Cost-effectiveness of erosion mitigation to meet water clarity targets in the Manawatū-Whanganui Region of New Zealand

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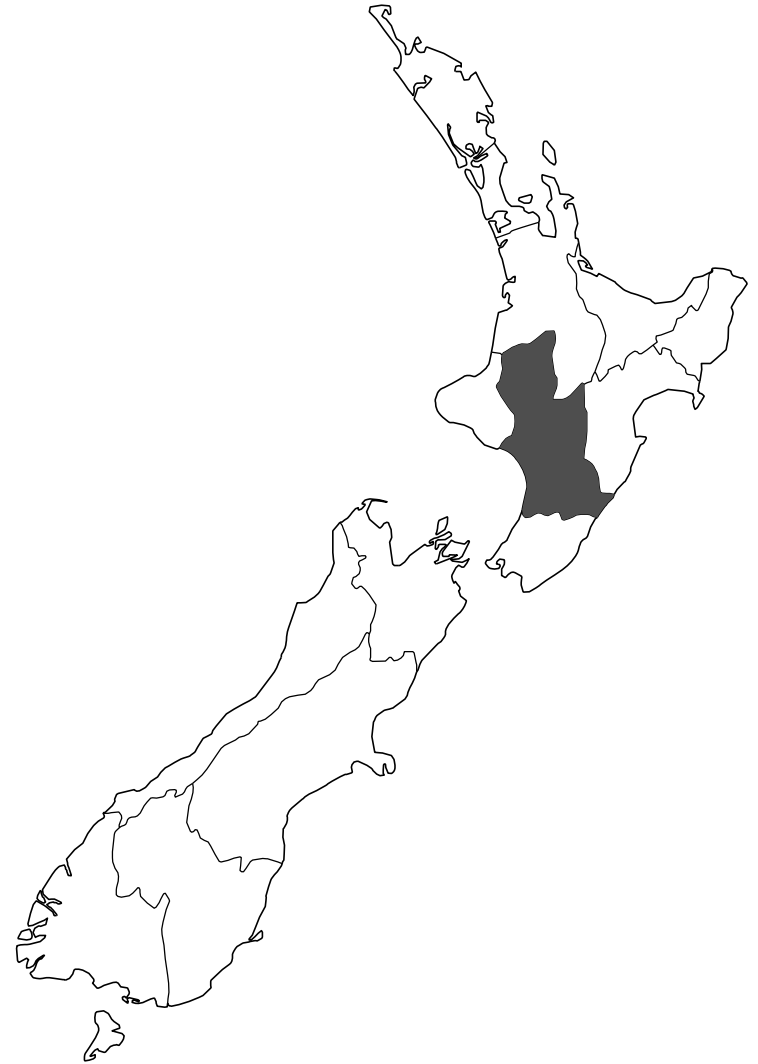[2] University of Maine

