# Hydrological and nutrient modelling of the Wilson Inlet catchment

Appendices (A–E)

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# Appendix A: Hydrological calibration

## A.1 Hydrological model testing

### A.1.1 Testing different hydrological models

We tested the following hydrological models in this project (Table A.1):

- GR4J (Perrin et al. 2003)
- LASCAM (Large Scale Catchment Model, Viney et al. 2000)

Models were tested in the Cuppup Creek catchment at flow gauge 603013. Models were calibrated using the Nash-Sutcliffe Efficiency (NSE) daily with bias penalty from 1/1/2005 to the 28/4/2017. The models were validated from 1985 to 2004. The LASCAM model performed significantly better for the calibration period but was slightly worse in the validation period (see Table A.1). Ultimately, we opted to use LASCAM due to its ability to model land-use changes over time and produce a better calibration.

*Table A.1: Calibration results of the hydrological models tested*

| Period | Statistic | 603013: LASCAM | 603013: GR4J |
|---|---|---|---|
| | Objective function usef for calibration | NSE daily bias | NSE daily bias |
| Calibration period (2005–2017) | NSE Daily | 0.86 | 0.79 |
| | NSE Daily & Bias Penalty | **0.86** | **0.77** |
| | NSE Log Daily & Bias Penalty | 0.39 | 0.48 |
| | NSE Monthly | 0.96 | 0.93 |
| | NSE Annual | 0.95 | 0.84 |
| | Volume Bias (%) | **-2.74** | **10.55** |
| Validation period (1975-2004) | NSE Daily | 0.81 | 0.81 |
| | NSE Daily & Bias Penalty | **0.80** | **0.81** |
| | NSE Log Daily & Bias Penalty | 0.52 | 0.55 |
| | NSE Monthly | 0.92 | 0.90 |
| | NSE Annual | 0.67 | 0.82 |
| | Volume Bias (%) | **-8.67** | **-2.47** |

### A.1.2 Testing the effect of plantation leaf area index responses to clearing

We tested the effect of three different plantation leaf area index (LAI) responses during the initial stages of the hydrological model development: a fixed annual LAI, a two-year LAI response to planting/harvesting and a five-year LAI response to planting/harvesting. All three tests had their LAI scaled according to the monthly factors given in Table A.2, were optimised using NSE log daily bias (1/1/2005 to 31/12/2016) and had no stream routing.

All three models had good calibration results with most statistics being similar in all three tests (Table A.3). However, the two-year plantation LAI response gave a better annual NSE score and had a closer matching cumulative flow plot and daily flow plots (Figure A.1).

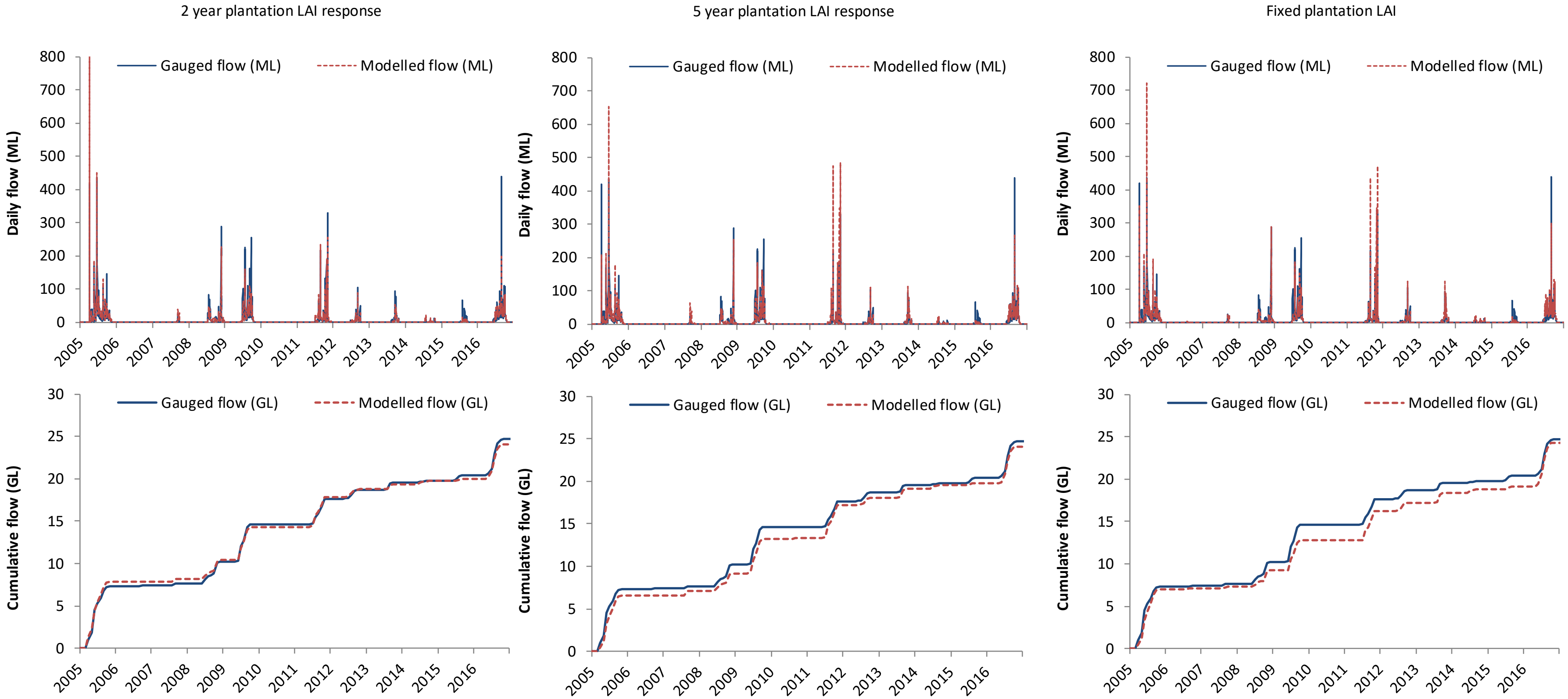
*Table A.2: Monthly LAI scaling factor used for all land uses*

| Month | LAI factor |
|---|---|
| Jan | 0.90 |
| Feb | 0.89 |
| Mar | 0.90 |
| Apr | 0.90 |
| May | 0.85 |
| Jun | 0.92 |
| Jul | 1.12 |
| Aug | 1.21 |
| Sep | 1.27 |
| Oct | 1.20 |
| Nov | 0.96 |
| Dec | 0.88 |

*Table A.3: Model calibration statistics for three different plantation LAI responses to clearing*

| Period | Statistic | 603190: 2-year LAI response | 603190: 5-year LAI response | 603190 fixed LAI |
|---|---|---|---|---|
| | Objective function use for calibration | NSE log daily bias | NSE log daily bias | NSE log daily bias |
| Calibration period (2005–2018) | NSE Daily | 0.47 | 0.68 | 0.67 |
| | NSE Daily & Bias Penalty | 0.47 | 0.68 | 0.67 |
| | NSE Log Daily & Bias Penalty | **0.84** | **0.84** | **0.87** |
| | NSE Monthly | 0.94 | 0.92 | 0.92 |
| | NSE Annual | **0.98** | **0.96** | **0.95** |
| | Volume Bias (%) | **-2.5** | **-2.3** | **-1.4** |
| Validation period (1975-2004) | NSE Daily | 0.51 | 0.42 | 0.28 |
| | NSE Daily & Bias Penalty | 0.19 | 0.06 | -0.74 |
| | NSE Log Daily & Bias Penalty | **0.11** | **0.20** | **-0.94** |
| | NSE Monthly | 0.69 | 0.69 | 0.38 |
| | NSE Annual | 0.38 | 0.30 | -0.54 |
| | Volume Bias (%) | **-39.6** | **-41.8** | **-69.8** |

*Figure A.1: Hydrographs and cumulative flow from three different plantation LAI responses to clearing*



# A.2 Hydrology parameters and functions

## A.2.1 LASCAM parameters

*Table A.4: Calibrated hydrology parameters by parameter set*

| Parameter | Parameter set ID | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 602009 | 603003 | 603004 | 603005 | 603007 | 603013 | 603020 | 603021 | 603022 | 603023 | 603190 | Quickup |
| alphag* | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 |
| betac* | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| betag* | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 |
| betass* | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| amn (mm) | 54 | 161 | 29 | 31 | 50 | 47 | 54 | 28 | 14 | 63 | 4 | 10 |
| amx (mm) | 197 | 502 | 314 | 364 | 364 | 403 | 419 | 255 | 205 | 242 | 153 | 828 |
| bmx (mm) | 1677 | 1461 | 783 | 1898 | 1750 | 1439 | 2285 | 502 | 2496 | 2428 | 1081 | 1576 |
| fmx (mm) | 776 | 322 | 368 | 448 | 206 | 218 | 412 | 865 | 585 | 629 | 212 | 400 |
| fs0 | 196 | 24 | 79 | 101 | 80 | 82 | 89 | 35 | 5 | 69 | 25 | 127 |
| dfs | 71 | 164 | 136 | 148 | 46 | 67 | 43 | 81 | 95 | 76 | 32 | 105 |
| td | 570 | 586 | 729 | 363 | 82 | 256 | 256 | 1488 | 364 | 209 | 1167 | 1259 |
| alphaa | 1.24 | 3.06 | 3.06 | 2.67 | 2.54 | 1.25 | 1.34 | 10.00 | 1.84 | 1.14 | 4.89 | 1.54 |
| alphab | 7.12 | 1.29 | 6.81 | 4.22 | 7.26 | 8.58 | 4.74 | 9.79 | 9.18 | 0.26 | 2.60 | 5.24 |
| alphac | 2.58 | 3.24 | 0.00 | 0.12 | 0.00 | 0.01 | 9.81 | 0.00 | 1.89 | 5.61 | 5.74 | 3.88 |
| alphaf | 4.08 | 0.18 | 3.32 | 6.82 | 4.06 | 9.94 | 3.29 | 2.98 | 4.38 | 5.17 | 8.74 | 0.85 |
| alphass | 10.99 | 1.56 | 4.68 | 10.83 | 5.16 | 10.89 | 10.98 | 1.30 | 10.37 | 10.96 | 0.10 | 8.24 |
| betaa | 58 | 3513 | 9914 | 5698 | 1062 | 342 | 452 | 1536 | 512 | 64 | 9999 | 5871 |
| betab | 0.65 | 8.54 | 9.86 | 5.56 | 6.16 | 9.85 | 0.17 | 9.99 | 4.99 | 9.96 | 9.84 | 8.33 |
| betaf | 6.84 | 8.92 | 2.06 | 3.55 | 0.15 | 4.31 | 5.91 | 1.00 | 9.99 | 3.01 | 5.11 | 8.76 |
| gammaa | 1.83 | 5.38 | 3.19 | 2.31 | 9.98 | 4.90 | 1.79 | 7.52 | 9.98 | 0.76 | 4.54 | 2.46 |
| gammab | 0.18 | 0.17 | 0.60 | 0.83 | 0.75 | 0.87 | 0.62 | 0.30 | 0.31 | 0.11 | 0.76 | 0.40 |
| gammaf | 0.50 | 0.69 | 0.37 | 0.51 | 0.70 | 0.47 | 0.43 | 0.65 | 0.66 | 0.13 | 0.28 | 0.27 |
| deltab | 2.49 | 3.95 | 3.32 | 2.51 | 0.14 | 0.45 | 2.32 | 0.52 | 2.13 | 2.38 | 4.21 | 2.39 |
| deltaf | 1.00 | 0.89 | 1.00 | 1.00 | 0.98 | 1.00 | 1.00 | 0.30 | 0.30 | 0.42 | 0.95 | 0.71 |
| dmu1 | 1.64 | 1.02 | 0.73 | 0.93 | 0.47 | 0.57 | 1.16 | 1.15 | 1.98 | 1.26 | 0.71 | 1.64 |
| dmu2 (mm) | 1250 | 707 | 2446 | 1933 | 807 | 631 | 1695 | 506 | 1353 | 1050 | 2333 | 1504 |
| dmu3 | 0.87 | 0.66 | 0.90 | 0.57 | 1.01 | 1.91 | 0.73 | 0.98 | 1.99 | 1.25 | 1.94 | 0.70 |

* Parameter is fixed. All other parameters are calibrated

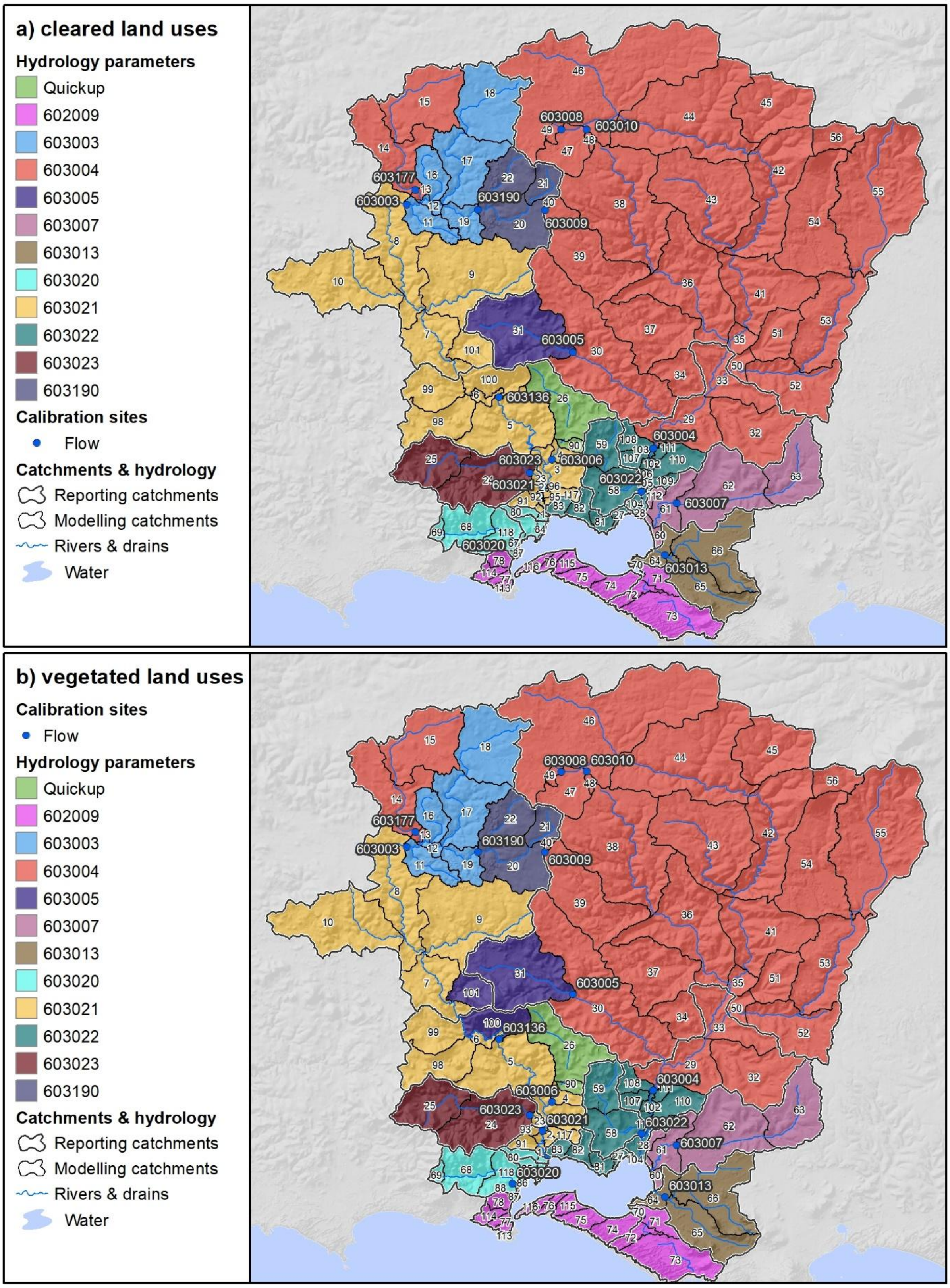



*Figure A.2: Hydrology parameter sets for cleared and vegetated land uses*

*Table A.5: Hydrology parameter sets by modelling catchment and average annual rainfall (anrain parameter)*

| Cat ID | Reporting catchment | anrain (mm) | Parameter set ID Cleared FU | Parameter set ID Vegetated FU | Cat ID | Reporting catchment | anrain (mm) | Parameter set ID Cleared FU | Parameter set ID Vegetated FU |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Lower Denmark River | 1000 | 603021 | 603021 | 60 | Sleeman River | 900 | 603007 | 603007 |
| 2 | Lower Denmark River | 1000 | 603021 | 603021 | 61 | Sleeman River | 900 | 603007 | 603007 |
| 3 | Lower Denmark River | 900 | 603021 | 603021 | 62 | Sleeman River | 900 | 603007 | 603007 |
| 4 | Lower Denmark River | 900 | 603021 | 603021 | 63 | Sleeman River | 900 | 603007 | 603007 |
| 5 | Lower Denmark River | 1000 | 603021 | 603021 | 64 | Cuppup Creek | 900 | 603013 | 603013 |
| 6 | Lower Denmark River | 1000 | 603021 | 603021 | 65 | Cuppup Creek | 900 | 603013 | 603013 |
| 7 | Upper Denmark River | 900 | 603021 | 603021 | 66 | Cuppup Creek | 900 | 603013 | 603013 |
| 8 | Upper Denmark River | 900 | 603021 | 603021 | 67 | Little River | 1000 | 603020 | 603020 |
| 9 | Upper Denmark River | 800 | 603021 | 603021 | 68 | Little River | 1000 | 603020 | 603020 |
| 10 | Upper Denmark River | 900 | 603021 | 603021 | 69 | Little River | 1000 | 603020 | 603020 |
| 11 | Upper Denmark River | 800 | 603003 | 603003 | 70 | Lake Saide | 900 | 602009 | 602009 |
| 12 | Upper Denmark River | 800 | 603003 | 603003 | 71 | Lake Saide | 900 | 602009 | 602009 |
| 13 | Upper Denmark River | 800 | 603004 | 603004 | 72 | Lake Saide | 900 | 602009 | 602009 |
| 14 | Upper Denmark River | 700 | 603004 | 603004 | 73 | Lake Saide | 900 | 602009 | 602009 |
| 15 | Upper Denmark River | 700 | 603004 | 603004 | 74 | Nullaki | 1000 | 602009 | 602009 |
| 16 | Upper Denmark River | 700 | 603003 | 603003 | 75 | Nullaki | 1000 | 602009 | 602009 |
| 17 | Upper Denmark River | 800 | 603003 | 603003 | 76 | Nullaki | 1000 | 602009 | 602009 |
| 18 | Upper Denmark River | 700 | 603003 | 603003 | 77 | Ocean Beach Road | 1100 | 602009 | 602009 |
| 19 | Upper Denmark River | 800 | 603003 | 603003 | 78 | Ocean Beach Road | 1100 | 602009 | 602009 |
| 20 | Upper Denmark River | 800 | 603190 | 603190 | 79 | Koorabup Creek | 1000 | 603020 | 603020 |
| 21 | Upper Denmark River | 800 | 603190 | 603190 | 80 | Koorabup Creek | 1000 | 603020 | 603020 |
| 22 | Upper Denmark River | 800 | 603190 | 603190 | 81 | Foreshore | 900 | 603022 | 603022 |
| 23 | Scotsdale Brook | 1000 | 603021 | 603021 | 82 | Foreshore | 900 | 603022 | 603022 |
| 24 | Scotsdale Brook | 1100 | 603023 | 603023 | 83 | Foreshore | 900 | 603022 | 603022 |
| 25 | Scotsdale Brook | 1100 | 603023 | 603023 | 84 | Foreshore | 1000 | 603020 | 603020 |
| 26 | Lower Denmark River | 900 | Quickup | Quickup | 85 | Foreshore | 1000 | 603020 | 603020 |
| 27 | Foreshore | 900 | 603022 | 603022 | 86 | Foreshore | 1000 | 603020 | 603020 |
| 28 | Lower Hay River | 900 | 603022 | 603022 | 87 | Foreshore | 1100 | 603020 | 603020 |
| 29 | Lower Hay River | 900 | 603004 | 603004 | 88 | Foreshore | 1100 | 603020 | 603020 |
| 30 | Upper Hay River | 900 | 603004 | 603004 | 90 | Lower Denmark River | 900 | Quickup | Quickup |
| 31 | Upper Hay River | 800 | 603005 | 603005 | 91 | Lower Denmark River | 1000 | 603021 | 603021 |
| 32 | Lower Hay River | 800 | 603004 | 603004 | 92 | Lower Denmark River | 1000 | 603021 | 603021 |
| 33 | Lower Hay River | 800 | 603004 | 603004 | 93 | Lower Denmark River | 1000 | 603021 | 603021 |
| 34 | Upper Hay River | 800 | 603004 | 603004 | 94 | Lower Denmark River | 1000 | 603021 | 603021 |
| 35 | Upper Hay River | 800 | 603004 | 603004 | 95 | Lower Denmark River | 1000 | 603021 | 603021 |
| 36 | Upper Hay River | 700 | 603004 | 603004 | 96 | Lower Denmark River | 1000 | 603021 | 603021 |
| 37 | Upper Hay River | 800 | 603004 | 603004 | 97 | Lower Denmark River | 1000 | 603021 | 603021 |
| 38 | Upper Hay River | 700 | 603004 | 603004 | 98 | Lower Denmark River | 1000 | 603021 | 603021 |
| 39 | Upper Hay River | 700 | 603004 | 603004 | 99 | Lower Denmark River | 1000 | 603021 | 603021 |
| 40 | Upper Hay River | 800 | 603004 | 603004 | 100 | Lower Denmark River | 1000 | 603021 | 603005 |
| 41 | Upper Hay River | 700 | 603004 | 603004 | 101 | Upper Denmark River | 900 | 603021 | 603005 |
| 42 | Upper Hay River | 700 | 603004 | 603004 | 102 | Lower Hay River | 900 | 603022 | 603022 |
| 43 | Upper Hay River | 700 | 603004 | 603004 | 103 | Lower Hay River | 900 | 603022 | 603022 |
| 44 | Upper Hay River | 600 | 603004 | 603004 | 104 | Lower Hay River | 900 | 603022 | 603022 |
| 45 | Upper Hay River | 600 | 603004 | 603004 | 105 | Sunny Glen Creek | 900 | 603022 | 603022 |
| 46 | Upper Hay River | 700 | 603004 | 603004 | 106 | Lower Hay River | 900 | 603022 | 603022 |
| 47 | Upper Hay River | 700 | 603004 | 603004 | 107 | Lower Hay River | 900 | 603022 | 603022 |
| 48 | Upper Hay River | 700 | 603004 | 603004 | 108 | Lower Hay River | 900 | 603022 | 603022 |
| 49 | Upper Hay River | 700 | 603004 | 603004 | 109 | Lower Hay River | 900 | 603022 | 603022 |
| 50 | Upper Hay River | 800 | 603004 | 603004 | 110 | Lower Hay River | 900 | 603022 | 603022 |
| 51 | Upper Hay River | 700 | 603004 | 603004 | 111 | Lower Hay River | 900 | 603022 | 603022 |
| 52 | Upper Hay River | 700 | 603004 | 603004 | 112 | Sleeman River | 900 | 603007 | 603007 |
| 53 | Upper Hay River | 700 | 603004 | 603004 | 113 | Ocean Beach Road | 1100 | 602009 | 602009 |
| 54 | Upper Hay River | 700 | 603004 | 603004 | 114 | Ocean Beach Road | 1100 | 602009 | 602009 |
| 55 | Upper Hay River | 700 | 603004 | 603004 | 115 | Nullaki | 1000 | 602009 | 602009 |
| 56 | Upper Hay River | 700 | 603004 | 603004 | 116 | Nullaki | 1000 | 602009 | 602009 |
| 58 | Sunny Glen Creek | 900 | 603022 | 603022 | 117 | Lower Denmark River | 900 | 603021 | 603021 |
| 59 | Sunny Glen Creek | 900 | 603022 | 603022 | 118 | Little River | 1000 | 603020 | 603020 |

## A.2.2 Storage node parameters (dams and lakes)

*Table A.6: Storage node parameters*

| Model component | Parameter | Lake Saide | Nenamup Inlet | Wentworth Road dam | Mount Hallowell Stud dam | Denmark Dam | Quickup Dam | Carter Dam |
|---|---|---|---|---|---|---|---|---|
| Storage details | Full Supply Level (m) | -0.2 | 0.1 | 3 | 3 | 8.2 | 45 | 35.39 |
| | Full Supply Volume (ML) | 27.2 | 277.9 | 0.0 | 13.9 | 444.0 | 0.0 | 0.0 |
| | Initial Storage Level | -0.8 | -0.8 | 0 | 0 | 0 | 37 | 33 |
| | Initial Storage Volume | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Dead Storage Level (m) | -0.2 | -0.2 | 3 | 3 | 0 | 37 | 35.39 |
| | Dead Storage Volume (ML) | 27.2 | 59.4 | 0.0 | 13.9 | 0.0 | 0.0 | 0.0 |
| Climate details | Climate Data-Rainfall file | Cat ID 73 Rainfall | Cat ID 72 Rainfall | Cat ID 69 Rainfall | Cat ID 68 Rainfall | Cat ID 05 Rainfall | Cat ID 26 Rainfall | Cat ID 26 Rainfall |
| | Climate Data-Evaporation file | Cat ID 73 Evap | Cat ID 72 Evap | Cat ID 69 Evap | Cat ID 68 Evap | Cat ID 05 Evap | Cat ID 26 Evap | Cat ID 26 Evap |

### A.2.3 Functions

*Table A.7: Functions used for the Nenamup Inlet and Lake Saide minimum flow requirement nodes*

| |
|---|
| **Flow from Lake Saide to Nenamup Inlet via the Wolves Pump Road flood management structure:**<br>*Used by the "LakeSaideToNenamup" minimum flow requirement node.*<br>$LakeSaideToNenamupDischarge =<br>if($LakeSaideStorageVol=0,0,if($LakeSaideLevel<=$NenamupInletLevel,0,if($LakeSaideFlow>400,400,$LakeSaideFlow))) |
| **Discharge from Nenamup Inlet to the Wilson Inlet via the Eden Road flood gates:**<br>*Used by the "EdenRoadGates" minimum flow requirement node.*<br>$NenamupRelease =<br>if($InetOpening=0,0,if($NenamupInletLevel<=$NenamupLevelCTF,0,if($NenamupInletFlow>400,400,$NenamupInletFlow))) |
| $LakeSaideFlow = $HeadDiff * 300 |
| $HeadDiff = $LakeSaideLevel-$NenamupInletLevel |
| $LakeSaideStorageVol = Lake Saide modelled storage volume (ML) |
| $LakeSaideLevel = Lake Saide modelled storage level (m) |
| $NenamupInletLevel = Nenamup Inlet modelled storage level (m) |
| $NenamupInletFlow = $NenamupInletLevel*444.44-44.444 |
| $InletOpening = daily timeseries file when the Wilson Inlet bar was open (value of 1) or closed (0). |
| $NenamupLevelCTF = 0.1 |
| $NenamupInletStorageVol = Nenamup Inlet modelled storage level (ML) |

*Table A.8: Functions used for water supply dams*

| |
|---|
| **The Albany–Denmark water supply pipeline:**<br>*Used by the "AlbanyWaterSupplyPipeline" inflow node.*<br>$AlbanyWaterSupply =<br>If($Now.Year<1990,0,if($QuickupStorageVolume>$QuickupDamVolThreshold,0,$DailyTownWaterDemand)) |
| **Pumpback from Denmark to Quickup Dam:**<br>*Used by the "DenmarkMeasuredPumpback" water user node.*<br>$Pumpback =<br>if($Now.Year<2020,$MeasuredDenmarkPumpback,If($QuickupStorageVolume<$QuickupDamVolThreshold,0,if($QuickupDamLevel>44.5,0,if($DenmarkDamLevel<8.20,0,if($DenmarkDamInflow=0,0,if($DenmarkDamInflow<20,$DenmarkDamInflow*0.2,4)))))) |
| **Quickup Dam water abstraction for town water supply:**<br>*Used by the "QuickupWaterSupply" water user node.*<br>$QuickupWaterSupply =<br>if($Now.Year<2020,$QuickupWaterSupplyTimeSeries,if($QuickupStorageVolume<$QuickupDamVolThreshold,0,$QuickupWaterSupplyTimeSeries)) |
| **Water abstraction from Denmark Dam for direct town water supply:**<br>*Used by the "DenmarkWaterSupply" water user node*<br>$DenmarkDamWaterSupply = timeseries of measured or estimated water abstraction for direct town water supply. |
| **Quickup Dam volume threshold that engages the Albany–Denmark water supply:**<br>$QuickupDamVolThreshold = 400 |
| **Modelled variable for determining the pumpback volume from Denmark Dam to Quickup Dam**<br>$DenmarkDamInflow = modelled downstream flow at 613136 on the previous day |
| $DailyTownWaterDemand = timeseries of measured or estimated town water demand (ML) |
| $DenmarkDamLevel = modelled storage level in Denmark Dam |
| $MeasuredDenmarkPumpback = timeseries of measured pumpback from Denmark to Quickup dam (ML) |
| $QuickupDamLevel = modelled storage level in Quickup Dam |
| $QuickupStorageVolume = modelled storage volume in Quickup Dam |

# A.3 Model performance

## A.3.1 Overall performance of the catchment model

The overall performance of the catchment model is represented here by summing all end-of-catchment measured and monitored flows. Days without measured flow are excluded from the sum of modelled flow data.

