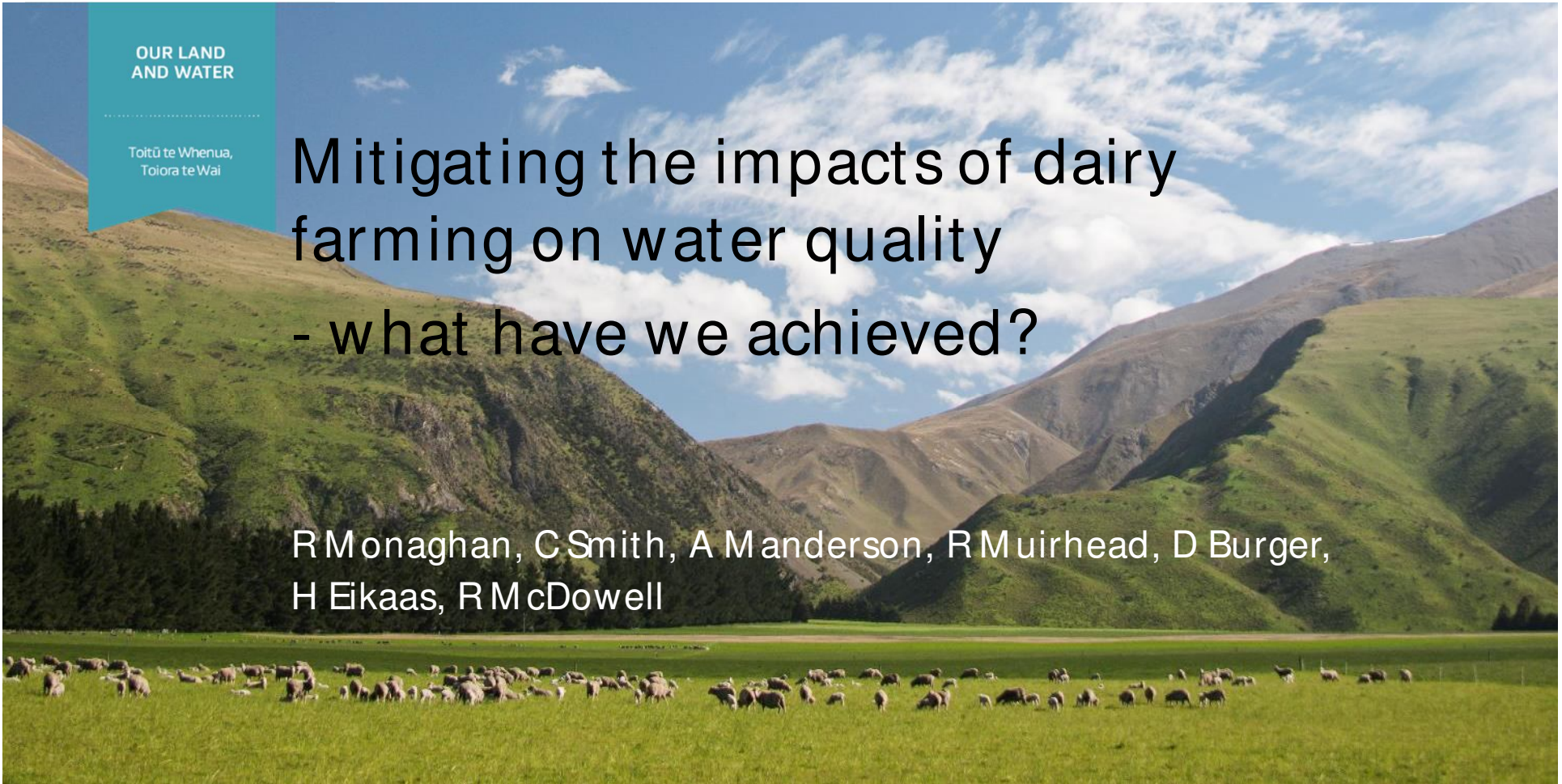


OUR LAND  
AND WATER

Toitū te Whenua,  
Toiora te Wai

# Mitigating the impacts of dairy farming on water quality - what have we achieved?

R Monaghan, C Smith, A Manderson, R Muirhead, D Burger,  
H Eikaas, R McDowell



---

