Cat skinning: alternatives to default water quality limits in your mine drainage

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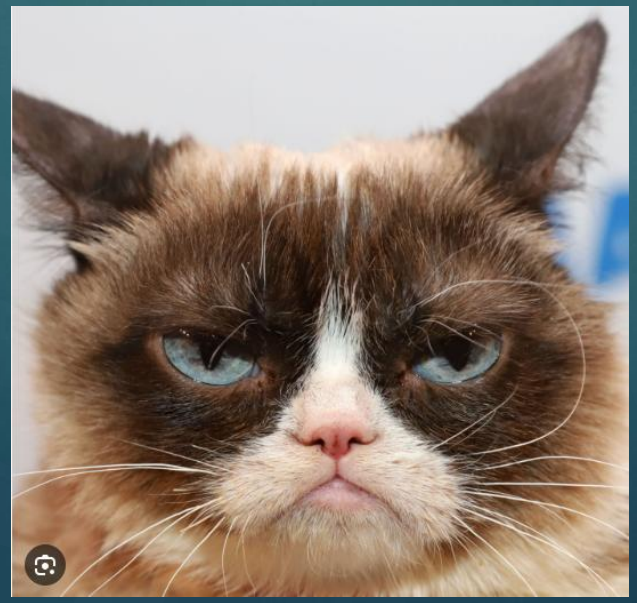
& Phil Lindsay (Bathurst)



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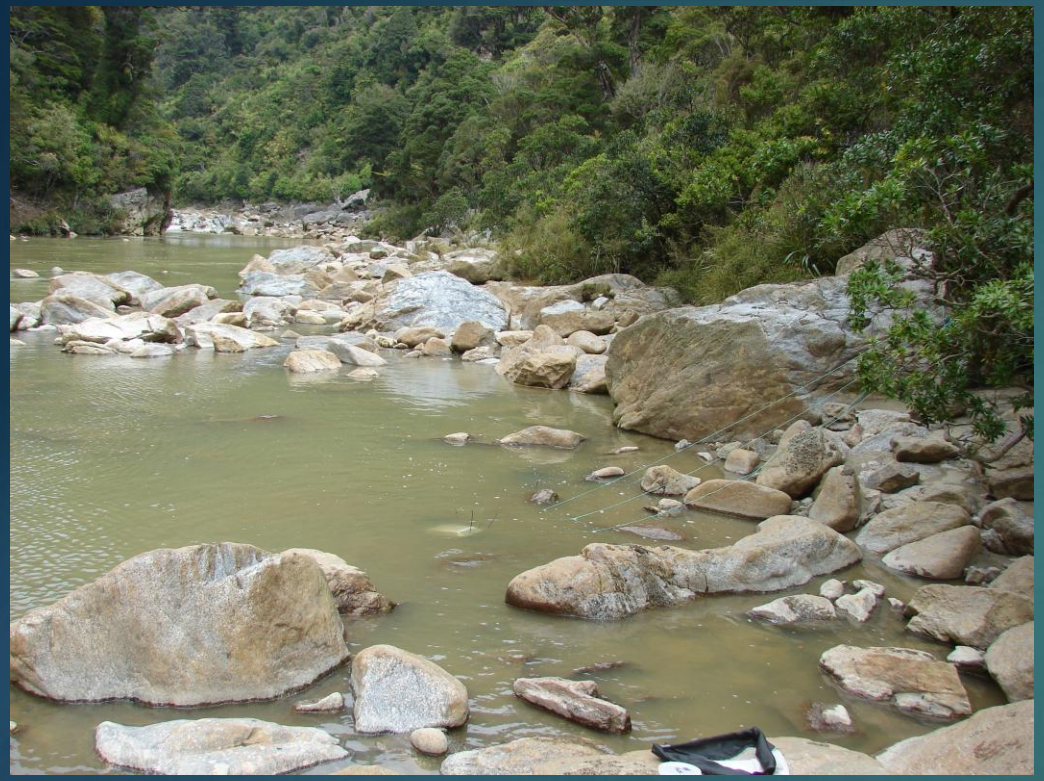
Acid Mine Drainage (AMD)



Low pH, metals, sometimes elevated turbidity
Sulphide mineral oxidation in the presence of oxygen and water
Water quality and values effected

Consenting and mine planning

- Mine consenting and planning typically requires WQ limits and objectives to protect or restore values.
- Default toxicity guidelines exist – ANZG, EPA, CWQG.
- But defaults are generic, are they always appropriate?

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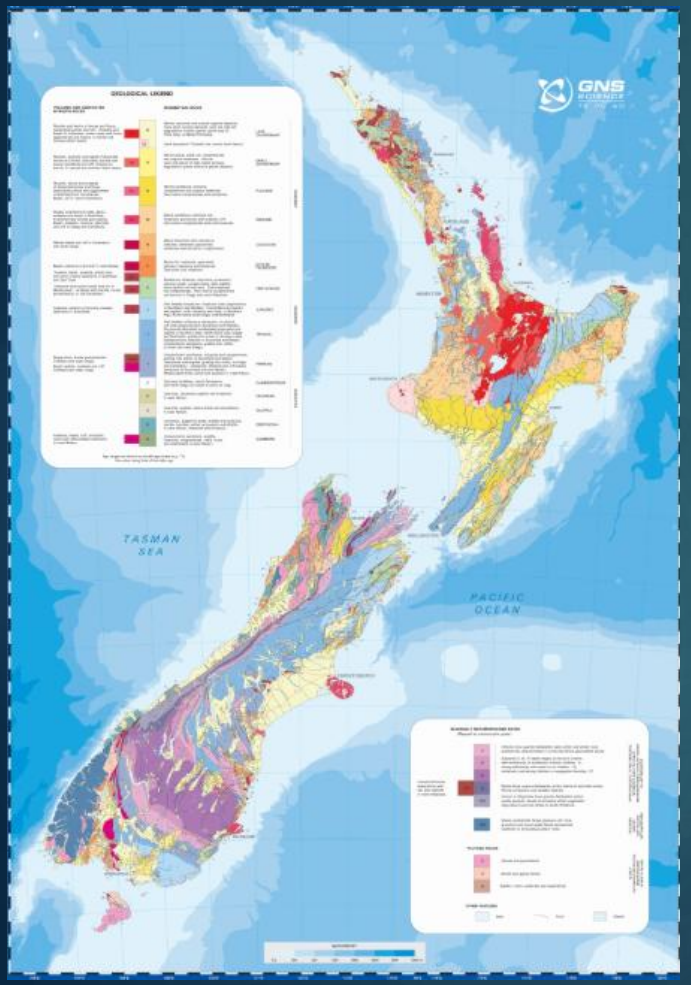
Guidelines – e.g. ANZG 2018

- Universal WQ numbers are not possible due to the diversity of ecosystems.

