

# **Technical note: Implementing the Otago LWRP GMP+ scenario in SedNetNZ**

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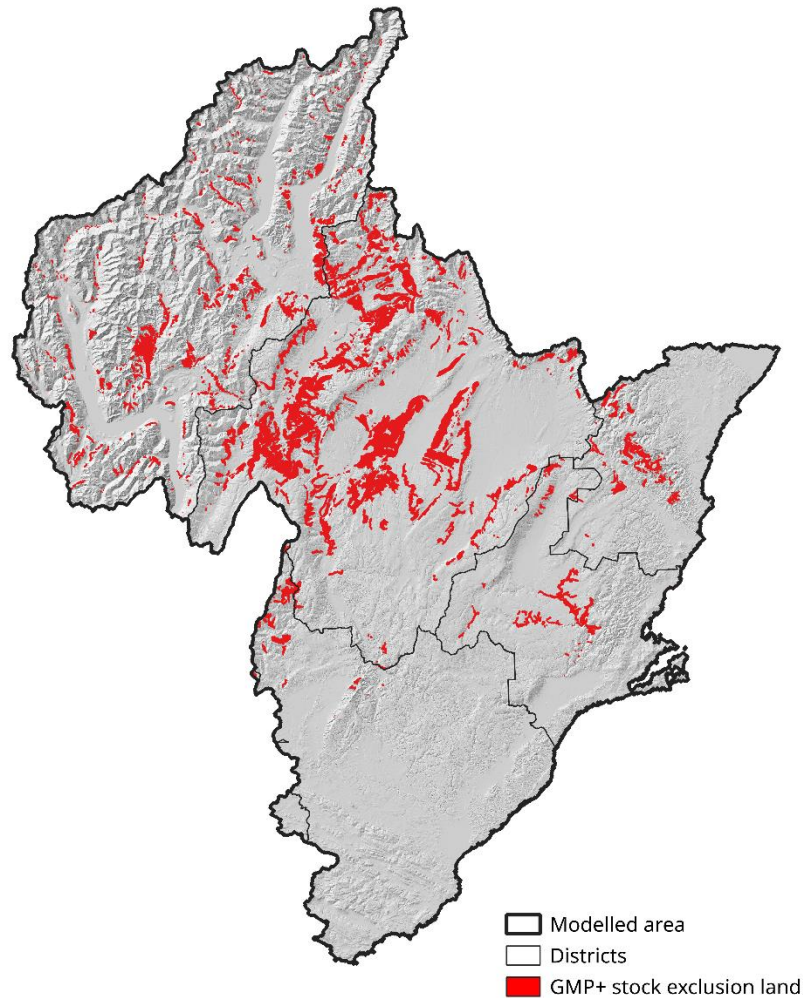
## **1 Background**

Otago Regional Council (ORC) previously contracted Manaaki Whenua – Landcare Research (MWLR) to model baseline mean annual suspended sediment loads and the reductions in load required to meet the suspended fine sediment attribute states (visual clarity) in the National Policy Statement for Freshwater Management 2020 at selected State of the Environment (SoE) water quality monitoring sites (Neverman & Smith, 2022). This work also included assessment of an aspirational mitigation scenario and its impact on the achievement of required load reductions.

Subsequently, ORC requested MWLR develop a further mitigation scenario which a) applies additional mitigations to represent a potential maximum sediment load reduction that may be achievable and b) assesses the corresponding achievement of NPS-FM bands for suspended fine sediment at SoE monitoring sites. This scenario is referred to as Good Management Practice Plus (GMP+). It was agreed with ORC that for sediment GMP+ would involve stock exclusion from steep erosion prone land in addition to the riparian fencing mitigation implemented for the aspirational scenario in Neverman & Smith (2022).

## **2 Methods**

The GMP+ scenario uses the SedNetNZ model configuration described in Neverman & Smith (2022), with the same land cover and mitigations as the aspirational scenario along with the addition of stock exclusion from steep erosion prone pastoral land. A spatial ruleset was developed in collaboration with ORC to determine the location of land deemed suitable for stock exclusion for the purpose of erosion reduction. This ruleset uses the intersection of Land Use Capability (LUC) 7e and 8e land (refer Lynn et al. 2009) from the New Zealand Land Resource Inventory (NZ LRI 3<sup>rd</sup> edition, Newsome et al. 2008) with low producing grassland (Class 41) in the 2018 land cover from the New Zealand Landcover Database (LCDB v5) (Newsome et al. 2008) to identify land where stock exclusion is implemented (Figure 1). Higher resolution, farm-scale LUC and land cover mapping may improve future modelling efforts but are not presently available for the Otago region.



**Figure 1. Land subject to stock exclusion in the GMP+ scenario.**

Table 1 summarises the proportion of land area subject to stock exclusion in the GMP+ scenario within the catchment draining to each SoE site. Stock are typically excluded from  $\leq 5\%$  of the SoE catchment areas. The largest extents of stock exclusion occur in the Lindis and Manuherikia catchments, with up to 17% of the SoE catchment subject to stock exclusion.

The effect of stock exclusion is represented by a change in the  $C$  factor within the NZUSLE surface erosion model (Equation 1 in Neverman & Smith (2022)) applied to those areas subject to stock exclusion. This change represents the surface erosion rates expected for ungrazed pasture. Based on the  $\sim 40\%$  difference in annualised average cover factors for grazed and ungrazed low producing pasture reported in Donovan & Monaghan (2021), we use a  $C$  factor of 0.006 to represent ungrazed low producing pasture (stock removed) in the NZUSLE.

Basher & Lynn (1996) and McIntosh & Allen (1998) found little or no change in soil properties after 15 – 45 years of stock removal on steep low producing grassland in Canterbury, similar to that in the Otago region, despite notable changes in

vegetation cover. This contrasts with the <1 year timeframe Drewry (2006) suggests is needed for soil recovery to occur in other farming systems. Modelling by Donovan & Monaghan (2021) also highlights the minimal impact grazing of low producing pasture has on soil physical properties, with a change in vegetation cover (*C* factor) being the predominant effect of grazing on erosion. We therefore do not alter the *K* factor in the NZUSLE as evidence suggests little or no difference in soil physical properties are expected following stock exclusion of low producing pasture on steep Otago hill country on a decadal scale.