# Background

On-going changes in how land is used

- Changes in land use
- Intensification and practice change



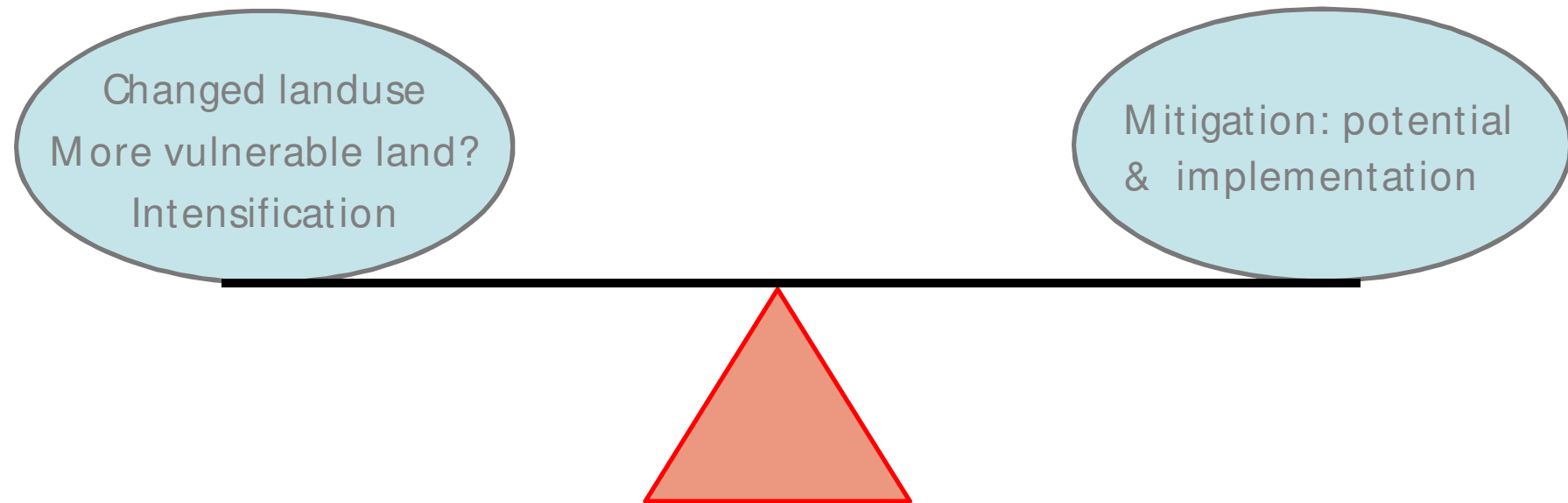
---

# Background

- Much research investment into managing and mitigating contaminant losses
- What has been achieved in the dairy sector?