Aim

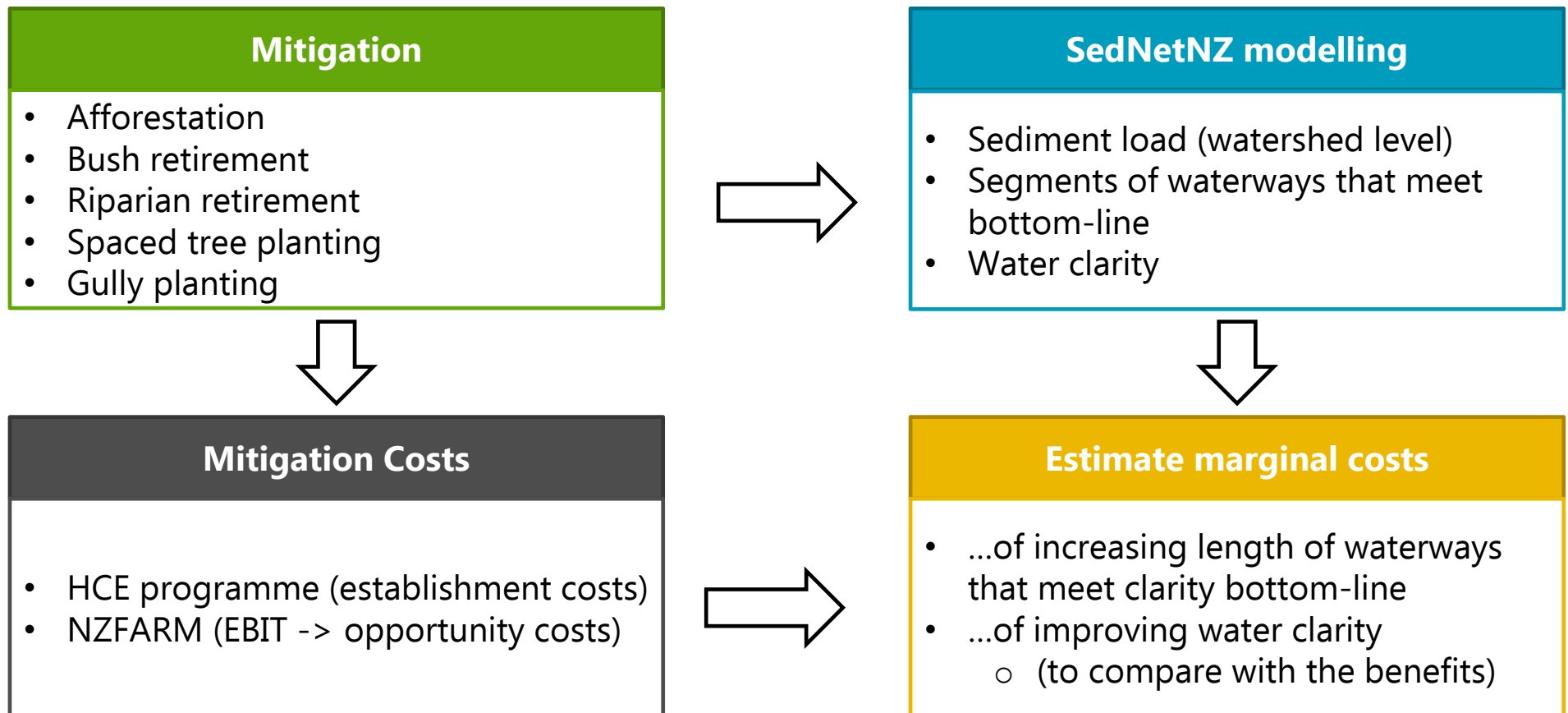Estimate the cost-effectiveness of erosion mitigation to meet water clarity targets

- Based on SedNetNZ modelling of erosion mitigation in the Manawatū-Whanganui Region (Vale et al. 2022, 2023)

Challenge:

- Mitigation is implemented locally
- The outcomes observed and quantified at a catchment or region scale

Approach

Mitigation

- Afforestation
- Bush retirement
- Riparian retirement
- Spaced tree planting
- Gully planting

SedNetNZ modelling

- Sediment load (watershed level)
- Segments of waterways that meet bottom-line
- Water clarity

Mitigation Costs

- HCE programme (establishment costs)
- NZFARM (EBIT -> opportunity costs)

Estimate marginal costs

- ...of increasing length of waterways that meet clarity bottom-line
- ...of improving water clarity
  - (to compare with the benefits)

Estimate marginal costs

1. Regression at REC2 level
   - Change in sediment load = F(areas of mitigation, sediment yield)
     - With a 10-year time lag
2. Regression at FMU level
   - Change in length of waterway that meet bottom-line = F(change in sediment load)
   - Change in water clarity = F(change in sediment load)
3. Cost
   - Establishment costs: Horizon Regional Council's Hill Country Erosion Programme
   - Opportunity cost: EBIT from NZFARM capitalised at 5%