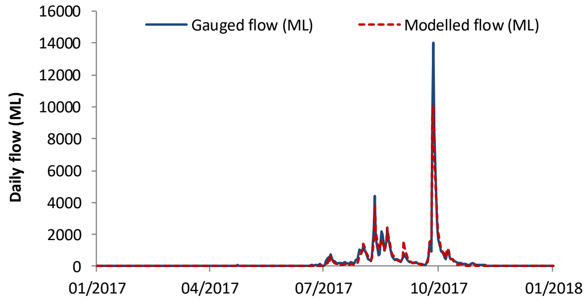

*Figure A.3: Flow measurement sites used to summarise the overall performance of the hydrological model*

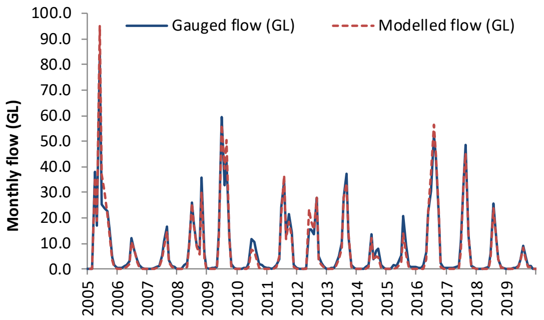
## *Overall model performance (sum of end-of-catchment flow sites)*

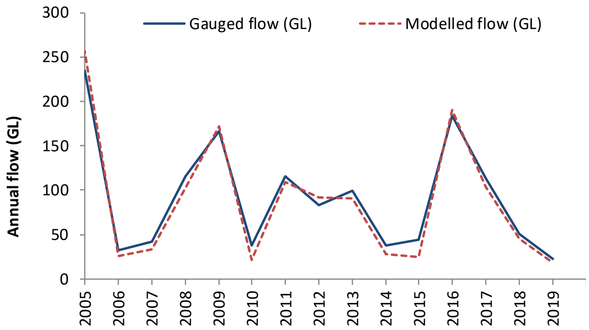
| Statistic | Calibration 1/01/2005 to 31/12/2018 | Validation 2/01/1984 to 31/12/2004 |
|---|---|---|
| NSE daily bias | 0.94 | 0.60 |
| NSE log daily bias | 0.83 | 0.55 |
| NSE daily | 0.94 | 0.84 |
| NSE monthly | 0.97 | 0.88 |
| NSE annual | 0.97 | 0.73 |
| Mass balance error | -5% | -35% |

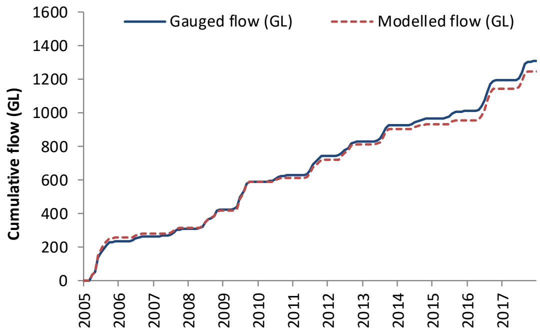
Objective function used for calibration: NSE daily bias

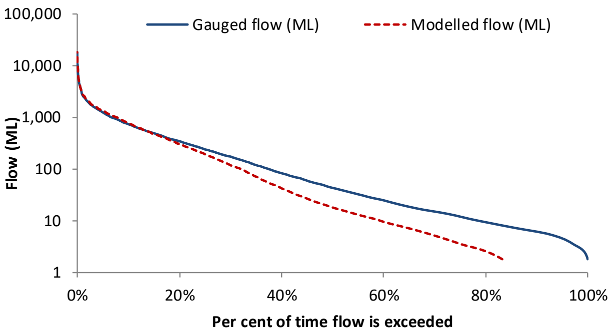
| Daily flow statistic | Calibration Gauged (ML) | Calibration Modelled (ML) | Validation Gauged (ML) | Validation Modelled (ML) |
|---|---|---|---|---|
| Min | 1 | 0 | 0 | 0 |
| Percentile: | | | | |
| *5th* | 5 | 0 | 0 | 0 |
| *10th* | 6 | 1 | 0 | 0 |
| *20th* | 9 | 2 | 0 | 0 |
| *50th* | 42 | 18 | 9 | 0 |
| *75th* | 235 | 189 | 118 | 37 |
| Max | 17 673 | 15 209 | 20 444 | 16 349 |



### A.3.2 Model performance: Little River

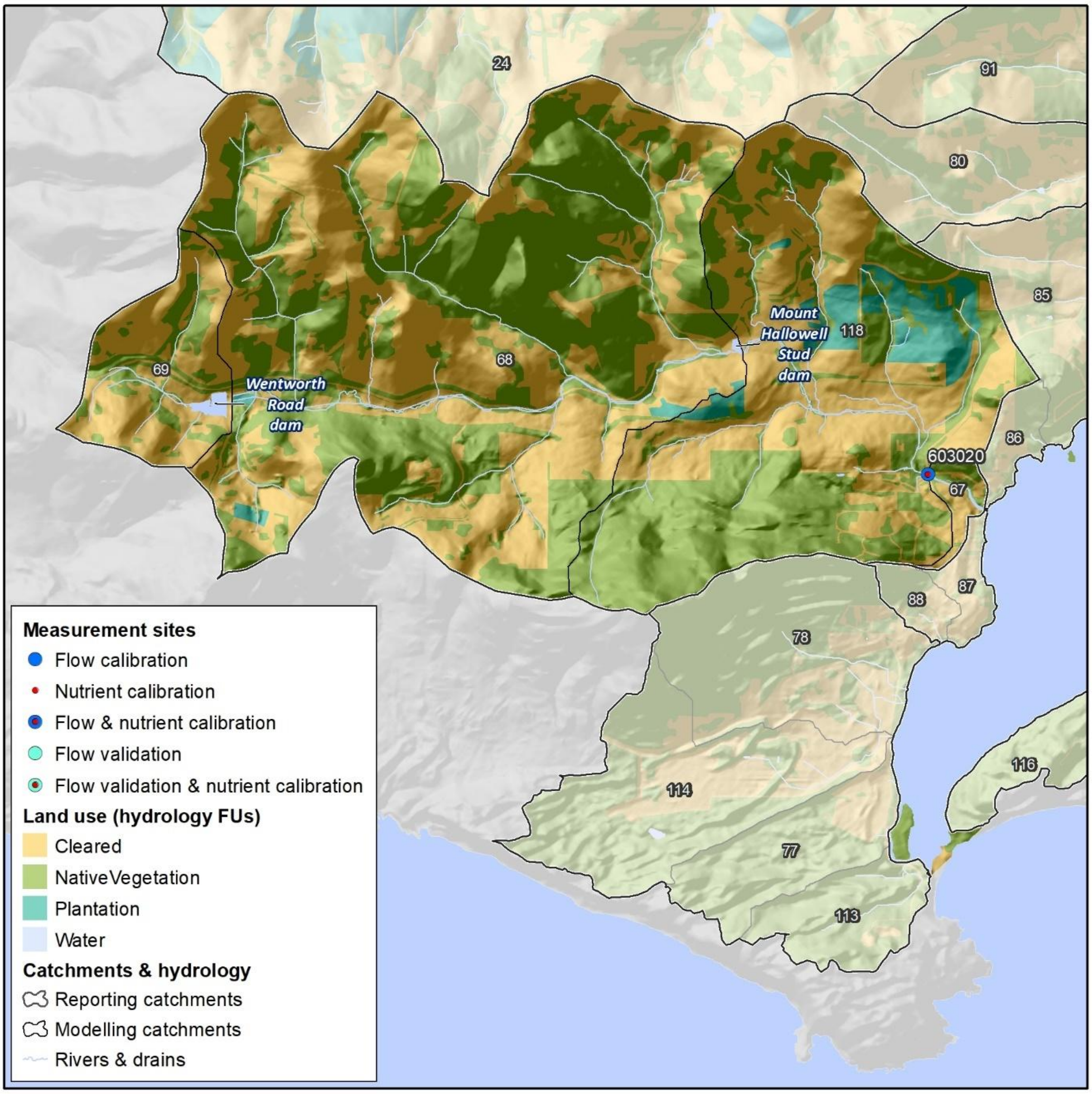


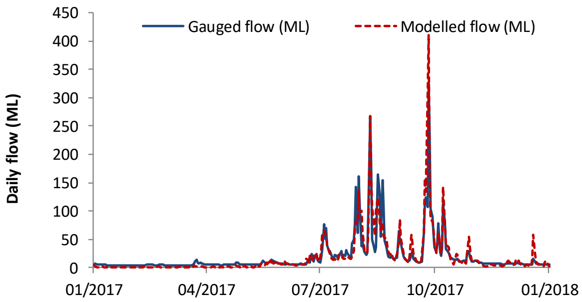

*Figure A.4: Little River model domain*

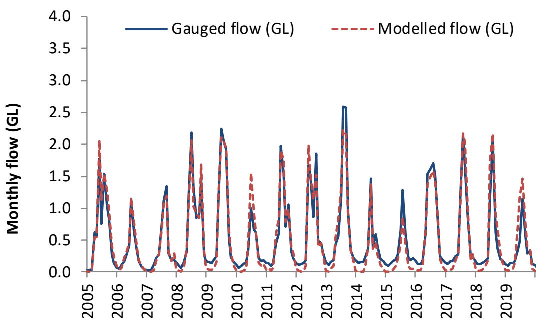
## *Little River – Ocean Beach Road – 603020*

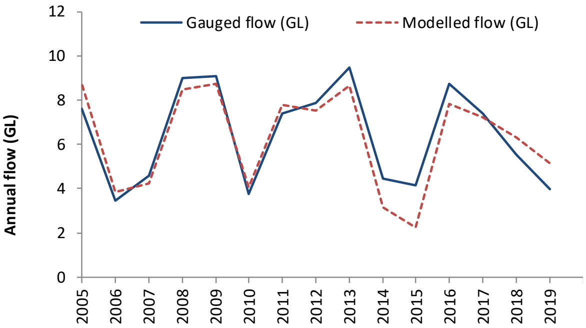
| Statistic | Calibration 1/01/2005 to 31/12/2018 | Validation 10/5/1997 to 31/12/2004 |
|---|---|---|
| NSE daily bias | 0.80 | 0.67 |
| NSE log daily bias | 0.65 | 0.78 |
| NSE daily | 0.80 | 0.75 |
| NSE monthly | 0.94 | 0.84 |
| NSE annual | 0.87 | -0.16 |
| Mass balance error | -4% | -22% |

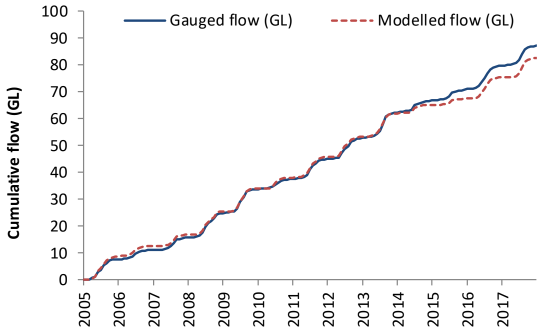
Objective function used for calibration: NSE daily bias

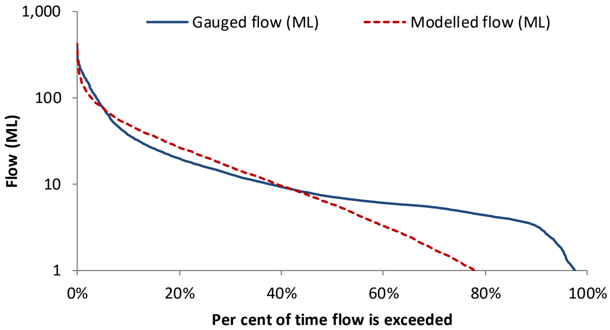
| Daily flow statistic | Calibration | | Validation | |
|---|---|---|---|---|
| | Gauged (ML) | Modelled (ML) | Gauged (ML) | Modelled (ML) |
| Min | 0 | 0 | 0 | 0 |
| Percentile: | | | | |
| *5th* | 2 | 0 | 0 | 0 |
| *10th* | 3 | 0 | 1 | 0 |
| *20th* | 4 | 1 | 1 | 1 |
| *50th* | 7 | 6 | 7 | 7 |
| *75th* | 16 | 20 | 25 | 23 |
| Max | 324 | 411 | 304 | 252 |



## A.3.3 Model performance: Denmark River and Scotsdale Brook

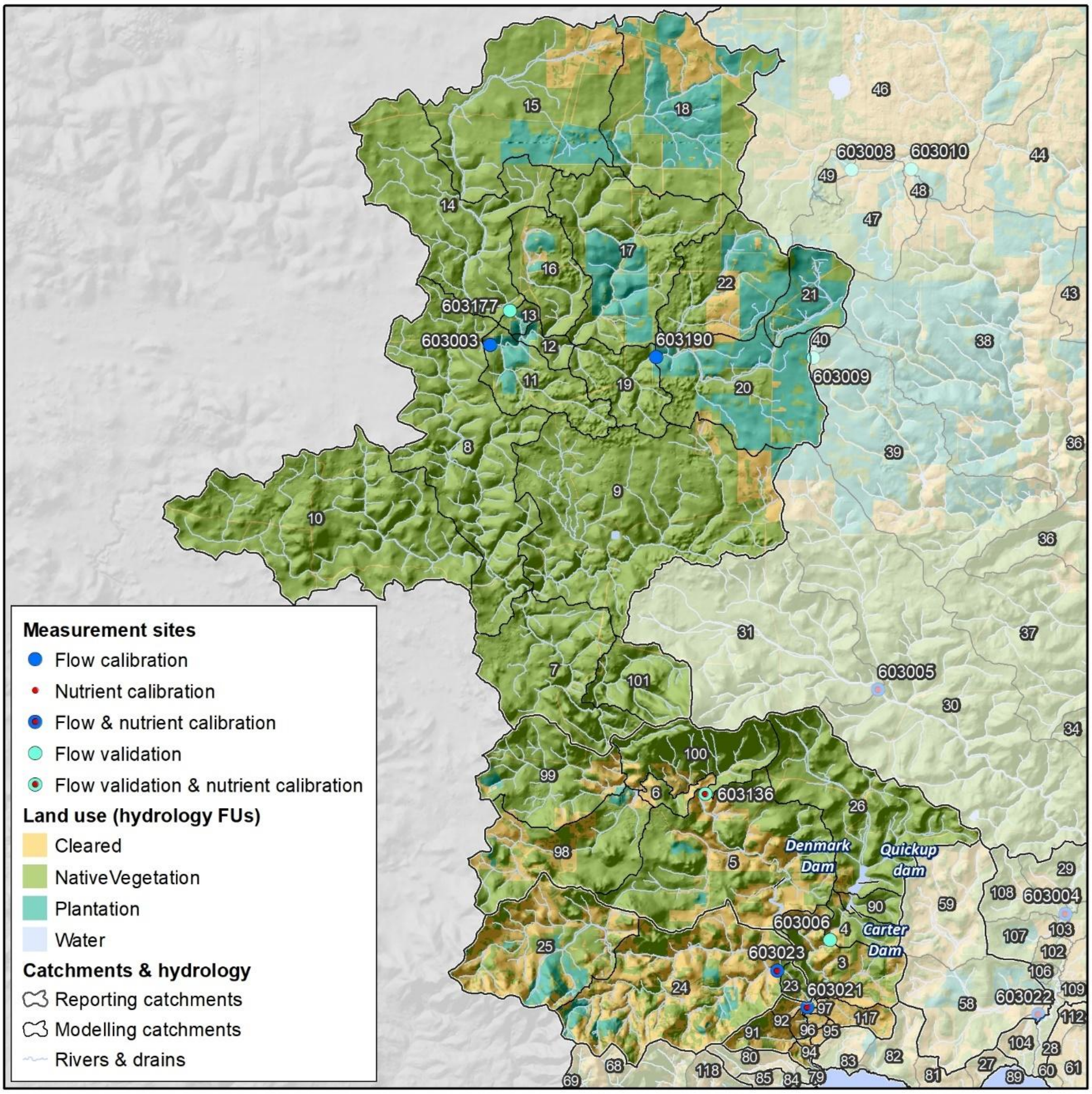


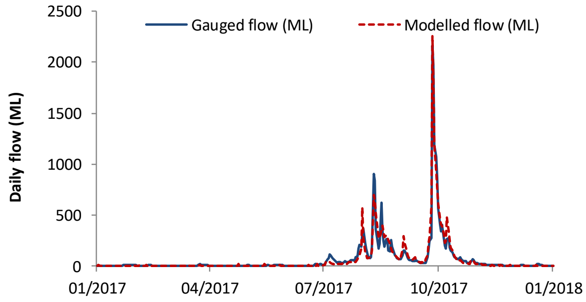

*Figure A.5: Denmark River and Scotsdale Brook model domain*

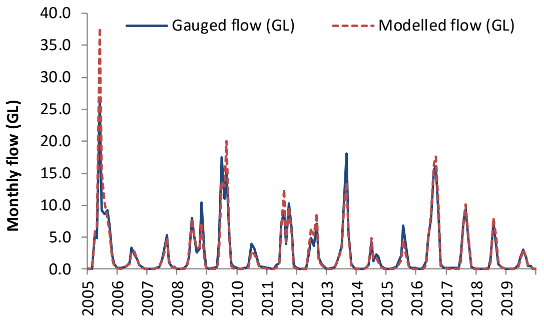
## *Denmark River – Denmark Ag College – 603021*

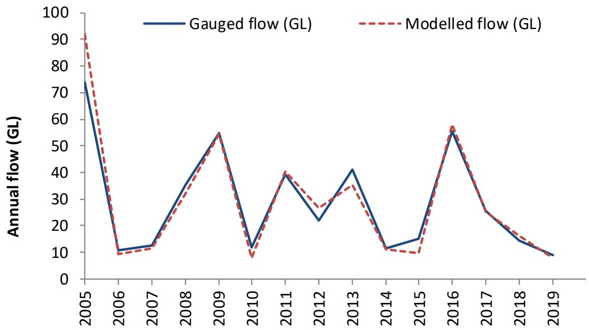
| Statistic | Calibration 1/01/2005 to 31/12/2018 | Validation 17/5/1997 to 31/12/2004 |
|---|---|---|
| NSE daily bias | 0.86 | 0.48 |
| NSE log daily bias | 0.81 | 0.49 |
| NSE daily | 0.86 | 0.75 |
| NSE monthly | 0.89 | 0.78 |
| NSE annual | 0.92 | -0.08 |
| Mass balance error | 2% | -36% |

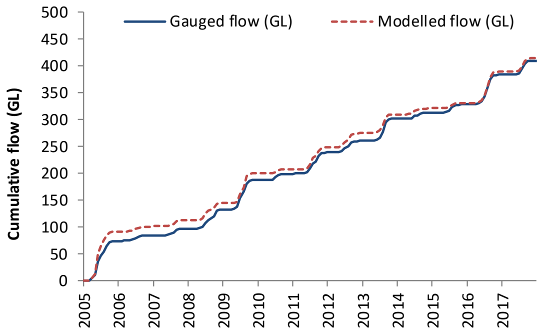
Objective function used for calibration: NSE daily bias

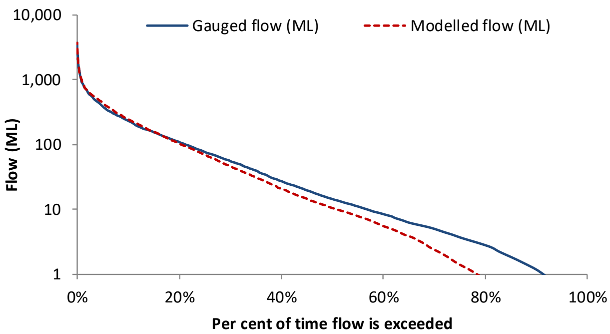
| Daily flow statistic | Calibration | | Validation | |
|---|---|---|---|---|
| | Gauged (ML) | Modelled (ML) | Gauged (ML) | Modelled (ML) |
| Min | 0 | 0 | 0 | 0 |
| Percentile: | | | | |
| *5th* | 0 | 0 | 0 | 0 |
| *10th* | 1 | 0 | 2 | 0 |
| *20th* | 3 | 1 | 4 | 1 |
| *50th* | 14 | 10 | 21 | 11 |
| *75th* | 76 | 69 | 112 | 69 |
| Max | 2 870 | 3 660 | 3 340 | 1 953 |



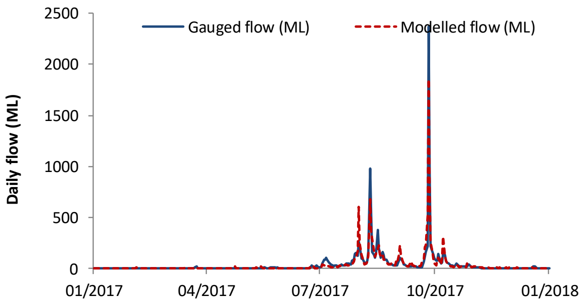



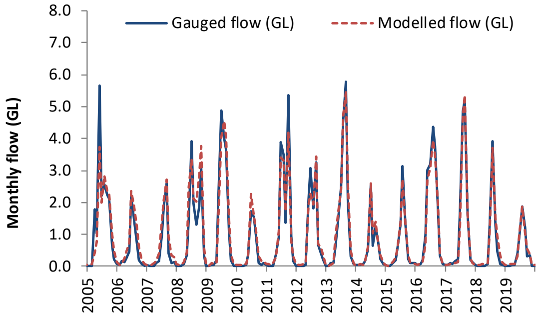
## *Scotsdale Brook - Pipehead - 603023*

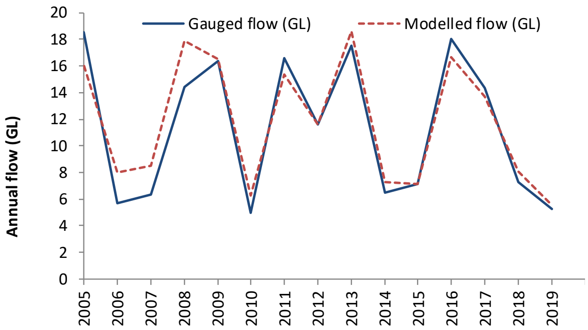
| Statistic | Calibration 1/01/2005 to 31/12/2018 | Validation 26/4/1997 to 31/12/2004 |
|---|---|---|
| NSE daily bias | 0.83 | 0.70 |
| NSE log daily bias | 0.67 | 0.68 |
| NSE daily | 0.83 | 0.72 |
| NSE monthly | 0.95 | 0.91 |
| NSE annual | 0.91 | 0.48 |
| Mass balance error | 4% | -12% |

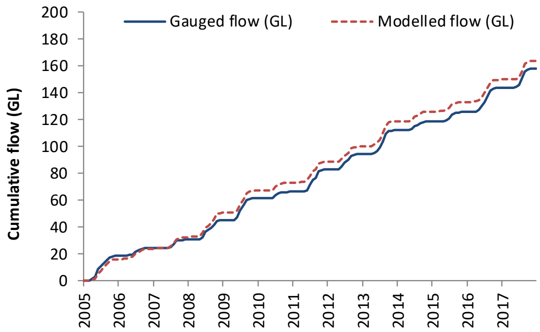
Objective function used for calibration: NSE daily bias

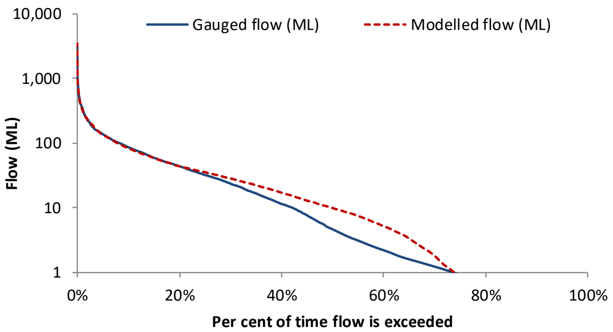
| Daily flow statistic | Calibration | | Validation | |
|---|---|---|---|---|
| | Gauged (ML) | Modelled (ML) | Gauged (ML) | Modelled (ML) |
| Min | 0 | 0 | 0 | 0 |
| Percentile: | | | | |
| *5th* | 0 | 0 | 0 | 0 |
| *10th* | 0 | 0 | 0 | 0 |
| *20th* | 1 | 0 | 1 | 1 |
| *50th* | 5 | 10 | 7 | 10 |
| *75th* | 32 | 36 | 45 | 38 |
| Max | 3 480 | 2 236 | 2 477 | 889 |



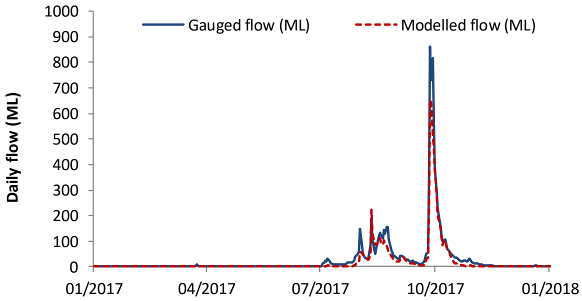



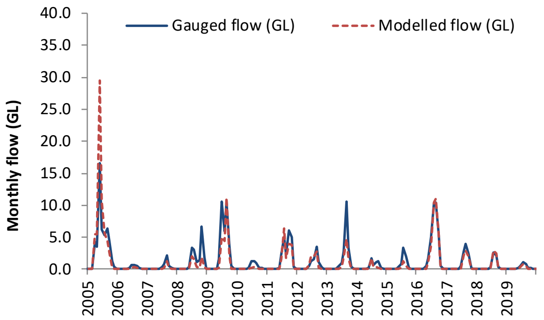
## *Denmark River – Mt Lindesay – 603136*

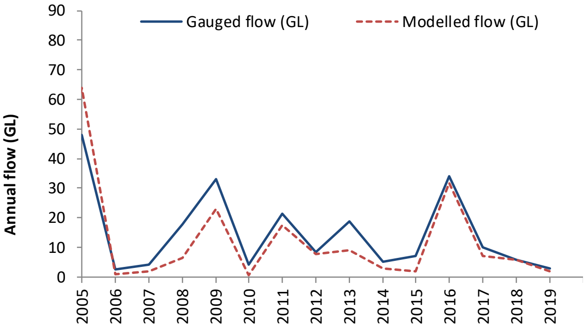
| Statistic | Calibration 1/01/2005 to 31/12/2018 | Validation 1/1/1975 to 31/12/2004 |
|---|---|---|
| NSE daily bias | 0.61 | -0.08 |
| NSE log daily bias | 0.66 | -0.30 |
| NSE daily | 0.66 | 0.57 |
| NSE monthly | 0.71 | 0.65 |
| NSE annual | 0.82 | 0.16 |
| Mass balance error | -18% | -56% |

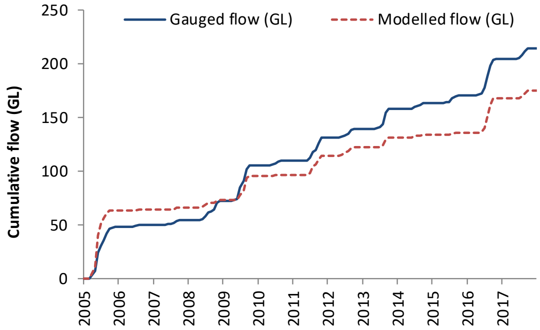
Objective function used for calibration: NSE log daily bias

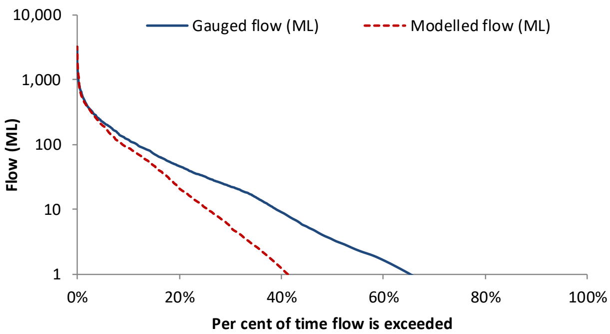
| Daily flow statistic | Calibration Gauged (ML) | Calibration Modelled (ML) | Validation Gauged (ML) | Validation Modelled (ML) |
|---|---|---|---|---|
| Min | 0 | 0 | 0 | 0 |
| Percentile: | | | | |
| *5th* | 0 | 0 | 0 | 0 |
| *10th* | 0 | 0 | 0 | 0 |
| *20th* | 0 | 0 | 1 | 0 |
| *50th* | 3 | 0 | 8 | 0 |
| *75th* | 32 | 11 | 67 | 13 |
| Max | 1 840 | 3 194 | 4 061 | 7 162 |



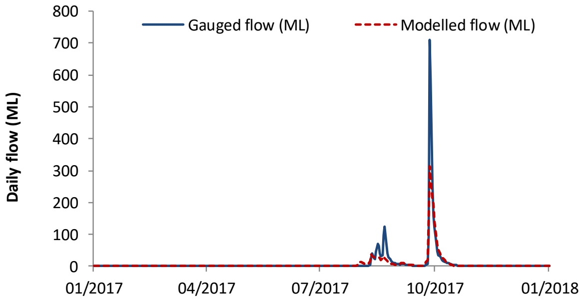



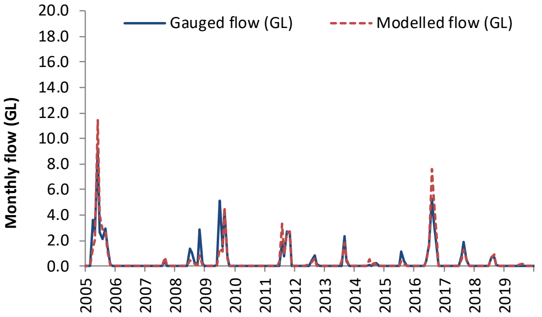
## *Denmark River – Kompup – 603003*

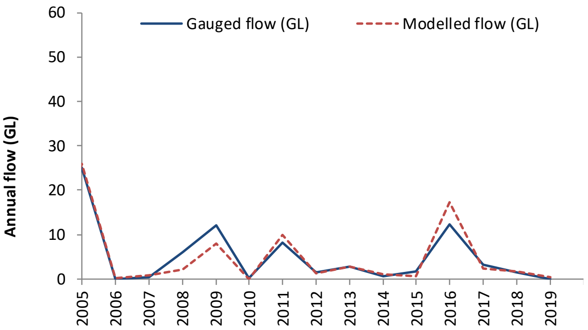
| Statistic | Calibration 1/01/2005 to 31/12/2018 | Validation 1/1/1975 to 31/12/2004 |
|---|---|---|
| NSE daily bias | 0.72 | 0.15 |
| NSE log daily bias | 0.75 | 0.36 |
| NSE daily | 0.72 | 0.64 |
| NSE monthly | 0.82 | 0.75 |
| NSE annual | 0.94 | 0.56 |
| Mass balance error | -1% | -48% |

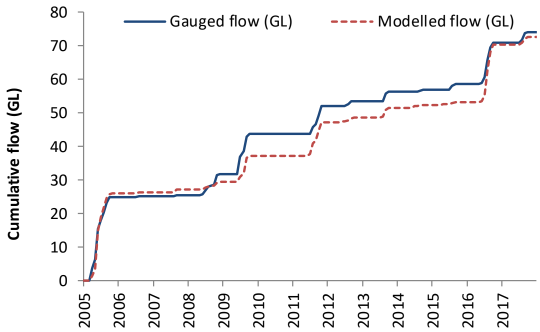
Objective function used for calibration: NSE log daily bias

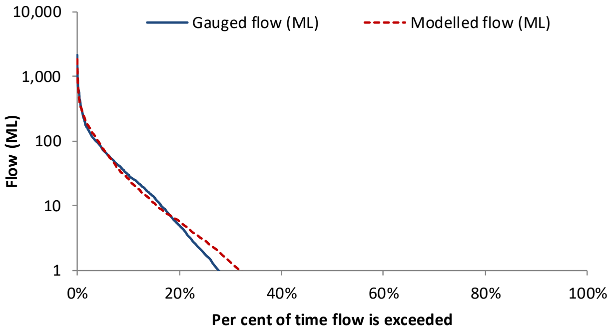
| Daily flow statistic | Calibration Gauged (ML) | Calibration Modelled (ML) | Validation Gauged (ML) | Validation Modelled (ML) |
|---|---|---|---|---|
| Min | 0 | 0 | 0 | 0 |
| Percentile: | | | | |
| *5th* | 0 | 0 | 0 | 0 |
| *10th* | 0 | 0 | 0 | 0 |
| *20th* | 0 | 0 | 0 | 0 |
| *50th* | 0 | 0 | 1 | 0 |
| *75th* | 2 | 3 | 17 | 5 |
| Max | 2 094 | 1 862 | 4 807 | 5 184 |



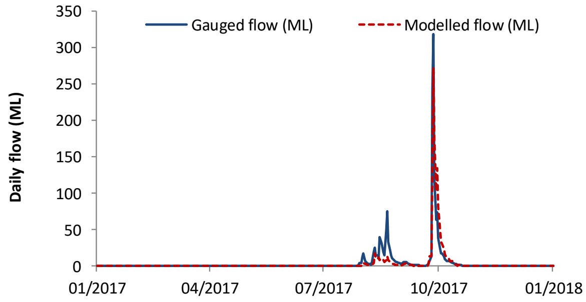



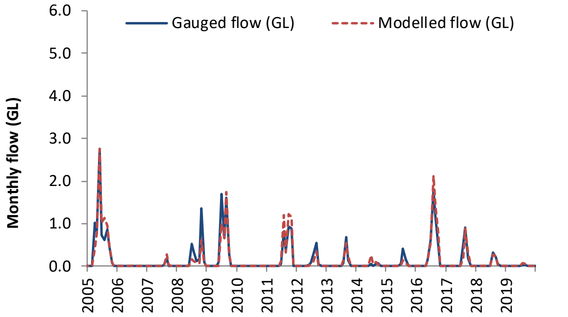
## *Yates Flat Creek - Woodanup - 603190*

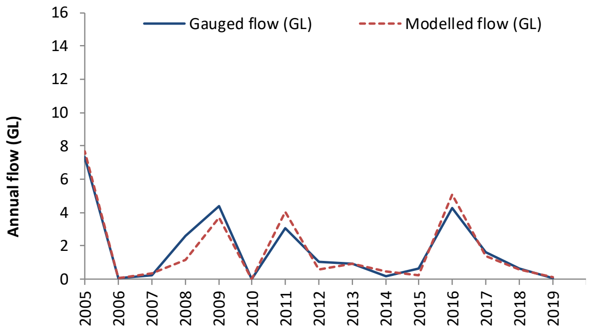
| Statistic | Calibration 1/01/2005 to 31/12/2018 | Validation 1/1/1975 to 31/12/2004 |
|---|---|---|
| NSE daily bias | 0.52 | -0.25 |
| NSE log daily bias | 0.92 | -0.11 |
| NSE daily | 0.52 | 0.20 |
| NSE monthly | 0.90 | 0.69 |
| NSE annual | 0.96 | 0.38 |
| Mass balance error | -3% | -46% |

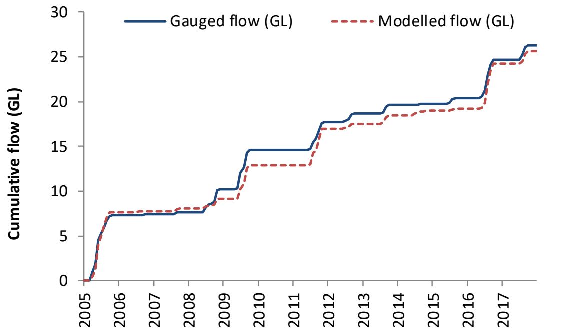
Objective function used for calibration: NSE log daily bias

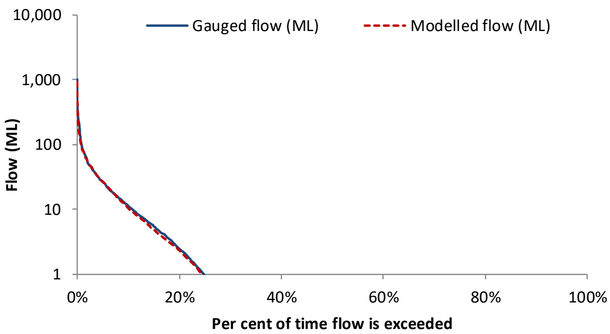
| Daily flow statistic | Calibration Gauged (ML) | Calibration Modelled (ML) | Validation Gauged (ML) | Validation Modelled (ML) |
|---|---|---|---|---|
| Min | 0 | 0 | 0 | 0 |
| Percentile: | | | | |
| *5th* | 0 | 0 | 0 | 0 |
| *10th* | 0 | 0 | 0 | 0 |
| *20th* | 0 | 0 | 0 | 0 |
| *50th* | 0 | 0 | 0 | 0 |
| *75th* | 1 | 1 | 6 | 2 |
| Max | 438 | 1 002 | 1 487 | 3 743 |



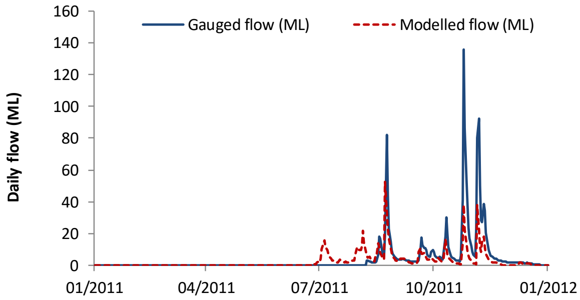



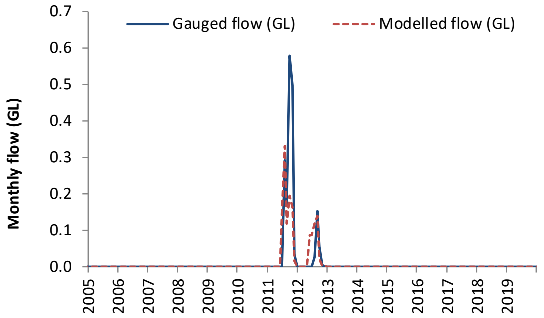
## *Perillup Brook - Perillup Brook - 603177*

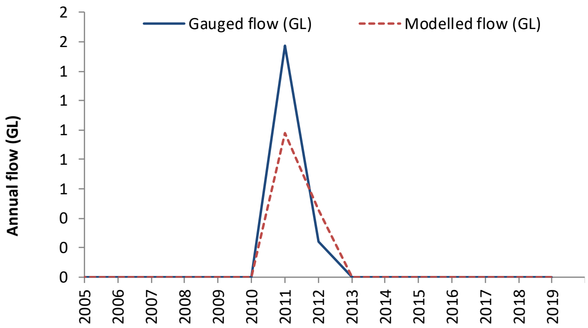
| Statistic | Calibration | Validation |
|---|---|---|
| | Not calibrated | 25/6/2011 to 19/3/2013 |
| NSE daily bias | - | 0.37 |
| NSE log daily bias | - | 0.04 |
| NSE daily | - | 0.44 |
| NSE monthly | - | 0.45 |
| NSE annual | - | 0.55 |
| Mass balance error | - | -21% |

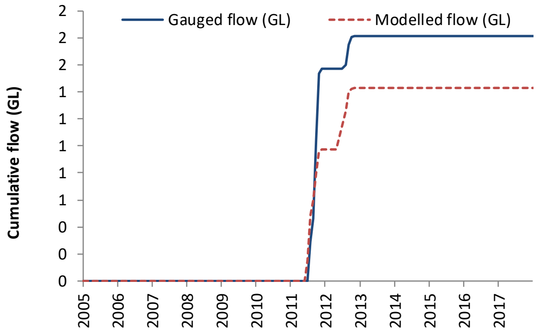
Objective function used for calibration: Not calibrated