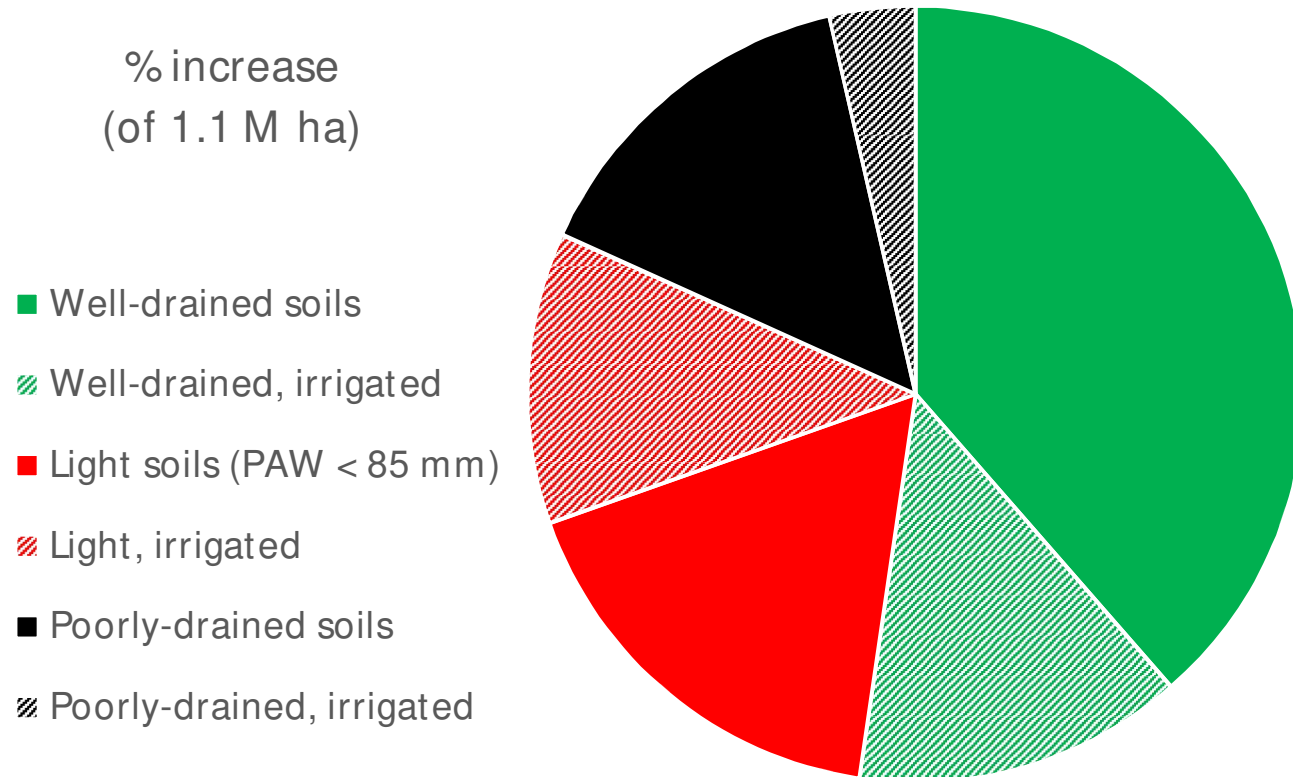
---

# Off-setting effects?



# Increases in dairy-farmed area: 1995 - 2015

## - soil drainage x irrigation



---

# Approach

- Typology approach, considering landscape vulnerability factors
  - Well-drained, poorly-drained or light soils (3)
  - Flat or rolling (2)
  - Irrigated, Wet (>1700 mm pa), Dry (<1100 mm) or Moist (4)
  - Winter warm v cool (2)
- Model farm types defined by Dairybase records
- Focus on N and P
- 2015 v 1995 (as a benchmark for area)

# Mitigations considered

Mitigation	Specific measure	Dairy
Stock exclusion		✓
Fertiliser mgmt.	- optimum soil P	✓
	- avoid risk months	✓
	- reduced N fertiliser input	✓
Effluent mgmt.	- Land application	✓
	- Enlarged areas	✓
	- Adjusting fertiliser inputs	✓
	- Deferred or low rate irrigation	✓
Irrigation mgmt.	- Reduced flood irrigation by-wash	✓
	- Reduced over-watering	✓
Off-paddock wintering		✓

---

# Starting assumptions

Attribute	1995	2015
SR, cows ha <sup>-1</sup>	2.7	3.0
MSkg ha <sup>-1</sup> yr <sup>-1</sup>	760	1150
MSkg cow <sup>-1</sup> yr <sup>-1</sup>	282	380
Fertiliser N, kg ha <sup>-1</sup> yr <sup>-1</sup>	70	125
Fertiliser P, kg ha <sup>-1</sup> yr <sup>-1</sup>	60	24
Pasture production, kg DM ha <sup>-1</sup> yr <sup>-1</sup>	11,970	13,570
Supplement N, kg ha <sup>-1</sup> yr <sup>-1</sup>	2	50



