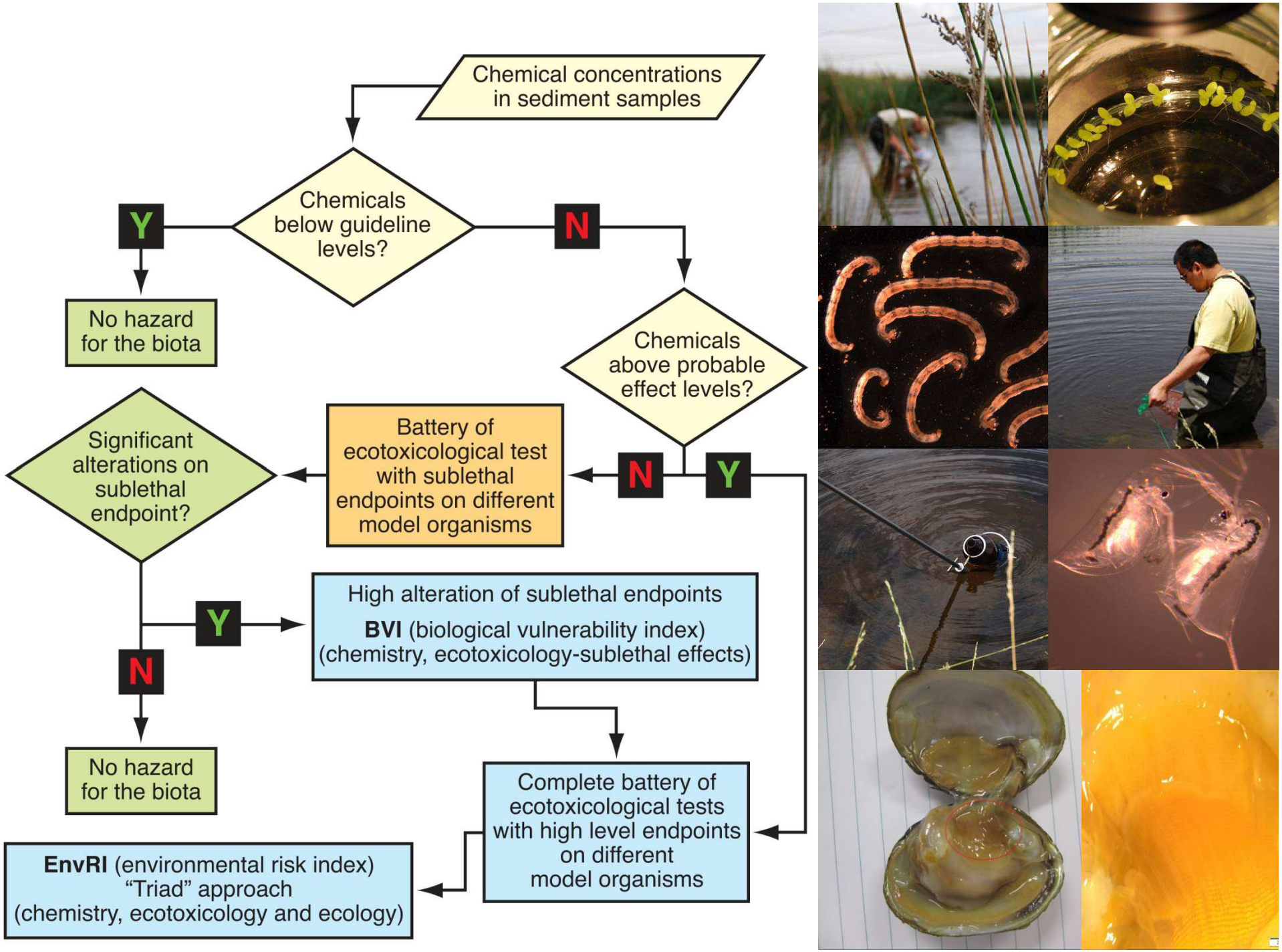


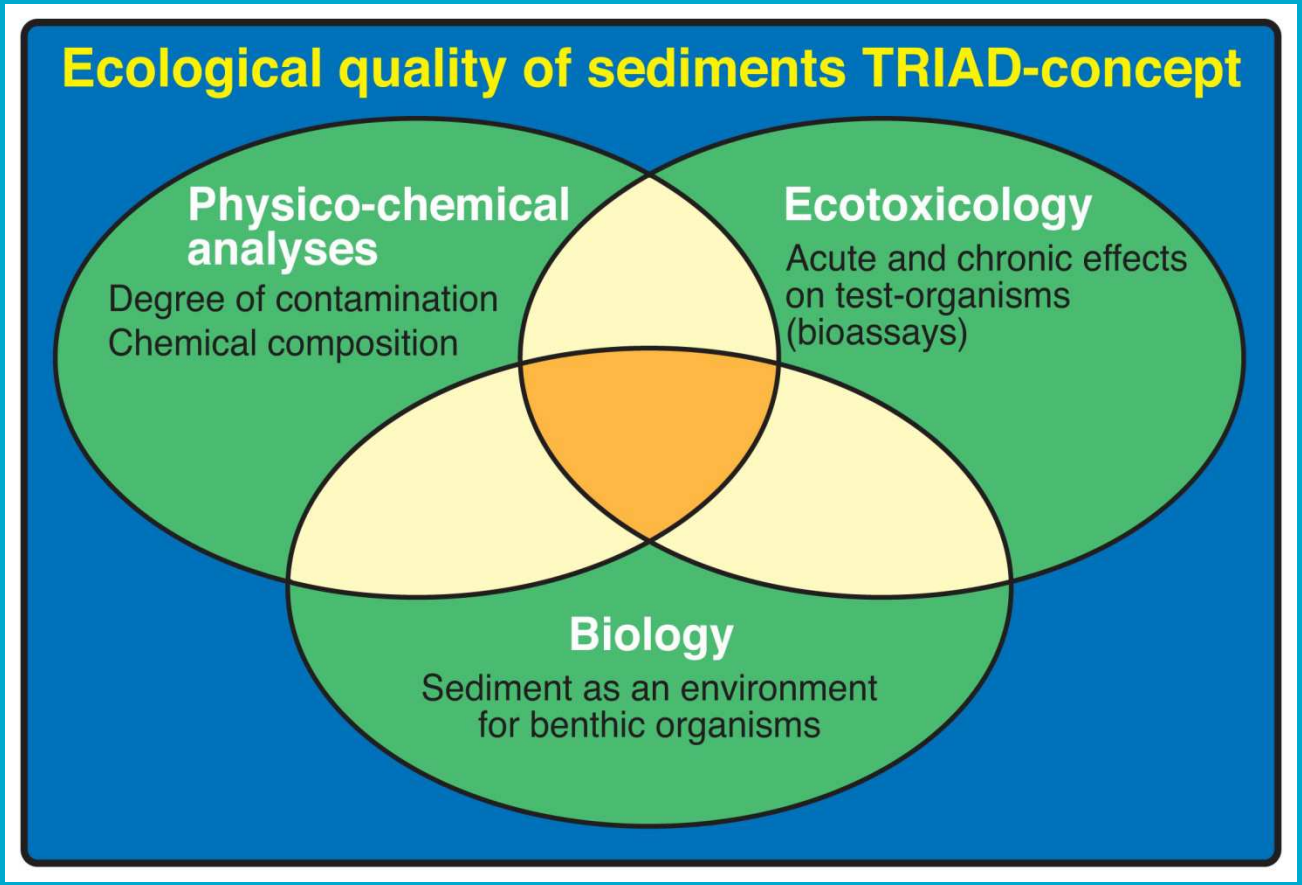

N
South Australia
0
10
Kilometres
Study areas
River Murray
Tailem Bend
Wellington
LF20
LF19
LF04
Milang
LF01
LF03
Lake Alexandrina
LF23
LF24
LF02
Narrung
LF06
LF17
LF15
LF21
LF13
LF12
Goolwa
Lake Albert
LF07
LF10
Murray Mouth
LF08
Meningie
Southern Ocean
CSIRO