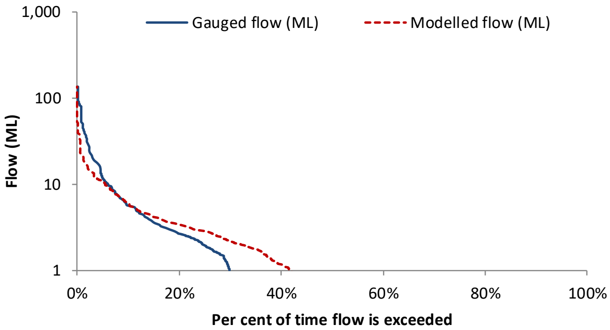
| Daily flow statistic | Calibration | | Validation | |
|---|---|---|---|---|
| | Gauged (ML) | Modelled (ML) | Gauged (ML) | Modelled (ML) |
| Min | - | - | 0 | 0 |
| Percentile: | | | | |
| *5th* | - | - | 0 | 0 |
| *10th* | - | - | 0 | 0 |
| *20th* | - | - | 0 | 0 |
| *50th* | - | - | 0 | 0 |
| *75th* | - | - | 2 | 3 |
| Max | - | - | 136 | 52 |



### A.3.4 Model performance: Hay River and Sunny Glen Creek

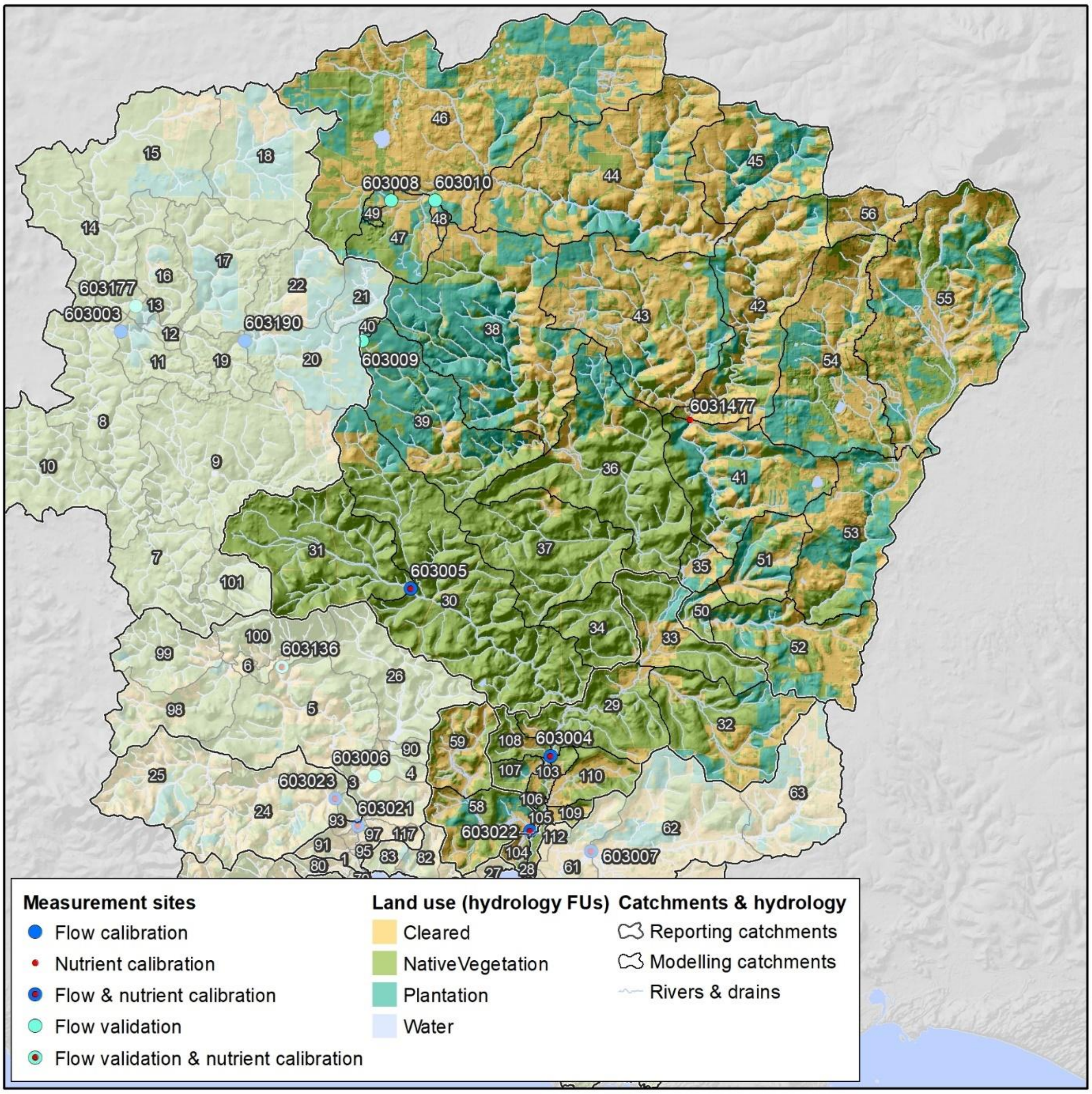


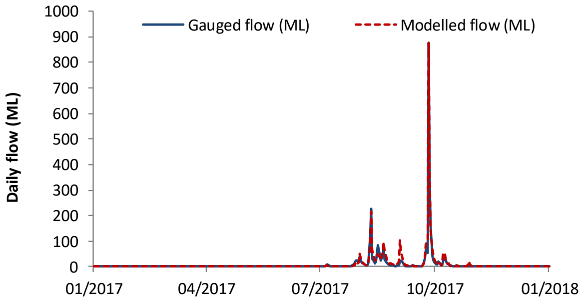

*Figure A.6: Hay River and Sunny Glen Creek model domain*

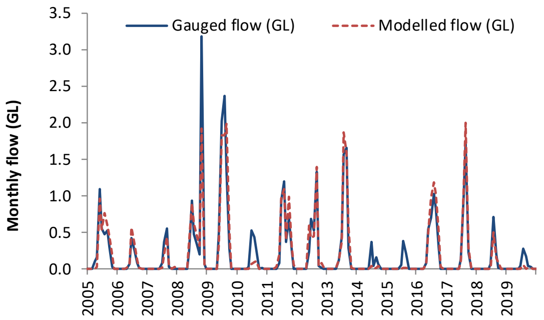
## *Sunny Glen Creek - Girrawheen - 603022*

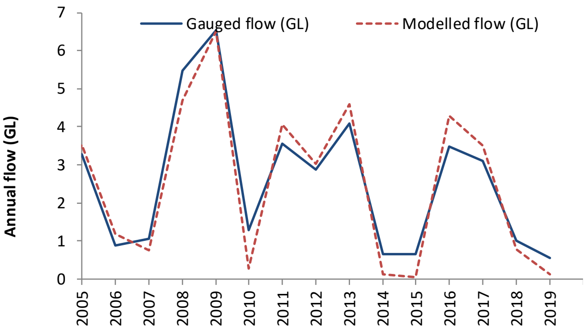
| Statistic | Calibration 1/01/2005 to 31/12/2018 | Validation 17/5/1997 to 31/12/2004 |
|---|---|---|
| NSE daily bias | 0.81 | 0.44 |
| NSE log daily bias | 0.81 | 0.68 |
| NSE daily | 0.81 | 0.60 |
| NSE monthly | 0.89 | 0.72 |
| NSE annual | 0.92 | -0.04 |
| Mass balance error | -1% | -29% |

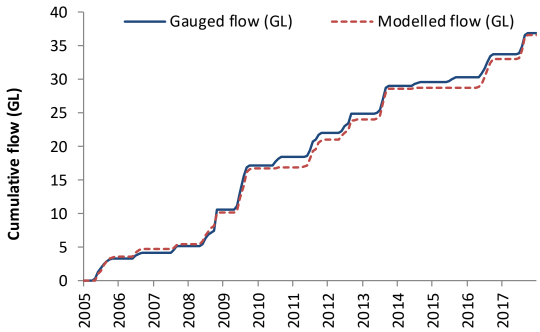
Objective function used for calibration: NSE daily bias

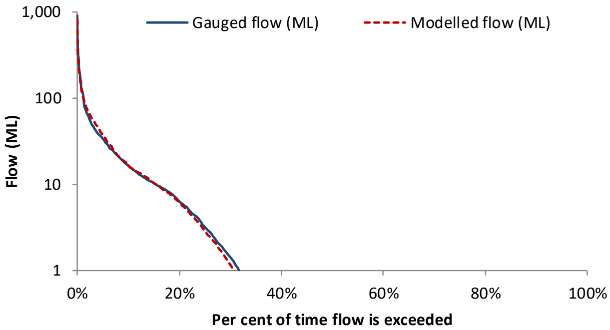
| Daily flow statistic | Calibration Gauged (ML) | Calibration Modelled (ML) | Validation Gauged (ML) | Validation Modelled (ML) |
|---|---|---|---|---|
| Min | 0 | 0 | 0 | 0 |
| Percentile: | | | | |
| *5th* | 0 | 0 | 0 | 0 |
| *10th* | 0 | 0 | 0 | 0 |
| *20th* | 0 | 0 | 0 | 0 |
| *50th* | 0 | 0 | 0 | 0 |
| *75th* | 3 | 3 | 10 | 3 |
| Max | 897 | 878 | 628 | 434 |



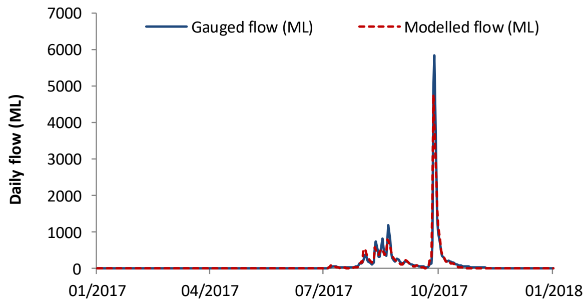



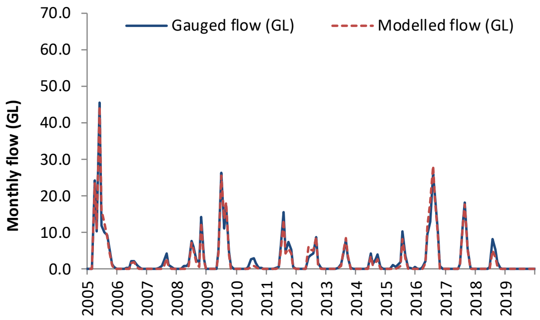
## *Hay River – Sunny Glen – 603004*

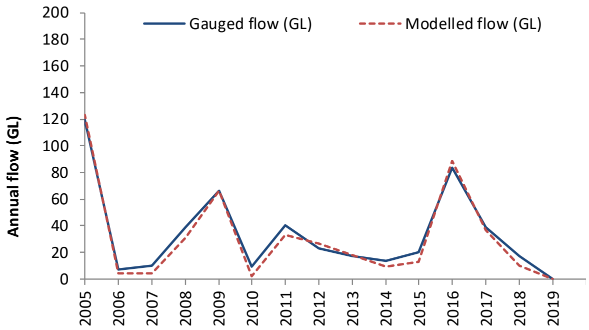
| Statistic | Calibration 1/01/2005 to 31/12/2018 | Validation 2/01/1984 to 31/12/2004 |
|---|---|---|
| NSE daily bias | 0.90 | 0.37 |
| NSE log daily bias | 0.70 | 0.00 |
| NSE daily | 0.91 | 0.77 |
| NSE monthly | 0.97 | 0.80 |
| NSE annual | 0.98 | 0.41 |
| Mass balance error | -8% | -44% |

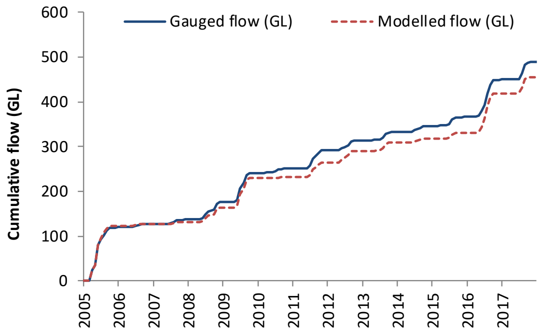
Objective function used for calibration: NSE daily bias

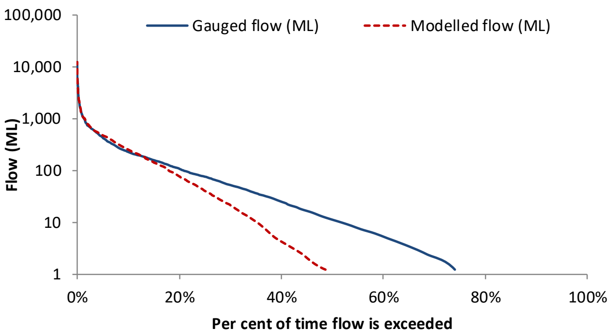
| Daily flow statistic | Calibration Gauged (ML) | Calibration Modelled (ML) | Validation Gauged (ML) | Validation Modelled (ML) |
|---|---|---|---|---|
| Min | 0 | 0 | 0 | 0 |
| Percentile: | | | | |
| *5th* | 0 | 0 | 0 | 0 |
| *10th* | 0 | 0 | 0 | 0 |
| *20th* | 0 | 0 | 1 | 0 |
| *50th* | 11 | 1 | 24 | 1 |
| *75th* | 77 | 41 | 140 | 55 |
| Max | 12 377 | 10 357 | 13 190 | 12 112 |



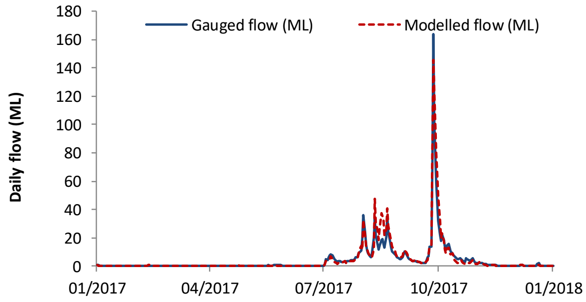



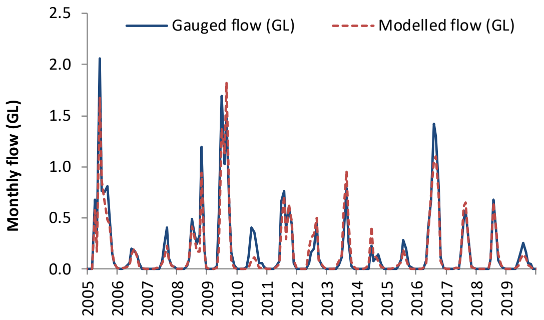
## *Michell River – Beigpiegup – 603005*

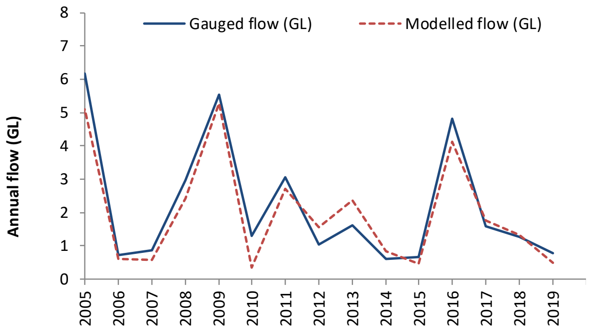
| Statistic | Calibration 1/01/2005 to 31/12/2018 | Validation 2/01/1986 to 31/12/2004 |
|---|---|---|
| NSE daily bias | 0.83 | -0.45 |
| NSE log daily bias | 0.69 | -0.10 |
| NSE daily | 0.84 | 0.41 |
| NSE monthly | 0.92 | 0.36 |
| NSE annual | 0.93 | -1.07 |
| Mass balance error | -9% | -64% |

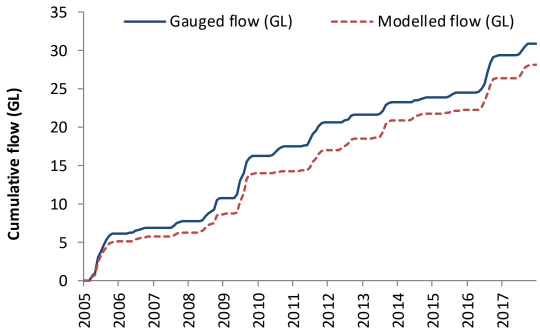
Objective function used for calibration: NSE log daily bias

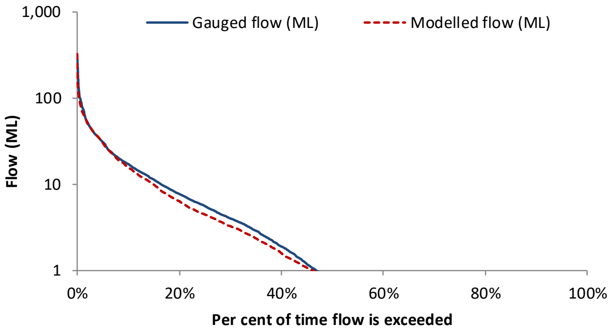
| Daily flow statistic | Calibration | | Validation | |
|---|---|---|---|---|
| | Gauged (ML) | Modelled (ML) | Gauged (ML) | Modelled (ML) |
| Min | 0 | 0 | 0 | 0 |
| Percentile: | | | | |
| *5th* | 0 | 0 | 0 | 0 |
| *10th* | 0 | 0 | 0 | 0 |
| *20th* | 0 | 0 | 0 | 0 |
| *50th* | 1 | 1 | 2 | 1 |
| *75th* | 6 | 4 | 10 | 3 |
| Max | 303 | 319 | 609 | 375 |



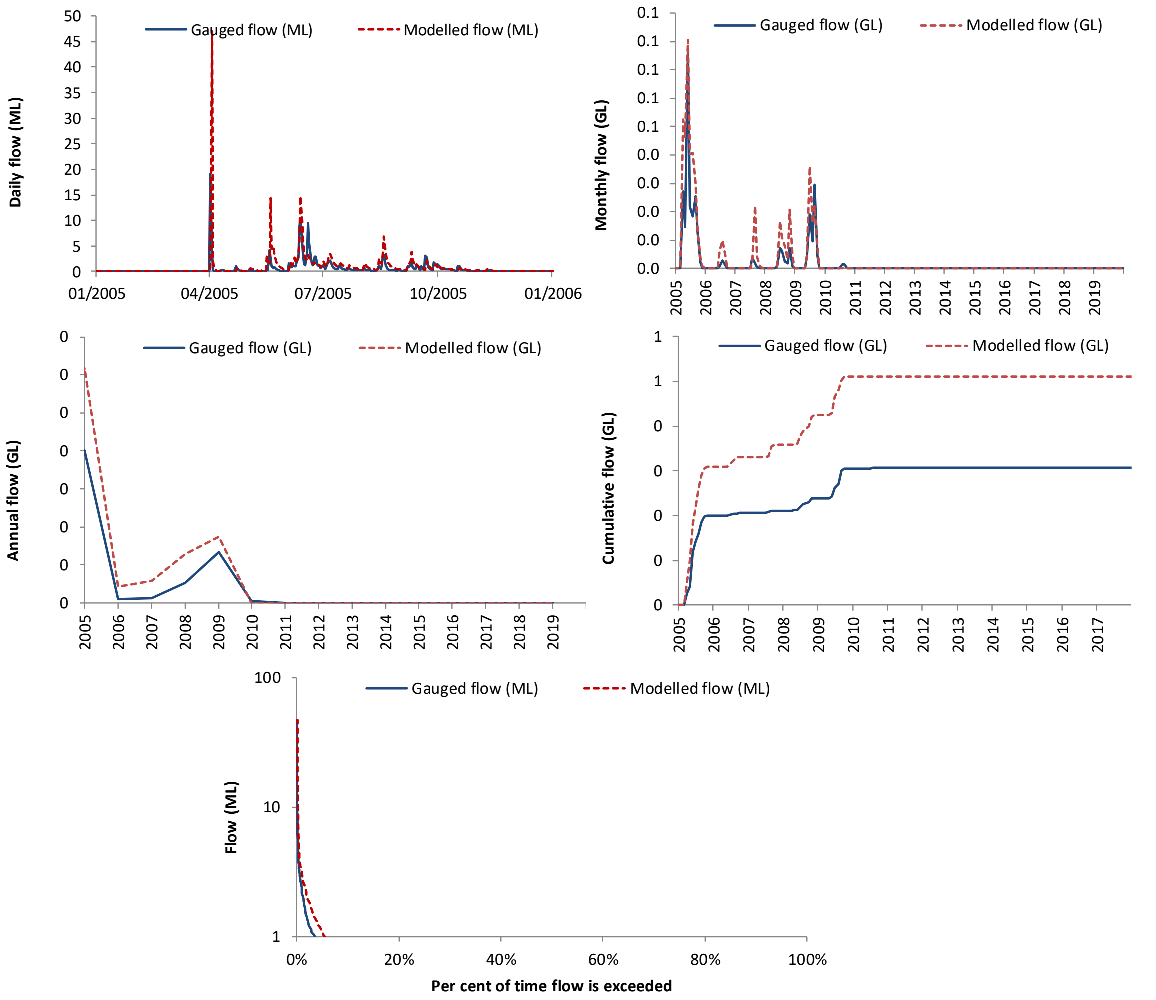



## *Upper Hay Tributary – Pardelup Prison Farm - 603008*

| Statistic | Calibration | Validation |
|---|---|---|
| | Not calibrated | 1/09/1988 to 2/03/2011 |
| NSE daily bias | -2.69 | 0.36 |
| NSE log daily bias | -0.24 | 0.61 |
| NSE daily | -1.78 | 0.37 |
| NSE monthly | 0.58 | 0.74 |
| NSE annual | 0.51 | 0.63 |
| Mass balance error | 66% | 8% |

Objective function used for calibration: Not calibrated

| Daily flow statistic | Calibration Gauged (ML) | Calibration Modelled (ML) | Validation Gauged (ML) | Validation Modelled (ML) |
|---|---|---|---|---|
| Min | 0 | 0 | 0 | 0 |
| Percentile: | | | | |
| *5th* | 0 | 0 | 0 | 0 |
| *10th* | 0 | 0 | 0 | 0 |
| *20th* | 0 | 0 | 0 | 0 |
| *50th* | 0 | 0 | 0 | 0 |
| *75th* | 0 | 0 | 0 | 0 |
| Max | 19 | 47 | 25 | 12 |




## *603009 and 603010 (Upper Hay)*

No flow measurement in the calibration period.

### A.3.5 Model performance: Sleeman River, Cuppup Creek and Lake Saide

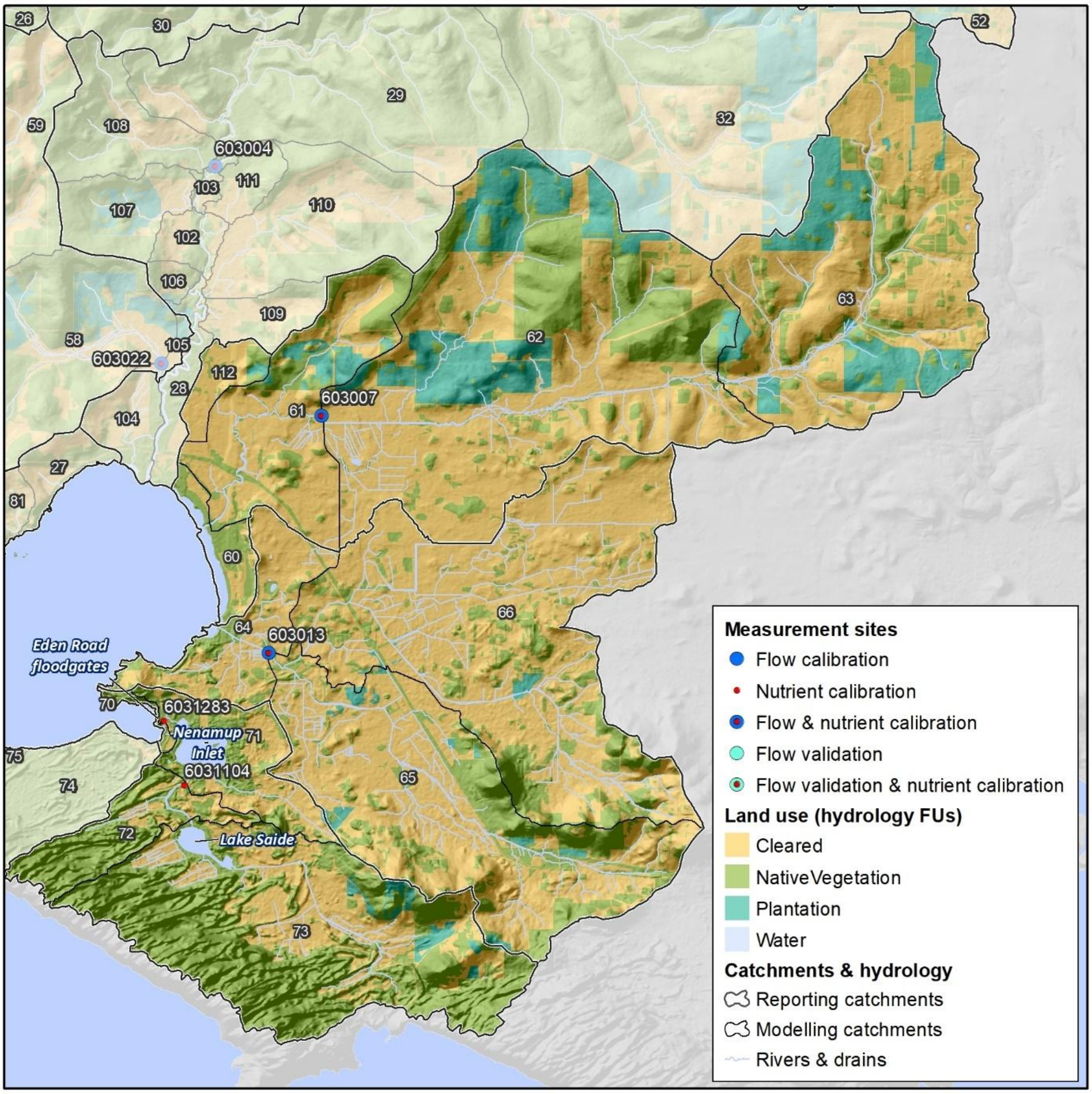


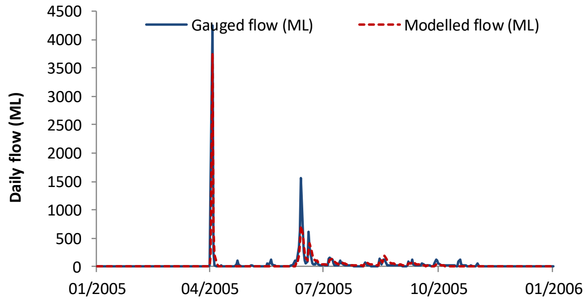

*Figure A.7: Sleeman River, Cuppup Creek and Lake Saide model domain*

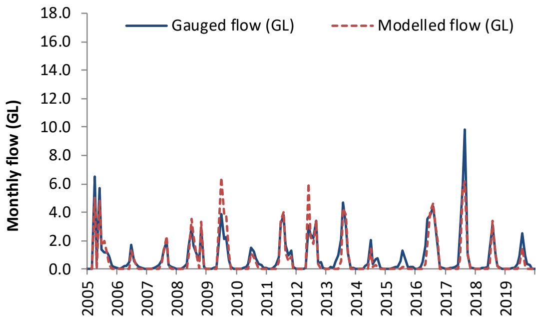
## *Sleeman River – Sleeman Rd Bridge – 603007*

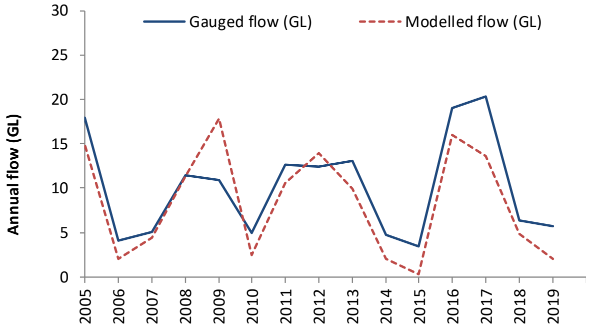
| Statistic | Calibration 1/01/2005 to 31/12/2018 | Validation 14/4/1985 to 31/12/2004 |
|---|---|---|
| NSE daily bias | 0.68 | 0.57 |
| NSE log daily bias | -0.10 | -0.14 |
| NSE daily | 0.71 | 0.57 |
| NSE monthly | 0.82 | 0.81 |
| NSE annual | 0.65 | 0.58 |
| Mass balance error | -15% | -5% |

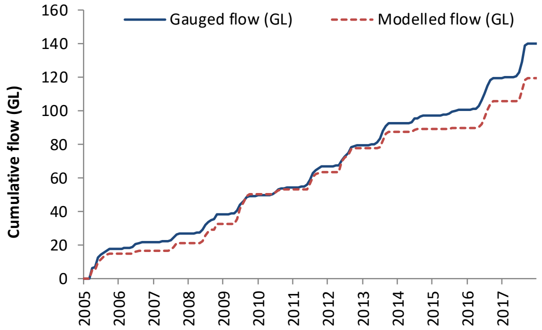
Objective function used for calibration: NSE daily bias

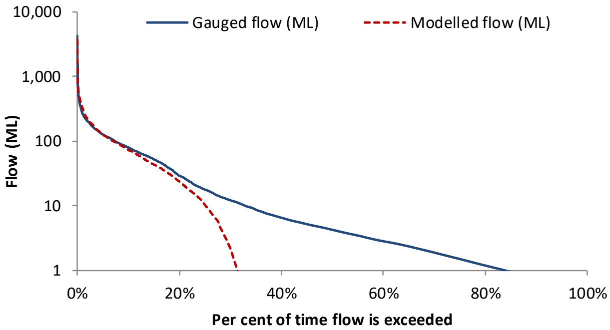
| Daily flow statistic | Calibration Gauged (ML) | Calibration Modelled (ML) | Validation Gauged (ML) | Validation Modelled (ML) |
|---|---|---|---|---|
| Min | 0 | 0 | 0 | 0 |
| Percentile: | | | | |
| *5th* | 0 | 0 | 1 | 0 |
| *10th* | 1 | 0 | 1 | 0 |
| *20th* | 1 | 0 | 2 | 0 |
| *50th* | 4 | 0 | 5 | 0 |
| *75th* | 18 | 10 | 20 | 20 |
| Max | 4 255 | 3 765 | 8 214 | 4 237 |



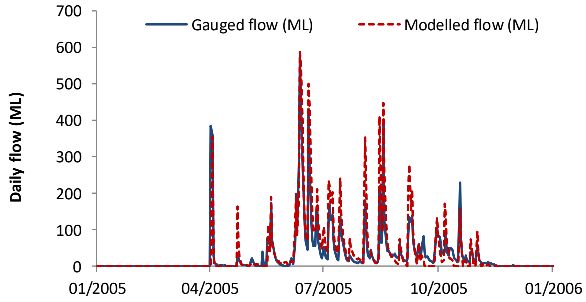



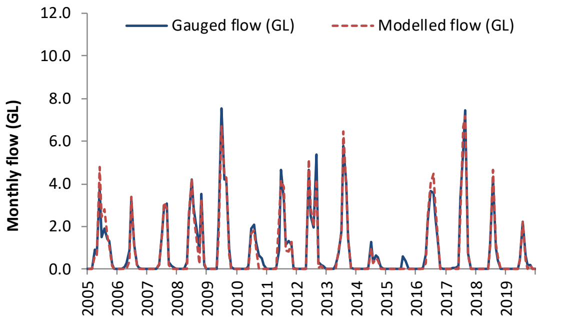
## *Cuppup River - Eden Rd - 603013*

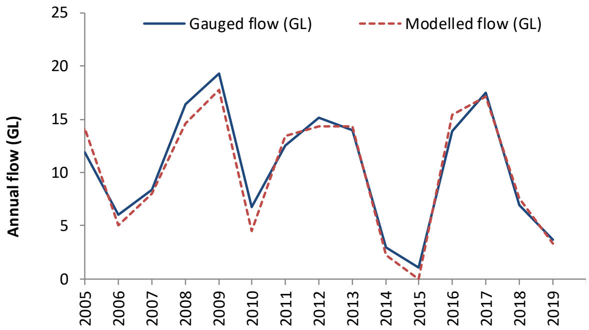
| Statistic | Calibration 1/01/2005 to 31/12/2018 | Validation 15/6/1989 to 31/12/2004 |
|---|---|---|
| NSE daily bias | 0.86 | 0.80 |
| NSE log daily bias | 0.39 | 0.52 |
| NSE daily | 0.86 | 0.81 |
| NSE monthly | 0.96 | 0.92 |
| NSE annual | 0.95 | 0.67 |
| Mass balance error | -3% | -9% |

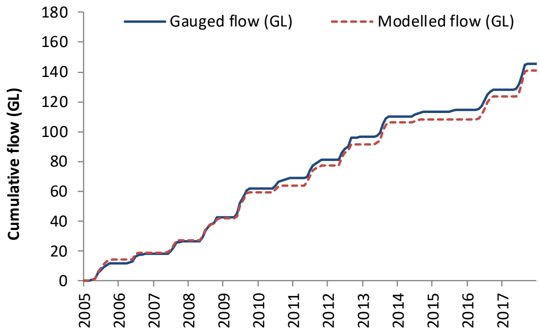
Objective function used for calibration: NSE daily bias

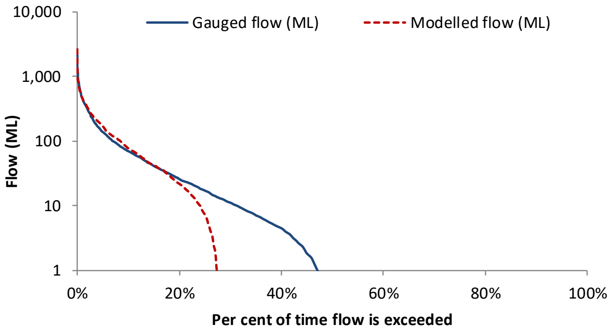
| Daily flow statistic | Calibration Gauged (ML) | Calibration Modelled (ML) | Validation Gauged (ML) | Validation Modelled (ML) |
|---|---|---|---|---|
| Min | 0 | 0 | 0 | 0 |
| Percentile: | | | | |
| *5th* | 0 | 0 | 0 | 0 |
| *10th* | 0 | 0 | 0 | 0 |
| *20th* | 0 | 0 | 0 | 0 |
| *50th* | 0 | 0 | 0 | 0 |
| *75th* | 17 | 7 | 19 | 16 |
| Max | 2 643 | 2 303 | 2 258 | 2 920 |