As stock exclusion from the riparian zone is already captured through implementation of riparian fencing in the aspirational scenario, no additional reduction in streambank erosion is applied in the GMP+ scenario.

The reduction in load relative to baseline and the achievable attribute band for the GMP+ scenario are reported for the 34 SoE sites identified in Neverman & Smith (2022) as having a baseline attribute state below band A.

### **3 Results**

A 29% reduction in end-of-catchment loads is achieved across the region between the baseline and GMP+ scenarios, with 348 kt yr<sup>-1</sup> of suspended sediment modelled to reach coastal receiving environments with implementation of GMP+ mitigations. This equates to a 2.8 kt yr<sup>-1</sup> reduction between the aspirational and GMP+ scenarios, a further 0.6% reduction relative to baseline.

The addition of stock exclusion in the GMP+ scenario further reduces erosion in 14% of REC2 sub-catchments in the modelled area compared to the aspirational scenario mitigations, while accumulated mean annual suspended sediment load is reduced in 25% of REC2 segments (Figure 4).

Suspended sediment loads at the SoE sites are presented in Table 1. Compared to results for the aspirational scenario reported in Neverman & Smith (2022), an additional reduction in sediment load is achieved at 25 of the 34 SoE sites for the GMP+ scenario. Additional reductions in load range from <1% – 2.5% relative to baseline. This results in the same achievable attribute states for the 34 SoE sites as the aspirational scenario (Table 4), with 12 sites being brought above the national bottom line, and an additional six sites achieving both bands A and B.

The additional reductions in load tend to reflect the extent of stock exclusion for most SoE catchments. In catchments such as the Lindis and Manuherikia, reductions in load at some SoE sites are relatively low compared with the extent of stock exclusion in the catchment. This is primarily due to higher proportions of the sediment load coming from unmitigated parts of the catchment which have higher

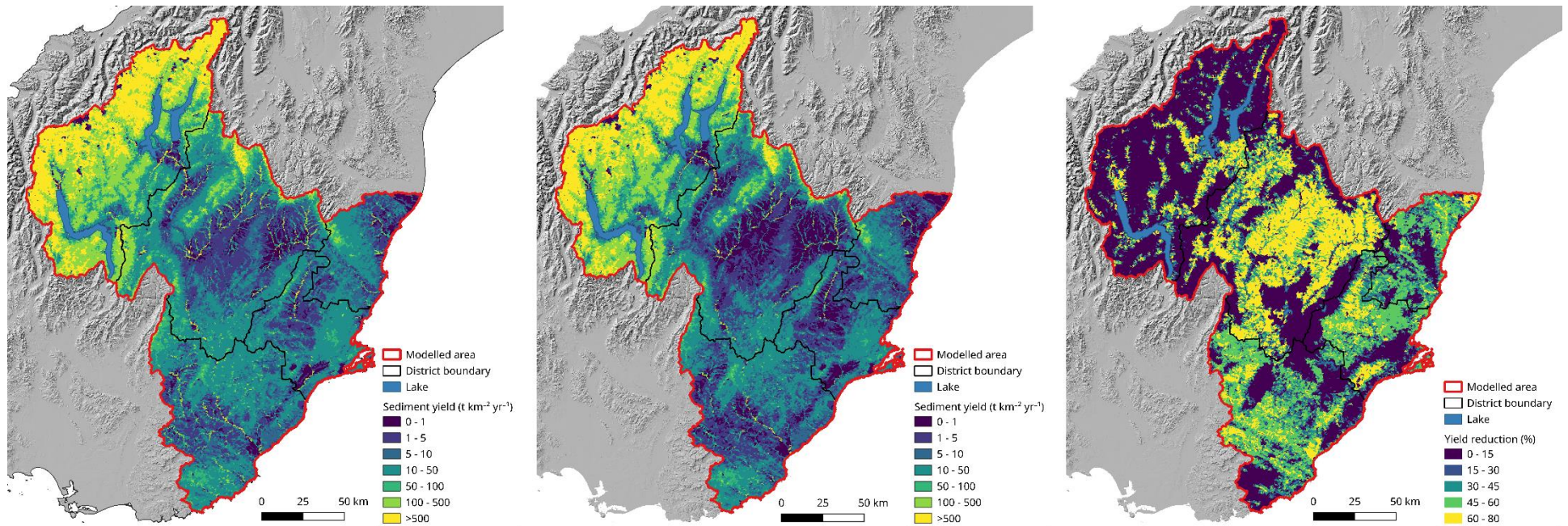
erosion rates, often 1 – 2 orders of magnitude higher than mitigated areas, due to steeper slopes and higher rainfall. Land deemed unsuitable for mitigation (i.e., land not mapped as pasture, cropland, orchards, vineyards, or perennial crops in the 2018 class in LCDB v5) covers a significant proportion of these SoE site catchments (e.g., ~40 – 60% of the catchment area for the Lindis and Manuherikia SoE sites is unmitigated, Table 1). As a result, stock exclusion may have a significant impact locally (with local reductions of 30 – 40%, Figure 4), but this impact diminishes as sediment loads from segments subject to stock exclusion combine with loads from other sources as they accumulate through the stream network to SoE sites and catchment outlets (Figure 4).