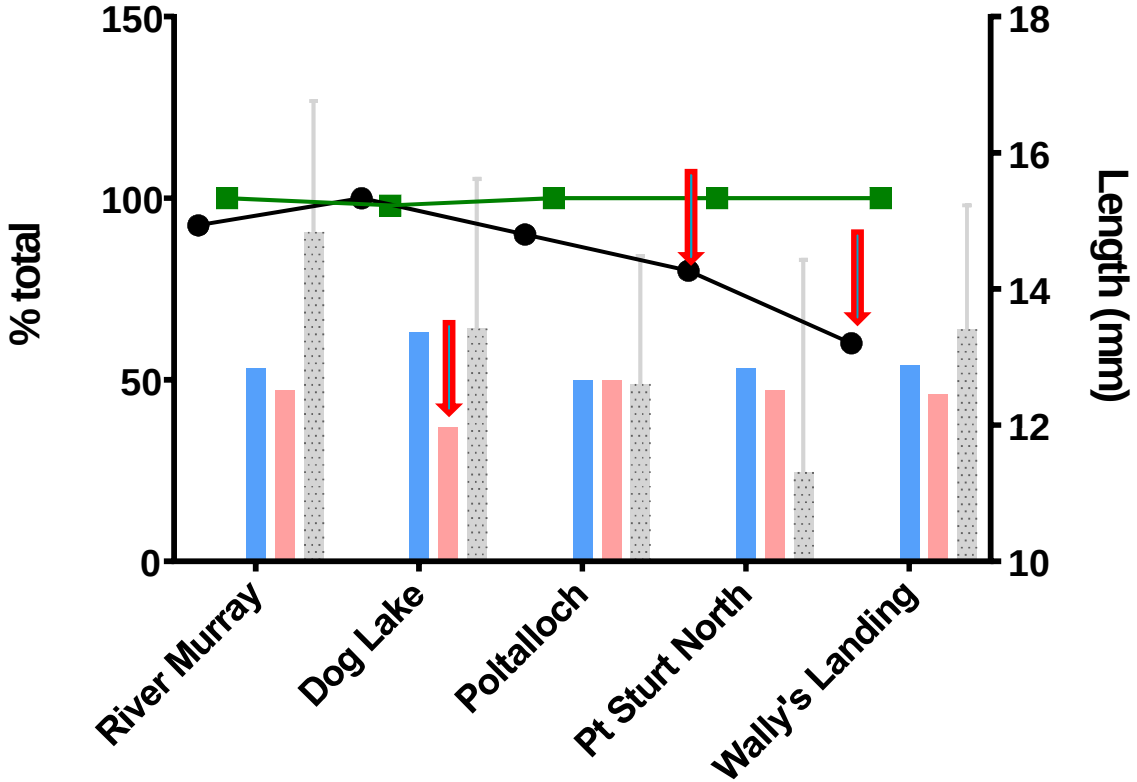
1. Are contaminants generated in the system?
2. Are contaminants bioavailable?
3. Is there a measurable response?
4. Are the contaminants causing this response?


Chemical concentrations in sediment samples
Chemicals below guideline levels?
Y
N
No hazard for the biota
Chemicals above probable effect levels?
N
Y
Battery of ecotoxicological test with sublethal endpoints on different model organisms
Significant alterations on sublethal endpoint?
Y
N
No hazard for the biota
High alteration of sublethal endpoints
BVI (biological vulnerability index) (chemistry, ecotoxicology-sublethal effects)
Complete battery of ecotoxicological tests with high level endpoints on different model organisms
EnvRI (environmental risk index) "Triad" approach (chemistry, ecotoxicology and ecology)