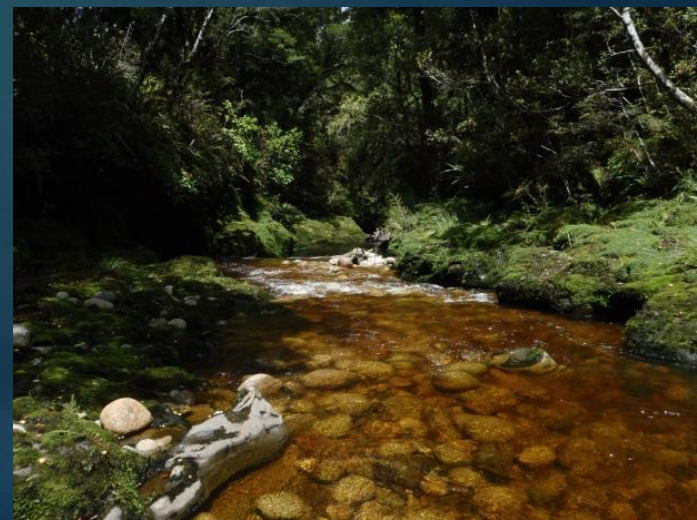


Guidelines – e.g. ANZG 2018

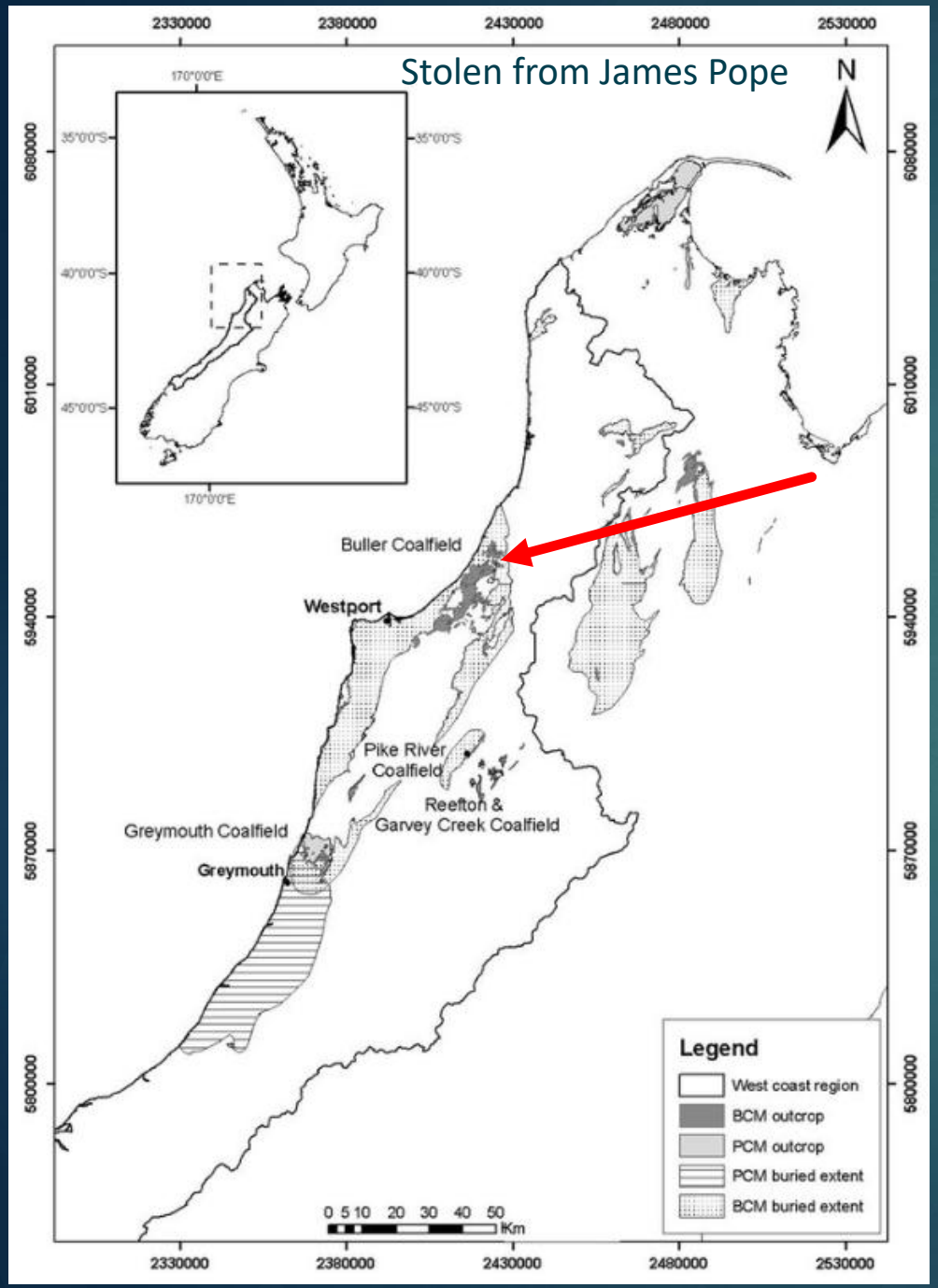
- Work is underway to provide ecoregion specific guidance, but biota **X** chemicals = huge task.
- In the meantime councils may use generic numbers to determine effects and permitted activity status.

But my streams are different

- ANZG encourages the use of local site specific data
- Toxicity assays are resource hungry to develop.
- What about field data? Ecology and water quality



Stockton and Denniston



- Buller coal measures (BCM), associated geology and environments create streams with distinctive natural chemistry
- Naturally low pH, elevated metals, high DOC.