Benefits of improving water clarity

1. Region-specific "willingness to pay" to improve water clarity

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RESEARCH ARTICLE

## Eliciting policy-relevant stated preference values for water quality: An application to New Zealand

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Sediment yields, visual clarity bottom lines and watersheds that met visual clarity bottom lines in the Manawatū-Whanganui Region in 2021 (Vale et al. 2022)
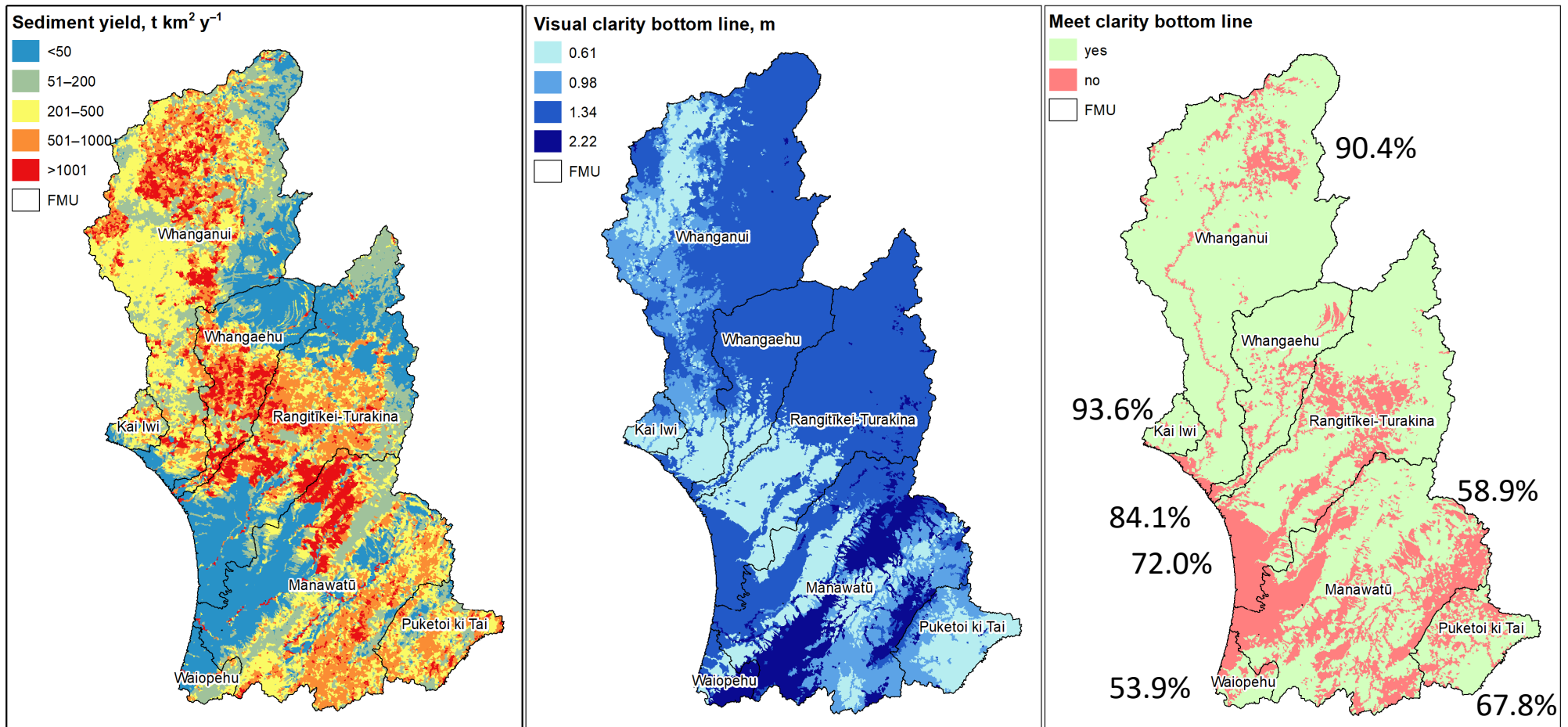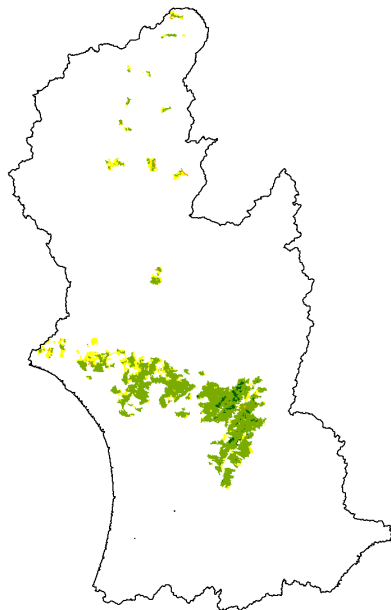
SedNetNZ scenario (PS2)