1-TRIAD Approach

Midge toxicity- whole sediment test

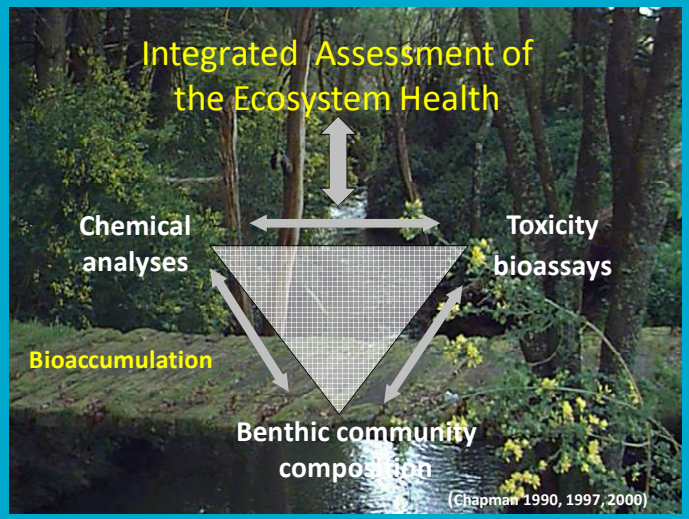


Red arrows represent significant effects

1- TRIAD Approach

Mostly un-impacted sites- recovered

17 sites sampled in March and Nov 2013



Surface water (Bioassays)

1. Microbial assessment (MARA)
2. Algae/duckweed
3. *Ceriodaphnia dubia* (waterflea)
4. *Paratya australiensis* (freshwater shrimp) survival and oxidative stress
5. Native fish (Golden perch or Murray cod larvae)

Sediment (top layer)

1. Whole-sediment ecotox - Midge - *Chironomus tepperi*
2. Pore-water - MARA and *Ceriodaphnia dubia*

Sediment (depth 2)

1. Whole-sediment ecotox - Midge - *Chironomus tepperi*
2. Pore-water-MARA and *Ceriodaphnia dubia*

Sediment (depth 3)

1. Whole-sediment ecotox - Midge - *Chironomus tepperi*
2. Pore-water-MARA and *Ceriodaphnia dubia*

Sediment (depth 4)

1. Whole-sediment ecotox - Midge - *Chironomus tepperi*
2. Pore-water-MARA and *Ceriodaphnia dubia*

Depth (cm)
10
20
30
40
50
60

Photo by David Robertson (2007), provided by Peter Teasdale, Griffith University)

2- Deeper sediment layers?

Direct toxicity assessment – Pore-water

Water samples	Microbial	Water flea Acute	Water flea Chronic
Boggy Creek (0-3 cm depth)	T	NT	LT
Boggy Creek (3-13 cm depth)	T	T	HT
Boggy Creek (13-27 cm depth)	LT	T	HT
Boggy Creek- (27-47 cm depth)	T	T	HT
Point Sturt North (0-12 cm depth)	NT	NT	LT
Point Sturt North (12-25 cm depth)	LT	T	HT
Point Sturt North (25-42 cm depth)	T	HT	HT
Point Sturt North (42-67 cm depth)	T	NT	LT
River water	NT	NT	NT

NT: No toxicity	LT: Low toxicity	T: Moderate to high toxicity	HT- very high toxicity
NOEC >100-90%	NOEC 89-49%	NOEC 50-10%	NOEC <10%

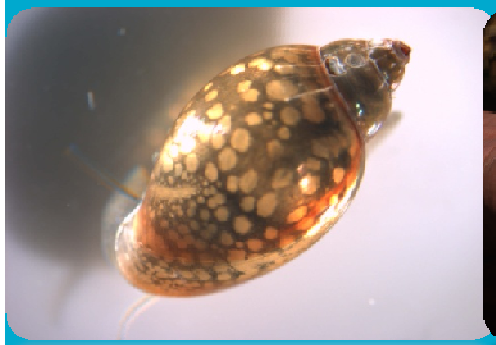
2- Deeper sediment layers?

Contaminants generated at the ASS impacted sites at deeper sediment depths if bioavailable, could be severely toxic to aquatic organisms .