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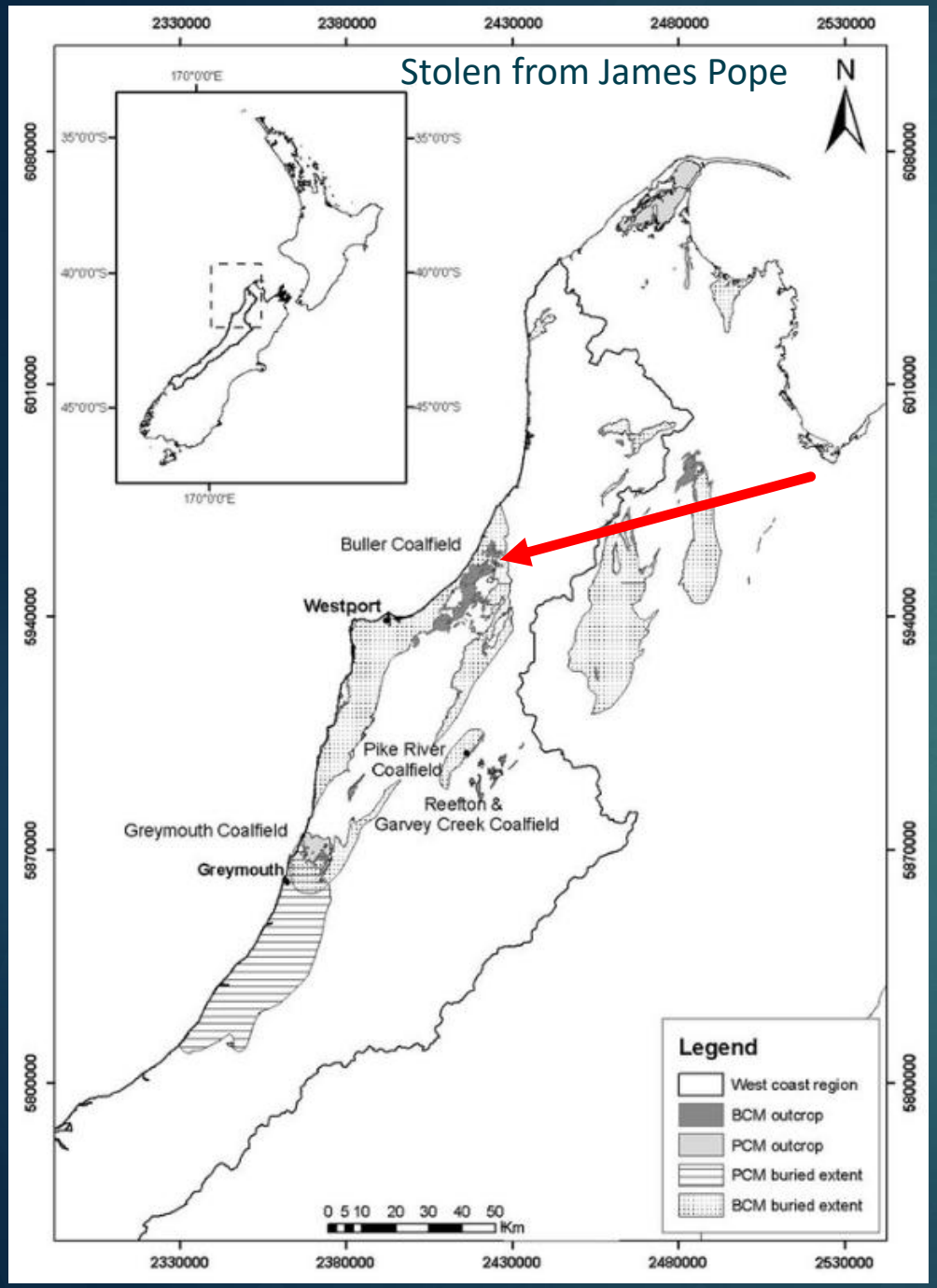

Stockton and Denniston

- Long history of coal mining
- Contemporary and historic AMD discharges
- Documented effects on ecology
- Extensive water management and remediation
- Future planning and consenting requires thresholds to guide recovery

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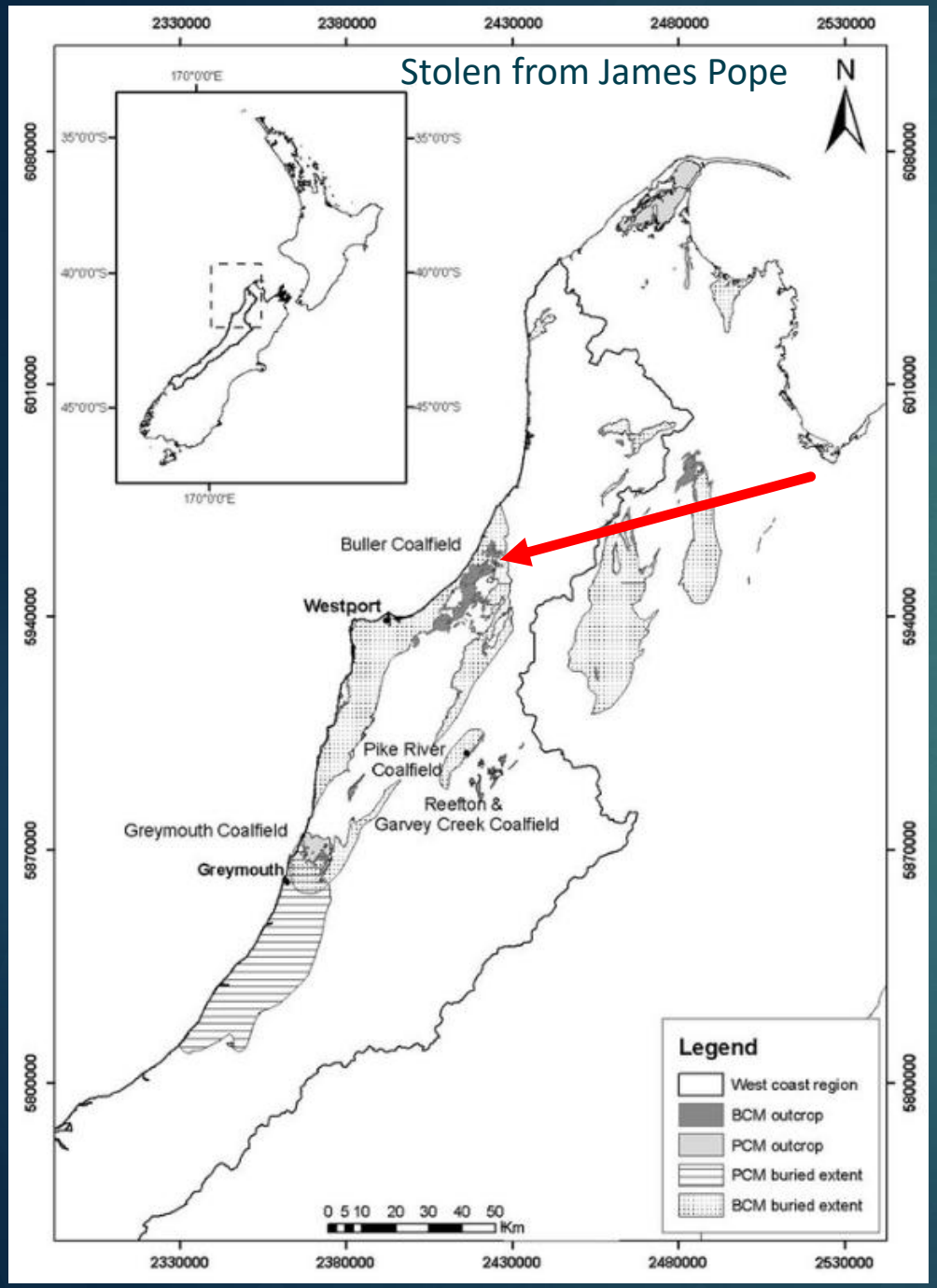