# Appendix B: Nutrient calibration

## B.1 Nutrient model parameters and daily data

### B.1.1 Nutrient generation model parameters


*Figure B.1: Nutrient model parameter sets*

*Table B.1: Nitrogen model parameters by parameter set (1 of 2)*

| Modelling land use | Cuppup | | | Denmark Ag College | | | Lake Saide | | | Little River | | | Lower Hay | | | Mitchell River | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | c | a | b | c | a | b | c | a | b | c | a | b | c | a | b | c |
| Bare soil & other (high PRI) | 0.014 | 0.001 | 0.109 | 0.046 | 0.206 | 0.034 | 0.129 | 0.07 | 0.101 | 0.042 | 0.394 | 0.034 | 0.014 | 0.25 | 0.056 | 0.596 | 0.213 | 0.105 |
| Bare soil & other (low PRI) | 0.014 | 0.001 | 0.109 | 0.046 | 0.206 | 0.034 | 0.129 | 0.07 | 0.101 | 0.042 | 0.394 | 0.034 | 0.014 | 0.25 | 0.056 | 0.596 | 0.213 | 0.105 |
| Beef (high PRI) | 0.237 | 0.001 | 1.843 | 0.771 | 0.206 | 0.567 | 2.172 | 0.07 | 1.693 | 0.714 | 0.394 | 0.572 | 0.234 | 0.25 | 0.931 | 10.04 | 0.213 | 1.761 |
| Beef (low PRI) | 0.237 | 0.001 | 1.843 | 0.771 | 0.206 | 0.567 | 2.172 | 0.07 | 1.693 | 0.714 | 0.394 | 0.572 | 0.234 | 0.25 | 0.931 | 10.04 | 0.213 | 1.761 |
| Cropping (high PRI) | 0.108 | 0.001 | 0.84 | 0.352 | 0.206 | 0.259 | 0.992 | 0.07 | 0.773 | 0.326 | 0.394 | 0.261 | 0.107 | 0.25 | 0.426 | 4.585 | 0.213 | 0.804 |
| Cropping (low PRI) | 0.108 | 0.001 | 0.84 | 0.352 | 0.206 | 0.259 | 0.992 | 0.07 | 0.773 | 0.326 | 0.394 | 0.261 | 0.107 | 0.25 | 0.426 | 4.585 | 0.213 | 0.804 |
| Dairy (high PRI) | 0.366 | 0.001 | 2.846 | 1.189 | 0.206 | 0.875 | 3.351 | 0.07 | 2.612 | 1.102 | 0.394 | 0.882 | 0.361 | 0.25 | 1.437 | 15.49 | 0.213 | 2.717 |
| Dairy (low PRI) | 0.366 | 0.001 | 2.846 | 1.189 | 0.206 | 0.875 | 3.351 | 0.07 | 2.612 | 1.102 | 0.394 | 0.882 | 0.361 | 0.25 | 1.437 | 15.49 | 0.213 | 2.717 |
| Feedlots & stockyards (high PRI) | 1.776 | 0.001 | 13.81 | 5.776 | 0.206 | 4.249 | 16.28 | 0.07 | 12.69 | 5.352 | 0.394 | 4.286 | 1.751 | 0.25 | 6.969 | 75.22 | 0.213 | 13.2 |
| Feedlots & stockyards (low PRI) | 1.776 | 0.001 | 13.81 | 5.776 | 0.206 | 4.249 | 16.28 | 0.07 | 12.69 | 5.352 | 0.394 | 4.286 | 1.751 | 0.25 | 6.969 | 75.22 | 0.213 | 13.2 |
| Horses (high PRI) | 0.189 | 0.001 | 1.47 | 0.615 | 0.206 | 0.452 | 1.734 | 0.07 | 1.352 | 0.57 | 0.394 | 0.456 | 0.187 | 0.25 | 0.744 | 8.011 | 0.213 | 1.405 |
| Horses (low PRI) | 0.189 | 0.001 | 1.47 | 0.615 | 0.206 | 0.452 | 1.734 | 0.07 | 1.352 | 0.57 | 0.394 | 0.456 | 0.187 | 0.25 | 0.744 | 8.011 | 0.213 | 1.405 |
| Horticulture (high PRI) | 1.729 | 0.001 | 13.45 | 5.623 | 0.206 | 4.136 | 15.85 | 0.07 | 12.36 | 5.21 | 0.394 | 4.172 | 1.705 | 0.25 | 6.786 | 73.23 | 0.213 | 12.85 |
| Horticulture (low PRI) | 1.729 | 0.001 | 13.45 | 5.623 | 0.206 | 4.136 | 15.85 | 0.07 | 12.36 | 5.21 | 0.394 | 4.172 | 1.705 | 0.25 | 6.786 | 73.23 | 0.213 | 12.85 |
| Lifestyle block (high PRI) | 0.148 | 0.001 | 1.151 | 0.481 | 0.206 | 0.354 | 1.356 | 0.07 | 1.057 | 0.446 | 0.394 | 0.357 | 0.146 | 0.25 | 0.581 | 6.266 | 0.213 | 1.099 |
| Lifestyle block (low PRI) | 0.148 | 0.001 | 1.151 | 0.481 | 0.206 | 0.354 | 1.356 | 0.07 | 1.057 | 0.446 | 0.394 | 0.357 | 0.146 | 0.25 | 0.581 | 6.266 | 0.213 | 1.099 |
| Native vegetation (high PRI) | 0.567 | 0.213 | 0.099 | 0.567 | 0.213 | 0.099 | 0.567 | 0.213 | 0.099 | 0.567 | 0.213 | 0.099 | 0.567 | 0.213 | 0.099 | 0.567 | 0.213 | 0.099 |
| Native vegetation (low PRI) | 0.567 | 0.213 | 0.099 | 0.567 | 0.213 | 0.099 | 0.567 | 0.213 | 0.099 | 0.567 | 0.213 | 0.099 | 0.567 | 0.213 | 0.099 | 0.567 | 0.213 | 0.099 |
| Orchard (high PRI) | 0.025 | 0.001 | 0.194 | 0.082 | 0.206 | 0.06 | 0.232 | 0.07 | 0.181 | 0.076 | 0.394 | 0.061 | 0.025 | 0.25 | 0.1 | 1.07 | 0.213 | 0.188 |
| Orchard (low PRI) | 0.025 | 0.001 | 0.194 | 0.082 | 0.206 | 0.06 | 0.232 | 0.07 | 0.181 | 0.076 | 0.394 | 0.061 | 0.025 | 0.25 | 0.1 | 1.07 | 0.213 | 0.188 |
| Piggeries & abattoirs (high PRI) | 0.851 | 0.001 | 6.618 | 2.767 | 0.206 | 2.035 | 7.797 | 0.07 | 6.079 | 2.564 | 0.394 | 2.053 | 0.839 | 0.25 | 3.339 | 36.03 | 0.213 | 6.321 |
| Piggeries & abattoirs (low PRI) | 0.851 | 0.001 | 6.618 | 2.767 | 0.206 | 2.035 | 7.797 | 0.07 | 6.079 | 2.564 | 0.394 | 2.053 | 0.839 | 0.25 | 3.339 | 36.03 | 0.213 | 6.321 |
| Plantation (high PRI) | 0.063 | 0.001 | 0.49 | 0.931 | 0.206 | 0.685 | 2.862 | 0.07 | 2.231 | 0.308 | 0.394 | 0.247 | 0.318 | 0.25 | 1.266 | 0 | 0.213 | 0 |
| Plantation (low PRI) | 0.063 | 0.001 | 0.49 | 0.931 | 0.206 | 0.685 | 2.862 | 0.07 | 2.231 | 0.308 | 0.394 | 0.247 | 0.318 | 0.25 | 1.266 | 0 | 0.213 | 0 |
| Point source (high PRI) | 0.014 | 0.001 | 0.109 | 0.046 | 0.206 | 0.034 | 0.129 | 0.07 | 0.101 | 0.042 | 0.394 | 0.034 | 0.014 | 0.25 | 0.056 | 0.596 | 0.213 | 0.105 |
| Point source (low PRI) | 0.014 | 0.001 | 0.109 | 0.046 | 0.206 | 0.034 | 0.129 | 0.07 | 0.101 | 0.042 | 0.394 | 0.034 | 0.014 | 0.25 | 0.056 | 0.596 | 0.213 | 0.105 |
| Potatoes (high PRI) | 0.138 | 0.001 | 1.073 | 0.448 | 0.206 | 0.33 | 1.262 | 0.07 | 0.984 | 0.415 | 0.394 | 0.332 | 0.136 | 0.25 | 0.541 | 5.833 | 0.213 | 1.023 |
| Potatoes (low PRI) | 0.138 | 0.001 | 1.073 | 0.448 | 0.206 | 0.33 | 1.262 | 0.07 | 0.984 | 0.415 | 0.394 | 0.332 | 0.136 | 0.25 | 0.541 | 5.833 | 0.213 | 1.023 |
| Recreation (high PRI) | 0.193 | 0.001 | 1.501 | 0.627 | 0.206 | 0.461 | 1.766 | 0.07 | 1.377 | 0.581 | 0.394 | 0.465 | 0.19 | 0.25 | 0.756 | 8.161 | 0.213 | 1.432 |
| Recreation (low PRI) | 0.193 | 0.001 | 1.501 | 0.627 | 0.206 | 0.461 | 1.766 | 0.07 | 1.377 | 0.581 | 0.394 | 0.465 | 0.19 | 0.25 | 0.756 | 8.161 | 0.213 | 1.432 |
| Roads & industrial (high PRI) | 0.014 | 0.001 | 0.109 | 0.046 | 0.206 | 0.034 | 0.129 | 0.07 | 0.101 | 0.042 | 0.394 | 0.034 | 0.014 | 0.25 | 0.056 | 0.596 | 0.213 | 0.105 |
| Roads & industrial (low PRI) | 0.014 | 0.001 | 0.109 | 0.046 | 0.206 | 0.034 | 0.129 | 0.07 | 0.101 | 0.042 | 0.394 | 0.034 | 0.014 | 0.25 | 0.056 | 0.596 | 0.213 | 0.105 |
| Rural living (bush block) (high PRI) | 0.054 | 0.001 | 0.42 | 0.967 | 0.206 | 0.711 | 1.749 | 0.07 | 1.364 | 0.23 | 0.394 | 0.184 | 0.13 | 0.25 | 0.517 | 10.21 | 0.213 | 1.79 |
| Rural living (bush block) (low PRI) | 0.054 | 0.001 | 0.42 | 0.967 | 0.206 | 0.711 | 1.749 | 0.07 | 1.364 | 0.23 | 0.394 | 0.184 | 0.13 | 0.25 | 0.517 | 10.21 | 0.213 | 1.79 |
| Urban (high PRI) | 0.243 | 0.001 | 1.89 | 0.789 | 0.206 | 0.58 | 2.225 | 0.07 | 1.735 | 0.731 | 0.394 | 0.585 | 0.239 | 0.25 | 0.951 | 10.28 | 0.213 | 1.803 |
| Urban (low PRI) | 0.243 | 0.001 | 1.89 | 0.789 | 0.206 | 0.58 | 2.225 | 0.07 | 1.735 | 0.731 | 0.394 | 0.585 | 0.239 | 0.25 | 0.951 | 10.28 | 0.213 | 1.803 |
| Viticulture (high PRI) | 0.142 | 0.001 | 1.104 | 0.461 | 0.206 | 0.339 | 1.298 | 0.07 | 1.012 | 0.427 | 0.394 | 0.342 | 0.14 | 0.25 | 0.557 | 5.998 | 0.213 | 1.052 |
| Viticulture (low PRI) | 0.142 | 0.001 | 1.104 | 0.461 | 0.206 | 0.339 | 1.298 | 0.07 | 1.012 | 0.427 | 0.394 | 0.342 | 0.14 | 0.25 | 0.557 | 5.998 | 0.213 | 1.052 |
| Wastewater irrigation (high PRI) | 0.109 | 0.001 | 0.848 | 1.617 | 0.206 | 1.189 | 4.97 | 0.07 | 3.875 | 0.536 | 0.394 | 0.429 | 0.552 | 0.25 | 2.197 | 0 | 0.213 | 0 |
| Wastewater irrigation (low PRI) | 0.109 | 0.001 | 0.848 | 1.617 | 0.206 | 1.189 | 4.97 | 0.07 | 3.875 | 0.536 | 0.394 | 0.429 | 0.552 | 0.25 | 2.197 | 0 | 0.213 | 0 |

*Table B.2: Nitrogen model parameters by parameter set (2 of 2)*

| Modelling land use | Mt Lindesay | | | Scotsdale Brook | | | Sleeman | | | Sunny Glen Creek | | | Upper Hay | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | c | a | b | c | a | b | c | a | b | c | a | b | c |
| Bare soil & other (high PRI) | 0.033 | 0.447 | 0.072 | 0.032 | 0.431 | 0.028 | 0.084 | 0.119 | 0.051 | 0.038 | 0.07 | 0.101 | 0.029 | 0.25 | 0.058 |
| Bare soil & other (low PRI) | 0.033 | 0.447 | 0.072 | 0.032 | 0.431 | 0.028 | 0.084 | 0.119 | 0.051 | 0.038 | 0.07 | 0.101 | 0.029 | 0.25 | 0.058 |
| Beef (high PRI) | 0.559 | 0.447 | 1.225 | 0.544 | 0.431 | 0.478 | 1.418 | 0.119 | 0.858 | 0.637 | 0.07 | 1.693 | 0.488 | 0.25 | 0.971 |
| Beef (low PRI) | 0.559 | 0.447 | 1.225 | 0.544 | 0.431 | 0.478 | 1.418 | 0.119 | 0.858 | 0.637 | 0.07 | 1.693 | 0.488 | 0.25 | 0.971 |
| Cropping (high PRI) | 0.255 | 0.447 | 0.559 | 0.248 | 0.431 | 0.218 | 0.648 | 0.119 | 0.392 | 0.291 | 0.07 | 0.773 | 0.223 | 0.25 | 0.444 |
| Cropping (low PRI) | 0.255 | 0.447 | 0.559 | 0.248 | 0.431 | 0.218 | 0.648 | 0.119 | 0.392 | 0.291 | 0.07 | 0.773 | 0.223 | 0.25 | 0.444 |
| Dairy (high PRI) | 0.862 | 0.447 | 1.89 | 0.839 | 0.431 | 0.737 | 2.188 | 0.119 | 1.324 | 0.983 | 0.07 | 2.613 | 0.753 | 0.25 | 1.499 |
| Dairy (low PRI) | 0.862 | 0.447 | 1.89 | 0.839 | 0.431 | 0.737 | 2.188 | 0.119 | 1.324 | 0.983 | 0.07 | 2.613 | 0.753 | 0.25 | 1.499 |
| Feedlots & stockyards (high PRI) | 4.186 | 0.447 | 9.176 | 4.076 | 0.431 | 3.582 | 10.63 | 0.119 | 6.429 | 4.775 | 0.07 | 12.69 | 3.658 | 0.25 | 7.28 |
| Feedlots & stockyards (low PRI) | 4.186 | 0.447 | 9.176 | 4.076 | 0.431 | 3.582 | 10.63 | 0.119 | 6.429 | 4.775 | 0.07 | 12.69 | 3.658 | 0.25 | 7.28 |
| Horses (high PRI) | 0.446 | 0.447 | 0.978 | 0.434 | 0.431 | 0.381 | 1.132 | 0.119 | 0.685 | 0.509 | 0.07 | 1.353 | 0.39 | 0.25 | 0.776 |
| Horses (low PRI) | 0.446 | 0.447 | 0.978 | 0.434 | 0.431 | 0.381 | 1.132 | 0.119 | 0.685 | 0.509 | 0.07 | 1.353 | 0.39 | 0.25 | 0.776 |
| Horticulture (high PRI) | 4.076 | 0.447 | 8.935 | 3.968 | 0.431 | 3.487 | 10.35 | 0.119 | 6.26 | 4.649 | 0.07 | 12.36 | 3.561 | 0.25 | 7.087 |
| Horticulture (low PRI) | 4.076 | 0.447 | 8.935 | 3.968 | 0.431 | 3.487 | 10.35 | 0.119 | 6.26 | 4.649 | 0.07 | 12.36 | 3.561 | 0.25 | 7.087 |
| Lifestyle block (high PRI) | 0.349 | 0.447 | 0.765 | 0.34 | 0.431 | 0.299 | 0.885 | 0.119 | 0.536 | 0.398 | 0.07 | 1.058 | 0.305 | 0.25 | 0.607 |
| Lifestyle block (low PRI) | 0.349 | 0.447 | 0.765 | 0.34 | 0.431 | 0.299 | 0.885 | 0.119 | 0.536 | 0.398 | 0.07 | 1.058 | 0.305 | 0.25 | 0.607 |
| Native vegetation (high PRI) | 0.567 | 0.213 | 0.099 | 0.567 | 0.213 | 0.099 | 0.567 | 0.213 | 0.099 | 0.567 | 0.213 | 0.099 | 0.567 | 0.213 | 0.099 |
| Native vegetation (low PRI) | 0.567 | 0.213 | 0.099 | 0.567 | 0.213 | 0.099 | 0.567 | 0.213 | 0.099 | 0.567 | 0.213 | 0.099 | 0.567 | 0.213 | 0.099 |
| Orchard (high PRI) | 0.06 | 0.447 | 0.132 | 0.058 | 0.431 | 0.051 | 0.151 | 0.119 | 0.091 | 0.068 | 0.07 | 0.181 | 0.052 | 0.25 | 0.103 |
| Orchard (low PRI) | 0.06 | 0.447 | 0.132 | 0.058 | 0.431 | 0.051 | 0.151 | 0.119 | 0.091 | 0.068 | 0.07 | 0.181 | 0.052 | 0.25 | 0.103 |
| Piggeries & abattoirs (high PRI) | 2.005 | 0.447 | 4.395 | 1.952 | 0.431 | 1.716 | 5.09 | 0.119 | 3.08 | 2.287 | 0.07 | 6.078 | 1.752 | 0.25 | 3.487 |
| Piggeries & abattoirs (low PRI) | 2.005 | 0.447 | 4.395 | 1.952 | 0.431 | 1.716 | 5.09 | 0.119 | 3.08 | 2.287 | 0.07 | 6.078 | 1.752 | 0.25 | 3.487 |
| Plantation (high PRI) | 0.446 | 0.447 | 0.978 | 0.664 | 0.431 | 0.584 | 0.3 | 0.119 | 0.182 | 0.839 | 0.07 | 2.23 | 1.261 | 0.25 | 2.509 |
| Plantation (low PRI) | 0.446 | 0.447 | 0.978 | 0.664 | 0.431 | 0.584 | 0.3 | 0.119 | 0.182 | 0.839 | 0.07 | 2.23 | 1.261 | 0.25 | 2.509 |
| Point source (high PRI) | 0.033 | 0.447 | 0.072 | 0.032 | 0.431 | 0.028 | 0.084 | 0.119 | 0.051 | 0.038 | 0.07 | 0.101 | 0.029 | 0.25 | 0.058 |
| Point source (low PRI) | 0.033 | 0.447 | 0.072 | 0.032 | 0.431 | 0.028 | 0.084 | 0.119 | 0.051 | 0.038 | 0.07 | 0.101 | 0.029 | 0.25 | 0.058 |
| Potatoes (high PRI) | 0.325 | 0.447 | 0.712 | 0.316 | 0.431 | 0.278 | 0.824 | 0.119 | 0.499 | 0.37 | 0.07 | 0.983 | 0.284 | 0.25 | 0.565 |
| Potatoes (low PRI) | 0.325 | 0.447 | 0.712 | 0.316 | 0.431 | 0.278 | 0.824 | 0.119 | 0.499 | 0.37 | 0.07 | 0.983 | 0.284 | 0.25 | 0.565 |
| Recreation (high PRI) | 0.454 | 0.447 | 0.995 | 0.442 | 0.431 | 0.388 | 1.153 | 0.119 | 0.698 | 0.518 | 0.07 | 1.377 | 0.397 | 0.25 | 0.79 |
| Recreation (low PRI) | 0.454 | 0.447 | 0.995 | 0.442 | 0.431 | 0.388 | 1.153 | 0.119 | 0.698 | 0.518 | 0.07 | 1.377 | 0.397 | 0.25 | 0.79 |
| Roads & industrial (high PRI) | 0.033 | 0.447 | 0.072 | 0.032 | 0.431 | 0.028 | 0.084 | 0.119 | 0.051 | 0.038 | 0.07 | 0.101 | 0.029 | 0.25 | 0.058 |
| Roads & industrial (low PRI) | 0.033 | 0.447 | 0.072 | 0.032 | 0.431 | 0.028 | 0.084 | 0.119 | 0.051 | 0.038 | 0.07 | 0.101 | 0.029 | 0.25 | 0.058 |
| Rural living (bush block) (high PRI) | 0.484 | 0.447 | 1.061 | 0.757 | 0.431 | 0.665 | 0.255 | 0.119 | 0.154 | 0.513 | 0.07 | 1.363 | 3.478 | 0.25 | 6.921 |
| Rural living (bush block) (low PRI) | 0.484 | 0.447 | 1.061 | 0.757 | 0.431 | 0.665 | 0.255 | 0.119 | 0.154 | 0.513 | 0.07 | 1.363 | 3.478 | 0.25 | 6.921 |
| Urban (high PRI) | 0.572 | 0.447 | 1.254 | 0.557 | 0.431 | 0.49 | 1.452 | 0.119 | 0.879 | 0.653 | 0.07 | 1.736 | 0.5 | 0.25 | 0.995 |
| Urban (low PRI) | 0.572 | 0.447 | 1.254 | 0.557 | 0.431 | 0.49 | 1.452 | 0.119 | 0.879 | 0.653 | 0.07 | 1.736 | 0.5 | 0.25 | 0.995 |
| Viticulture (high PRI) | 0.334 | 0.447 | 0.732 | 0.325 | 0.431 | 0.286 | 0.847 | 0.119 | 0.513 | 0.381 | 0.07 | 1.013 | 0.292 | 0.25 | 0.581 |
| Viticulture (low PRI) | 0.334 | 0.447 | 0.732 | 0.325 | 0.431 | 0.286 | 0.847 | 0.119 | 0.513 | 0.381 | 0.07 | 1.013 | 0.292 | 0.25 | 0.581 |
| Wastewater irrigation (high PRI) | 0.774 | 0.447 | 1.697 | 1.154 | 0.431 | 1.014 | 0.521 | 0.119 | 0.315 | 1.458 | 0.07 | 3.875 | 2.191 | 0.25 | 4.36 |
| Wastewater irrigation (low PRI) | 0.774 | 0.447 | 1.697 | 1.154 | 0.431 | 1.014 | 0.521 | 0.119 | 0.315 | 1.458 | 0.07 | 3.875 | 2.191 | 0.25 | 4.36 |

*Table B.3: Phosphorus model parameters by parameter set (1 of 2)*

| Modelling land use | Cuppup | | | Denmark Ag College | | | Lake Saide | | | Little River | | | Lower Hay | | | Mitchell River | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | c | a | b | c | a | b | c | a | b | c | a | b | c | a | b | c |
| Bare soil & other (high PRI) | 0.004 | 0.100 | - | 0.000 | 0.300 | 0.000 | 0.001 | 0.100 | - | 0.002 | 0.450 | - | 0.000 | 0.392 | 0.000 | 0.006 | 0.140 | 0.001 |
| Bare soil & other (low PRI) | 0.032 | 0.100 | - | 0.002 | 0.300 | 0.001 | 0.007 | 0.100 | - | 0.013 | 0.450 | - | 0.001 | 0.392 | 0.000 | 0.045 | 0.140 | 0.009 |
| Beef (high PRI) | 0.250 | 0.100 | - | 0.017 | 0.300 | 0.005 | 0.053 | 0.100 | - | 0.103 | 0.450 | - | 0.008 | 0.392 | 0.003 | 0.352 | 0.140 | 0.074 |
| Beef (low PRI) | 1.996 | 0.100 | - | 0.138 | 0.300 | 0.041 | 0.427 | 0.100 | - | 0.824 | 0.450 | - | 0.066 | 0.392 | 0.022 | 2.817 | 0.140 | 0.591 |
| Cropping (high PRI) | 0.088 | 0.100 | - | 0.006 | 0.300 | 0.002 | 0.019 | 0.100 | - | 0.037 | 0.450 | - | 0.003 | 0.392 | 0.001 | 0.125 | 0.140 | 0.026 |
| Cropping (low PRI) | 0.707 | 0.100 | - | 0.049 | 0.300 | 0.015 | 0.151 | 0.100 | - | 0.292 | 0.450 | - | 0.023 | 0.392 | 0.008 | 0.997 | 0.140 | 0.209 |
| Dairy (high PRI) | 0.444 | 0.100 | - | 0.031 | 0.300 | 0.009 | 0.095 | 0.100 | - | 0.183 | 0.450 | - | 0.015 | 0.392 | 0.005 | 0.626 | 0.140 | 0.131 |
| Dairy (low PRI) | 3.550 | 0.100 | - | 0.246 | 0.300 | 0.074 | 0.759 | 0.100 | - | 1.466 | 0.450 | - | 0.118 | 0.392 | 0.039 | 5.011 | 0.140 | 1.050 |
| Feedlots & stockyards (high PRI) | 1.002 | 0.100 | - | 0.069 | 0.300 | 0.021 | 0.214 | 0.100 | - | 0.414 | 0.450 | - | 0.033 | 0.392 | 0.011 | 1.415 | 0.140 | 0.297 |
| Feedlots & stockyards (low PRI) | 8.018 | 0.100 | - | 0.555 | 0.300 | 0.167 | 1.714 | 0.100 | - | 3.312 | 0.450 | - | 0.266 | 0.392 | 0.088 | 11.318 | 0.140 | 2.373 |
| Horses (high PRI) | 0.291 | 0.100 | - | 0.020 | 0.300 | 0.006 | 0.062 | 0.100 | - | 0.120 | 0.450 | - | 0.010 | 0.392 | 0.003 | 0.411 | 0.140 | 0.086 |
| Horses (low PRI) | 2.331 | 0.100 | - | 0.161 | 0.300 | 0.048 | 0.498 | 0.100 | - | 0.963 | 0.450 | - | 0.077 | 0.392 | 0.025 | 3.291 | 0.140 | 0.690 |
| Horticulture (high PRI) | 3.113 | 0.100 | - | 0.216 | 0.300 | 0.065 | 0.665 | 0.100 | - | 1.286 | 0.450 | - | 0.103 | 0.392 | 0.034 | 4.394 | 0.140 | 0.921 |
| Horticulture (low PRI) | 24.903 | 0.100 | - | 1.724 | 0.300 | 0.517 | 5.322 | 0.100 | - | 10.286 | 0.450 | - | 0.825 | 0.392 | 0.272 | 35.150 | 0.140 | 7.369 |
| Lifestyle block (high PRI) | 0.053 | 0.100 | - | 0.004 | 0.300 | 0.001 | 0.011 | 0.100 | - | 0.022 | 0.450 | - | 0.002 | 0.392 | 0.001 | 0.075 | 0.140 | 0.016 |
| Lifestyle block (low PRI) | 0.424 | 0.100 | - | 0.029 | 0.300 | 0.009 | 0.091 | 0.100 | - | 0.175 | 0.450 | - | 0.014 | 0.392 | 0.005 | 0.598 | 0.140 | 0.125 |
| Native vegetation (high PRI) | 0.003 | 0.140 | 0.001 | 0.003 | 0.140 | 0.001 | 0.003 | 0.140 | 0.001 | 0.003 | 0.140 | 0.001 | 0.003 | 0.140 | 0.001 | 0.003 | 0.140 | 0.001 |
| Native vegetation (low PRI) | 0.024 | 0.140 | 0.005 | 0.024 | 0.140 | 0.005 | 0.024 | 0.140 | 0.005 | 0.024 | 0.140 | 0.005 | 0.024 | 0.140 | 0.005 | 0.024 | 0.140 | 0.005 |
| Orchard (high PRI) | 0.137 | 0.100 | - | 0.010 | 0.300 | 0.003 | 0.029 | 0.100 | - | 0.057 | 0.450 | - | 0.005 | 0.392 | 0.001 | 0.193 | 0.140 | 0.041 |
| Orchard (low PRI) | 1.095 | 0.100 | - | 0.076 | 0.300 | 0.023 | 0.234 | 0.100 | - | 0.452 | 0.450 | - | 0.036 | 0.392 | 0.012 | 1.546 | 0.140 | 0.324 |
| Piggeries & abattoirs (high PRI) | 1.488 | 0.100 | - | 0.103 | 0.300 | 0.031 | 0.318 | 0.100 | - | 0.615 | 0.450 | - | 0.049 | 0.392 | 0.016 | 2.100 | 0.140 | 0.440 |
| Piggeries & abattoirs (low PRI) | 11.904 | 0.100 | - | 0.824 | 0.300 | 0.247 | 2.544 | 0.100 | - | 4.917 | 0.450 | - | 0.394 | 0.392 | 0.130 | 16.802 | 0.140 | 3.522 |
| Plantation (high PRI) | 0.301 | 0.100 | - | 0.095 | 0.300 | 0.029 | 0.320 | 0.100 | - | 0.203 | 0.450 | - | 0.051 | 0.392 | 0.017 | 0.000 | 0.140 | - |
| Plantation (low PRI) | 2.411 | 0.100 | - | 0.760 | 0.300 | 0.228 | 2.558 | 0.100 | - | 1.621 | 0.450 | - | 0.409 | 0.392 | 0.135 | 0.000 | 0.140 | - |
| Point source (high PRI) | 0.004 | 0.100 | - | 0.000 | 0.300 | 0.000 | 0.001 | 0.100 | - | 0.002 | 0.450 | - | 0.000 | 0.392 | 0.000 | 0.006 | 0.140 | 0.001 |
| Point source (low PRI) | 0.032 | 0.100 | - | 0.002 | 0.300 | 0.001 | 0.007 | 0.100 | - | 0.013 | 0.450 | - | 0.001 | 0.392 | 0.000 | 0.045 | 0.140 | 0.009 |
| Potatoes (high PRI) | 2.565 | 0.100 | - | 0.178 | 0.300 | 0.053 | 0.548 | 0.100 | - | 1.060 | 0.450 | - | 0.085 | 0.392 | 0.028 | 3.621 | 0.140 | 0.759 |
| Potatoes (low PRI) | 20.523 | 0.100 | - | 1.421 | 0.300 | 0.426 | 4.386 | 0.100 | - | 8.477 | 0.450 | - | 0.680 | 0.392 | 0.224 | 28.967 | 0.140 | 6.073 |
| Recreation (high PRI) | 0.044 | 0.100 | - | 0.003 | 0.300 | 0.001 | 0.009 | 0.100 | - | 0.018 | 0.450 | - | 0.001 | 0.392 | 0.000 | 0.062 | 0.140 | 0.013 |
| Recreation (low PRI) | 0.350 | 0.100 | - | 0.024 | 0.300 | 0.007 | 0.075 | 0.100 | - | 0.144 | 0.450 | - | 0.012 | 0.392 | 0.004 | 0.494 | 0.140 | 0.103 |
| Roads & industrial (high PRI) | 0.004 | 0.100 | - | 0.000 | 0.300 | 0.000 | 0.001 | 0.100 | - | 0.002 | 0.450 | - | 0.000 | 0.392 | 0.000 | 0.006 | 0.140 | 0.001 |
| Roads & industrial (low PRI) | 0.032 | 0.100 | - | 0.002 | 0.300 | 0.001 | 0.007 | 0.100 | - | 0.013 | 0.450 | - | 0.001 | 0.392 | 0.000 | 0.045 | 0.140 | 0.009 |
| Rural living (bush block) (high PRI) | 0.009 | 0.100 | - | 0.003 | 0.300 | 0.001 | 0.007 | 0.100 | - | 0.005 | 0.450 | - | 0.001 | 0.392 | 0.000 | 0.054 | 0.140 | 0.011 |
| Rural living (bush block) (low PRI) | 0.069 | 0.100 | - | 0.026 | 0.300 | 0.008 | 0.052 | 0.100 | - | 0.040 | 0.450 | - | 0.006 | 0.392 | 0.002 | 0.434 | 0.140 | 0.091 |
| Urban (high PRI) | 0.353 | 0.100 | - | 0.024 | 0.300 | 0.007 | 0.075 | 0.100 | - | 0.146 | 0.450 | - | 0.012 | 0.392 | 0.004 | 0.498 | 0.140 | 0.104 |
| Urban (low PRI) | 2.823 | 0.100 | - | 0.196 | 0.300 | 0.059 | 0.603 | 0.100 | - | 1.166 | 0.450 | - | 0.094 | 0.392 | 0.031 | 3.985 | 0.140 | 0.835 |
| Viticulture (high PRI) | 0.298 | 0.100 | - | 0.021 | 0.300 | 0.006 | 0.064 | 0.100 | - | 0.123 | 0.450 | - | 0.010 | 0.392 | 0.003 | 0.421 | 0.140 | 0.088 |
| Viticulture (low PRI) | 2.384 | 0.100 | - | 0.165 | 0.300 | 0.050 | 0.510 | 0.100 | - | 0.985 | 0.450 | - | 0.079 | 0.392 | 0.026 | 3.365 | 0.140 | 0.706 |
| Wastewater irrigation (high PRI) | 0.182 | 0.100 | - | 0.058 | 0.300 | 0.017 | 0.193 | 0.100 | - | 0.123 | 0.450 | - | 0.031 | 0.392 | 0.010 | 0.000 | 0.140 | - |
| Wastewater irrigation (low PRI) | 1.458 | 0.100 | - | 0.460 | 0.300 | 0.138 | 1.547 | 0.100 | - | 0.980 | 0.450 | - | 0.248 | 0.392 | 0.082 | 0.000 | 0.140 | - |