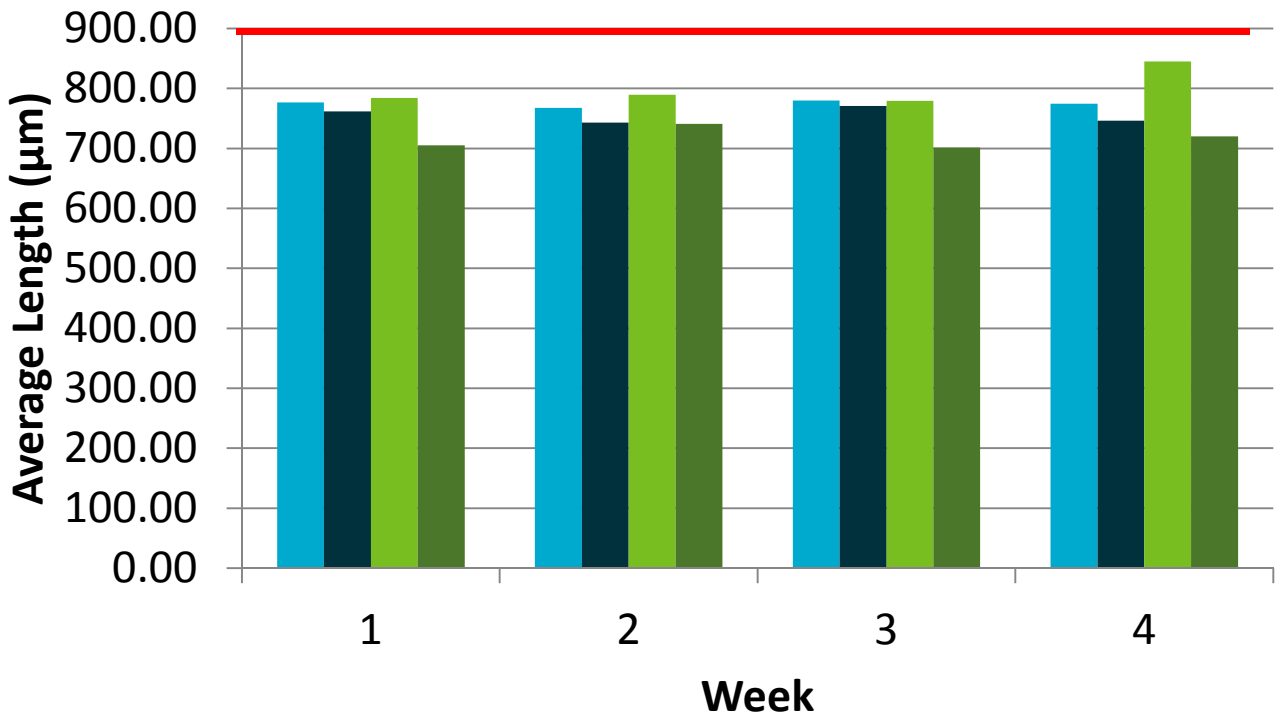


3- In-situ assessment-caging studies

Snail, yabby, mussel and shrimp

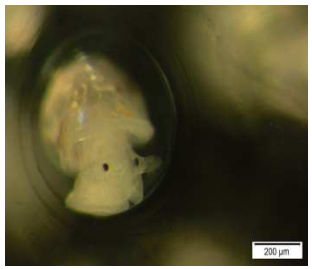



Snail growth in surface water collected from