Stockton and Denniston

Will the generic guidelines work?

- CWQG diss. Al <0.005 – ref. 0.24
- ANZG diss. pH 7.23- 7.8 – ref. pH 4.23

Problem No. 1. Need novel thresholds

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Ecology

- Can we develop WQ thresholds using relationships with bugs?
- Bugs time-integrate effects in streams
- Macroinvertebrate Community Index (MCI) 0-200
- Each species has a tolerance score

MCI SCORE

x

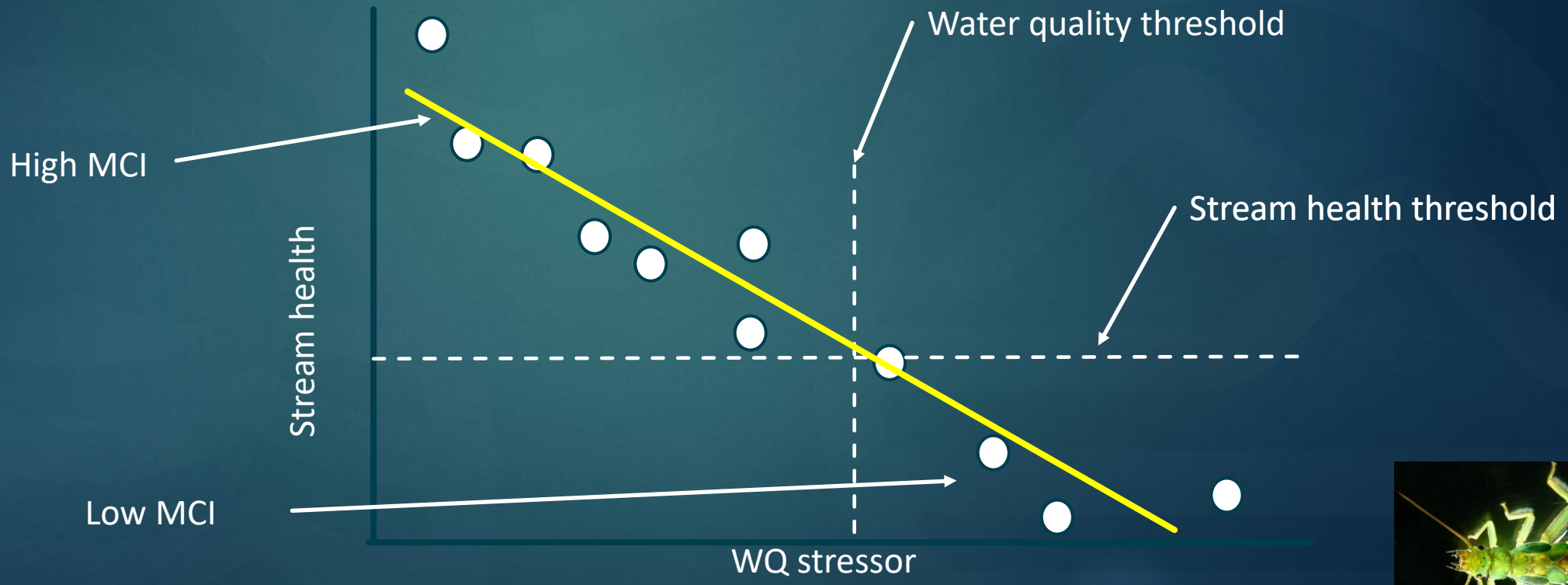
y

w

z

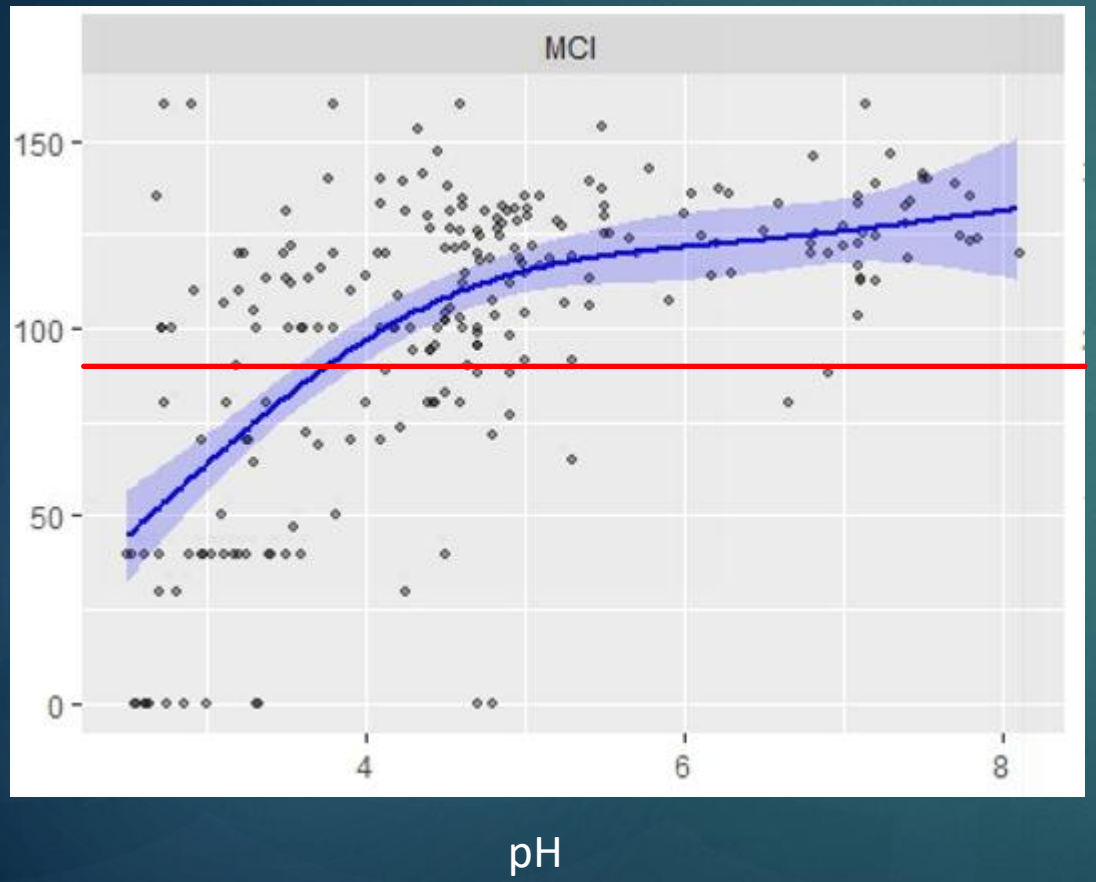
Ecology

- Can we develop WQ thresholds using relationships with bugs?



Ecology

- Can we develop WQ thresholds using relationships with bugs?



Stop the bus

- At low pH there is a spread of MCI values right across the spectrum
- That wont pass the certainty text
- Tolerance values are wrong for AMD streams

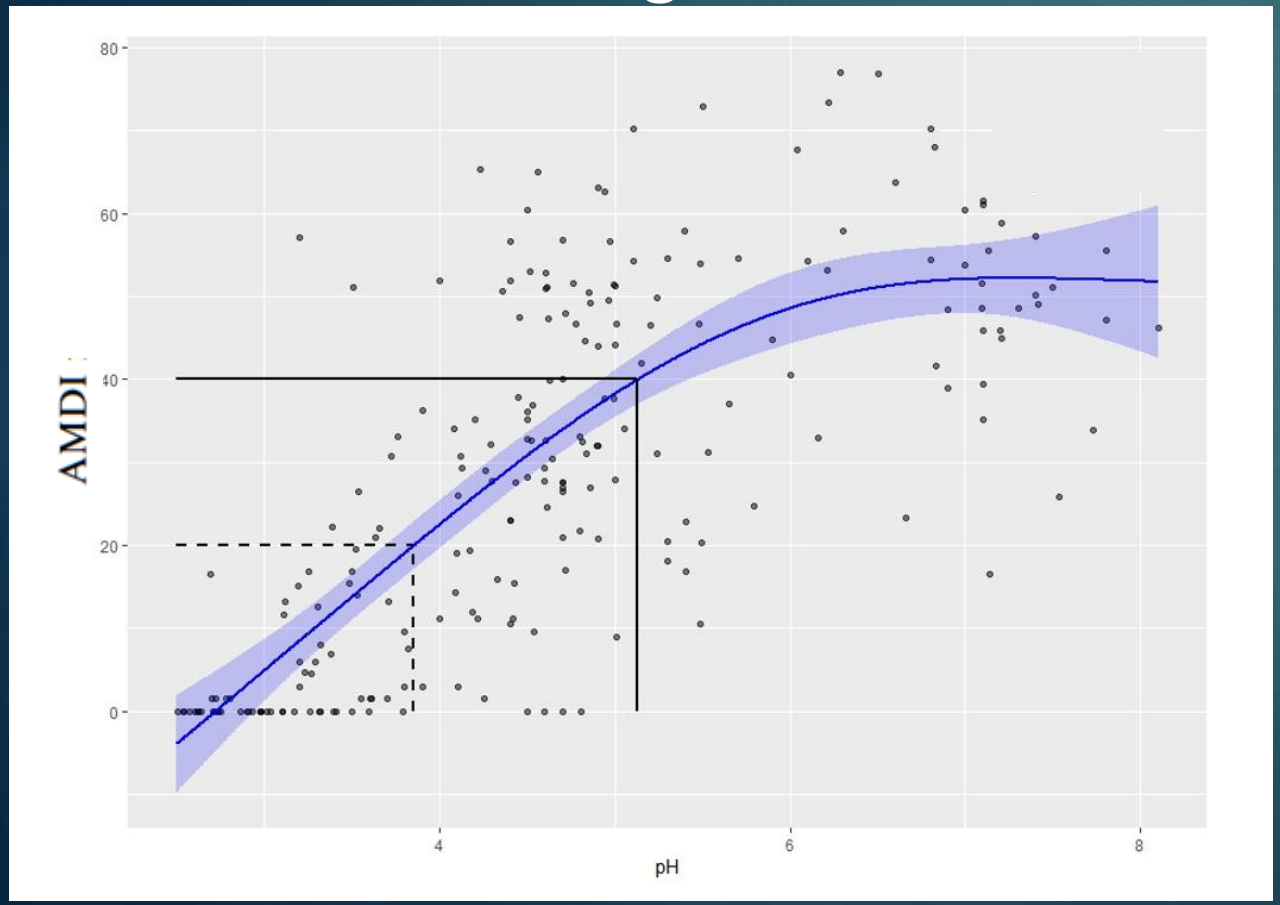
Problem No.2

Ecology

- Can we develop WQ thresholds using relationships with bugs?