**Table 1. Total mean annual suspended sediment loads at SoE water quality monitoring sites under each modelled scenario, rounded to 2 significant figures. The proportion by area of SoE catchments with unmitigated land and land subject to stock exclusion in the GMP+ scenario are also reported, rounded to the nearest integer value.**

| Site ID                             | Site no. | Baseline suspended sediment load (kt yr <sup>-1</sup> ) | Areal extent of unmitigated land (%) | Aspirational scenario                          |                               | GMP+ scenario                       |  |                               |
|-------------------------------------|----------|---|--------------------------------------|--|-------------------------------|-------------------------------------|--|-------------------------------|
|                                     |          |   |                                      | Suspended sediment load (kt yr <sup>-1</sup> ) | Load reduction achievable (%) | Areal extent of stock exclusion (%) | Suspended sediment load (kt yr <sup>-1</sup> ) | Load reduction achievable (%) |
| Benger burn at SH8                  | 1        | 3.9   | 7                                    | 1.8  | 55                            | 0                                   | 1.8  | 55                            |
| Catlins at Houipapa                 | 2        | 5.1   | 63                                   | 4.3  | 17                            | <1                                  | 4.3  | 17                            |
| Clutha @ Balclutha                  | 3        | 270   | 60                                   | 200  | 28                            | 5                                   | 200  | 29                            |
| Clutha @ Millers Flat               | 4        | 140   | 68                                   | 120  | 18                            | 6                                   | 120  | 19                            |
| Crookston Burn at Kelso Road        | 5        | 1.8   | 27                                   | 1.3  | 30                            | <1                                  | 1.3  | 30                            |
| Heriot Burn at Park Hill Road       | 6        | 2.8   | 10                                   | 1.6  | 45                            | 1                                   | 1.5  | 46                            |
| Kawarau @ Chards Rd                 | 7        | 410   | 89                                   | 380  | 6                             | 2                                   | 380  | 6                             |
| Kye Burn at SH85 Bridge             | 8        | 23  | 39                                   | 19   | 20                            | 3                                   | 18   | 20                            |
| Lindis at Ardgour Road              | 9        | 59  | 47                                   | 47   | 20                            | 17                                  | 46   | 22                            |
| Lindis at Lindis Peak               | 10       | 47  | 57                                   | 40   | 14                            | 12                                  | 39   | 16                            |
| Lindsays Creek at North Road Bridge | 11       | 0.4   | 60                                   | 0.35   | 11                            | 0                                   | 0.35   | 11                            |
| Lovells Creek at Station Road       | 12       | 0.72  | 17                                   | 0.51   | 30                            | 0                                   | 0.51   | 30                            |
| Manuherikia at Blackstone Hill      | 13       | 13  | 70                                   | 8.6  | 32                            | 3                                   | 8.6  | 33                            |

| Site ID                        | Site no. | Baseline suspended sediment load (kt yr <sup>-1</sup> ) | Areal extent of unmitigated land (%) | Aspirational scenario                          |                               | GMP+ scenario                       |  |                               |
|--------------------------------|----------|---|--------------------------------------|--|-------------------------------|-------------------------------------|--|-------------------------------|
|                                |          |   |                                      | Suspended sediment load (kt yr <sup>-1</sup> ) | Load reduction achievable (%) | Areal extent of stock exclusion (%) | Suspended sediment load (kt yr <sup>-1</sup> ) | Load reduction achievable (%) |
| Manuherikia at Galloway        | 14       | 130   | 37                                   | 110  | 18                            | 11                                  | 110  | 18                            |
| Manuherikia at Ophir           | 15       | 120   | 41                                   | 100  | 16                            | 9                                   | 100  | 16                            |
| Mill Creek at Fish Trap        | 16       | 0.042   | 47                                   | 0.03   | 27                            | <1                                  | 0.03   | 27                            |
| Owhiro Stream at Riverside Rd  | 17       | 0.31  | 30                                   | 0.18   | 42                            | 0                                   | 0.18   | 42                            |
| Pomahaka at Burkes Ford        | 18       | 56  | 28                                   | 35   | 38                            | 2                                   | 34   | 39                            |
| Pomahaka at Glenken            | 19       | 31  | 38                                   | 22   | 30                            | 5                                   | 21   | 33                            |
| Sutton Stream at SH87          | 20       | 1.9   | 39                                   | 1.3  | 33                            | <1                                  | 1.2  | 33                            |
| Taieri at Allanton Bridge      | 21       | 110   | 34                                   | 74   | 31                            | 2                                   | 73   | 31                            |
| Taieri at Creamery Road bridge | 22       | 18  | 48                                   | 13   | 26                            | 4                                   | 13   | 27                            |
| Taieri at Linnburn Runs Road   | 23       | 5.7   | 88                                   | 5.4  | 6                             | <1                                  | 5.3  | 7                             |
| Taieri at Outram               | 24       | 100   | 34                                   | 71   | 31                            | 3                                   | 70   | 31                            |
| Taieri at Stonehenge           | 25       | 7.5   | 74                                   | 6.4  | 14                            | 3                                   | 6.4  | 15                            |
| Taieri at Sutton               | 26       | 75  | 38                                   | 53   | 29                            | 3                                   | 53   | 30                            |
| Taieri at Tiroiti              | 27       | 57  | 41                                   | 42   | 26                            | 3                                   | 42   | 27                            |
| Taieri at Waipiata             | 28       | 25  | 44                                   | 18   | 28                            | 3                                   | 18   | 28                            |

| Site ID                           | Site no. | Baseline suspended sediment load (kt yr <sup>-1</sup> ) | Areal extent of unmitigated land (%) | Aspirational scenario                          |                               | GMP+ scenario                       |  |                               |
|-----------------------------------|----------|---|--------------------------------------|--|-------------------------------|-------------------------------------|--|-------------------------------|
|                                   |          |   |                                      | Suspended sediment load (kt yr <sup>-1</sup> ) | Load reduction achievable (%) | Areal extent of stock exclusion (%) | Suspended sediment load (kt yr <sup>-1</sup> ) | Load reduction achievable (%) |
| Thomsons Creek at SH85            | 29       | 8.6   | 36                                   | 6.3  | 27                            | 3                                   | 6.3  | 27                            |
| Tokomairiro at Lisnatunny         | 30       | 0.91  | 60                                   | 0.76   | 16                            | 0                                   | 0.76   | 16                            |
| Tokomairiro at West Branch Bridge | 31       | 1.6   | 54                                   | 1.3  | 18                            | 0                                   | 1.3  | 18                            |
| Waipori at Waipori Falls Reserve  | 32       | 0.85  | 72                                   | 0.84   | 1                             | 0                                   | 0.84   | 1                             |
| Wairuna at Millar Road            | 33       | 0.64  | 4                                    | 0.25   | 61                            | 0                                   | 0.25   | 61                            |
| Waitahuna at Tweeds Bridge        | 34       | 6   | 35                                   | 3.7  | 38                            | 0                                   | 3.7  | 38                            |