sites weekly collection of snails



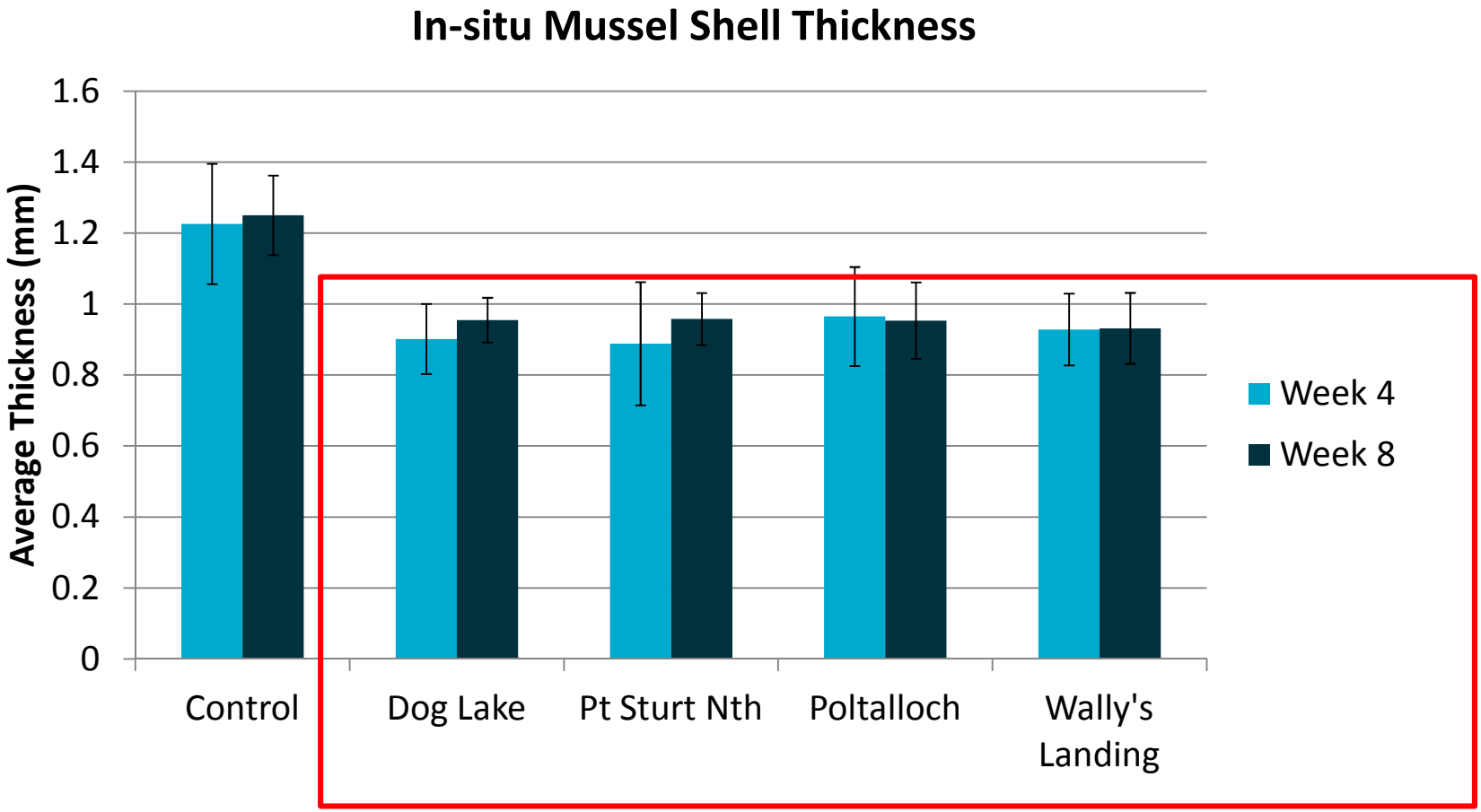
The red line shows the minimum length of the snails reared fully under the laboratory conditions . (ranged from 900-1100) µm