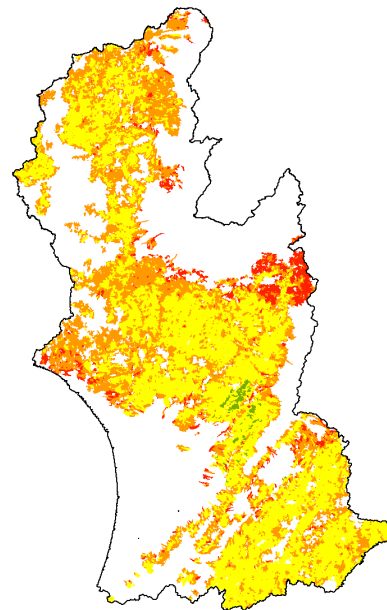| Date	What implemented
By 2030	existing WFPs
By 2035	works on top-priority land
By 2045	works on high-priority land
By 2065	works on low-priority land
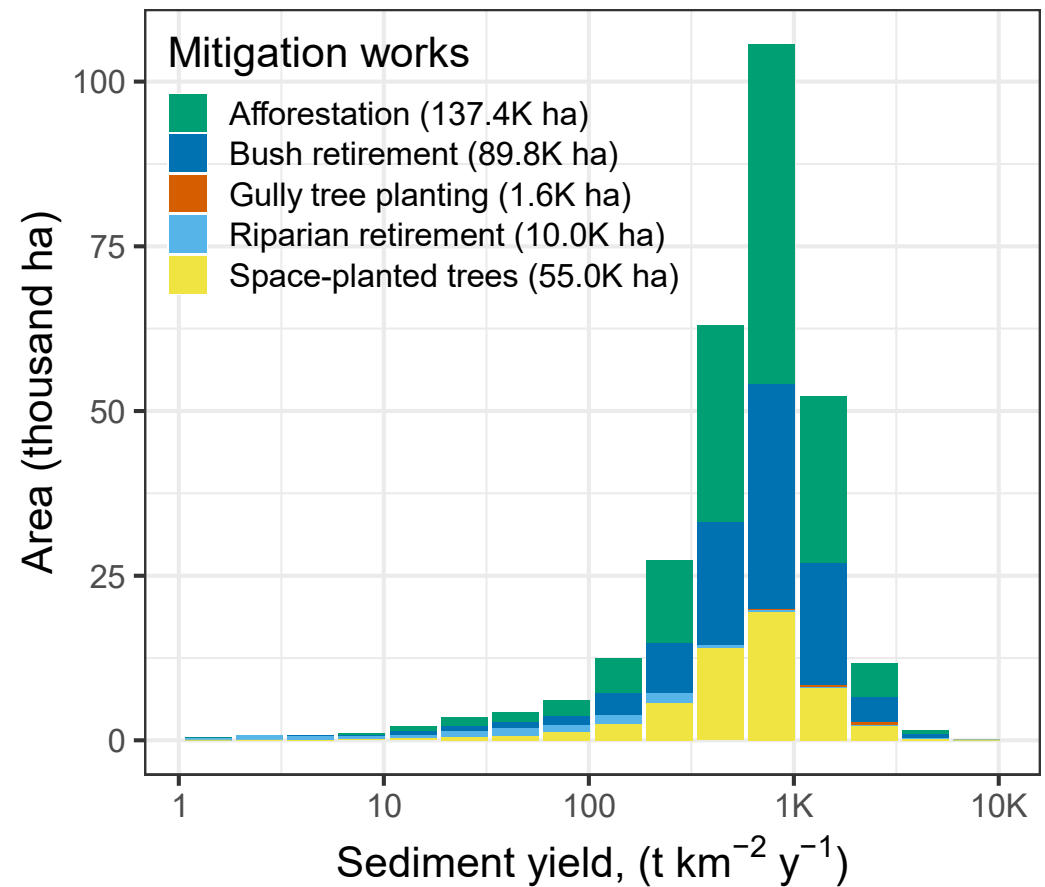
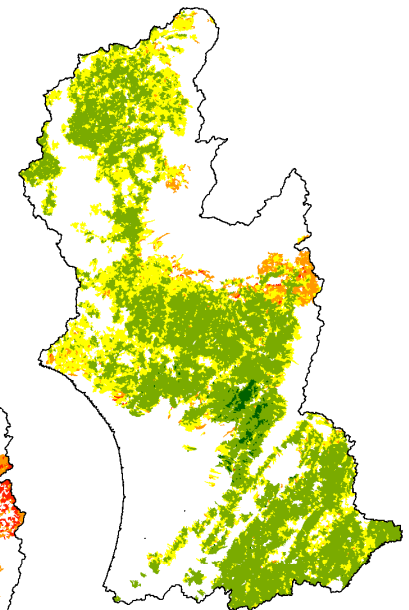# Marginal costs to achieving water clarity targets (by REC2 and mitigation measures)
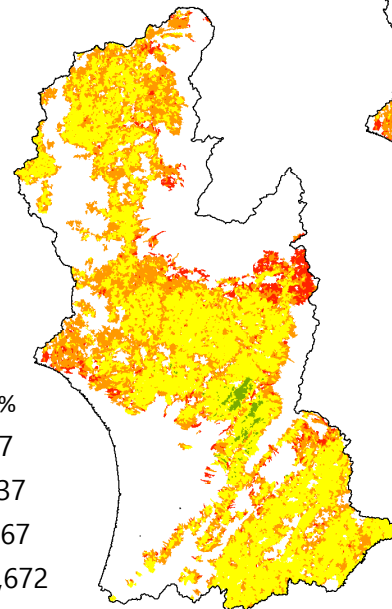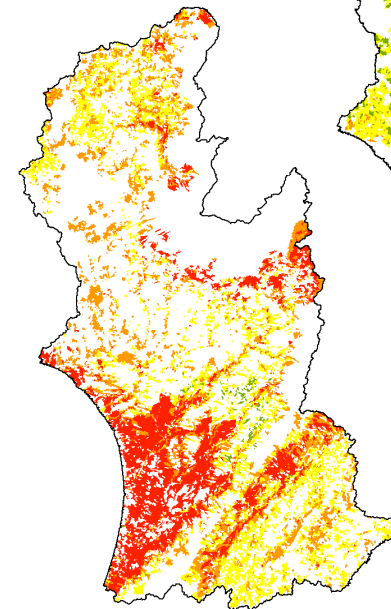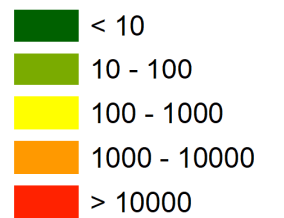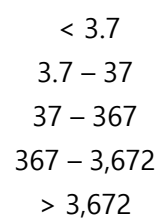
Gully tree planting