Don’t panic

- **Acid Mine Drainage Index** – uses AMD specific tolerance score.

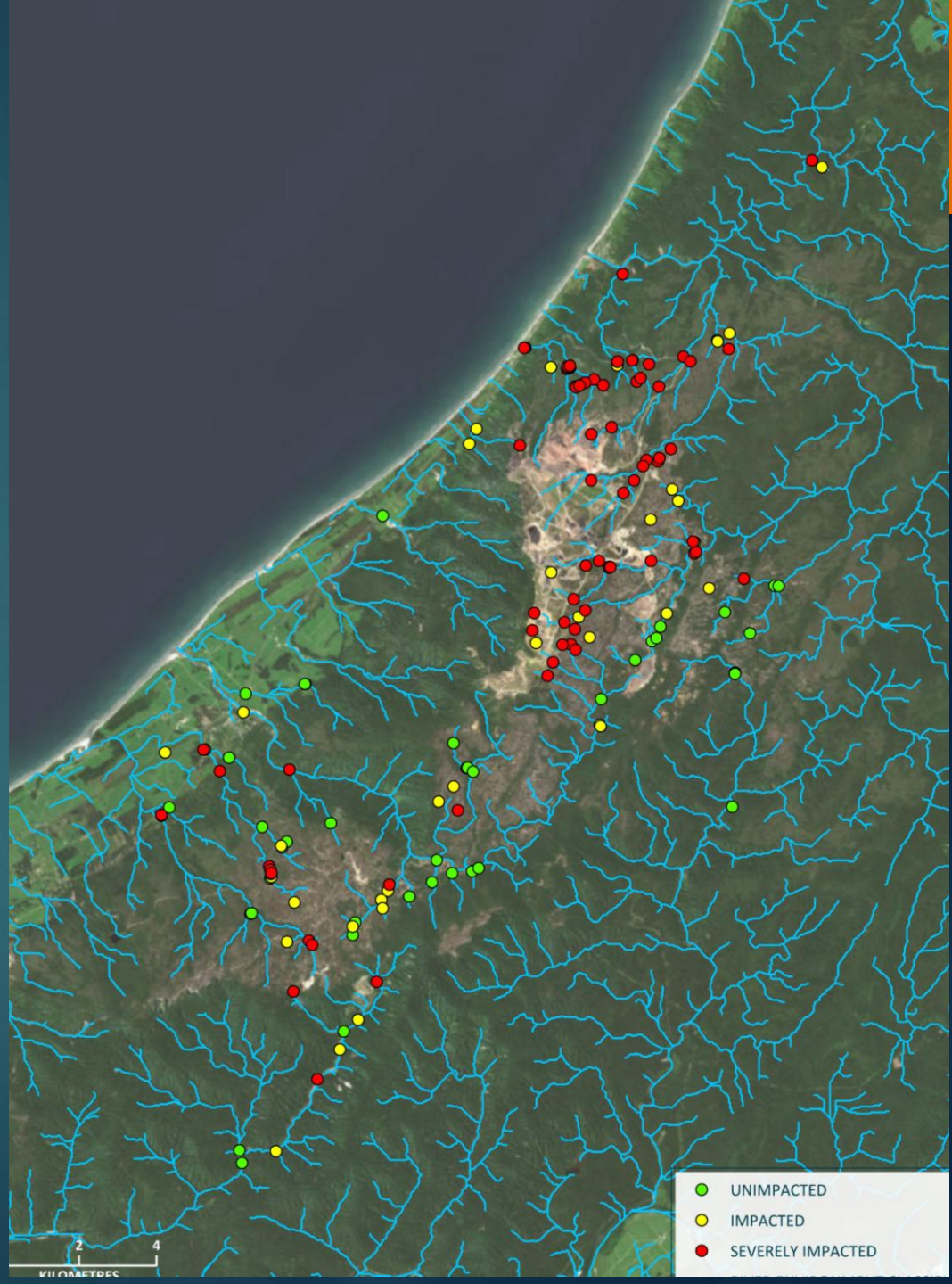


Likely water quality	AMDI range
Severely impacted	<20
Impacted	20–40
Unimpacted	>40

pH

BCM Threshold development

- 217 sites/occasions
- Reference and impact
- pH and dissolved aluminium chosen as AMD proxies.
- pH 4.6 (2.5-8.1)
  Al 0.29 (0.01- 159)
- Calculate the AMDI