*Table B.4: Phosphorus model parameters by parameter set (2 of 2)*

| Modelling land use | Mt Lindesay | | | Scotsdale Brook | | | Sleeman | | | Sunny Glen Creek | | | Upper Hay | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | c | a | b | c | a | b | c | a | b | c | a | b | c |
| Bare soil & other (high PRI) | 0.000 | 0.050 | - | 0.001 | 0.200 | - | 0.001 | 0.260 | 0.000 | 0.001 | 0.100 | - | 0.000 | 0.300 | 0.000 |
| Bare soil & other (low PRI) | 0.003 | 0.050 | - | 0.006 | 0.200 | - | 0.005 | 0.260 | 0.002 | 0.006 | 0.100 | - | 0.002 | 0.300 | 0.001 |
| Beef (high PRI) | 0.021 | 0.050 | - | 0.044 | 0.200 | - | 0.039 | 0.260 | 0.017 | 0.048 | 0.100 | - | 0.013 | 0.300 | 0.004 |
| Beef (low PRI) | 0.167 | 0.050 | - | 0.353 | 0.200 | - | 0.314 | 0.260 | 0.135 | 0.386 | 0.100 | - | 0.104 | 0.300 | 0.034 |
| Cropping (high PRI) | 0.007 | 0.050 | - | 0.016 | 0.200 | - | 0.014 | 0.260 | 0.006 | 0.017 | 0.100 | - | 0.005 | 0.300 | 0.001 |
| Cropping (low PRI) | 0.059 | 0.050 | - | 0.125 | 0.200 | - | 0.111 | 0.260 | 0.048 | 0.137 | 0.100 | - | 0.037 | 0.300 | 0.012 |
| Dairy (high PRI) | 0.037 | 0.050 | - | 0.078 | 0.200 | - | 0.070 | 0.260 | 0.030 | 0.086 | 0.100 | - | 0.023 | 0.300 | 0.007 |
| Dairy (low PRI) | 0.298 | 0.050 | - | 0.627 | 0.200 | - | 0.559 | 0.260 | 0.241 | 0.687 | 0.100 | - | 0.184 | 0.300 | 0.060 |
| Feedlots & stockyards (high PRI) | 0.084 | 0.050 | - | 0.177 | 0.200 | - | 0.158 | 0.260 | 0.068 | 0.194 | 0.100 | - | 0.052 | 0.300 | 0.017 |
| Feedlots & stockyards (low PRI) | 0.672 | 0.050 | - | 1.416 | 0.200 | - | 1.262 | 0.260 | 0.544 | 1.552 | 0.100 | - | 0.416 | 0.300 | 0.136 |
| Horses (high PRI) | 0.024 | 0.050 | - | 0.052 | 0.200 | - | 0.046 | 0.260 | 0.020 | 0.056 | 0.100 | - | 0.015 | 0.300 | 0.005 |
| Horses (low PRI) | 0.195 | 0.050 | - | 0.412 | 0.200 | - | 0.367 | 0.260 | 0.158 | 0.451 | 0.100 | - | 0.121 | 0.300 | 0.039 |
| Horticulture (high PRI) | 0.261 | 0.050 | - | 0.550 | 0.200 | - | 0.490 | 0.260 | 0.211 | 0.602 | 0.100 | - | 0.162 | 0.300 | 0.053 |
| Horticulture (low PRI) | 2.087 | 0.050 | - | 4.398 | 0.200 | - | 3.920 | 0.260 | 1.690 | 4.820 | 0.100 | - | 1.293 | 0.300 | 0.421 |
| Lifestyle block (high PRI) | 0.004 | 0.050 | - | 0.009 | 0.200 | - | 0.008 | 0.260 | 0.004 | 0.010 | 0.100 | - | 0.003 | 0.300 | 0.001 |
| Lifestyle block (low PRI) | 0.036 | 0.050 | - | 0.075 | 0.200 | - | 0.067 | 0.260 | 0.029 | 0.082 | 0.100 | - | 0.022 | 0.300 | 0.007 |
| Native vegetation (high PRI) | 0.003 | 0.140 | 0.001 | 0.003 | 0.140 | 0.001 | 0.003 | 0.140 | 0.001 | 0.003 | 0.140 | 0.001 | 0.003 | 0.140 | 0.001 |
| Native vegetation (low PRI) | 0.024 | 0.140 | 0.005 | 0.024 | 0.140 | 0.005 | 0.024 | 0.140 | 0.005 | 0.024 | 0.140 | 0.005 | 0.024 | 0.140 | 0.005 |
| Orchard (high PRI) | 0.012 | 0.050 | - | 0.024 | 0.200 | - | 0.022 | 0.260 | 0.009 | 0.027 | 0.100 | - | 0.007 | 0.300 | 0.002 |
| Orchard (low PRI) | 0.092 | 0.050 | - | 0.193 | 0.200 | - | 0.172 | 0.260 | 0.074 | 0.212 | 0.100 | - | 0.057 | 0.300 | 0.019 |
| Piggeries & abattoirs (high PRI) | 0.125 | 0.050 | - | 0.263 | 0.200 | - | 0.234 | 0.260 | 0.101 | 0.288 | 0.100 | - | 0.077 | 0.300 | 0.025 |
| Piggeries & abattoirs (low PRI) | 0.998 | 0.050 | - | 2.103 | 0.200 | - | 1.874 | 0.260 | 0.808 | 2.304 | 0.100 | - | 0.618 | 0.300 | 0.201 |
| Plantation (high PRI) | 0.076 | 0.050 | - | 0.245 | 0.200 | - | 0.038 | 0.260 | 0.016 | 0.290 | 0.100 | - | 0.152 | 0.300 | 0.050 |
| Plantation (low PRI) | 0.608 | 0.050 | - | 1.959 | 0.200 | - | 0.303 | 0.260 | 0.130 | 2.316 | 0.100 | - | 1.219 | 0.300 | 0.397 |
| Point source (high PRI) | 0.000 | 0.050 | - | 0.001 | 0.200 | - | 0.001 | 0.260 | 0.000 | 0.001 | 0.100 | - | 0.000 | 0.300 | 0.000 |
| Point source (low PRI) | 0.003 | 0.050 | - | 0.006 | 0.200 | - | 0.005 | 0.260 | 0.002 | 0.006 | 0.100 | - | 0.002 | 0.300 | 0.001 |
| Potatoes (high PRI) | 0.215 | 0.050 | - | 0.453 | 0.200 | - | 0.404 | 0.260 | 0.174 | 0.497 | 0.100 | - | 0.133 | 0.300 | 0.043 |
| Potatoes (low PRI) | 1.720 | 0.050 | - | 3.625 | 0.200 | - | 3.231 | 0.260 | 1.393 | 3.972 | 0.100 | - | 1.065 | 0.300 | 0.347 |
| Recreation (high PRI) | 0.004 | 0.050 | - | 0.008 | 0.200 | - | 0.007 | 0.260 | 0.003 | 0.009 | 0.100 | - | 0.002 | 0.300 | 0.001 |
| Recreation (low PRI) | 0.029 | 0.050 | - | 0.062 | 0.200 | - | 0.055 | 0.260 | 0.024 | 0.068 | 0.100 | - | 0.018 | 0.300 | 0.006 |
| Roads & industrial (high PRI) | 0.000 | 0.050 | - | 0.001 | 0.200 | - | 0.001 | 0.260 | 0.000 | 0.001 | 0.100 | - | 0.000 | 0.300 | 0.000 |
| Roads & industrial (low PRI) | 0.003 | 0.050 | - | 0.006 | 0.200 | - | 0.005 | 0.260 | 0.002 | 0.006 | 0.100 | - | 0.002 | 0.300 | 0.001 |
| Rural living (bush block) (high PRI) | 0.003 | 0.050 | - | 0.009 | 0.200 | - | 0.001 | 0.260 | 0.000 | 0.006 | 0.100 | - | 0.014 | 0.300 | 0.005 |
| Rural living (bush block) (low PRI) | 0.022 | 0.050 | - | 0.074 | 0.200 | - | 0.009 | 0.260 | 0.004 | 0.047 | 0.100 | - | 0.112 | 0.300 | 0.036 |
| Urban (high PRI) | 0.030 | 0.050 | - | 0.062 | 0.200 | - | 0.056 | 0.260 | 0.024 | 0.068 | 0.100 | - | 0.018 | 0.300 | 0.006 |
| Urban (low PRI) | 0.237 | 0.050 | - | 0.499 | 0.200 | - | 0.444 | 0.260 | 0.192 | 0.546 | 0.100 | - | 0.147 | 0.300 | 0.048 |
| Viticulture (high PRI) | 0.025 | 0.050 | - | 0.053 | 0.200 | - | 0.047 | 0.260 | 0.020 | 0.058 | 0.100 | - | 0.016 | 0.300 | 0.005 |
| Viticulture (low PRI) | 0.200 | 0.050 | - | 0.421 | 0.200 | - | 0.375 | 0.260 | 0.162 | 0.461 | 0.100 | - | 0.124 | 0.300 | 0.040 |
| Wastewater irrigation (high PRI) | 0.046 | 0.050 | - | 0.148 | 0.200 | - | 0.023 | 0.260 | 0.010 | 0.175 | 0.100 | - | 0.092 | 0.300 | 0.030 |
| Wastewater irrigation (low PRI) | 0.368 | 0.050 | - | 1.185 | 0.200 | - | 0.183 | 0.260 | 0.079 | 1.401 | 0.100 | - | 0.737 | 0.300 | 0.240 |

*Table B.5: Nutrient model parameter sets by modelling catchment*

| Cat ID | Reporting | Nutrient parameter set ID | Cat ID | Reporting | Nutrient parameter set ID |
|---|---|---|---|---|---|
| 1 | Lower Denmark River | Denmark Ag College | 60 | Sleeman River | Sleeman |
| 2 | Lower Denmark River | Denmark Ag College | 61 | Sleeman River | Sleeman |
| 3 | Lower Denmark River | Denmark Ag College | 62 | Sleeman River | Sleeman |
| 4 | Lower Denmark River | Denmark Ag College | 63 | Sleeman River | Sleeman |
| 5 | Lower Denmark River | Denmark Ag College | 64 | Cuppup Creek | Cuppup |
| 6 | Lower Denmark River | Denmark Ag College | 65 | Cuppup Creek | Cuppup |
| 7 | Upper Denmark River | Mt Lindesay | 66 | Cuppup Creek | Cuppup |
| 8 | Upper Denmark River | Mt Lindesay | 67 | Little River | Little River |
| 9 | Upper Denmark River | Mt Lindesay | 68 | Little River | Little River |
| 10 | Upper Denmark River | Mt Lindesay | 69 | Little River | Little River |
| 11 | Upper Denmark River | Mt Lindesay | 70 | Lake Saide | Lake Saide |
| 12 | Upper Denmark River | Mt Lindesay | 71 | Lake Saide | Lake Saide |
| 13 | Upper Denmark River | Mt Lindesay | 72 | Lake Saide | Lake Saide |
| 14 | Upper Denmark River | Mt Lindesay | 73 | Lake Saide | Lake Saide |
| 15 | Upper Denmark River | Mt Lindesay | 74 | Nullaki | Sunny Glen Creek |
| 16 | Upper Denmark River | Mt Lindesay | 75 | Nullaki | Sunny Glen Creek |
| 17 | Upper Denmark River | Mt Lindesay | 76 | Nullaki | Sunny Glen Creek |
| 18 | Upper Denmark River | Mt Lindesay | 77 | Ocean Beach Road | Sunny Glen Creek |
| 19 | Upper Denmark River | Mt Lindesay | 78 | Ocean Beach Road | Sunny Glen Creek |
| 20 | Upper Denmark River | Mt Lindesay | 79 | Koorabup Creek | Denmark Ag College |
| 21 | Upper Denmark River | Mt Lindesay | 80 | Koorabup Creek | Denmark Ag College |
| 22 | Upper Denmark River | Mt Lindesay | 81 | Foreshore | Denmark Ag College |
| 23 | Scotsdale Brook | Scotsdale Brook | 82 | Foreshore | Denmark Ag College |
| 24 | Scotsdale Brook | Scotsdale Brook | 83 | Foreshore | Denmark Ag College |
| 25 | Scotsdale Brook | Scotsdale Brook | 84 | Foreshore | Denmark Ag College |
| 26 | Lower Denmark River | Denmark Ag College | 85 | Foreshore | Denmark Ag College |
| 27 | Foreshore | Lower Hay | 86 | Foreshore | Denmark Ag College |
| 28 | Lower Hay River | Lower Hay | 87 | Foreshore | Denmark Ag College |
| 29 | Lower Hay River | Lower Hay | 88 | Foreshore | Denmark Ag College |
| 30 | Upper Hay River | Lower Hay | 90 | Lower Denmark River | Denmark Ag College |
| 31 | Upper Hay River | Mitchell River | 91 | Lower Denmark River | Denmark Ag College |
| 32 | Lower Hay River | Lower Hay | 92 | Lower Denmark River | Denmark Ag College |
| 33 | Lower Hay River | Lower Hay | 93 | Lower Denmark River | Denmark Ag College |
| 34 | Upper Hay River | Lower Hay | 94 | Lower Denmark River | Denmark Ag College |
| 35 | Upper Hay River | Lower Hay | 95 | Lower Denmark River | Denmark Ag College |
| 36 | Upper Hay River | Lower Hay | 96 | Lower Denmark River | Denmark Ag College |
| 37 | Upper Hay River | Lower Hay | 97 | Lower Denmark River | Denmark Ag College |
| 38 | Upper Hay River | Lower Hay | 98 | Lower Denmark River | Denmark Ag College |
| 39 | Upper Hay River | Lower Hay | 99 | Lower Denmark River | Denmark Ag College |
| 40 | Upper Hay River | Lower Hay | 100 | Lower Denmark River | Mt Lindesay |
| 41 | Upper Hay River | Lower Hay | 101 | Upper Denmark River | Mitchell River |
| 42 | Upper Hay River | Upper Hay | 102 | Lower Hay River | Sunny Glen Creek |
| 43 | Upper Hay River | Upper Hay | 103 | Lower Hay River | Sunny Glen Creek |
| 44 | Upper Hay River | Upper Hay | 104 | Lower Hay River | Sunny Glen Creek |
| 45 | Upper Hay River | Upper Hay | 105 | Sunny Glen Creek | Sunny Glen Creek |
| 46 | Upper Hay River | Upper Hay | 106 | Lower Hay River | Sunny Glen Creek |
| 47 | Upper Hay River | Upper Hay | 107 | Lower Hay River | Sunny Glen Creek |
| 48 | Upper Hay River | Upper Hay | 108 | Lower Hay River | Sunny Glen Creek |
| 49 | Upper Hay River | Upper Hay | 109 | Lower Hay River | Sunny Glen Creek |
| 50 | Upper Hay River | Lower Hay | 110 | Lower Hay River | Sunny Glen Creek |
| 51 | Upper Hay River | Lower Hay | 111 | Lower Hay River | Sunny Glen Creek |
| 52 | Upper Hay River | Lower Hay | 112 | Sleeman River | Sleeman |
| 53 | Upper Hay River | Lower Hay | 113 | Ocean Beach Road | Sunny Glen Creek |
| 54 | Upper Hay River | Upper Hay | 114 | Ocean Beach Road | Sunny Glen Creek |
| 55 | Upper Hay River | Upper Hay | 115 | Nullaki | Sunny Glen Creek |
| 56 | Upper Hay River | Upper Hay | 116 | Nullaki | Sunny Glen Creek |
| 58 | Sunny Glen Creek | Sunny Glen Creek | 117 | Lower Denmark River | Denmark Ag College |
| 59 | Sunny Glen Creek | Sunny Glen Creek | 118 | Little River | Little River |

## Calibrated land-use nutrient export rates

*Table B.6: Range in average annual nutrient exports (2010–19) for the various land uses*

| Land use | Nitrogen<br>kg/ha/yr | Phosphorus<br>kg/ha/yr |
|---|---|---|
| Septic tanks* | 0.42 – 3.64 | 0.033 – 0.189 |
| Beef & other grazing | 0.46 – 6.14 | 0.009 – 0.872 |
| Cropping | 0.19 – 0.19 | 0.003 – 0.003 |
| Dairy | 1.37 – 6.50 | 0.020 – 0.871 |
| Horses | 0.44 – 2.75 | 0.014 – 0.387 |
| Horticulture | 3.05 – 43 | 0.075 – 12.7 |
| Intensive animal use | 2.69 – 15 | 0.050 – 0.507 |
| Lifestyle block | 0.32 – 3.79 | 0.003 – 0.164 |
| Native vegetation | 0.03 – 0.58 | <0.001 – 0.012 |
| Other landuses | 0.03 – 0.51 | <0.001 – 0.025 |
| Plantation | 0.04 – 1.58 | 0.003 – 0.485 |
| Roads & industrial | 0.08 – 0.43 | 0.001 – 0.014 |
| Urban | 0.48 – 6.11 | 0.007 – 0.957 |
| Viticulture & orchards | 0.11 – 1.81 | 0.005 – 0.371 |

* kg/septic tank/yr

## B.1.2 Riparian filtering model parameters

*Table B.7: Riparian filtering model parameters*

| Cat ID | Riparian P removal H= High L = Low | Total riparian length (km) | Vegetated (%) | Existing fencing or fencing not required (%) | Base case: N removal (%) | Base case: P removal (%) | Max fencing scenario: N removal (%) | Max fencing scenario: P removal (%) | Max fencing & revegetation scenario: N removal (%) | Max fencing & revegetation scenario: P removal (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | H | 2.2 | 97 | 64 | 29 | 29 | 30 | 30 | 30 | 30 |
| 2 | H | 0.5 | 100 | 100 | 30 | 30 | 30 | 30 | 30 | 30 |
| 3 | H | 18.6 | 78 | 22 | 23 | 23 | 30 | 30 | 30 | 30 |
| 4 | H | 4.6 | 96 | 0 | 29 | 29 | 30 | 30 | 30 | 30 |
| 5 | H | 46.8 | 77 | 16 | 23 | 23 | 30 | 30 | 30 | 30 |
| 6 | H | 3.9 | 100 | 53 | 30 | 30 | 30 | 30 | 30 | 30 |
| 7 | H | 37.7 | 99 | 24 | 30 | 30 | 30 | 30 | 30 | 30 |
| 8 | H | 83.3 | 99 | 19 | 30 | 30 | 30 | 30 | 30 | 30 |
| 9 | H | 92.9 | 93 | 0 | 28 | 28 | 30 | 30 | 30 | 30 |
| 10 | H | 60.8 | 99 | 0 | 30 | 30 | 30 | 30 | 30 | 30 |
| 11 | H | 15.9 | 92 | 3 | 28 | 28 | 30 | 30 | 30 | 30 |
| 12 | H | 4.2 | 99 | 44 | 30 | 30 | 30 | 30 | 30 | 30 |
| 13 | H | 1.7 | 73 | 0 | 22 | 22 | 30 | 30 | 30 | 30 |
| 14 | H | 43.8 | 99 | 0 | 30 | 30 | 30 | 30 | 30 | 30 |
| 15 | H | 31.0 | 82 | 0 | 25 | 25 | 30 | 30 | 30 | 30 |
| 16 | H | 13.7 | 73 | 0 | 22 | 22 | 30 | 30 | 30 | 30 |
| 17 | H | 37.0 | 88 | 24 | 26 | 26 | 30 | 30 | 30 | 30 |
| 18 | H | 32.6 | 61 | 16 | 18 | 18 | 30 | 30 | 30 | 30 |
| 19 | H | 12.7 | 97 | 0 | 29 | 29 | 30 | 30 | 30 | 30 |
| 20 | H | 23.6 | 62 | 0 | 19 | 19 | 30 | 30 | 30 | 30 |
| 21 | H | 12.0 | 46 | 0 | 14 | 14 | 29 | 29 | 30 | 30 |
| 22 | H | 18.8 | 72 | 0 | 22 | 22 | 30 | 30 | 30 | 30 |
| 23 | H | 1.8 | 99 | 98 | 30 | 30 | 30 | 30 | 30 | 30 |
| 24 | H | 59.3 | 70 | 58 | 21 | 21 | 27 | 27 | 30 | 30 |
| 25 | H | 41.0 | 70 | 69 | 21 | 21 | 26 | 26 | 30 | 30 |
| 26 | H | 40.4 | 98 | 0 | 29 | 29 | 30 | 30 | 30 | 30 |
| 27 | L | 0.7 | 19 | 0 | 6 | 1 | 21 | 6 | 30 | 6 |
| 28 | L | 6.6 | 99 | 62 | 30 | 5 | 30 | 7 | 30 | 7 |
| 29 | L | 33.7 | 89 | 29 | 27 | 4 | 30 | 8 | 30 | 8 |
| 30 | H | 111.8 | 97 | 0 | 29 | 29 | 30 | 30 | 30 | 30 |
| 31 | H | 65.5 | 99 | 0 | 30 | 30 | 30 | 30 | 30 | 30 |
| 32 | L | 40.4 | 64 | 0 | 19 | 3 | 30 | 8 | 30 | 8 |
| 33 | L | 27.9 | 84 | 16 | 25 | 4 | 30 | 8 | 30 | 8 |
| 34 | H | 15.2 | 96 | 0 | 29 | 29 | 30 | 30 | 30 | 30 |
| 35 | H | 8.7 | 66 | 38 | 20 | 20 | 29 | 29 | 30 | 30 |
| 36 | H | 65.8 | 87 | 0 | 26 | 26 | 30 | 30 | 30 | 30 |
| 37 | H | 43.0 | 96 | 0 | 29 | 29 | 30 | 30 | 30 | 30 |
| 38 | H | 98.0 | 71 | 0 | 21 | 21 | 30 | 30 | 30 | 30 |
| 39 | H | 54.1 | 80 | 0 | 24 | 24 | 30 | 30 | 30 | 30 |
| 40 | H | 1.3 | 67 | 0 | 20 | 20 | 30 | 30 | 30 | 30 |
| 41 | H | 39.7 | 63 | 18 | 19 | 19 | 30 | 30 | 30 | 30 |
| 42 | H | 69.2 | 76 | 5 | 23 | 23 | 30 | 30 | 30 | 30 |
| 43 | H | 71.0 | 60 | 0 | 18 | 18 | 30 | 30 | 30 | 30 |
| 44 | H | 71.4 | 73 | 12 | 22 | 22 | 30 | 30 | 30 | 30 |
| 45 | H | 31.2 | 69 | 0 | 21 | 21 | 30 | 30 | 30 | 30 |
| 46 | H | 91.3 | 61 | 1 | 18 | 18 | 30 | 30 | 30 | 30 |
| 47 | H | 17.9 | 48 | 13 | 15 | 15 | 28 | 28 | 30 | 30 |
| 48 | H | 0.6 | 0 | 0 | 0 | 0 | 15 | 15 | 30 | 30 |
| 49 | H | 1.1 | 19 | 0 | 6 | 6 | 21 | 21 | 30 | 30 |
| 50 | L | 6.4 | 71 | 0 | 21 | 4 | 30 | 9 | 30 | 9 |
| 51 | H | 16.8 | 59 | 0 | 18 | 18 | 30 | 30 | 30 | 30 |
| 52 | H | 19.2 | 55 | 0 | 17 | 17 | 30 | 30 | 30 | 30 |
| 53 | H | 22.1 | 80 | 0 | 24 | 24 | 30 | 30 | 30 | 30 |
| 54 | H | 53.2 | 57 | 0 | 17 | 17 | 30 | 30 | 30 | 30 |
| 55 | H | 86.4 | 48 | 0 | 14 | 14 | 29 | 29 | 30 | 30 |
| 56 | H | 11.1 | 46 | 0 | 14 | 14 | 29 | 29 | 30 | 30 |

| Cat ID | Riparian P removal H= High L = Low | Total riparian length (km) | Vegetated (%) | Existing fencing or fencing not required (%) | Base case: N removal (%) | Base case: P removal (%) | Max fencing scenario: N removal (%) | Max fencing scenario: P removal (%) | Max fencing & revegetation scenario: N removal (%) | Max fencing & revegetation scenario: P removal (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 58 | L | 24.5 | 46 | 0 | 14 | 2 | 29 | 7 | 30 | 7 |
| 59 | L | 22.1 | 42 | 0 | 13 | 2 | 28 | 7 | 30 | 7 |
| 60 | L | 0.0 | 100 | 100 | 30 | 5 | 30 | 5 | 30 | 5 |
| 61 | L | 17.7 | 50 | 31 | 15 | 3 | 25 | 6 | 30 | 6 |
| 62 | L | 70.2 | 35 | 7 | 11 | 2 | 24 | 6 | 30 | 6 |
| 63 | L | 39.2 | 49 | 33 | 15 | 2 | 25 | 6 | 30 | 6 |
| 64 | L | 14.1 | 18 | 6 | 5 | 1 | 20 | 6 | 30 | 6 |
| 65 | L | 61.5 | 20 | 7 | 6 | 1 | 20 | 6 | 30 | 6 |
| 66 | L | 87.6 | 8 | 21 | 3 | 1 | 15 | 5 | 30 | 5 |
| 67 | H | 0.7 | 88 | 0 | 26 | 26 | 30 | 30 | 30 | 30 |
| 68 | H | 31.7 | 81 | 0 | 24 | 24 | 30 | 30 | 30 | 30 |
| 69 | H | 3.9 | 60 | 0 | 18 | 18 | 30 | 30 | 30 | 30 |
| 70 | L | 0.2 | 94 | 0 | 28 | 5 | 30 | 10 | 30 | 10 |
| 71 | L | 4.8 | 53 | 0 | 16 | 3 | 30 | 8 | 30 | 8 |
| 72 | L | 4.6 | 67 | 0 | 20 | 3 | 30 | 8 | 30 | 8 |
| 73 | L | 26.5 | 41 | 0 | 12 | 2 | 27 | 7 | 30 | 7 |
| 74 | L | 0.0 | 0 | 0 | 0 | 0 | 15 | 5 | 30 | 5 |
| 75 | L | 1.7 | 22 | 0 | 7 | 1 | 22 | 6 | 30 | 6 |
| 76 | L | 1.4 | 0 | 0 | 15 | 5 | 30 | 10 | 30 | 10 |
| 77 | L | 0.2 | 73 | 0 | 22 | 5 | 30 | 10 | 30 | 10 |
| 78 | L | 3.1 | 49 | 0 | 15 | 2 | 30 | 7 | 30 | 7 |
| 79 | H | 1.1 | 75 | 0 | 22 | 22 | 30 | 30 | 30 | 30 |
| 80 | H | 5.8 | 62 | 0 | 19 | 19 | 30 | 30 | 30 | 30 |
| 81 | L | 4.4 | 27 | 0 | 8 | 1 | 23 | 6 | 30 | 6 |
| 82 | L | 4.9 | 85 | 0 | 26 | 4 | 30 | 9 | 30 | 9 |
| 83 | H | 2.6 | 70 | 0 | 21 | 21 | 30 | 30 | 30 | 30 |
| 84 | H | 0.6 | 91 | 0 | 27 | 27 | 30 | 30 | 30 | 30 |
| 85 | H | 4.0 | 72 | 0 | 22 | 22 | 30 | 30 | 30 | 30 |
| 86 | H | 0.2 | 100 | 0 | 30 | 30 | 30 | 30 | 30 | 30 |
| 87 | H | 0.2 | 95 | 0 | 29 | 29 | 30 | 30 | 30 | 30 |
| 88 | H | 0.4 | 31 | 0 | 15 | 15 | 30 | 30 | 30 | 30 |
| 90 | H | 3.0 | 93 | 0 | 28 | 28 | 30 | 30 | 30 | 30 |
| 91 | H | 2.8 | 71 | 4 | 21 | 21 | 30 | 30 | 30 | 30 |
| 92 | H | 2.4 | 83 | 61 | 25 | 25 | 30 | 30 | 30 | 30 |
| 93 | H | 1.2 | 38 | 24 | 11 | 11 | 23 | 23 | 30 | 30 |
| 94 | H | 0.1 | 100 | 100 | 30 | 30 | 30 | 30 | 30 | 30 |
| 95 | H | 0.8 | 63 | 0 | 19 | 19 | 30 | 30 | 30 | 30 |
| 96 | H | 0.7 | 98 | 11 | 29 | 29 | 30 | 30 | 30 | 30 |
| 97 | H | 0.1 | 100 | 66 | 30 | 30 | 30 | 30 | 30 | 30 |
| 98 | H | 21.2 | 68 | 1 | 20 | 20 | 30 | 30 | 30 | 30 |
| 99 | H | 33.2 | 88 | 3 | 26 | 26 | 30 | 30 | 30 | 30 |
| 100 | H | 27.9 | 97 | 16 | 29 | 29 | 30 | 30 | 30 | 30 |
| 101 | H | 17.7 | 100 | 0 | 30 | 30 | 30 | 30 | 30 | 30 |
| 102 | L | 2.9 | 86 | 50 | 26 | 4 | 30 | 7 | 30 | 7 |
| 103 | L | 1.4 | 100 | 91 | 30 | 5 | 30 | 5 | 30 | 5 |
| 104 | L | 5.9 | 34 | 5 | 10 | 2 | 24 | 6 | 30 | 6 |
| 105 | L | 0.4 | 89 | 0 | 27 | 4 | 30 | 9 | 30 | 9 |
| 106 | L | 0.3 | 70 | 78 | 21 | 4 | 24 | 5 | 30 | 5 |
| 107 | L | 3.9 | 34 | 0 | 10 | 2 | 25 | 7 | 30 | 7 |
| 108 | L | 6.8 | 80 | 0 | 24 | 4 | 30 | 9 | 30 | 9 |
| 109 | L | 0.4 | 2 | 0 | 0 | 0 | 15 | 5 | 30 | 5 |
| 110 | L | 11.7 | 42 | 0 | 13 | 2 | 28 | 7 | 30 | 7 |
| 111 | L | 1.1 | 11 | 0 | 3 | 1 | 18 | 6 | 30 | 6 |
| 112 | L | 0.1 | 0 | 0 | 0 | 0 | 15 | 5 | 30 | 5 |
| 113 | L | 2.0 | 93 | 0 | 28 | 5 | 30 | 10 | 30 | 10 |
| 114 | L | 2.0 | 24 | 0 | 7 | 1 | 22 | 6 | 30 | 6 |
| 115 | L | 0.0 | 0 | 0 | 0 | 0 | 15 | 5 | 30 | 5 |
| 116 | L | 0.0 | 0 | 0 | 0 | 0 | 15 | 5 | 30 | 5 |
| 117 | H | 4.0 | 36 | 0 | 11 | 11 | 26 | 26 | 30 | 30 |
| 118 | H | 19.0 | 63 | 0 | 19 | 19 | 30 | 30 | 30 | 30 |
| Total | | 2535.1 | 71 | 9 | 20 | 16 | 28 | 21 | 30 | 22 |

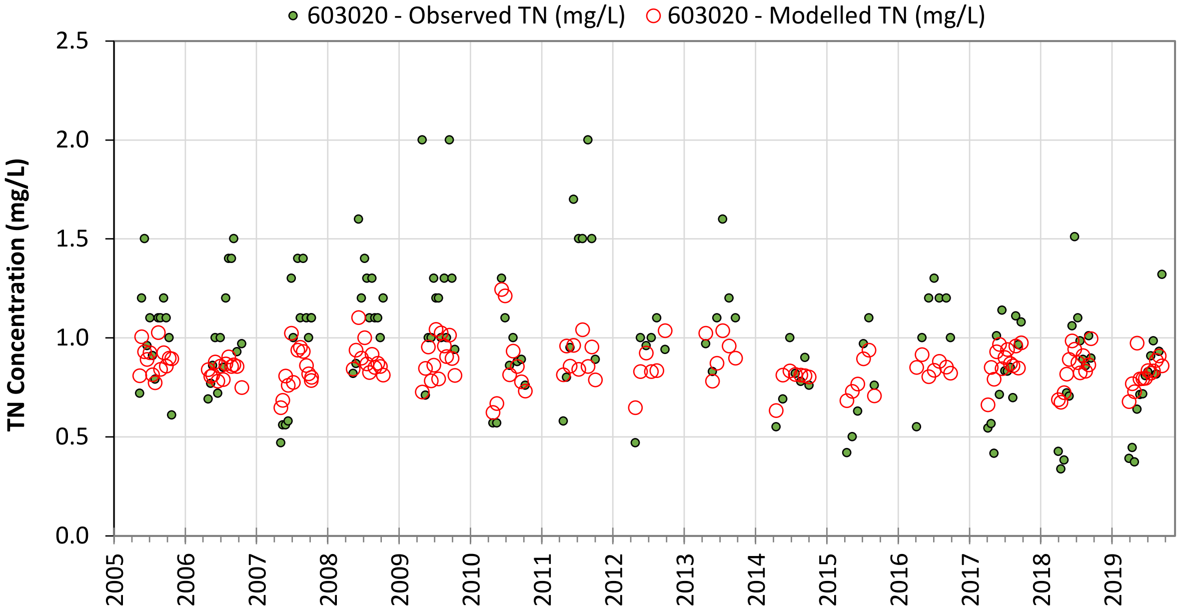
### B.1.3 Storage node parameters

*Table B.8: Storage node nutrient model parameters*

| Model component | Parameter | Lake Saide | Nenamup Inlet | Wentworth Road dam | Mount Hallowell Stud dam | Denmark Dam | Quickup Dam | Carter Dam |
|---|---|---|---|---|---|---|---|---|
| Constituent model | TN storage decay model (s) | 6,048,000 | 12,960,000 | Nil | Nil | Nil | Nil | Nil |
| | TP storage decay model (s) | 864,000 | 5,184,000 | Nil | Nil | Nil | Nil | Nil |