Afforestation

Space planting
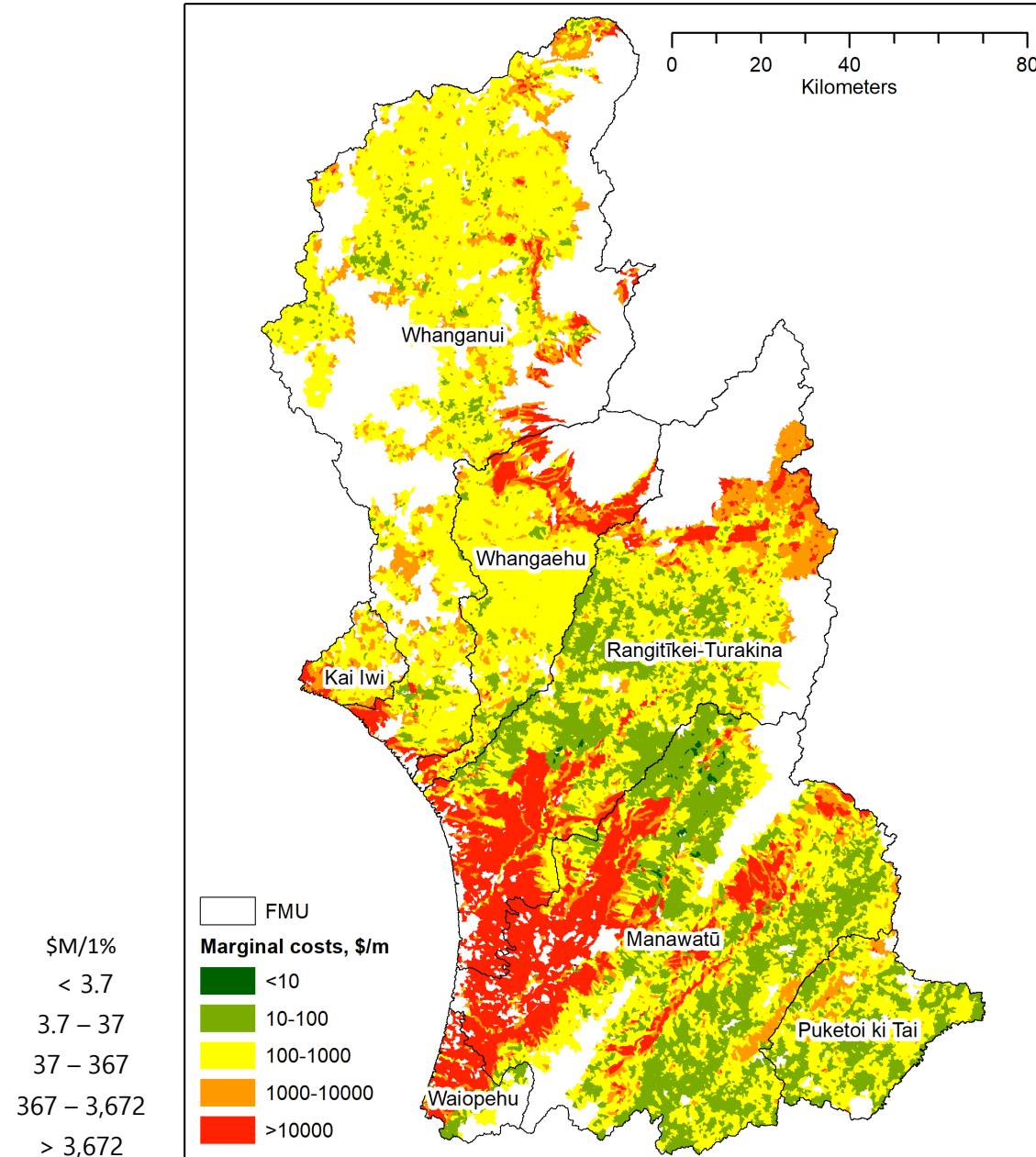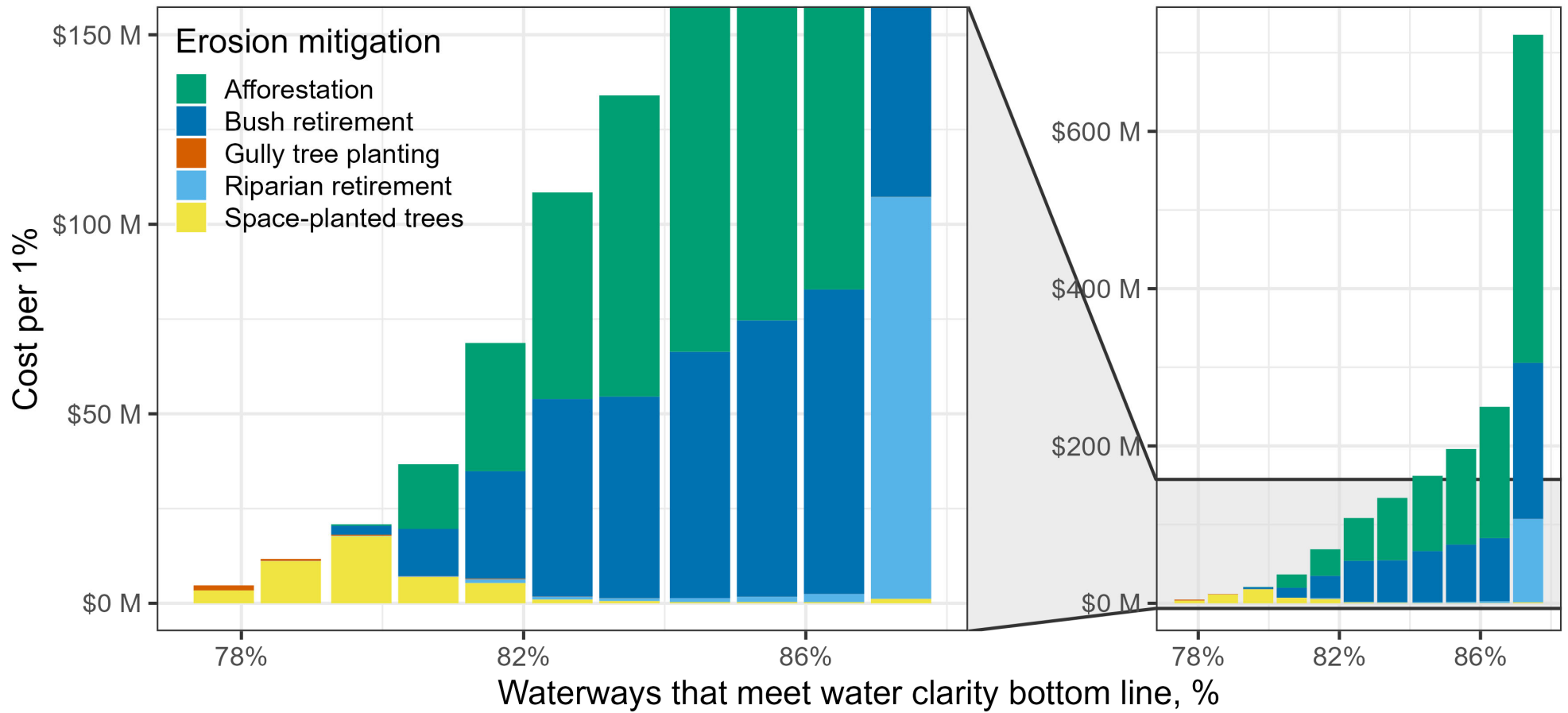
Bush retirement

Riparian retirement

Marginal costs, $/m

	Marginal costs, $/m	$M/1%
(dark green)	< 10	< 3.7
(green)	10 - 100	3.7 – 37
(yellow)	100 - 1000	37 – 367
(orange)	1000 - 10000	367 – 3,672
(red)	> 10000	> 3,672

Marginal costs to achieving water clarity targets (by REC2)

$M/1%

< 3.7

3.7 – 37

37 – 367

367 – 3,672

> 3,672

FMU

Marginal costs, $/m

<10

10-100

100-1000

1000-10000

>10000

Whanganui

Whangaehu

Rangitīkei-Turakina

Kai Iwi

Manawatū

Puketoi ki Tai

Waiopehu

0   20   40   80
Kilometers

Marginal abatement cost curve to achieving water clarity bottom line

Erosion mitigation
- Afforestation
- Bush retirement
- Gully tree planting
- Riparian retirement
- Space-planted trees