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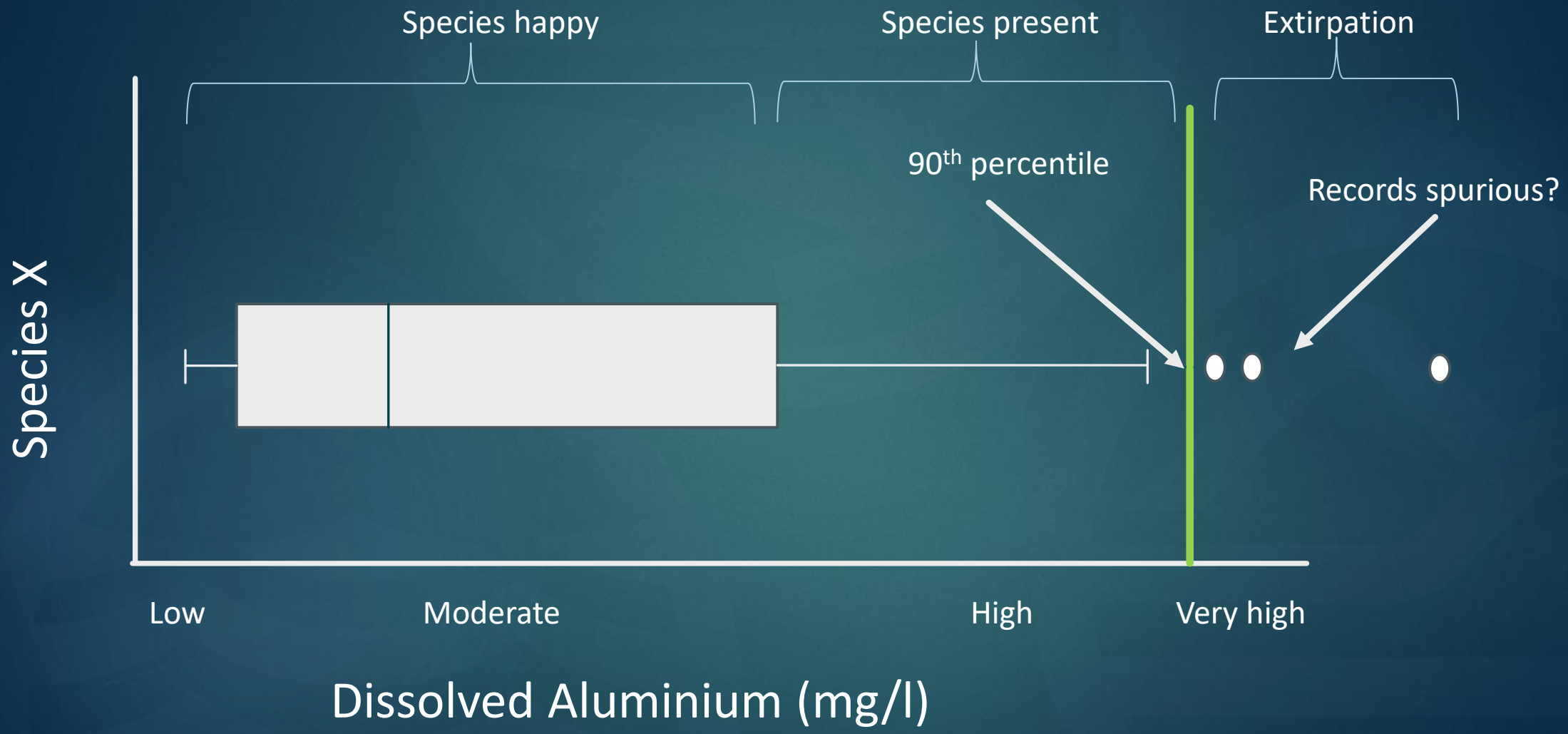
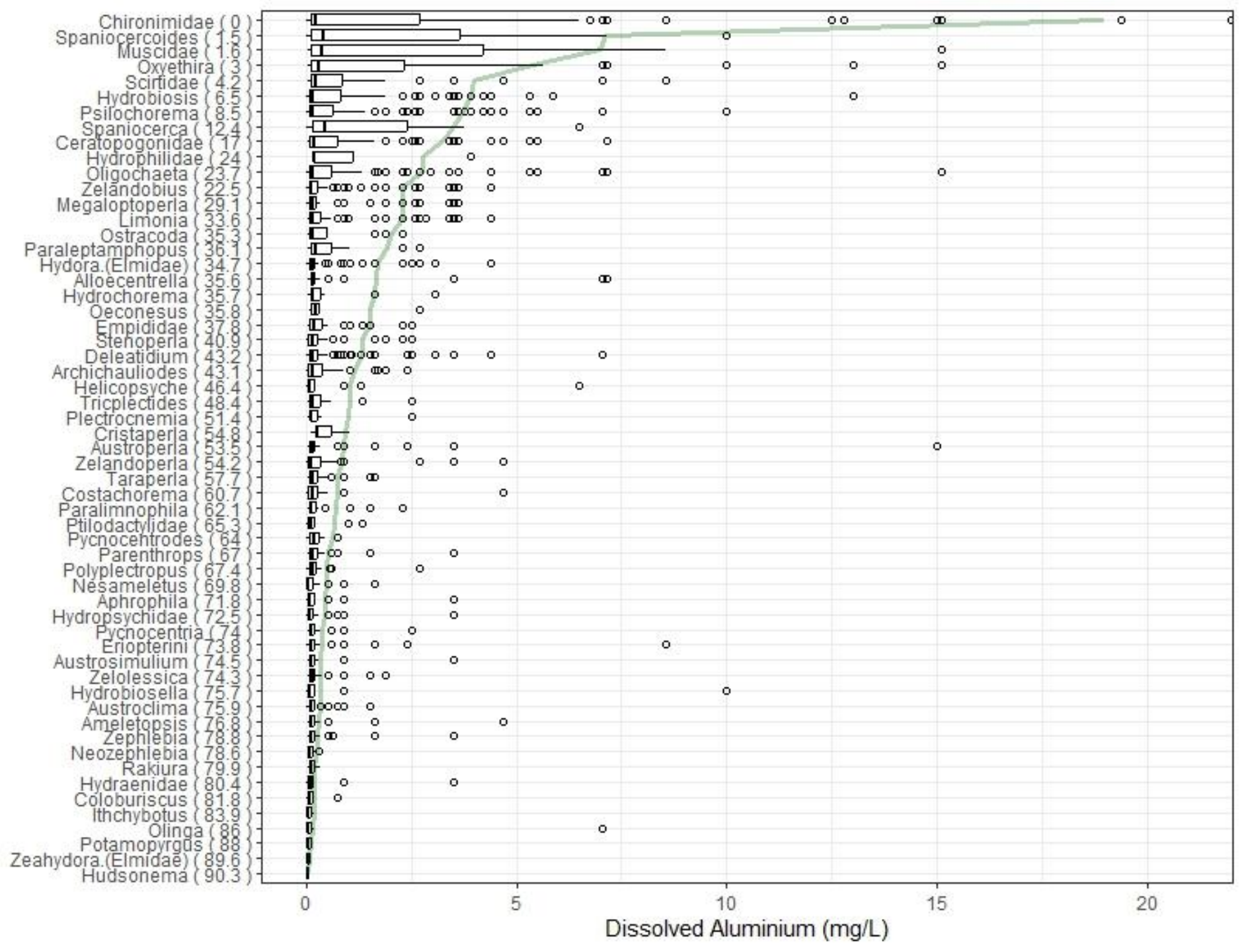