---

# Other sources of information

Dairy Statistics

Dairy Catchments study

Parliamentary Commissioner for the Environment

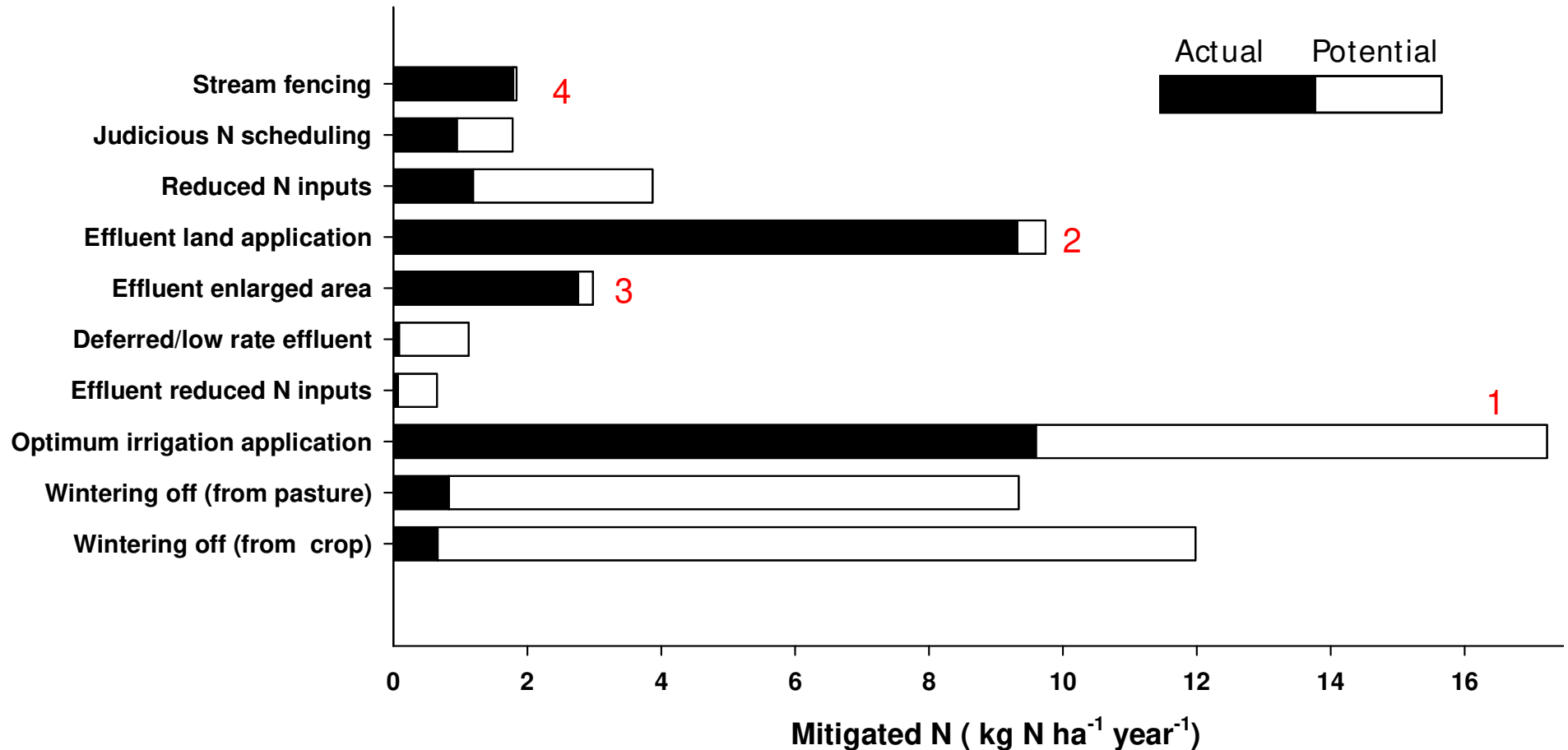
Regional Council records

Surveys of Rural Decision Makers (e.g. Brown 2017)