# B.2 Daily modelled and measured nutrient concentrations

## B.2.1 Little River, Ocean Bead Rd (AWRC ref. 603020)



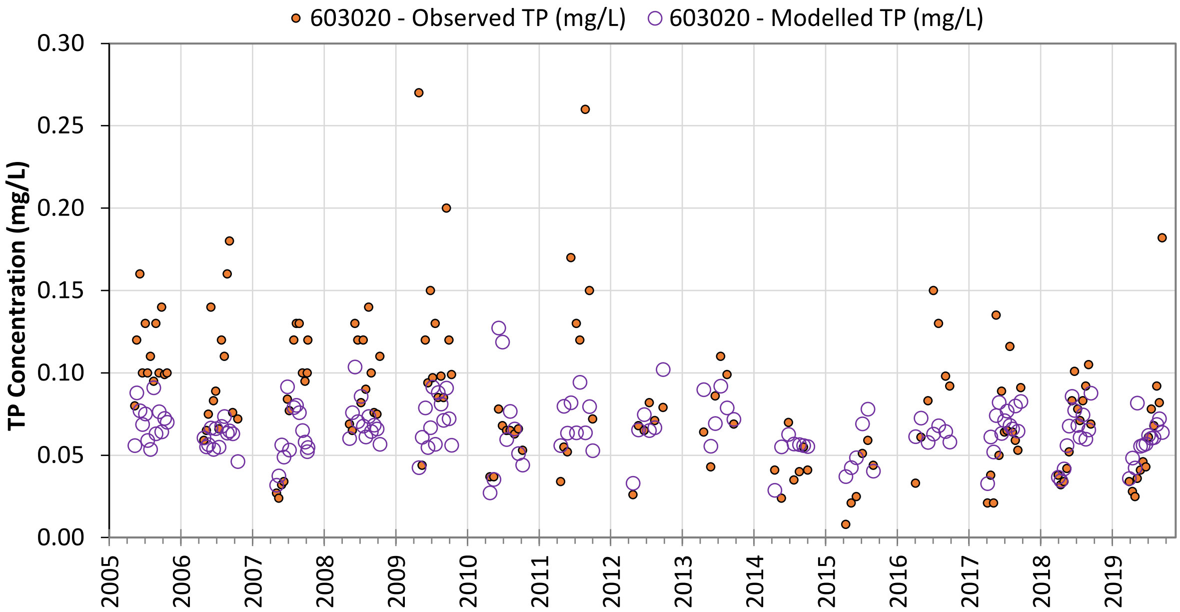
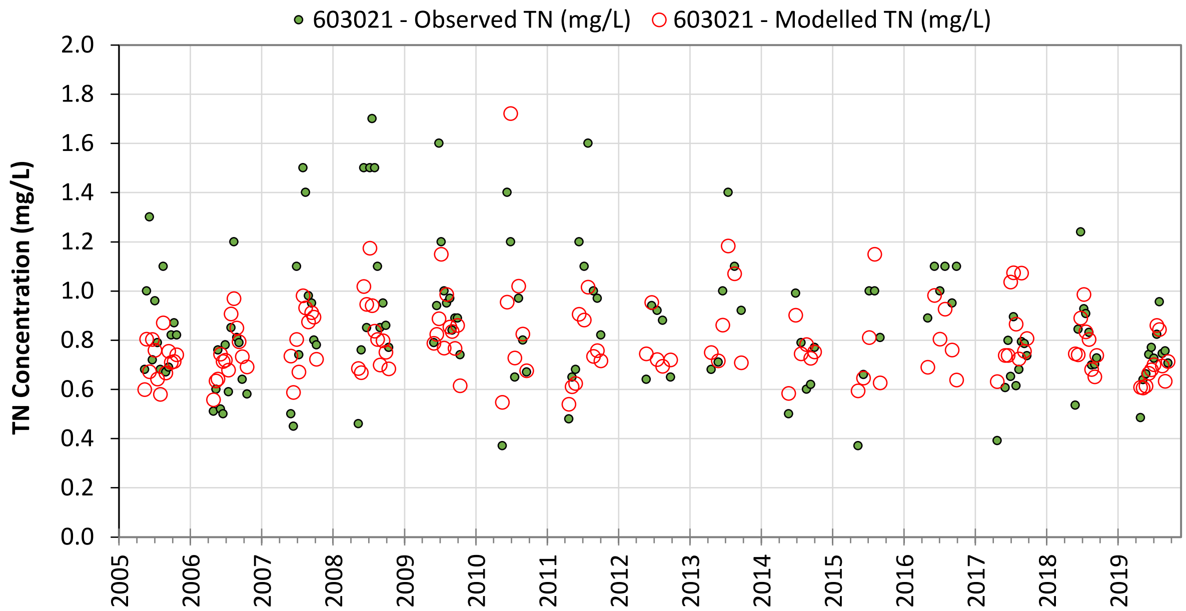




*Figure B.2: Measured and modelled winter total nitrogen (TN, top graph) and total phosphorus (TP, bottom graph) at Ocean Beach Rd (Little River, AWRC ref. 603020)*

### B.2.2 Denmark River, Denmark Ag College (AWRC ref. 603021)



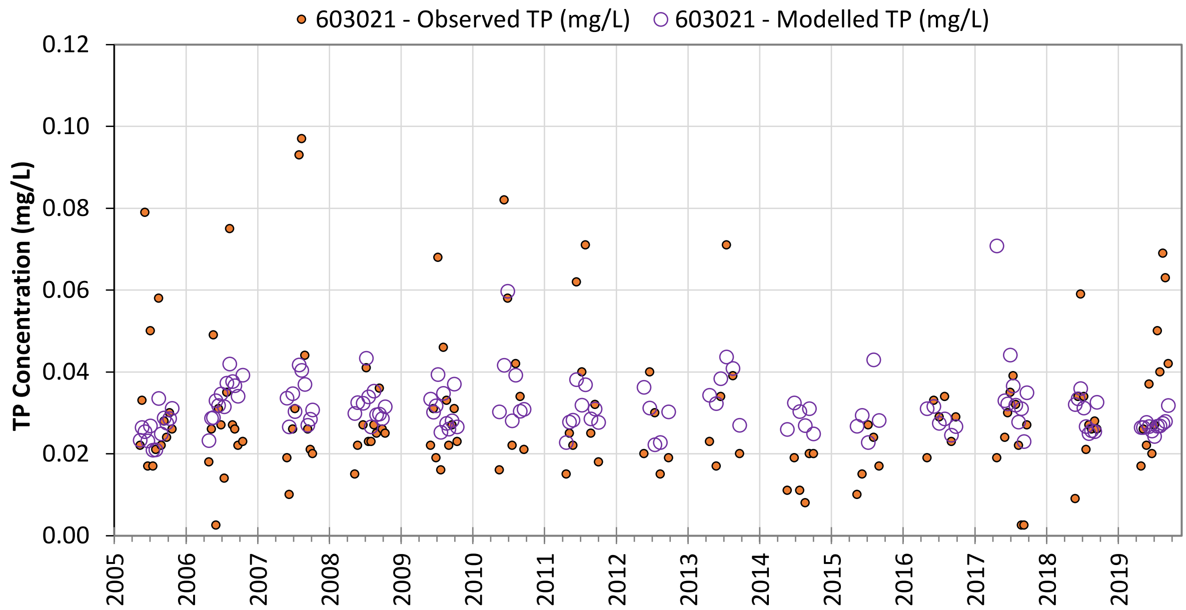
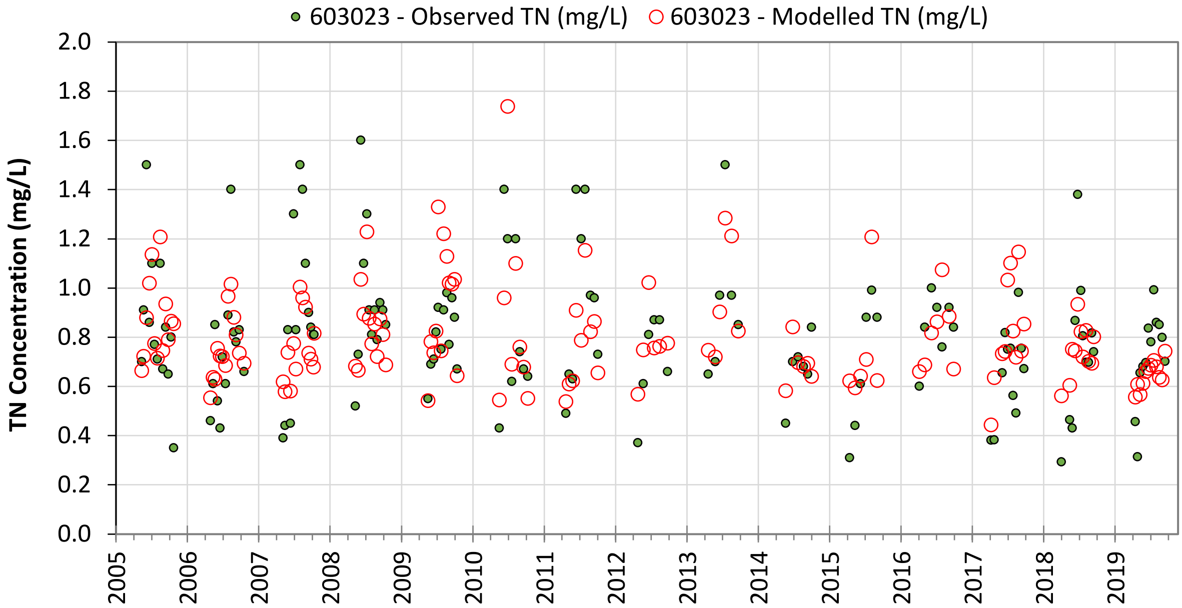




*Figure B.3: Measured and modelled winter total nitrogen (TN, top graph) and total phosphorus (TP, bottom graph) at Denmark Ag College (Denmark River, AWRC ref. 603021)*

### B.2.3 Scotsdale Brook, Pipehead (AWRC ref. 603023)



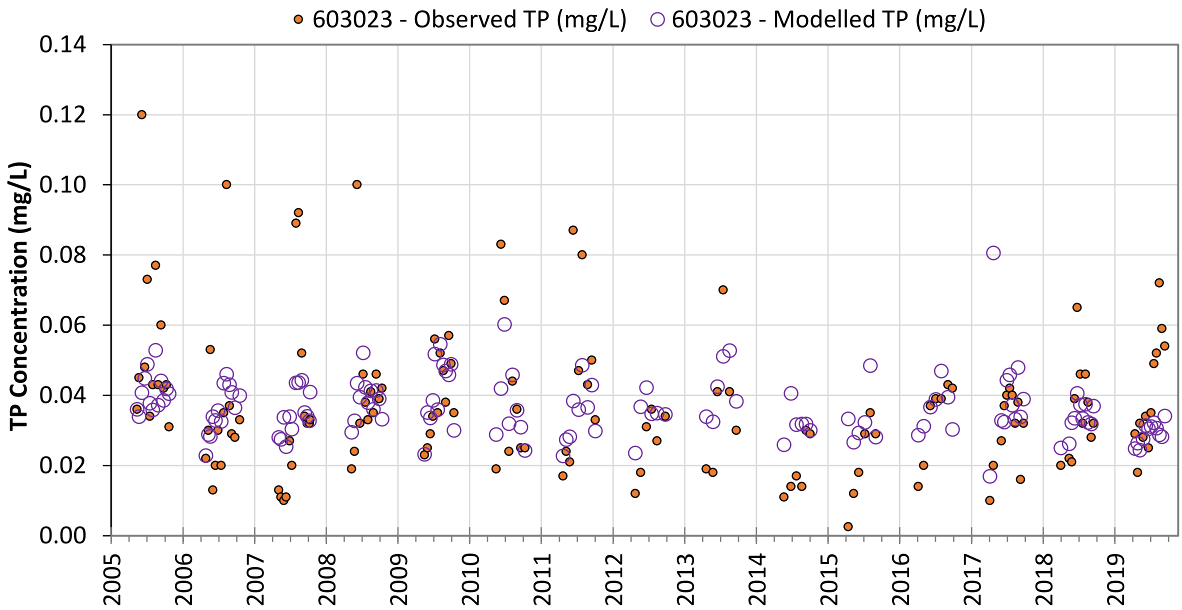




*Figure B.4: Measured and modelled winter total nitrogen (TN, top graph) and total phosphorus (TP, bottom graph) at Pipehead (Scotsdale, AWRC ref. 603023)*

### B.2.4 Denmark River, Mt Lindesay (AWRC ref. 603136)

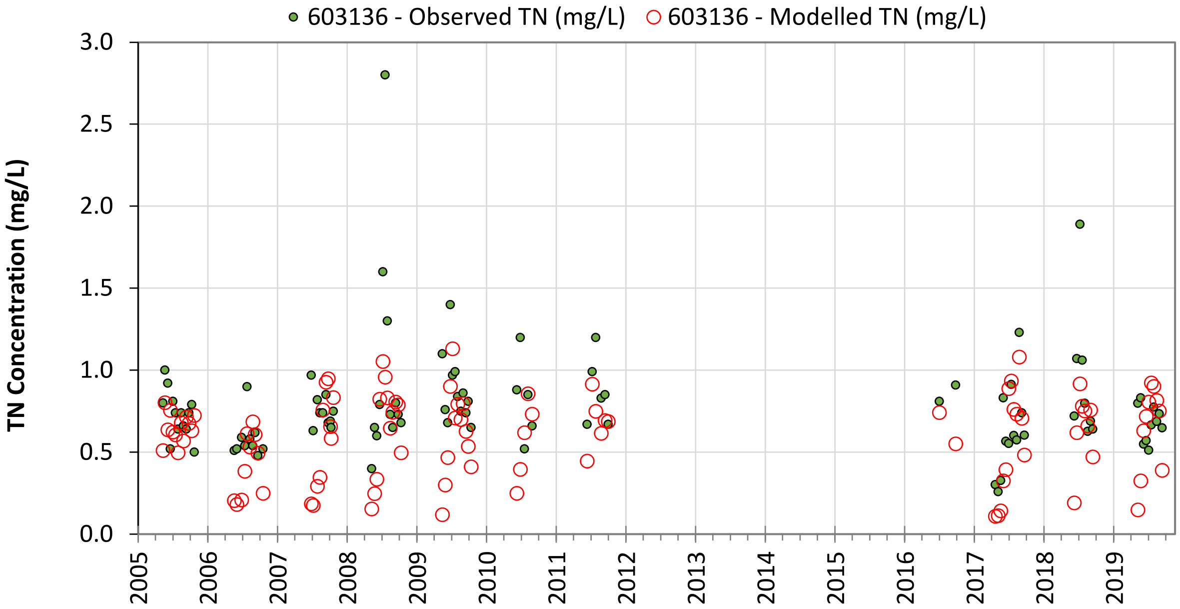
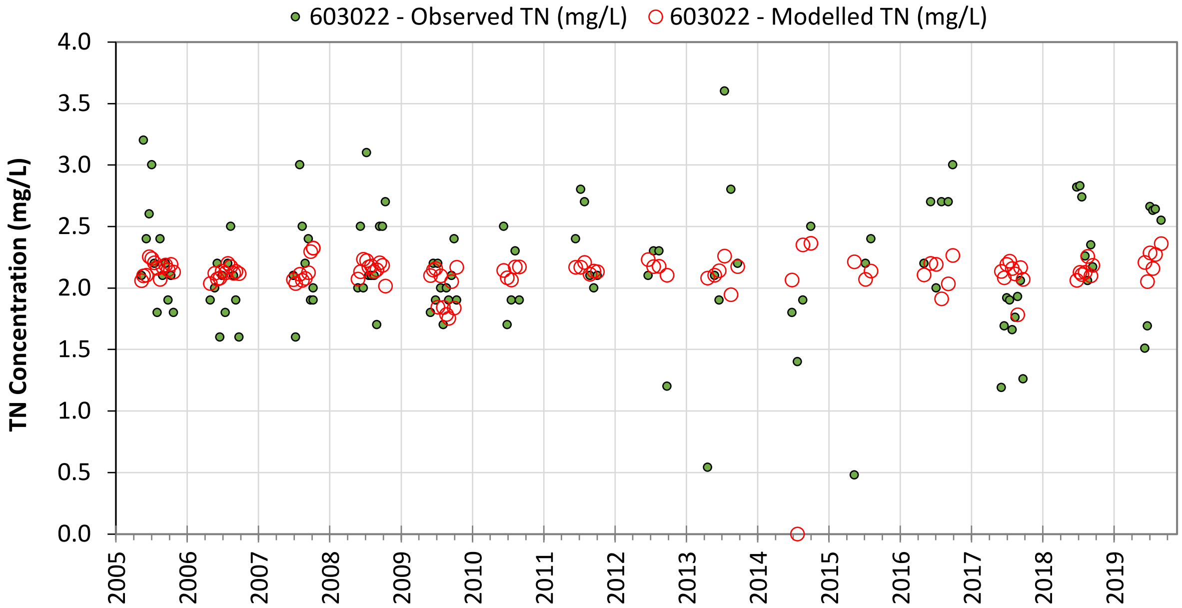




*Figure B.5: Measured and modelled winter total nitrogen (TN, top graph) and total phosphorus (TP, bottom graph) at Mt Lindesay (Denmark River, AWRC ref. 603136)*

### B.2.5 Sunny Glen Creek, Girrawheen (AWRC ref. 603022)



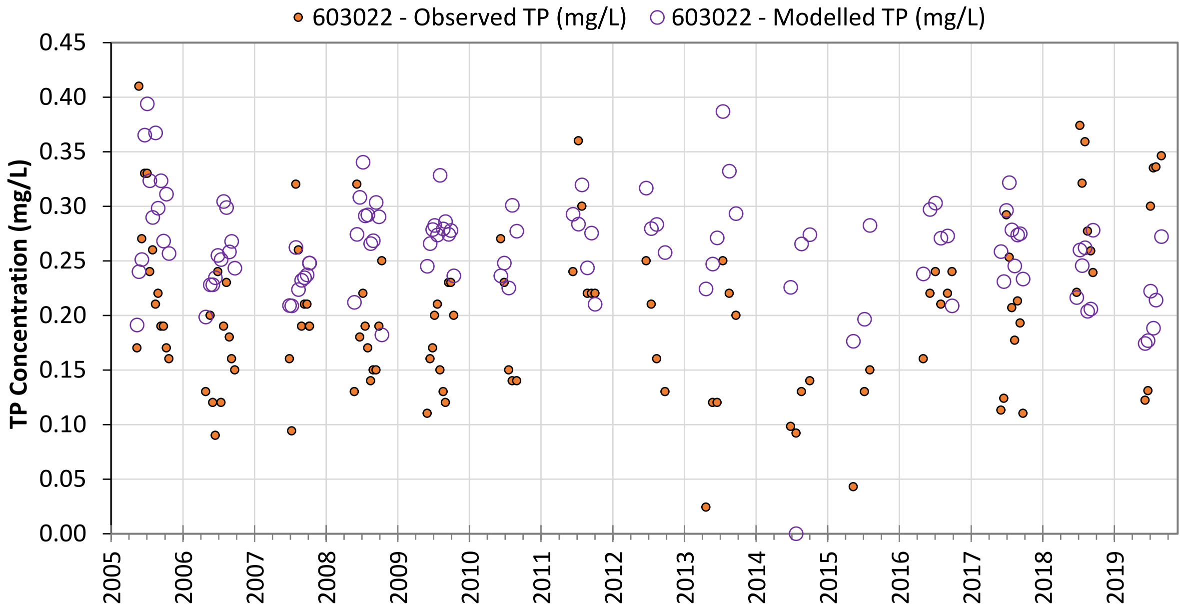
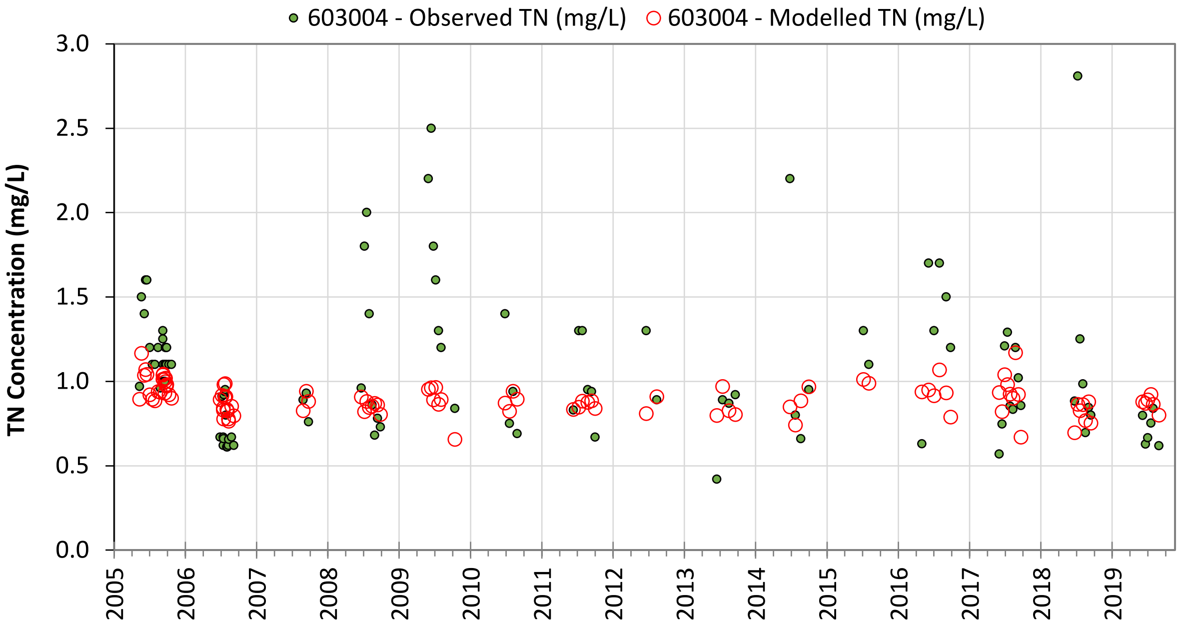




*Figure B.6: Measured and modelled winter total nitrogen (TN, top graph) and total phosphorus (TP, bottom graph) at Girrawheen (Sunny Glen Creek, AWRC ref. 603022)*

### B.2.6 Hay River, Sunny Glen (AWRC ref. 603004)



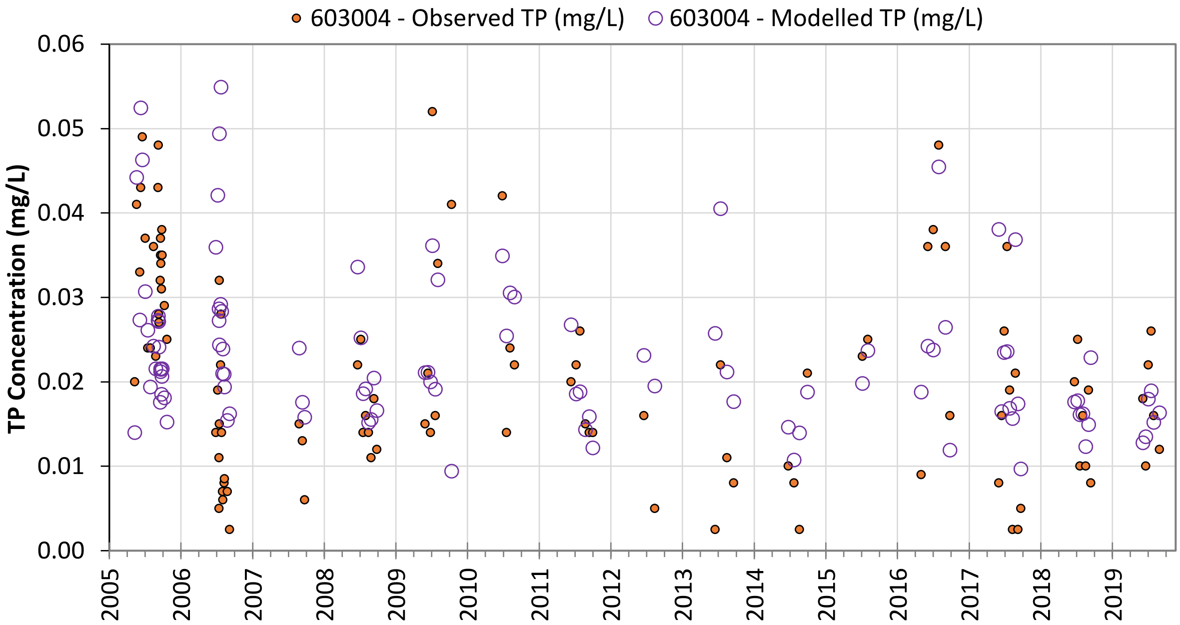




*Figure B.7: Measured and modelled winter total nitrogen (TN, top graph) and total phosphorus (TP, bottom graph) at Sunny Glen (Hay River, AWRC ref. 603004)*

### B.2.7 Mitchell River, Beigpiegup (AWRC ref. 603005)

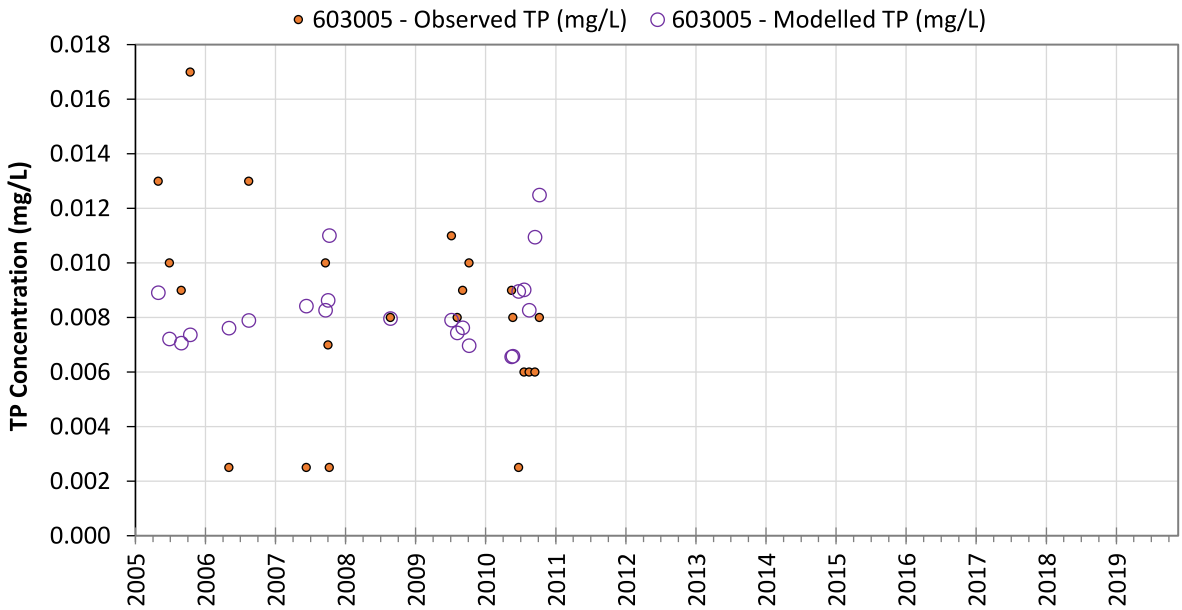
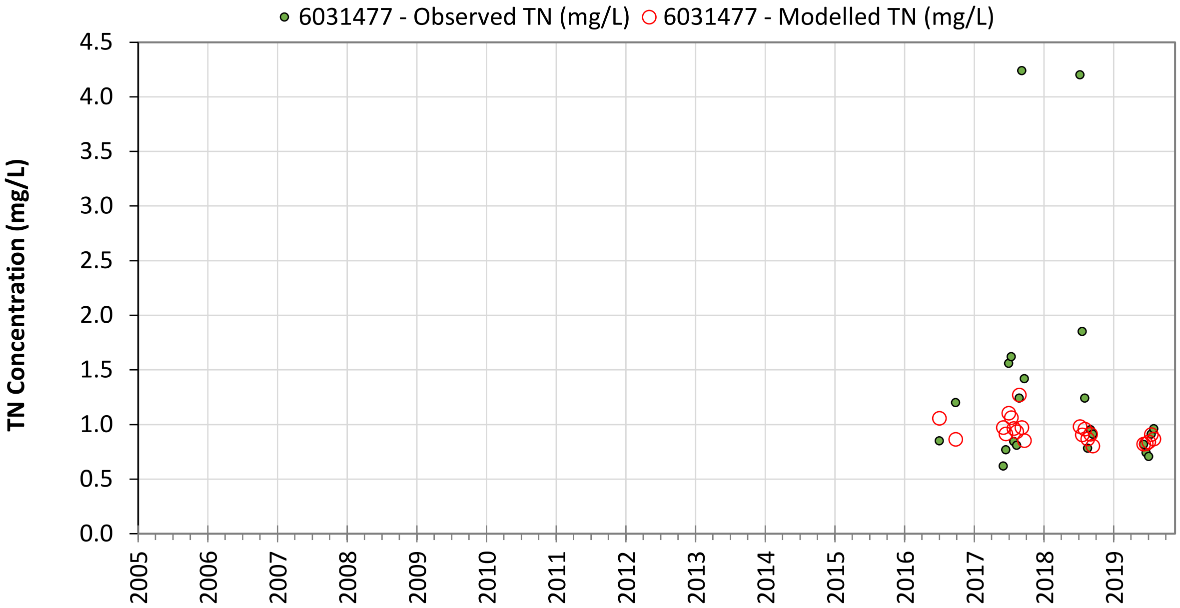




*Figure B.8: Measured and modelled winter total nitrogen (TN, top graph) and total phosphorus (TP, bottom graph) at Beigpiegup (Mitchell River, AWRC ref. 603005)*

### B.2.8 Hay River, EVh01 (AWRC ref. 6031477)



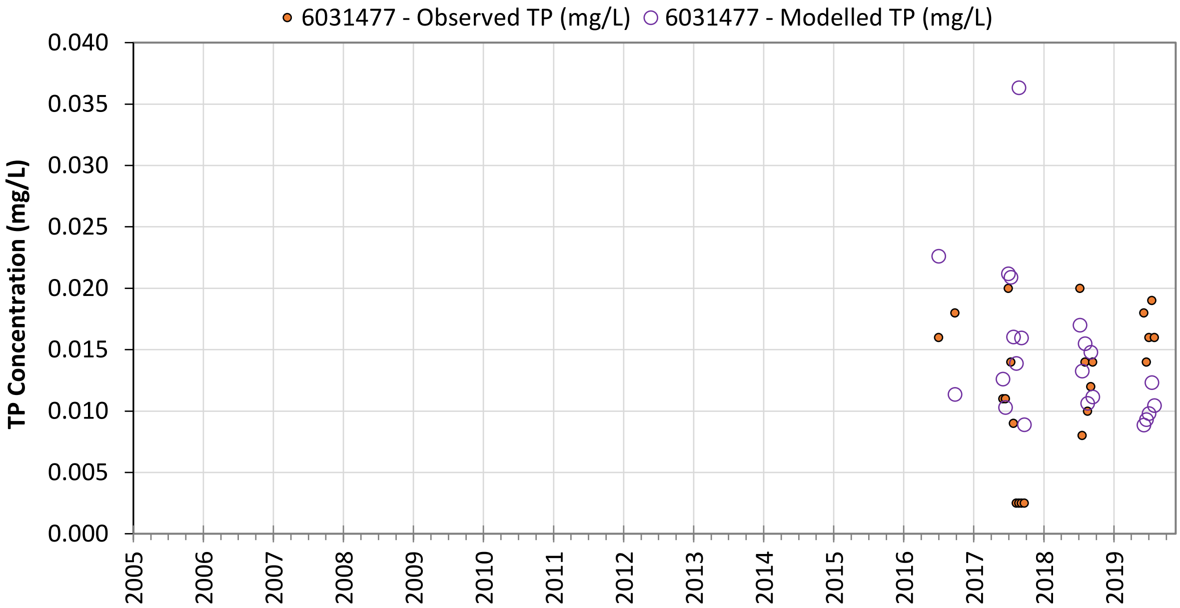




*Figure B.9: Measured and modelled winter total nitrogen (TN, top graph) and total phosphorus (TP, bottom graph) at EVhay01 (Hay River, AWRC ref. 6031477)*

### B.2.9 Sleeman River, Sleeman Rd Bridge (AWRC ref. 603007)

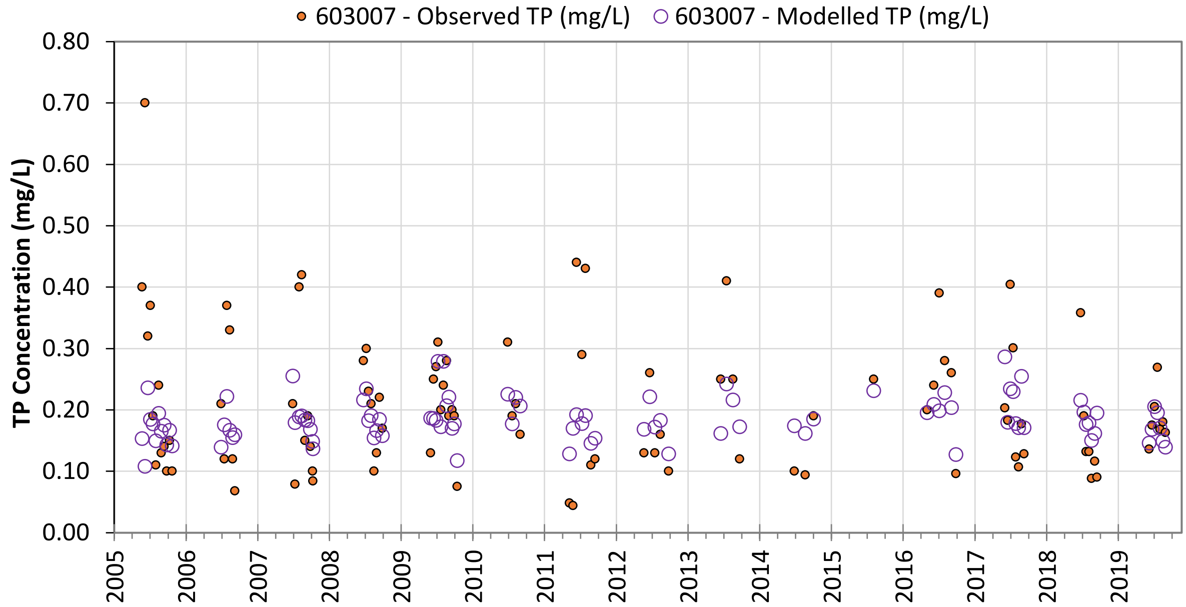
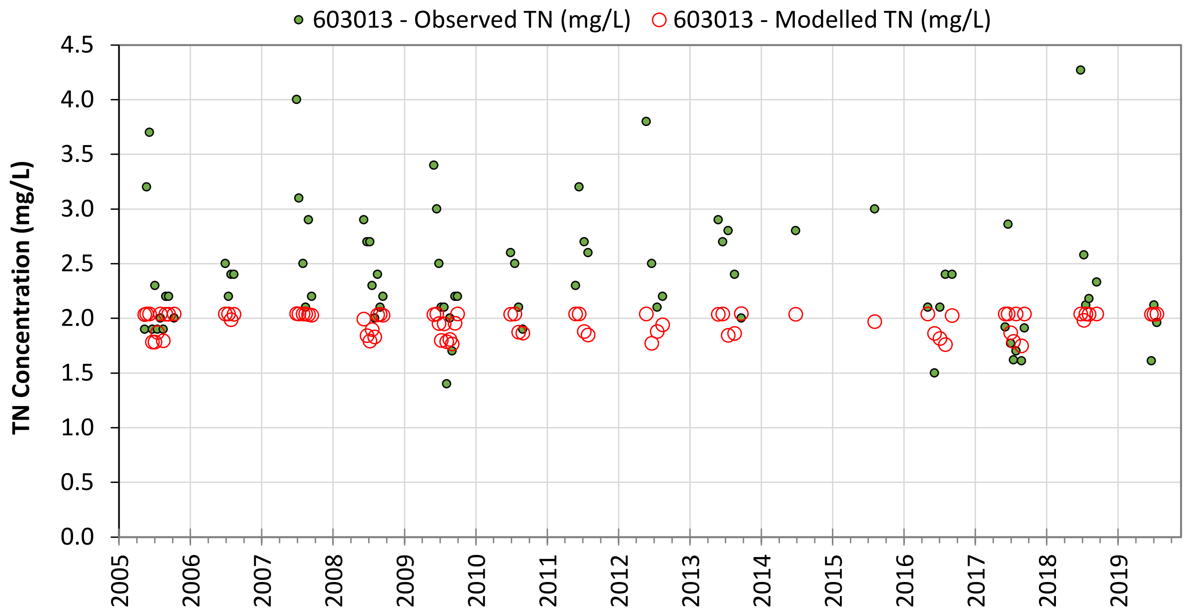