**Figure 2. REC2 sub-catchment suspended sediment yield ( $t\ km^{-2}\ yr^{-1}$ ) for the baseline (left) and GMP+ (centre) scenarios, and the percentage reduction in yield between the scenarios (right).**



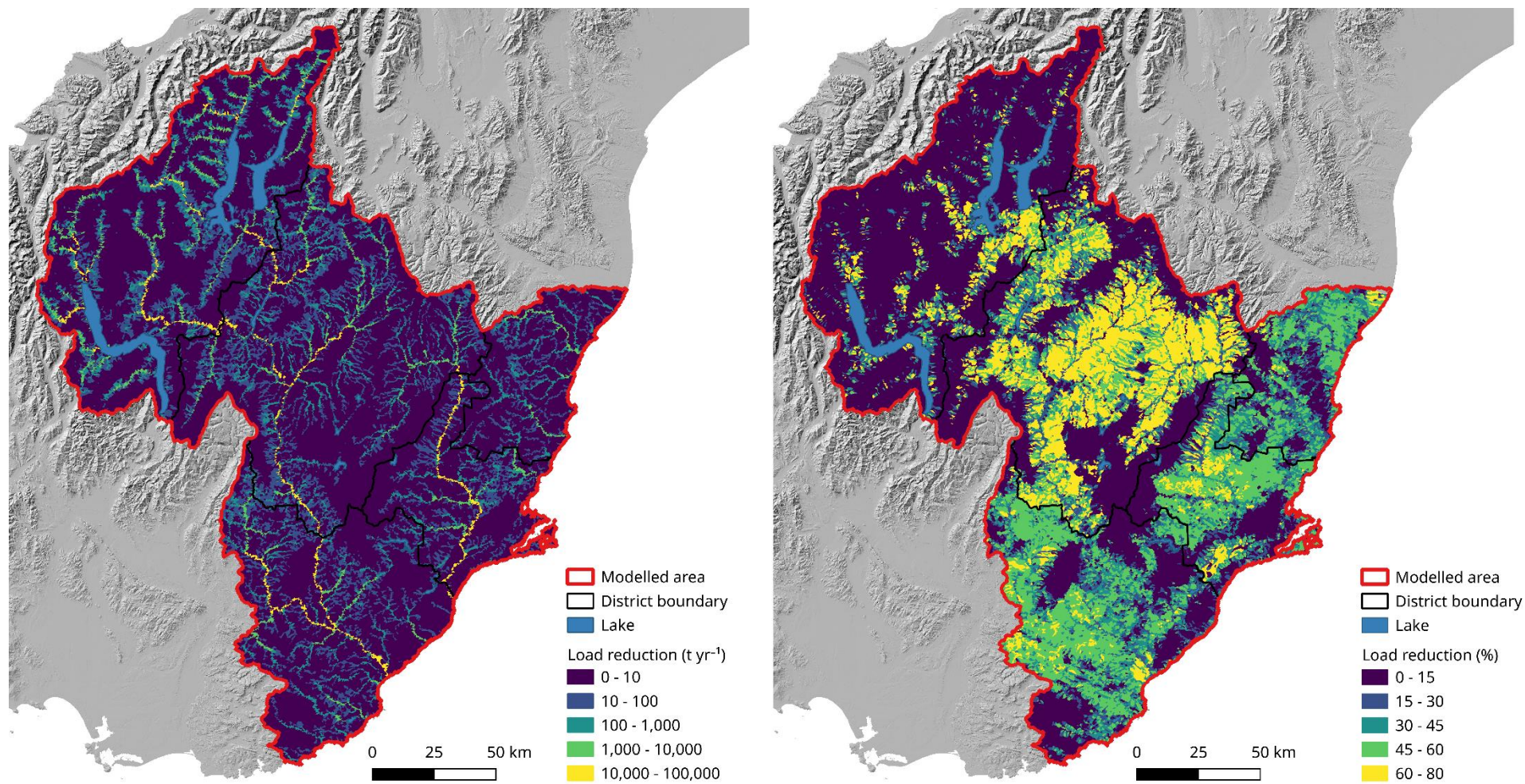
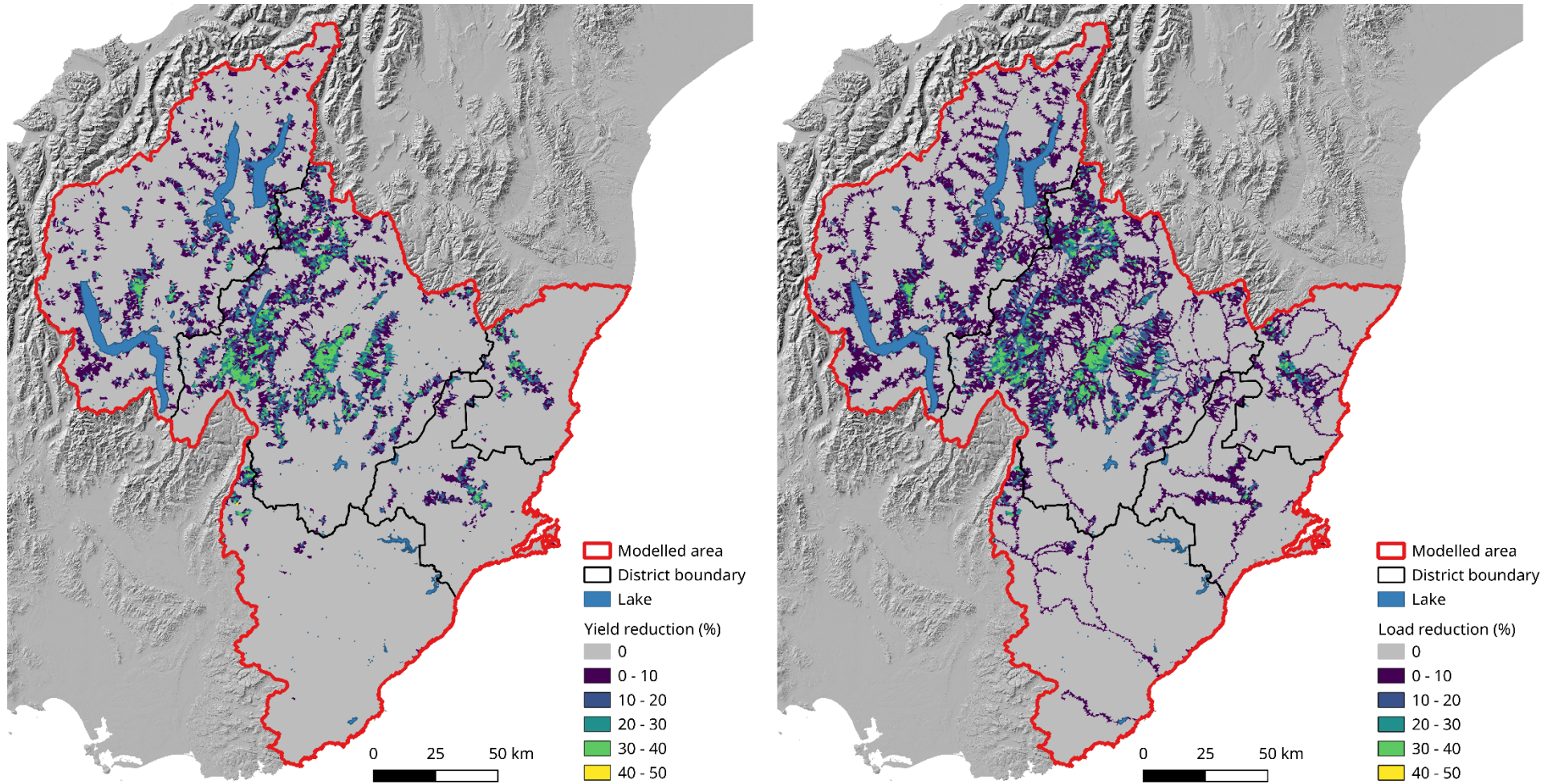