- Dog Lake
- Poltalloch
- Pt. Sturt Nth
- Wally's Landing

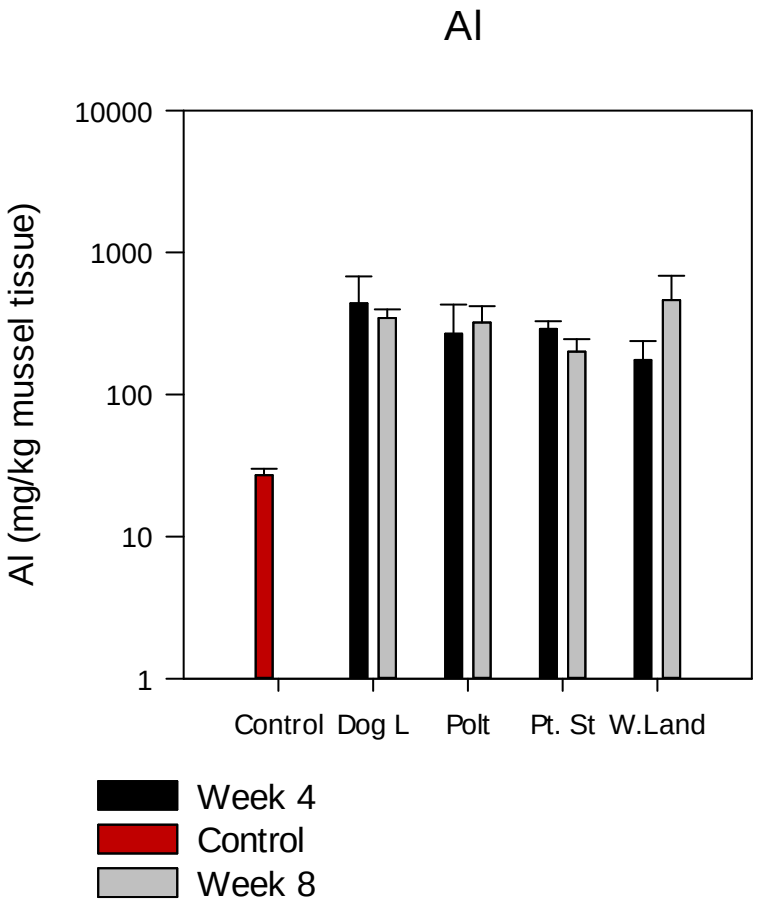


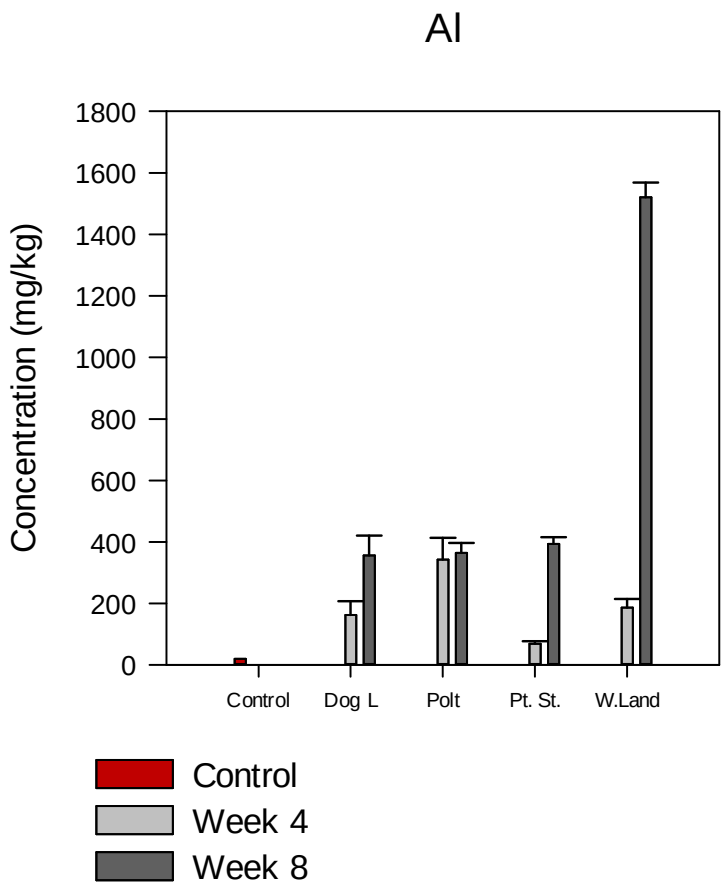
Mussel thickness

shell thinning observed at all sites



Body burden- Mussel and yabby tissue





Now

1. Lower Lakes recovering
2. Flows are important to maintain ecosystem health
3. Ecotoxicological approaches are successful in identifying hotspots and contaminants responsible for the adverse effects.

If in near future

Thank you

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Mitigation and Technologies

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