*Figure B.10: Measured and modelled winter total nitrogen (TN, top graph) and total phosphorus (TP, bottom graph) at Sleeman Rd Bridge (Sleeman River, AWRC ref. 603007)*

### B.2.10 Cuppup River, Eden Rd (AWRC ref. 603013)



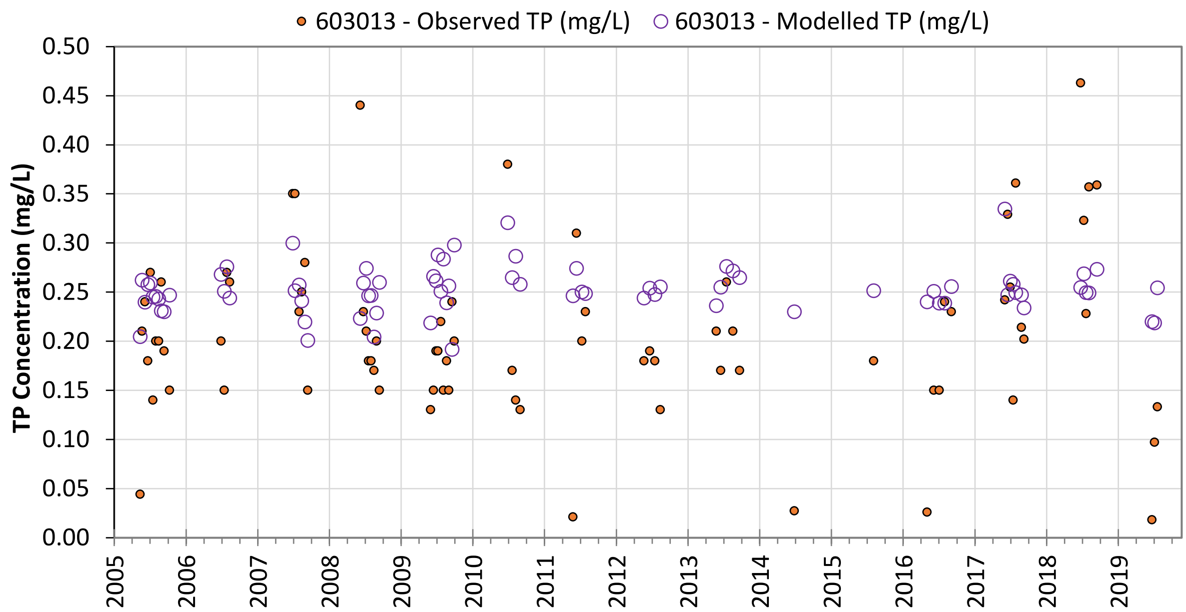
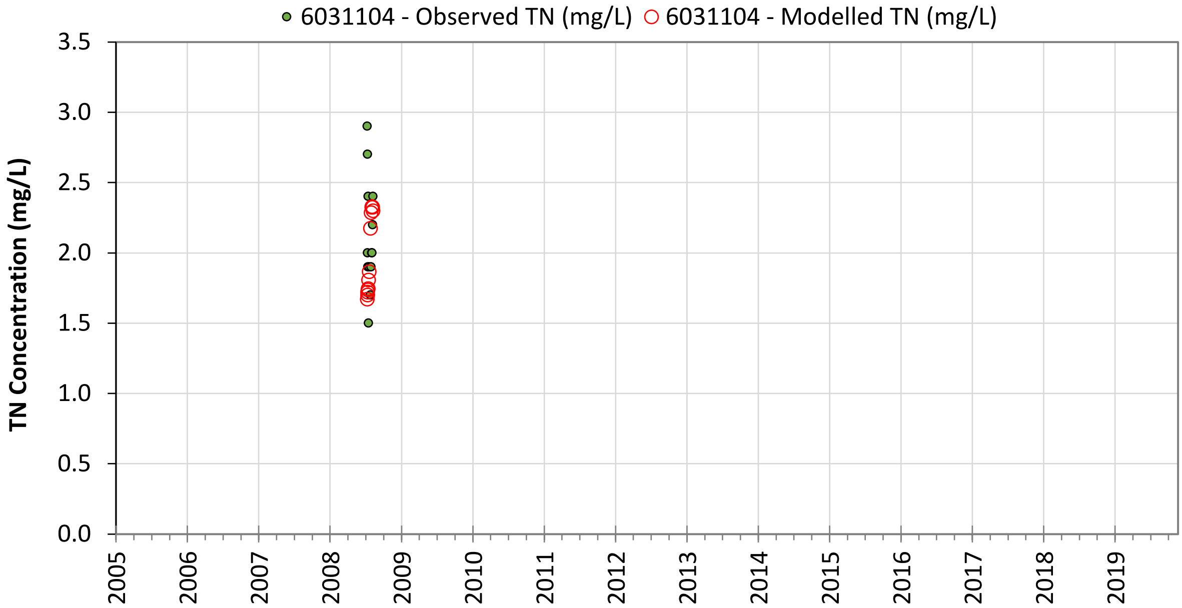




*Figure B.11: Measured and modelled winter total nitrogen (TN, top graph) and total phosphorus (TP, bottom graph) at Eden Rd (Cuppup River, AWRC ref. 603013)*

### B.2.11 Lake Saide Drain, Bridge 127-Wolves (AWRC ref. 6031104)



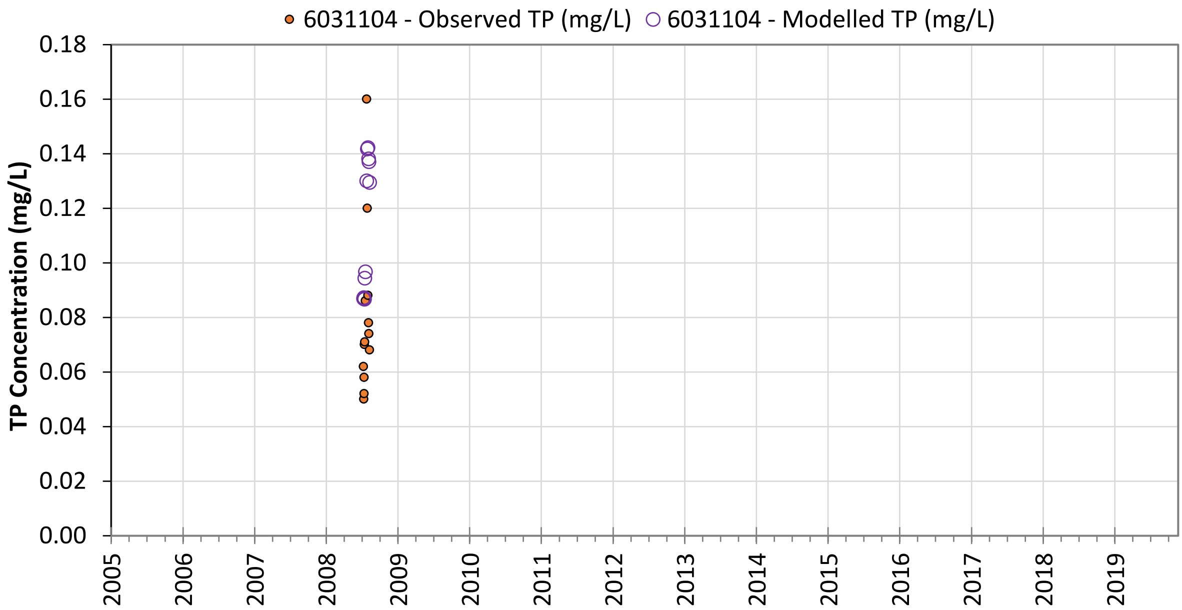
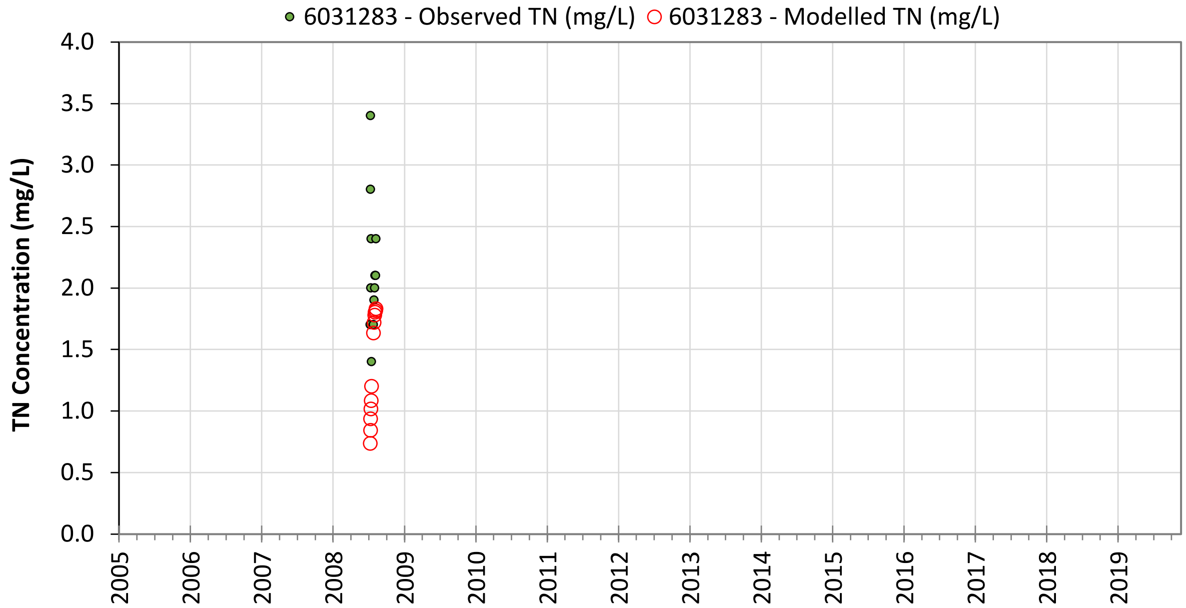




*Figure B.12: Measured and modelled winter total nitrogen (TN, top graph) and total phosphorus (TP, bottom graph) at Bridge 127-Wolves (Lake Saide Drain, AWRC ref. 6031104)*

### B.2.12 Nenamup Inlet Drain (AWRC ref. 6031283)



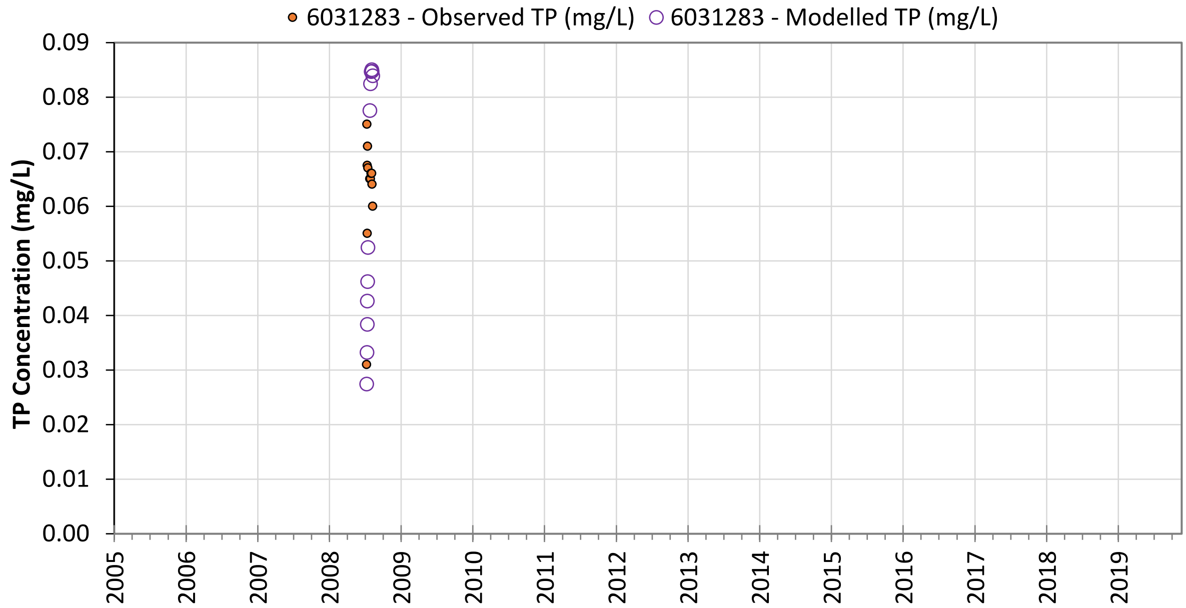




*Figure B.13: Measured and modelled winter total nitrogen (TN, top graph) and total phosphorus (TP, bottom graph) at Nenamup Inlet Drain (AWRC ref. 6031283)*

# Appendix C: Point sources and septic tanks

## C.1 Point sources

We identified 24 nutrient point sources in the Wilson Inlet catchment (see Table C.1 and Figure C.1). Of these, we included 20 in the model. Intensive animal industries (piggeries, feedlots, stockyards) were modelled using the diffuse model described in Section 3.1 of the main report. The following sections of this appendix detail our modelling approach for wastewater treatment plants (WWTP), beverage-making sites and dairy sheds. We identified four point sources but did not include them in the model, as follows:

- **Two landfill sites (Mount Barker and Denmark)**: these were not included due to the difficulty in estimating their nutrient contributions to surface water. Groundwater contaminant transport modelling would likely be required to adequately quantify these emissions, which was outside of the scope of this project.
- **Treated wastewater from the Pardelup Prison farm**: this was not included because we could not find detailed publicly available information about the treatment and management of wastewater, other than a report saying that grey water is treated and used for onsite irrigation. Although we did not explicitly model this reuse, we mapped the land uses within the prison farm, such as the areas used for horticulture. In the model, these land uses assume nutrient input and surplus rates as given in the main report.
- **A septage disposal site**: this was not included in the model because the site was constructed in about 2020 and therefore not in the model's basecase period.

*Table C.1: Point sources identified in the Wilson Inlet catchment*

| # | Type | Facility name | Licence | Included in model | Reporting catchment | Cat ID |
|---|---|---|---|---|---|---|
| 1 | Dairy shed | Dairy shed #1 | - | Yes | Sunny Glen | 59 |
| 2 | Dairy shed | Dairy shed #2 | - | Yes | Lower Denmark | 117 |
| 3 | Dairy shed | Dairy shed #3 | - | Yes | Scotsdale | 24 |
| 4 | Dairy shed | Dairy shed #4 | - | Yes | Upper Denmark | 9 |
| 5 | Dairy shed | Dairy shed #5 | - | Yes | Lower Hay | 33 |
| 6 | Dairy shed | Dairy shed #6 | - | Yes | Lower Hay | 32 |
| 7 | Dairy shed | Dairy shed #7 | - | Yes | Sleeman | 63 |
| 8 | Dairy shed | Dairy shed #8 | - | Yes | Sleeman | 61 |
| 9 | Feedlots & stockyards | Small feedlot | - | Yes | Upper Hay | 42 |
| 10 | Feedlots & stockyards | Great Southern Regional Cattle Saleyards | L7407/1998/9 | Yes | Upper Hay | 55 |
| 11 | Feedlots & stockyards | Stockyard | - | Yes | Foreshore | 83 |
| 12 | Feedlots & stockyards | Small feedlot | - | Yes | Lower Denmark | 117 |
| 13 | Piggery | Piggery #1 | - | Yes | Upper Hay | 45 |
| 14 | Piggery | Piggery #2 | - | Yes | Upper Hay | 36 |
| 15 | Wastewater irrigation | West Cape Howe Wines | L7730/2001/8 | Yes | Upper Hay | 44 |
| 16 | Wastewater irrigation | Forest Hill Wines | L8042/2004/4 | Yes | Little River | 118 |
| 17 | Wastewater irrigation | Howard Park | L80434/2005/4 | Yes | Scotsdale | 23 |
| 18 | Wastewater irrigation | Willoughby Estate | L8081/2006/3 | Yes | Lower Denmark | 117 |
| 19 | WWTP | Denmark WWTP | L6315/1991/11 | Yes | Koorabup | 79 |
| 20 | WWTP | Mount Barker WWTP | L6314/1991/12 | Yes | Upper Hay | 42 |
| 21 | Landfill | Mount Barker Landfill | L7026/1997/14 | No | Upper Hay | 55 |
| 22 | Landfill | Waste Transfer Station (Denmark) | L6862/1997/11 | No | Foreshore | 82 |
| 23 | Septage pond | Liquid waste facility (Pile Rd) | L9022/2016/2 | No | Upper Hay | 47 |
| 24 | Wastewater | Pardelup Prison Farm | - | No | Upper Hay | 47 |

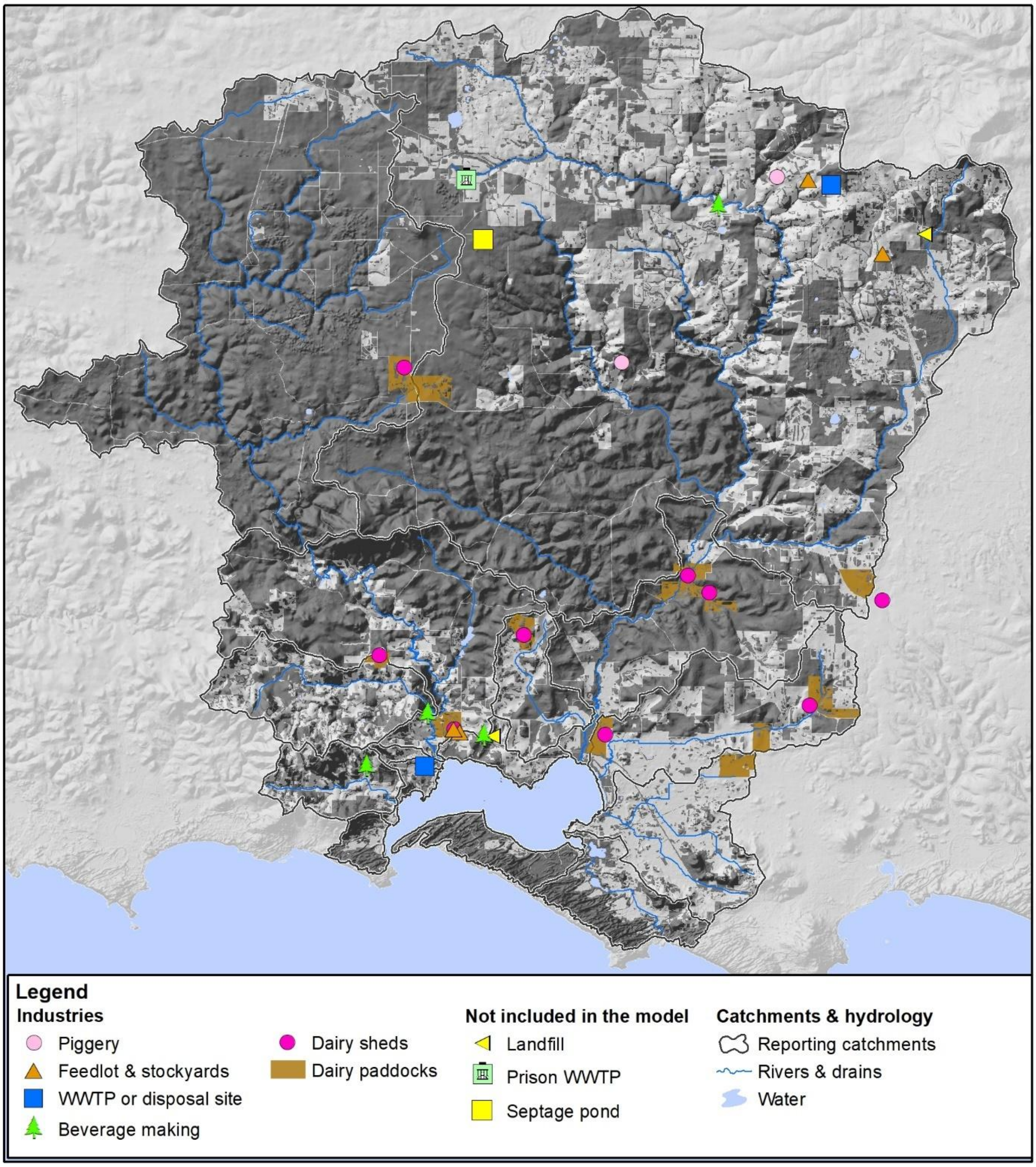



*Figure C.1: All identified point sources and dairy sheds*

## *Dairy sheds*

Dairy sheds can be a significant source of nutrients and were included in our model using inflow nodes. Inflow nodes require a pre-computed timeseries of water discharge and nutrient concentrations. We did this by estimating the timeseries of nutrient loss from dairy sheds based on published literature, assumptions and model calibration. This approach was similar to that of the Peel-Harvey catchment modelling (Hennig et al. 2021). For each dairy shed, we calculated the mass of nitrogen and phosphorus produced in dairy shed effluent based on the approximate number of cattle for each farm (numbers provided by Western

Dairy). We then calculated the nutrient mass available for loss to surface water by multiplying the nutrient load in dairy shed effluent by the nutrient loss factor (see Table C.2). All eight dairy sheds used the same nutrient loss factors (0.14 for nitrogen and 0.05 for phosphorus). We derived the nutrient loss factors through calibration. The loss factor for nitrogen was similar to the Peel-Harvey catchment's factor. However, the phosphorus loss factor was about 60% lower than that of the Peel-Harvey. This indicates greater soil phosphorus retention on the dairy farms in the Wilson Inlet.

We assume that the mass of daily nutrient loss is a proportion of daily functional unit flow of the model timestep to average annual functional unit flow (1975–2019). This assumption avoids large spikes in nutrient concentration downstream when catchment flows cease or are very low.

*Table C.2: Dairy shed assumptions*

| Parameter | Units | Value (Wilson Inlet) | Value (Peel-Harvey) |
|---|---|---|---|
| Wash-down volume per cow per day | kL/cow/day | 0.06 | 0.06 |
| Number of milking days per year | # days | 365 | 365 |
| Effluent TN concentration | mg/L | 200 | 200 |
| Effluent TP concentration | mg/L | 40 | 40 |
| *Mass of nitrogen in dairy effluent* | *kg/cow/yr* | *4.38* | *4.38* |
| *Mass of phosphorus in dairy effluent* | *kg/cow/yr* | *0.88* | *0.876* |
| **Nitrogen loss factor** | **Factor** | **0.14** | **0.15** |
| **Phosphorus loss factor** | **Factor** | **0.05** | **0.13** |
| **Nitrogen load available for loss to surface water** | **kg/cow/yr** | **0.61** | **0.66** |
| **Phosphorus load available for loss to surface water** | **kg/cow/yr** | **0.04** | **0.11** |

### *Denmark WWTP*

The Denmark WWTP infiltrates treated wastewater adjacent to an unnamed stream in the Koorabup reporting catchment. This discharge site is less than 1 km from Wilson Inlet. Measured nutrient concentrations in this stream suggest that treated wastewater enters this unnamed stream and is mobilised to Wilson Inlet.

We assume there is no attenuation of nutrients between the infiltration of treated wastewater and its mobilisation to Wilson Inlet, other than dilution from catchment sources of flow. We took the volume of treated wastewater discharge and the concentrations of nutrients from monthly estimates in the Water Corporation's annual environmental reports (AER). We incorporated this data in the model at a daily timestep using the periods below (all months are inclusive):

- January 1960 to June 2010 uses data from the 2009–10 AER
- July 2010 to June 2012 uses data from the 2010–11 and 2011–12 AER
- July 2012 to June 2014 uses data from the 2011–12 AER
- July 2014 to June 2015 uses data from the 2014–15 AER
- July 2015 to June 2018 uses data from the 2017–18 AER

- July 2018 to June 2019 uses data from the 2018–19 AER
- July 2019 and onwards uses data from the 2019–20 AER

Figure C.2 shows the assumed daily timeseries of discharge from the Denmark WWTP as well as annual nutrient loads to the Wilson Inlet.

### *Mount Barker WWTP disposal site (woodlot irrigation)*

The Mount Barker WWTP is located north-east of the town and is in the Kalgan River catchment, which drains to the Oyster Harbour estuary. However, treated wastewater is pumped to an irrigation site in the Upper Hay catchment (Ooranggatup Creek, modelling catchment 42). The land use of this irrigation site has changed over the years. Initially the site was used for dryland pasture grazing until it was converted to a vineyard in 2000. This vineyard began using treated wastewater for irrigation at some point before early 2013 when the Water Corporation took ownership. Today, most of the 126 ha site is used as woodlot for treated wastewater irrigation.

We used the Water Corporation's 2014–15 and 2015–16 AER to parameterise the amount of irrigation and nutrient inputs of the disposal site in the catchment model. The assumed daily irrigation depth differs by month (see Figure C.3). We simulated irrigation in the catchment model by combining the depth of treated wastewater irrigation with the rainfall data for modelling catchment 42. Nutrient inputs to the woodlot from treated wastewater irrigation were 22 kg/ha/yr for nitrogen and 5 kg/ha/yr for phosphorus. We also created a leaf area index (LAI) timeseries to account for the land-use changes from grazing to vineyards to woodlots since 2000, which was based on aerial photography (see Figure C.4). We assumed harvesting of the woodlot every 10 years.

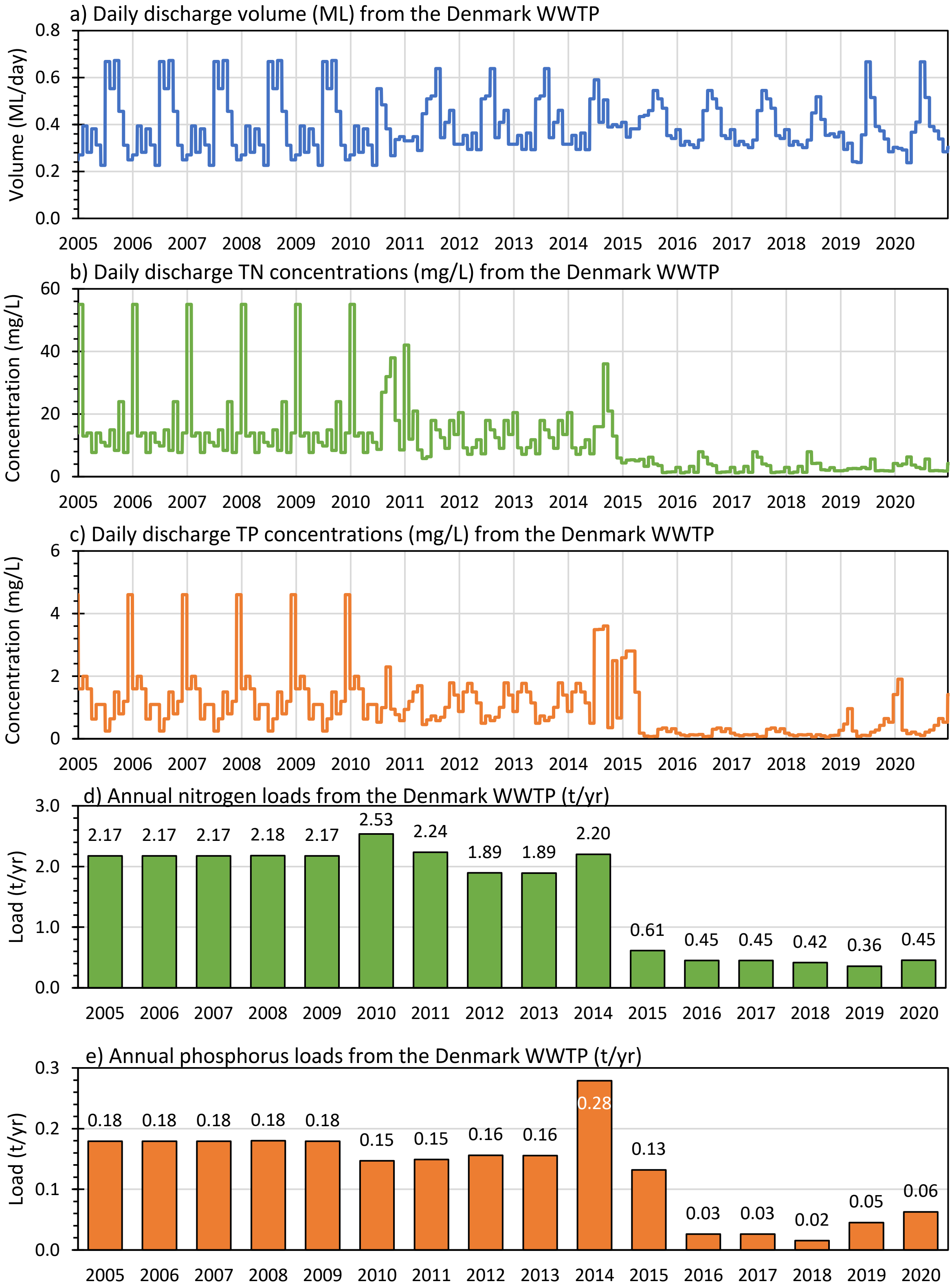



*Figure C.2: Assumed daily discharge and nutrient concentrations, and annual nutrient loads from the Denmark WWTP*

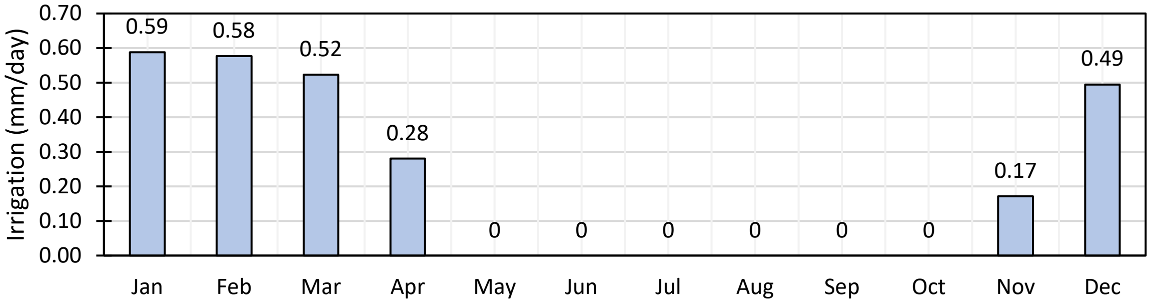



*Figure C.3: Assumed monthly woodlot irrigation based on data from the Water Corporation's 2014–15 and 2015–16 annual environmental reports*

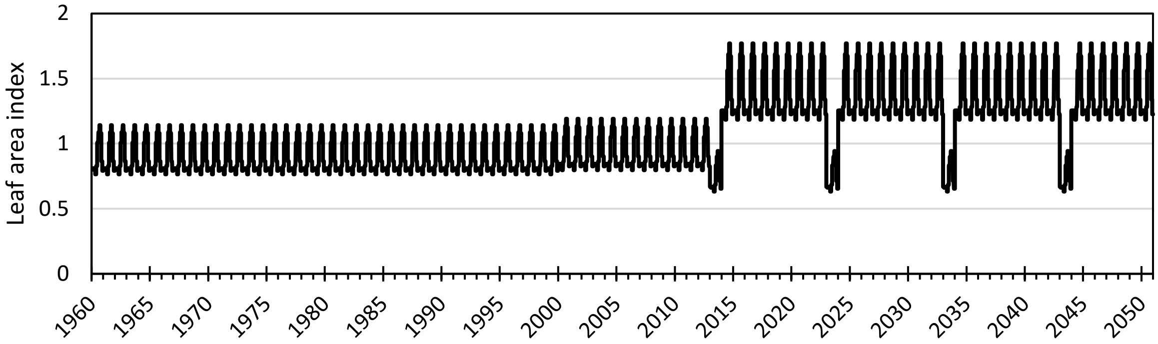



*Figure C.4: Assumed leaf area index of the Mount Barker disposal site*

### *Wastewater irrigation (beverage making)*

Three sites irrigate woodlots with treated wastewater from alcoholic beverage making (see Table C.3). A fourth site irrigates its vineyards with treated wastewater, which typically is carefully managed to avoid unpleasant flavours when overfertilised. Hence, we opted to model this site in the same way as other vineyards. For the sites listed in Table C.3, we estimated the irrigation and nutrient application using the criteria given in their environmental licences – the results were mostly similar to those for the Mount Barker WWTP disposal site. Thus, we opted to model the three sites using the same approach, nutrient application and irrigation rates as the Mount Barker disposal site.

*Table C.3: Estimated annual nutrient loading and irrigation of sites that irrigate woodlots with treated wastewater*

| Site (env licence) | Cat ID | Climate ID | Treated wastewater irrigation | | | Max licensed concentrations | | Max estimated emissions to land | | Licensed maxiumum loading to land | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Volume | Area | Irrigation | TN | TP | N load | P load | N load | P load |
| | | | KL/yr | (ha) | (mm/yr) | (mg/L) | (mg/L) | (kg/ha/yr) | (kg/ha/yr) | (kg/ha/yr) | (kg/ha/yr) |
| Howard Park wines (L8042/2004/4) | 23 Scotsdale Brook | 23 | 0.70 | 2.1 | 34 | 30 | 7.5 | 10 | 2.5 | 480 | 120 |
| Wiloughby Estate (L8081/2006/3) | 117 Little River | 3 | 1.05 | 1.4 | 74 | 30 | 7.5 | 22 | 5.6 | 480 | 120 |
| Forest Hill Winery (L8042/2004/4) | 118 Lower Denmark | 68 | 0.90 | 1.4 | 64 | 30 | 7.5 | 19 | 4.8 | 480 | 120 |
| **Assumed in catchment model** | | | - | - | **79** | **27** | **6.2** | **22** | **5.0** | - | - |

## C.2 Septic tanks

We identified unsewered lots using the Water Corporation's 2016 sewerage connection spatial layer. As there is no known mapping of alternative treatment units, we assumed that all unsewered properties dispose of onsite wastewater using septic tanks. We assumed septic tanks discharge 56.6 kL/person/yr (Loh & Coghlan 2003), which results in the discharge of 5.5 kg/person/yr of nitrogen and 1.1 kg/person/yr of phosphorus (Whelan et al. 1981). We assumed each septic tank serviced a dwelling with 2.2 people (Denmark suburb ABS 2016). When mapping septic tanks, we assigned one to each unsewered accommodation unit, caravan bay or camping site. Therefore, each mapped septic tank – regardless of its use (residential, industrial, accommodation) – is assumed to discharge 124.5 kL/dwelling/yr of effluent, 12.1 kg/dwelling/yr of nitrogen, and 2.4 kg/dwelling/yr of phosphorus to land.

We calibrated the proportion of nutrients mobilised to surface water from land discharge to groundwater concentrations in modelling catchments 84 to 88. About 27% of the septic tanks in the Wilson Inlet catchment are in these catchments.