Figure 3. Absolute (left) and proportional (right) REC2 sub-catchment suspended sediment load reductions between the baseline and GMP+ scenarios.



**Figure 4. Proportional reductions in sediment yield (left) and sediment load (right) for REC2 sub-catchments between the aspirational and GMP+ scenarios.**

**Table 2. Proportional and absolute reductions in mean annual suspended sediment load required to achieve NPS-FM 2020 attribute states at water quality monitoring sites, rounded to 2 significant figures.**

| Site ID                             | Proportional reduction in load required (%) |        |        | Absolute reduction in load required (kt yr <sup>-1</sup> ) |        |        |
|-------------------------------------|---|--------|--------|--|--------|--------|
|                                     | National bottom line                        | B band | A band | National bottom line                                       | B band | A band |
| Benger burn at SH8                  | 18  | 33     | 44     | 0.73   | 1.3    | 1.7    |
| Catlins at Houipapa                 | 0   | 0      | 4      | 0  | 0      | 0.23   |
| Clutha @ Balclutha                  | 40  | 51     | 59     | 110  | 140    | 160    |
| Clutha @ Millers Flat               | 4   | 21     | 34     | 6.4  | 31     | 50     |
| Crookston Burn at Kelso Road        | 13  | 28     | 40     | 0.24   | 0.52   | 0.74   |
| Heriot Burn at Park Hill Road       | 38  | 49     | 57     | 1.1  | 1.4    | 1.6    |
| Kawarau @ Chards Rd                 | 0   | 2      | 19     | 0  | 9.9    | 76     |
| Kye Burn at SH85 Bridge             | 0   | 11     | 26     | 0  | 2.5    | 6      |
| Lindis at Ardgour Road              | 0   | 0      | 11     | 0  | 0      | 6.4    |
| Lindis at Lindis Peak               | 0   | 5      | 21     | 0  | 2.5    | 9.8    |
| Lindsays Creek at North Road Bridge | 0   | 4      | 20     | 0  | 0.016  | 0.079  |
| Lovells Creek at Station Road       | 19  | 33     | 44     | 0.13   | 0.24   | 0.32   |
| Manuherikia at Blackstone Hill      | 11  | 26     | 39     | 1.4  | 3.4    | 4.9    |
| Manuherikia at Galloway             | 30  | 43     | 52     | 40   | 56     | 69     |
| Manuherikia at Ophir                | 35  | 46     | 55     | 42   | 56     | 67     |
| Mill Creek at Fish Trap             | 46  | 55     | 63     | 0.019  | 0.023  | 0.026  |
| Owhiro Stream at Riverside Rd       | 79  | 83     | 86     | 0.25   | 0.26   | 0.26   |
| Pomahaka at Burkes Ford             | 4   | 21     | 34     | 2.5  | 12     | 19     |
| Pomahaka at Glenken                 | 26  | 39     | 49     | 8.2  | 12     | 15     |