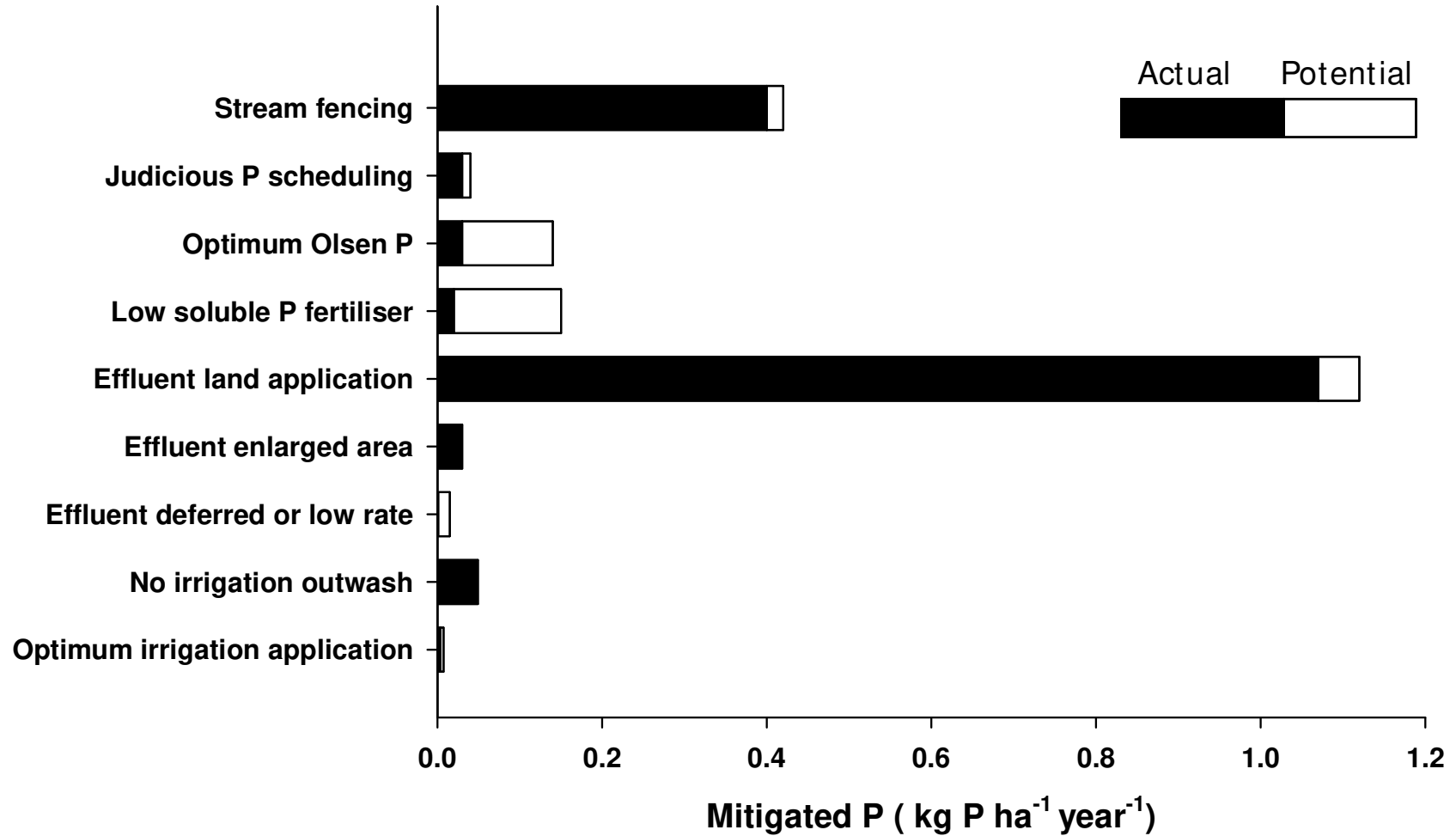
Literature (grey and peer-reviewed)

*Pers. commun.*

# Mitigated N loads: dairy (area-weighted estimates)



# Mitigated P loads: dairy (area-weighted estimates)



# Changes: 1995 v 2015

		1995	2015	Change
Area	M ha NZ	1.2	2.3	+91%
N loss	kg ha <sup>-1</sup> yr <sup>-1</sup>	42	50	+20%
	Gg yr <sup>-1</sup> NZ	51	117	+130%
P loss	kg ha <sup>-1</sup> yr <sup>-1</sup>	1.7	1.1	-34%
	Gg yr <sup>-1</sup> NZ	2.1	2.6	+26%

# Changes: 1995 v 2015

		1995	2015	Change
Area	M ha NZ	1.2	2.3	+91%
N loss	kg ha <sup>-1</sup> yr <sup>-1</sup>	42	50	+20%
	Gg yr <sup>-1</sup> NZ	51	117	+130%
	- <i>discounted for changed area</i>		98	+92%
P loss	kg ha <sup>-1</sup> yr <sup>-1</sup>	1.7	1.1	-34%
	Gg yr <sup>-1</sup> NZ	2.1	2.6	+26%

# Changes: 1995 v 2015

		1995	2015	Change
Area	M ha NZ	1.2	2.3	+91%
N loss	kg ha <sup>-1</sup> yr <sup>-1</sup>	42	50	+20%
	Gg yr <sup>-1</sup> NZ	51	117	+130%
	- <i>discounted for changed area</i>		98	+92%
P loss	kg ha <sup>-1</sup> yr <sup>-1</sup>	1.7	1.1	-34%
	Gg yr <sup>-1</sup> NZ	2.1	2.6	+26%
	- <i>discounted for changed area</i>		2.2	+5%

---

# So what have we achieved?

## Loads (2015) and mitigation effects

	With mitigation Gg yr <sup>-1</sup> NZ	Without mitigation? Gg yr <sup>-1</sup> NZ	Mitigation effect
N loss	117	181*	35%
P loss	2.6	6.4*	59%

\* up to

---

# Summary

- Most important measures:
  - Stock exclusion and improved effluent and water irrigation practices
- P mitigation has reduced per hectare (-26%) losses; little change in total losses
- N mitigation has been considerable but not sufficient to offset intensification





---

# Acknowledgements

Funded by DairyNZ and the Sources & Flows programme of the Our Land & Water National Science Challenge

Guidance from many rural professionals (esp. 1995 attributes)