Cost per 1%

$150 M
$100 M
$50 M
$0 M

$600 M
$400 M
$200 M
$0 M

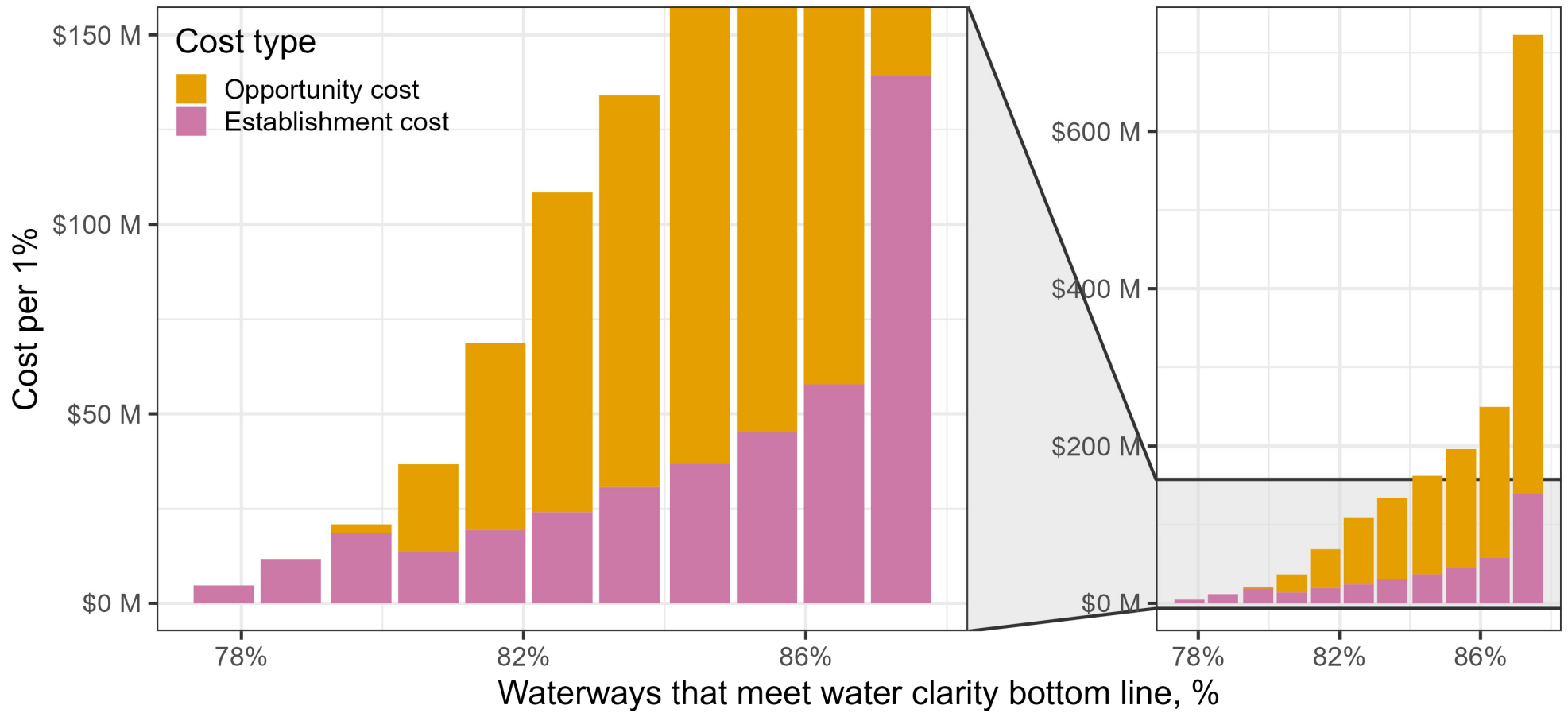78%   82%   86%
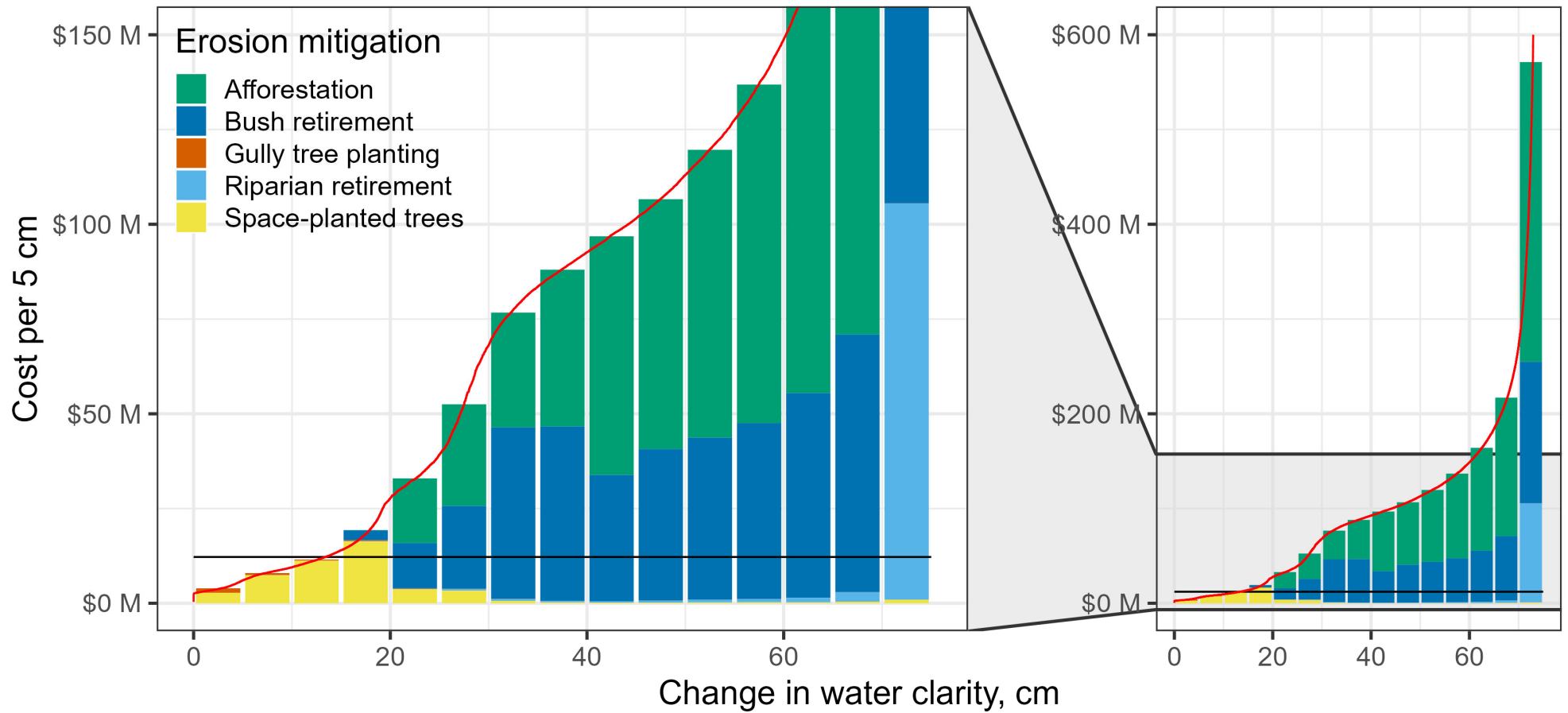
Waterways that meet water clarity bottom line, %