| Site ID                           | Proportional reduction in load required (%) |        |        | Absolute reduction in load required (kt yr <sup>-1</sup> ) |        |        |
|-----------------------------------|---|--------|--------|--|--------|--------|
|                                   | National bottom line                        | B band | A band | National bottom line                                       | B band | A band |
| Sutton Stream at SH87             | 40  | 51     | 59     | 0.76   | 0.95   | 1.1    |
| Taieri at Allanton Bridge         | 59  | 67     | 72     | 63   | 71     | 77     |
| Taieri at Creamery Road bridge    | 30  | 43     | 52     | 5.4  | 7.6    | 9.3    |
| Taieri at Linnburn Runs Road      | 0   | 3      | 19     | 0  | 0.19   | 1.1    |
| Taieri at Outram                  | 0   | 12     | 26     | 0  | 12     | 27     |
| Taieri at Stonehenge              | 0   | 3      | 19     | 0  | 0.25   | 1.5    |
| Taieri at Sutton                  | 55  | 63     | 69     | 41   | 47     | 51     |
| Taieri at Tiroiti                 | 77  | 81     | 84     | 44   | 46     | 48     |
| Taieri at Waipiata                | 39  | 50     | 58     | 9.8  | 12     | 15     |
| Thomsons Creek at SH85            | 54  | 62     | 69     | 4.7  | 5.4    | 5.9    |
| Tokomairiro at Lisnatunny         | 10  | 26     | 38     | 0.092  | 0.23   | 0.35   |
| Tokomairiro at West Branch Bridge | 0   | 0      | 12     | 0  | 0      | 0.19   |
| Waipori at Waipori Falls Reserve  | 1   | 19     | 32     | 0.012  | 0.16   | 0.27   |
| Wairuna at Millar Road            | 61  | 68     | 73     | 0.39   | 0.43   | 0.47   |
| Waitahuna at Tweeds Bridge        | 19  | 33     | 44     | 1.1  | 2      | 2.7    |

**Table 3. Absolute and proportional reductions in mean annual suspended sediment load under the aspirational and GMP+ scenarios relative to baseline at water quality monitoring sites, rounded to 2 significant figures.**

| Site ID                             | Baseline attribute state | Aspirational scenario                            |                               |                            | GMP+ scenario                                    |                               |                            |
|-------------------------------------|--------------------------|--|-------------------------------|----------------------------|--|-------------------------------|----------------------------|
|                                     |                          | Load reduction achievable (kt yr <sup>-1</sup> ) | Load reduction achievable (%) | Achievable attribute state | Load reduction achievable (kt yr <sup>-1</sup> ) | Load reduction achievable (%) | Achievable attribute state |
| Benger burn at SH8                  | D                        | 2.2  | 55                            | A                          | 2.2  | 55                            | A                          |
| Catlins at Houipapa                 | B                        | 0.87   | 17                            | A                          | 0.87   | 17                            | A                          |
| Clutha @ Balclutha                  | D                        | 77   | 28                            | D                          | 78   | 29                            | D                          |
| Clutha @ Millers Flat               | D                        | 27   | 18                            | C                          | 28   | 19                            | C                          |
| Crookston Burn at Kelso Road        | D                        | 0.56   | 30                            | B                          | 0.56   | 30                            | B                          |
| Heriot Burn at Park Hill Road       | D                        | 1.3  | 45                            | C                          | 1.3  | 46                            | C                          |
| Kawarau @ Chards Rd                 | C                        | 23   | 6                             | B                          | 24   | 6                             | B                          |
| Kye Burn at SH85 Bridge             | C                        | 4.6  | 20                            | B                          | 4.7  | 20                            | B                          |
| Lindis at Ardgour Road              | B                        | 12   | 20                            | A                          | 13   | 22                            | A                          |
| Lindis at Lindis Peak               | C                        | 6.7  | 14                            | B                          | 7.5  | 16                            | B                          |
| Lindsays Creek at North Road Bridge | C                        | 0.042  | 11                            | B                          | 0.042  | 11                            | B                          |
| Lovells Creek at Station Road       | D                        | 0.21   | 30                            | C                          | 0.21   | 30                            | C                          |
| Manuherikia at Blackstone Hill      | D                        | 4.1  | 32                            | B                          | 4.1  | 33                            | B                          |
| Manuherikia at Galloway             | D                        | 23   | 18                            | D                          | 24   | 18                            | D                          |

| Site ID                        | Baseline attribute state | Aspirational scenario                            |                               |                            | GMP+ scenario                                    |                               |                            |
|--------------------------------|--------------------------|--|-------------------------------|----------------------------|--|-------------------------------|----------------------------|
|                                |                          | Load reduction achievable (kt yr <sup>-1</sup> ) | Load reduction achievable (%) | Achievable attribute state | Load reduction achievable (kt yr <sup>-1</sup> ) | Load reduction achievable (%) | Achievable attribute state |
| Manuherikia at Ophir           | D                        | 19   | 16                            | D                          | 19   | 16                            | D                          |
| Mill Creek at Fish Trap        | D                        | 0.011  | 27                            | D                          | 0.011  | 27                            | D                          |
| Owhiro Stream at Riverside Rd  | D                        | 0.13   | 42                            | D                          | 0.13   | 42                            | D                          |
| Pomahaka at Burkes Ford        | D                        | 21   | 38                            | A                          | 22   | 39                            | A                          |
| Pomahaka at Glenken            | D                        | 9.5  | 30                            | C                          | 10   | 33                            | C                          |
| Sutton Stream at SH87          | D                        | 0.62   | 33                            | D                          | 0.63   | 33                            | D                          |
| Taieri at Allanton Bridge      | D                        | 33   | 31                            | D                          | 33   | 31                            | D                          |
| Taieri at Creamery Road bridge | D                        | 4.6  | 26                            | D                          | 4.8  | 27                            | D                          |
| Taieri at Linnburn Runs Road   | C                        | 0.37   | 6                             | B                          | 0.37   | 7                             | B                          |
| Taieri at Outram               | C                        | 31   | 31                            | A                          | 32   | 31                            | A                          |
| Taieri at Stonehenge           | C                        | 1.1  | 14                            | B                          | 1.1  | 15                            | B                          |
| Taieri at Sutton               | D                        | 22   | 29                            | D                          | 22   | 30                            | D                          |
| Taieri at Tiroiti              | D                        | 15   | 26                            | D                          | 15   | 27                            | D                          |
| Taieri at Waipiata             | D                        | 7  | 28                            | D                          | 7.1  | 28                            | D                          |
| Thomsons Creek at SH85         | D                        | 2.3  | 27                            | D                          | 2.3  | 27                            | D                          |
| Tokomairiro at Lisnatunny      | D                        | 0.15   | 16                            | C                          | 0.15   | 16                            | C                          |