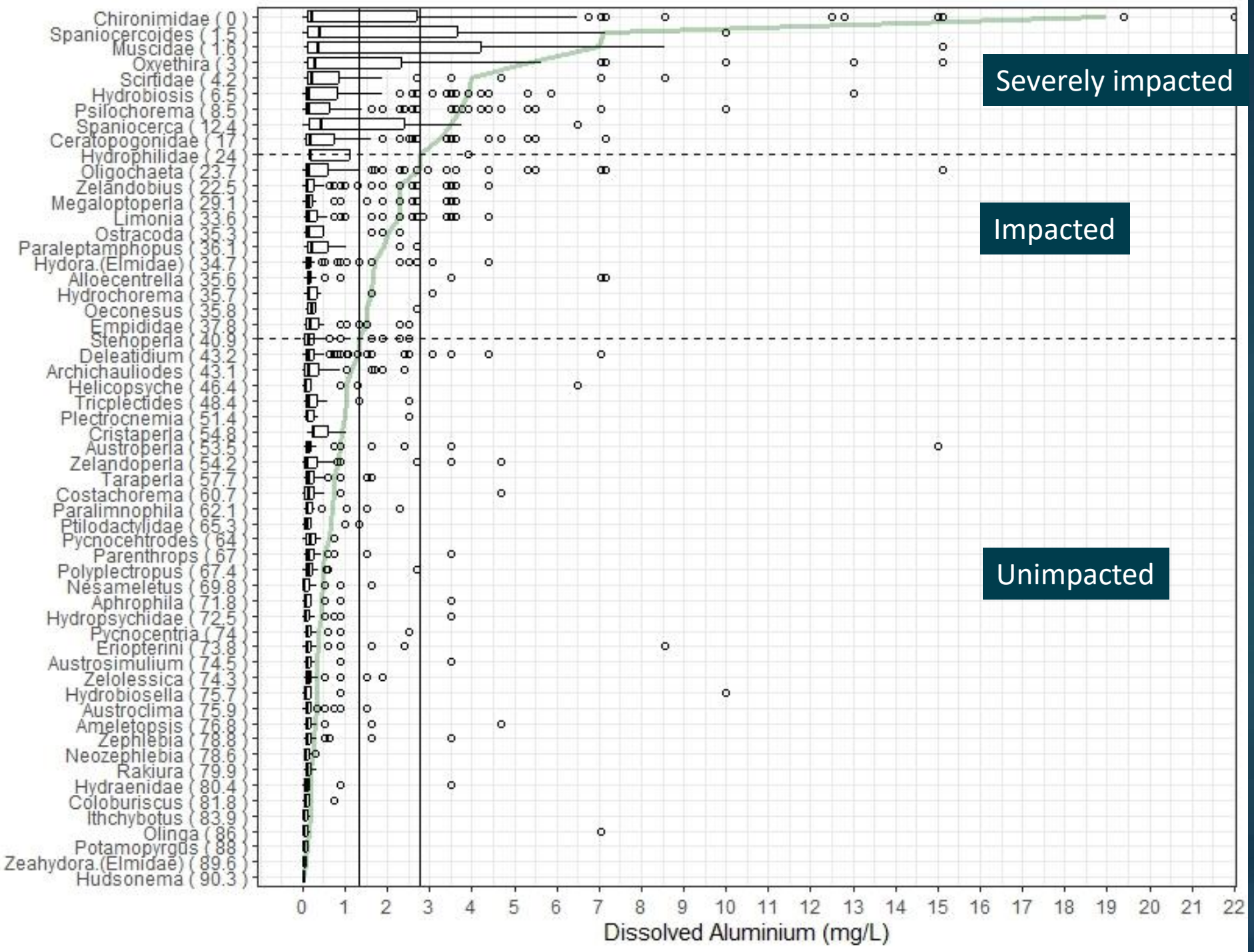
Regression-ish method uses central tendency (mean or median), but we want to know were recovery begins.