Marginal abatement cost curve to achieving water clarity bottom line

Marginal abatement cost curve to improve water clarity

Erosion mitigation
- Afforestation
- Bush retirement
- Gully tree planting
- Riparian retirement
- Space-planted trees

Cost per 5 cm

$150 M
$100 M
$50 M
$0 M

$600 M
$400 M
$200 M
$0 M

Change in water clarity, cm

0   20   40   60

Benefits of mitigation actions included and not included in the analysis

Benefits	Afforestation	Bush retire-ment	Gully tree planting	Riparian retire-ment	Spaced tree planting	Included
Water clarity control	✓✓	✓✓	✓✓✓	✓	✓✓✓	Yes
Nutrient reduction	✓	✓	✓	✓✓✓	✓	No
E. coli reduction	✓	✓	✓	✓✓✓	✓	No
Carbon sequestration	✓✓✓	✓	✓✓✓	✓	✓	No
Provision of biodiversity	✓✓	✓✓✓	✓✓	✓✓✓	✓	No
Aesthetics	✓	✓✓	✓✓	✓✓	✓	No
Timber production	✓✓✓		✓✓✓			No
Shelter for livestock					✓	No

Take home messages

- The range of marginal costs of achieving water clarity targets and improving water clarity is **enormous**

- The marginal costs depend on (in order of importance)
  - Mitigation type (effectiveness and establishment costs)
  - Location-specific land productivity
  - Location-specific sediment yield

- The most cost-effective (for water clarity) are gully tree planting and space planting, and the least cost-effective is riparian retirement

  - However, there are other benefits that need to be considered when making decisions!