| Site ID                           | Baseline attribute state | Aspirational scenario                            |                               |                            | GMP+ scenario                                    |                               |                            |
|-----------------------------------|--------------------------|--|-------------------------------|----------------------------|--|-------------------------------|----------------------------|
|                                   |                          | Load reduction achievable (kt yr <sup>-1</sup> ) | Load reduction achievable (%) | Achievable attribute state | Load reduction achievable (kt yr <sup>-1</sup> ) | Load reduction achievable (%) | Achievable attribute state |
| Tokomairiro at West Branch Bridge | B                        | 0.3  | 18                            | A                          | 0.3  | 18                            | A                          |
| Waipori at Waipori Falls Reserve  | D                        | 0.013  | 1                             | C                          | 0.013  | 1                             | C                          |
| Wairuna at Millar Road            | D                        | 0.4  | 61                            | C                          | 0.4  | 61                            | C                          |
| Waitahuna at Tweeds Bridge        | D                        | 2.3  | 38                            | B                          | 2.3  | 38                            | B                          |

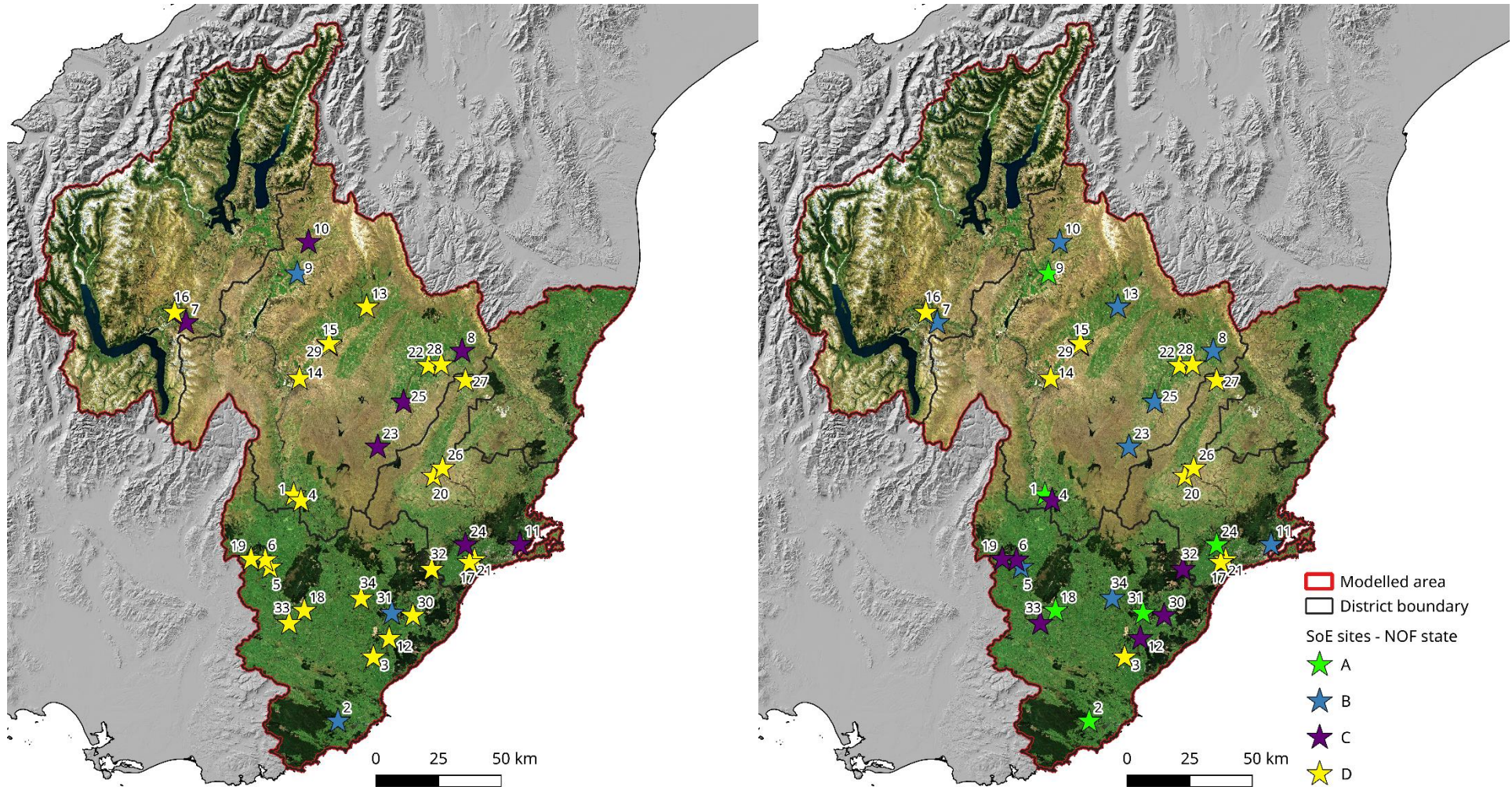


Figure 5. Attribute state achieved under the baseline (left) and GMP+ (right) scenarios at the 34 SoE sites.