Species ordered by 90th percentile

Cumulative AMDI on y axis



Species ordered by 90th percentile

Cumulative AMDI

Dissolved Al corresponding to AMDI

AMDI impacted <2.8 mg/l
AMDI unimpacted <1.3 mg/l

Summary

	Guidelines	Reference state	Site specific threshold
pH	7.23 – 7.8	4.23 annual median	>4.14
Diss. Al	<0.005 mg/l	0.24 mg/l	1.3 mg/l

- No modifying factors
- Conservative protection
- Does not account for local adaptation
- Uses only toxic forms (Al3+)

- Modifying factors included
- Beginning of recovery
- Account for local adaptation
- Includes non-toxic components

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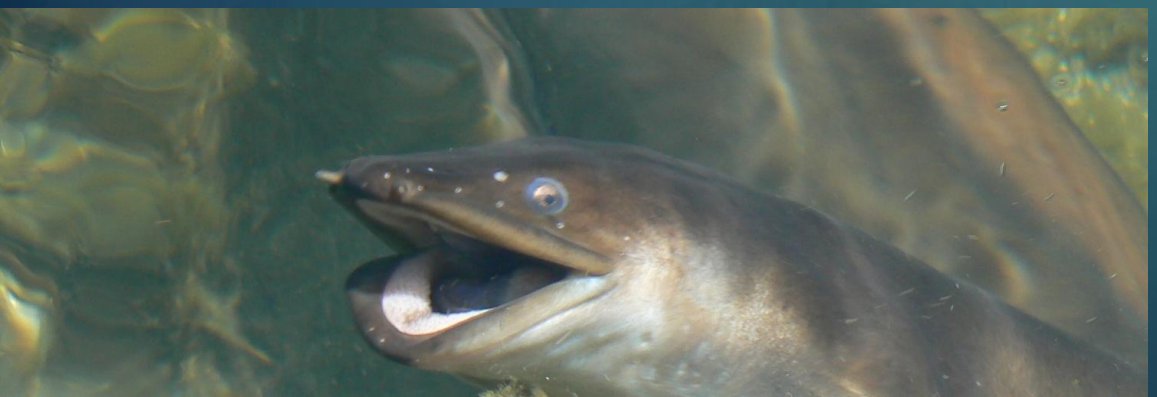
Summary

- ANZG etc. guidelines are defaults when site specific info is not available
- Local field data is a practical alternative
- Requires ecology and water quality data – good use of consent monitoring
- Locally specific thresholds give extra legitimacy to compliance monitoring and effects assessments.



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Acknowledgments

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Data

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Blood, sweat and tears

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