**Table 4. Count of SoE sites in each band under the baseline, aspirational, and GMP+ scenarios. Sites are only counted in the highest band with which they comply, i.e. if a site is counted in band A it is not counted in band B, although it would also comply with band B.**

| <b>Count of sites achieving band</b> |                          |                              |                      |
|--------------------------------------|--------------------------|------------------------------|----------------------|
| <b>NOF band</b>                      | <b>Baseline scenario</b> | <b>Aspirational scenario</b> | <b>GMP+ scenario</b> |
| A                                    | 0                        | 6                            | 6                    |
| B                                    | 3                        | 9                            | 9                    |
| C                                    | 7                        | 7                            | 7                    |
| National Bottom Line                 | 0                        | 0                            | 0                    |
| D                                    | 24                       | 12                           | 12                   |
| Total                                | 34                       | 34                           | 34                   |

**Table 5. Comparison of load reductions required to achieve the national bottom line and the reductions achieved in the aspirational and GMP+ scenarios at the 12 sites that are unable to achieve the national bottom line under the aspirational and GMP+ scenarios.**

| <b>Site ID</b>                 | <b>Site no.</b> | <b>Suspended sediment class</b> | <b>Baseline visual clarity (m)</b> | <b>National bottom line visual clarity threshold (m)</b> | <b>Reduction required to achieve national bottom line (%)</b> | <b>Load reduction achievable Aspirational scenario (%)</b> | <b>Load reduction achievable GMP+ scenario (%)</b> |
|--------------------------------|-----------------|---------------------------------|------------------------------------|--|---|--|--|
| Clutha @ Balclutha             | 3               | 3                               | 1.51                               | 2.22   | 40  | 28   | 29   |
| Manuherikia at Galloway        | 14              | 3                               | 1.69                               | 2.22   | 30  | 18   | 18   |
| Manuherikia at Ophir           | 15              | 3                               | 1.60                               | 2.22   | 35  | 16   | 16   |
| Mill Creek at Fish Trap        | 16              | 3                               | 1.39                               | 2.22   | 46  | 27   | 27   |
| Owhiro Stream at Riverside Rd  | 17              | 1                               | 0.40                               | 1.34   | 79  | 42   | 42   |
| Sutton Stream at SH87          | 20              | 3                               | 1.50                               | 2.22   | 40  | 33   | 33   |
| Taieri at Allanton Bridge      | 21              | 3                               | 1.12                               | 2.22   | 59  | 31   | 31   |
| Taieri at Creamery Road bridge | 22              | 3                               | 1.69                               | 2.22   | 30  | 26   | 27   |
| Taieri at Sutton               | 26              | 3                               | 1.21                               | 2.22   | 55  | 29   | 30   |
| Taieri at Tiroiti              | 27              | 3                               | 0.73                               | 2.22   | 77  | 26   | 27   |
| Taieri at Waipiata             | 28              | 3                               | 1.52                               | 2.22   | 39  | 28   | 28   |
| Thomsons Creek at SH85         | 29              | 3                               | 1.22                               | 2.22   | 54  | 27   | 27   |

## 4 References

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## 5 Data dictionary

The accompanying data supplied with this technical note are supplied as vector data (ESRI Shapefiles). The attribute fields for the files are described below.

The data layer **ORC\_SedNetNZ\_loads\_and\_yields\_GMPplus.shp** contains SedNetNZ model outputs (mean annual suspended sediment loads and yields) for the GMP+ scenario.

### Filename: ORC\_SedNetNZ\_loads\_and\_yields\_GMPplus.shp

| Attribute Field | Description  |
|-----------------|--|
| nzsegment       | Stream segment ID from REC2 v2.4.  |
| GMPLoad         | SedNetNZ modelled accumulated mean annual suspended sediment load ( $\text{t yr}^{-1}$ ) for the GMP+ scenario.  |
| AbLoadRed       | Absolute reduction ( $\text{t yr}^{-1}$ ) in SedNetNZ modelled accumulated mean annual suspended sediment load ( $\text{t yr}^{-1}$ ) between the baseline and GMP+ scenarios.             |
| PrLoadRed       | Proportional reduction in SedNetNZ modelled accumulated mean annual suspended sediment load ( $\text{t yr}^{-1}$ ) between the baseline and GMP+ scenarios.                                |
| GMPYield        | SedNetNZ modelled local specific suspended sediment yield ( $\text{t km}^{-2} \text{ yr}^{-1}$ ) from erosion processes for the baseline scenario. Does not include floodplain deposition. |

The data layer **ORC\_SoE\_site\_compliance\_GMPplus.shp** contains NPS-FM 2020 compliance results for the 34 SoE sites analysed.

### Filename: ORC\_SoE\_site\_compliance\_GMPplus.shp

| Attribute Field | Description  |
|-----------------|--|
| sID             | Site ID - as supplied by ORC   |
| nzsegment       | Stream segment ID from REC2 v2.4.  |
| Med_Clar        | Baseline visual clarity (m) - as supplied by ORC   |
| SedClass        | Corrected sediment class (see Neverman & Smith (2022)) for the reach based on Hicks et al. (2020). |
| BaseBand        | Baseline NOF attribute state.  |
| PrNBL           | Proportional reduction in load required to achieve the national bottom line.                       |
| PrBband         | Proportional reduction in load required to achieve the B band.                                     |
| PrAband         | Proportional reduction in load required to achieve the A band.                                     |
| PrRedAch        | Achievable proportional load reduction between the baseline and GMP+ scenarios.                    |
| AbNBL           | Absolute reduction in load ( $\text{t yr}^{-1}$ ) required to achieve the national bottom line.    |
| AbBband         | Absolute reduction in load ( $\text{t yr}^{-1}$ ) required to achieve the B band.                  |
| AbAband         | Absolute reduction in load ( $\text{t yr}^{-1}$ ) required to achieve the A band.                  |
| AbRedAch        | Achievable absolute load reduction ( $\text{t yr}^{-1}$ ) between the baseline and GMP+ scenarios. |
| GMPBand         | NOF attribute state achievable under the GMP+ scenario.  |