We used groundwater measurements from six bores adjacent to Wilson Inlet for calibration (Figure C.5). Of these bores, five also had an upgradient bore that we considered during the calibration process. In addition, catchment 87 had two calibration bores and two upstream bores.

The objective of this calibration was to achieve a good fit with measured data, particularly high nutrient concentration measurements, which could indicate the presence of septic tank effluent. We used the calibration that produced the best overall match to all observed data in the catchment model. See Table C.4 for the export rates.

*Table C.4: Septic tank nutrient export categories and calibrated nitrogen and phosphorus exports*

| Export category | N export | P export | # septics | % of septics |
|---|---|---|---|---|
| Heavy soils | 40% | 0.5% | 265 | 17% |
| Moderate soils | 14% | 4% | 965 | 61% |
| Sandy soils | 40% | 20% | 348 | 22% |
| Not included in the model | | | 714 | 45% |
| Total (included in the model) | 24% | 7% | 1578 | 100% |
| Total | 17% | 5% | 2292 | |

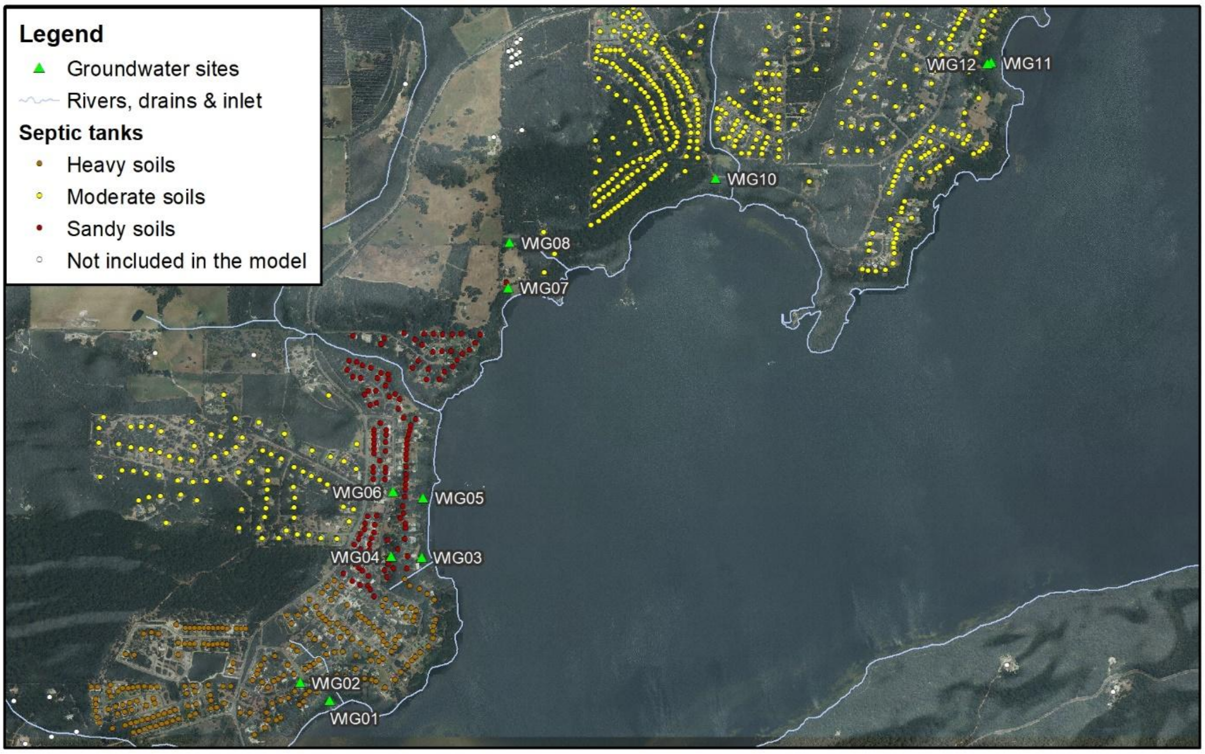



*Figure C.5: Map of groundwater sites used to calibrate septic tank nutrient exports*

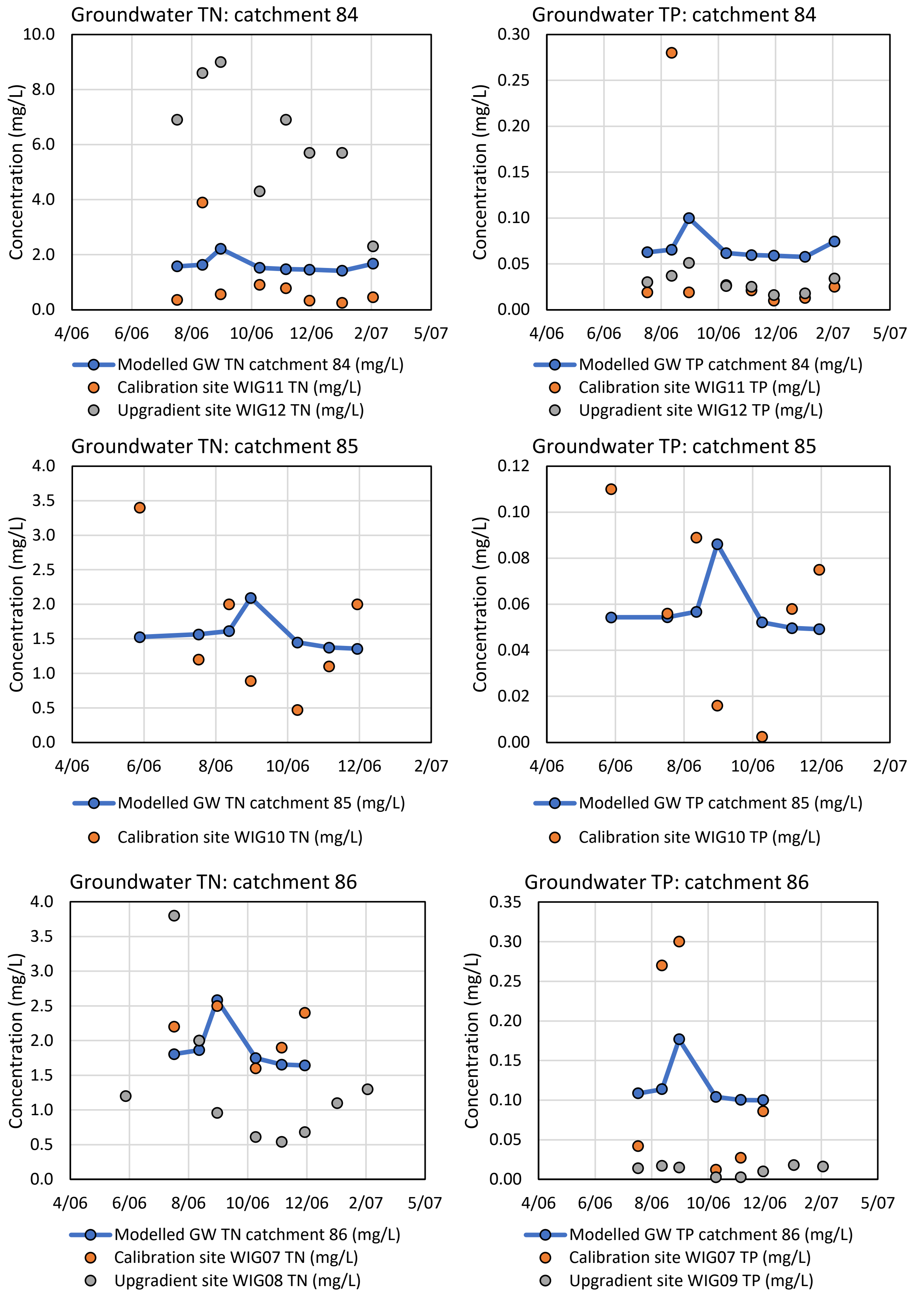



*Figure C.6: Groundwater nutrient calibration for modelling catchments 84–86*

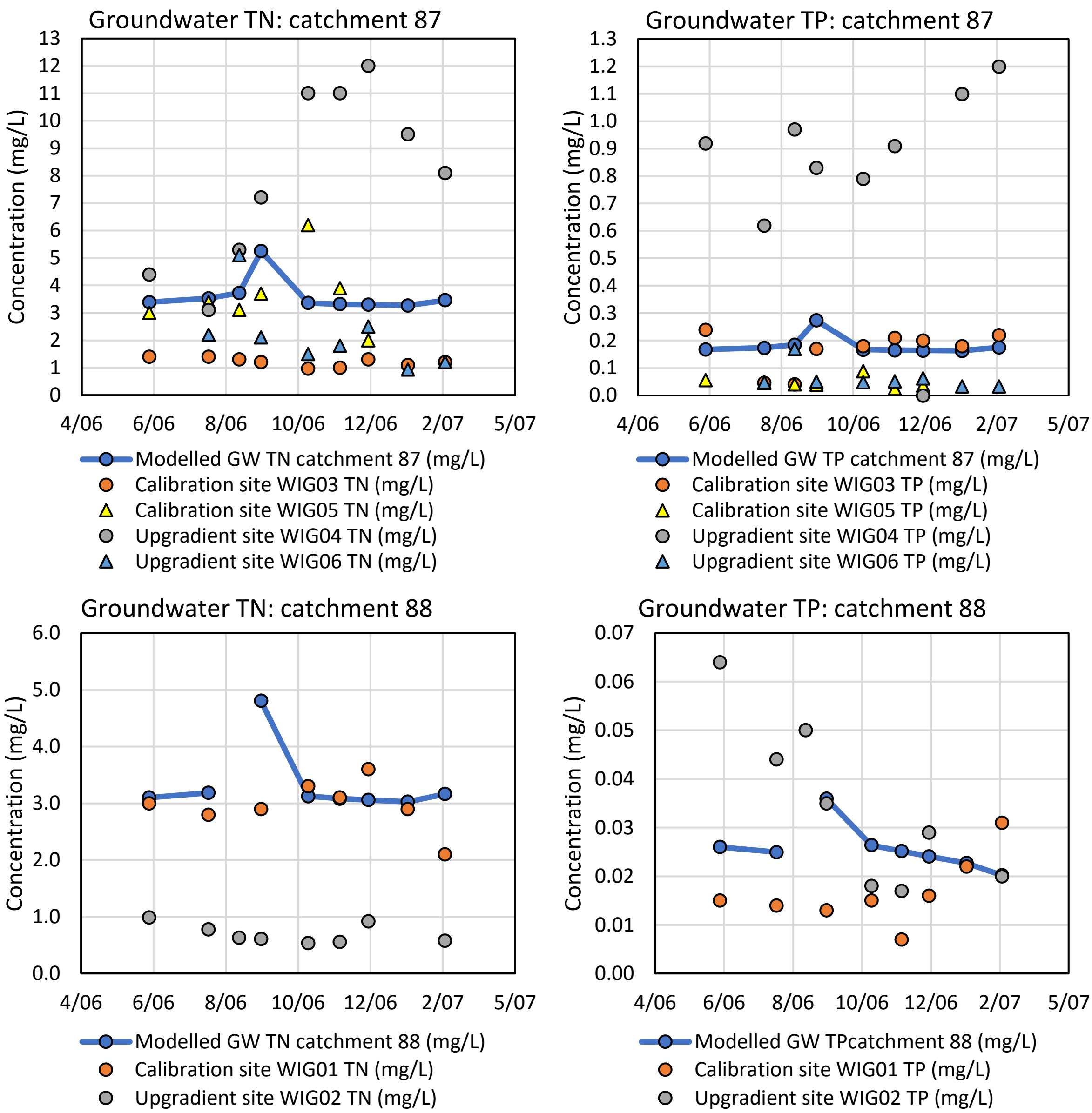



*Figure C.7: Groundwater nutrient calibration for modelling catchments 87–88*

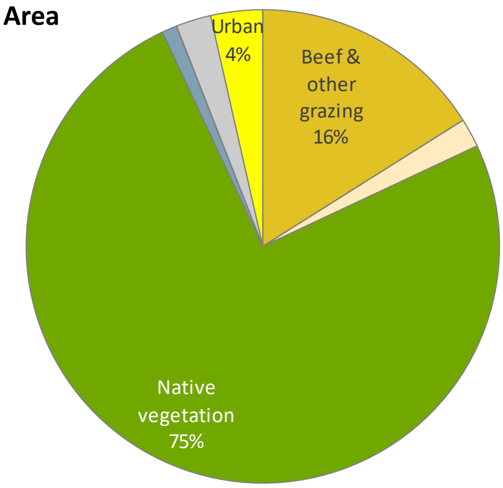
# Appendix D: Source separation

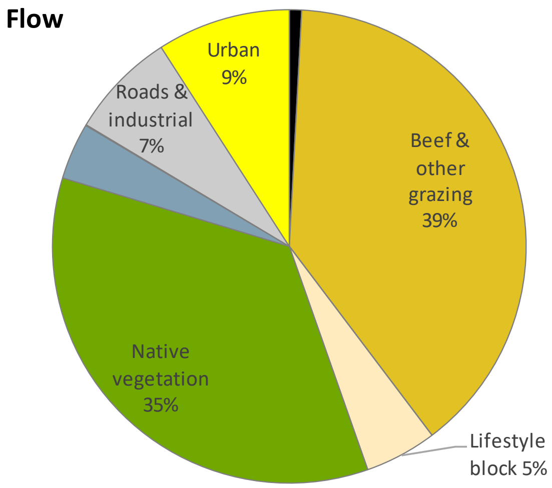
## D.1 Ocean Beach Road

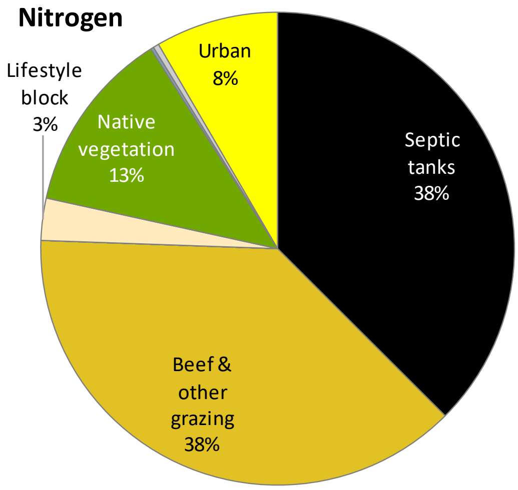

*Figure D.1: Land uses of the Ocean Beach Road reporting catchment*

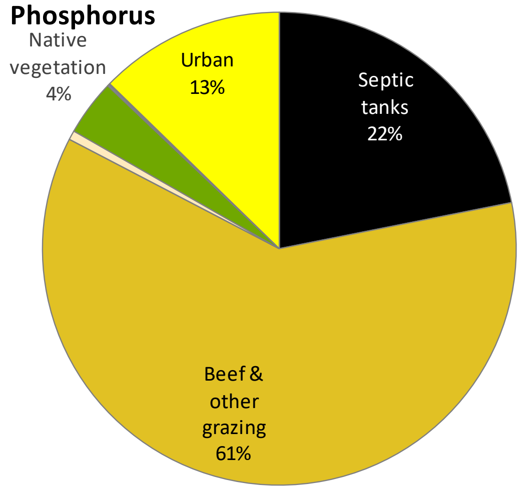
Ocean Beach Road source separation

| Landuse name | Colour | Area | | Flow | | Nitrogen | | Phosphorus | |
|---|---|---|---|---|---|---|---|---|---|
| | | (ha) | (%) | (ML/yr) | (%) | (kg/yr) | (%) | (kg/yr) | (%) |
| Septic tanks | | 266 | - | 10 | 1% | 968 | 37% | 50 | 22% |
| Beef & other grazing | | 160 | 16% | 464 | 39% | 982 | 38% | 140 | 61% |
| Cropping | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Dairy | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Horses | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Horticulture | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Intensive animal use | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Lifestyle block | | 20 | 2% | 59 | 5% | 74 | 3% | 1 | 1% |
| Native vegetation | | 748 | 75% | 418 | 35% | 325 | 13% | 9 | 4% |
| Other landuses | | 10 | 1% | 46 | 4% | 5 | 0% | 0 | 0% |
| Plantation | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Point source | | 0 | 0% | 1 | 0% | 0 | 0% | 0 | 0% |
| Roads & industrial | | 24 | 2% | 87 | 7% | 10 | 0% | 0 | 0% |
| Urban | | 35 | 4% | 108 | 9% | 217 | 8% | 29 | 13% |
| Viticulture & orchards | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Total: Generated by catchment | | 997 | 100% | 1 192 | 100% | 2 581 | 100% | 230 | 100% |
| Removal (-) or gain (+) | | - | | 0 | 0% | 0 | 0% | 0 | 0% |
| Total: Leaving catchment | | 997 | 100% | 1 192 | 100% | 2 581 | 100% | 230 | 100% |



## D.2 Little River

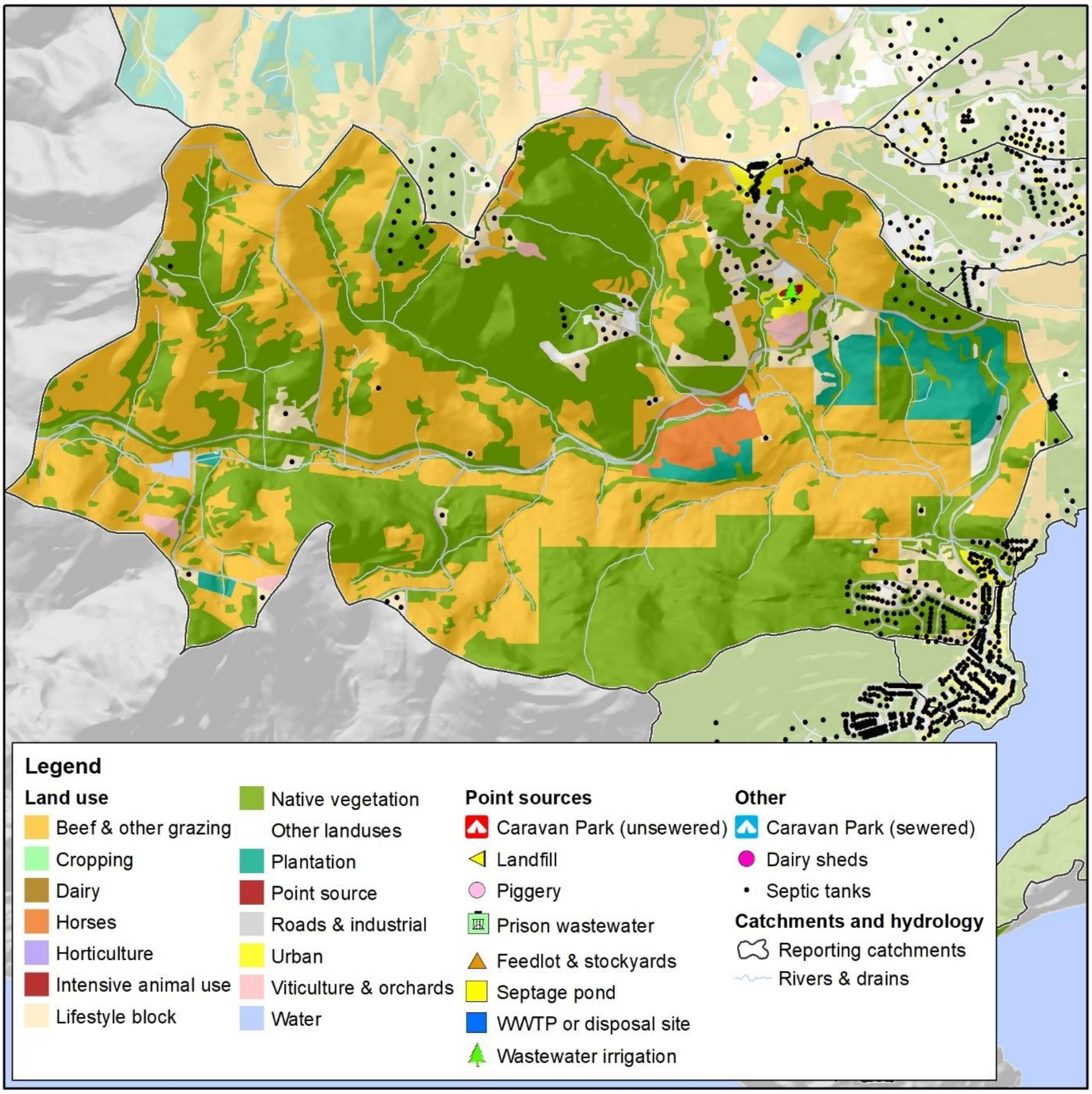
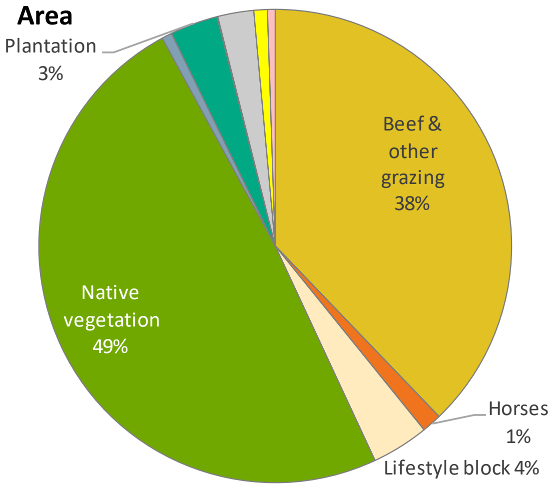
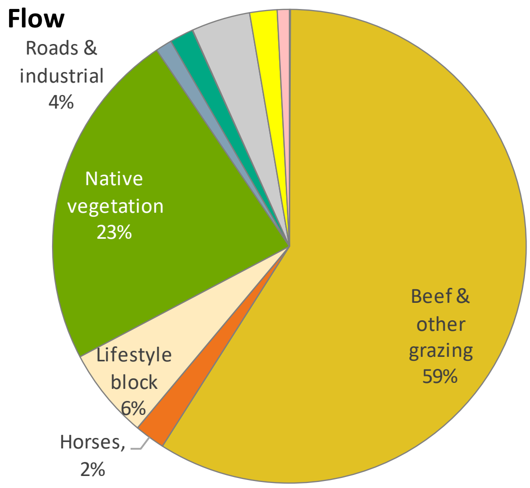


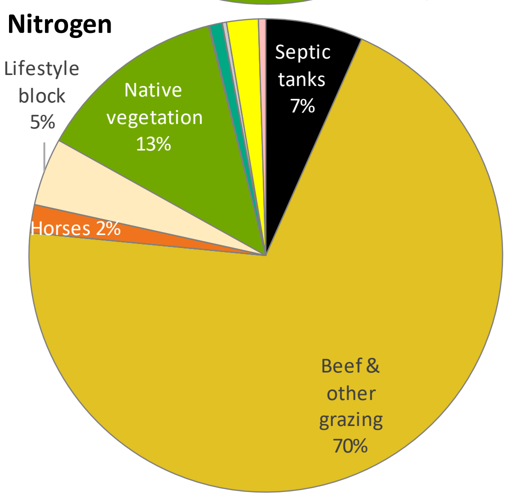

*Figure D.2: Land uses of the Little River reporting catchment*

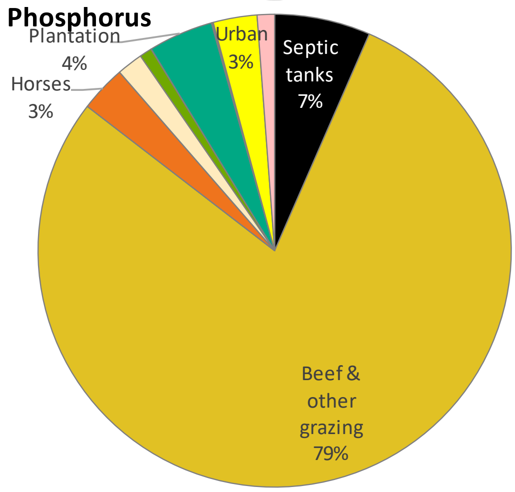
Little River source separation

| Landuse name | Colour | Area (ha) | Area (%) | Flow (ML/yr) | Flow (%) | Nitrogen (kg/yr) | Nitrogen (%) | Phosphorus (kg/yr) | Phosphorus (%) |
|---|---|---|---|---|---|---|---|---|---|
| Septic tanks | | 251 | - | 4 | 0% | 411 | 7% | 34 | 7% |
| Beef & other grazing | | 1 209 | 38% | 3 591 | 59% | 4 325 | 70% | 415 | 79% |
| Cropping | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Dairy | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Horses | | 43 | 1% | 127 | 2% | 119 | 2% | 17 | 3% |
| Horticulture | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Intensive animal use | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Lifestyle block | | 125 | 4% | 377 | 6% | 287 | 5% | 9 | 2% |
| Native vegetation | | 1 567 | 49% | 1 416 | 23% | 806 | 13% | 4 | 1% |
| Other landuses | | 22 | 1% | 69 | 1% | 5 | 0% | 0 | 0% |
| Plantation | | 105 | 3% | 99 | 2% | 53 | 1% | 23 | 4% |
| Point source | | 1 | 0% | 2 | 0% | 2 | 0% | 0 | 0% |
| Roads & industrial | | 79 | 2% | 244 | 4% | 17 | 0% | 0 | 0% |
| Urban | | 30 | 1% | 114 | 2% | 134 | 2% | 16 | 3% |
| Viticulture & orchards | | 17 | 1% | 50 | 1% | 30 | 0% | 6 | 1% |
| Total: Generated by catchment | | 3 198 | 100% | 6 092 | 100% | 6 188 | 100% | 526 | 100% |
| Removal (-) or gain (+) | | - | | 3 | 0% | 0 | 0% | 0 | 0% |
| Total: Leaving catchment | | 3 198 | 100% | 6 096 | 100% | 6 188 | 100% | 526 | 100% |



# D.3 Koorabup Creek

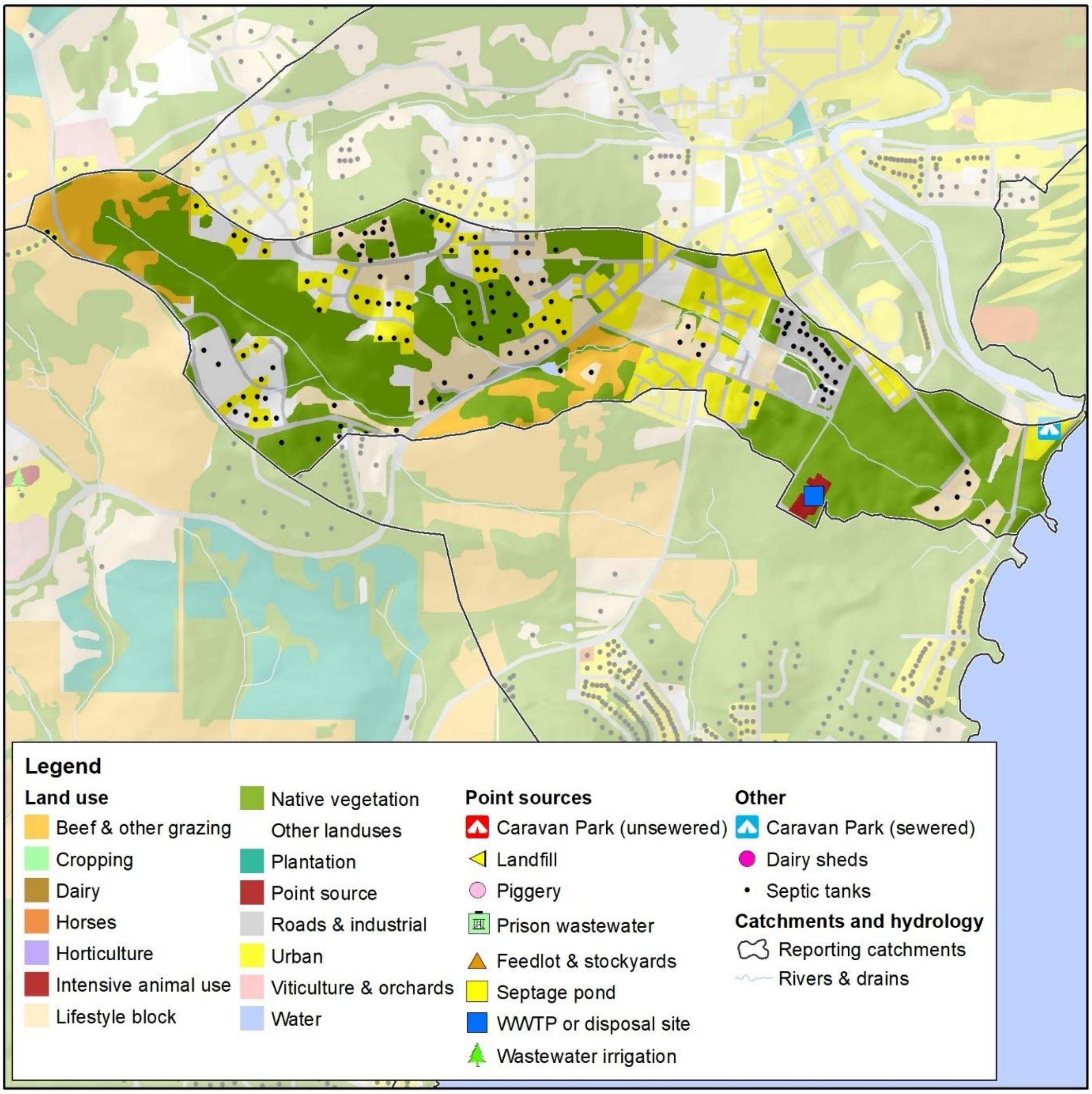
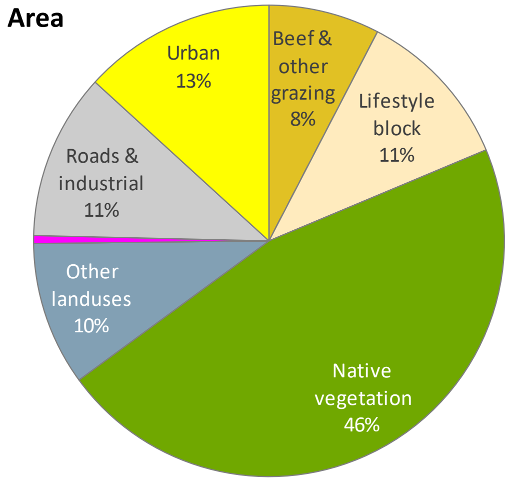
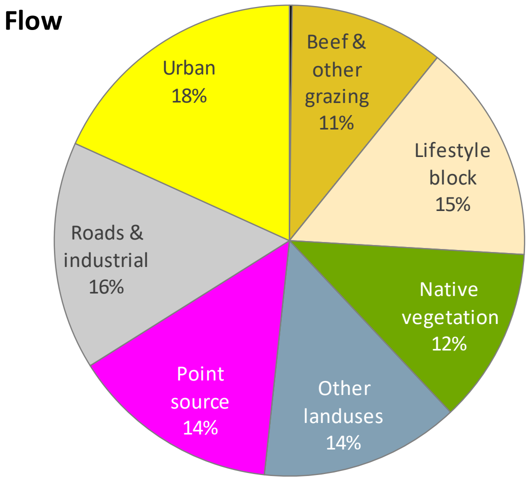


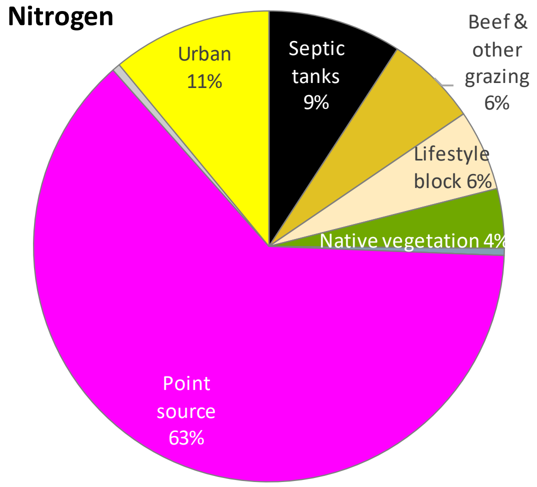

*Figure D.3: Land uses of the Koorabup Creek reporting catchment*

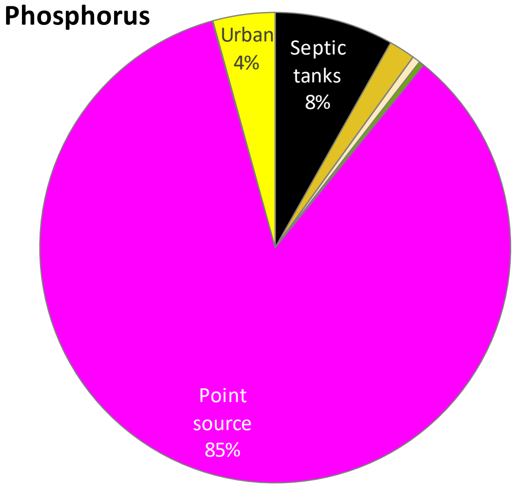
Koorabup Creek source separation

| Landuse name | Colour | Area (ha) | Area (%) | Flow (ML/yr) | Flow (%) | Nitrogen (kg/yr) | Nitrogen (%) | Phosphorus (kg/yr) | Phosphorus (%) |
|---|---|---|---|---|---|---|---|---|---|
| Septic tanks | | 136 | - | 2 | 0% | 191 | 9% | 11 | 8% |
| Beef & other grazing | | 29 | 8% | 111 | 11% | 131 | 6% | 2 | 2% |
| Cropping | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Dairy | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Horses | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Horticulture | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Intensive animal use | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Lifestyle block | | 41 | 11% | 157 | 15% | 115 | 6% | 1 | 1% |
| Native vegetation | | 173 | 46% | 125 | 12% | 85 | 4% | 0 | 0% |
| Other landuses | | 37 | 10% | 142 | 14% | 10 | 0% | 0 | 0% |
| Plantation | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Point source | | 2 | 1% | 149 | 14% | 1 305 | 63% | 113 | 85% |
| Roads & industrial | | 43 | 11% | 163 | 16% | 11 | 1% | 0 | 0% |
| Urban | | 49 | 13% | 189 | 18% | 228 | 11% | 6 | 4% |
| Viticulture & orchards | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Total: Generated by catchment | | 374 | 100% | 1 039 | 100% | 2 077 | 100% | 133 | 100% |
| Removal (-) or gain (+) | | - | | 0 | 0% | 0 | 0% | 0 | 0% |
| Total: Leaving catchment | | 374 | 100% | 1 039 | 100% | 2 077 | 100% | 133 | 100% |



# D.4 Lower Denmark

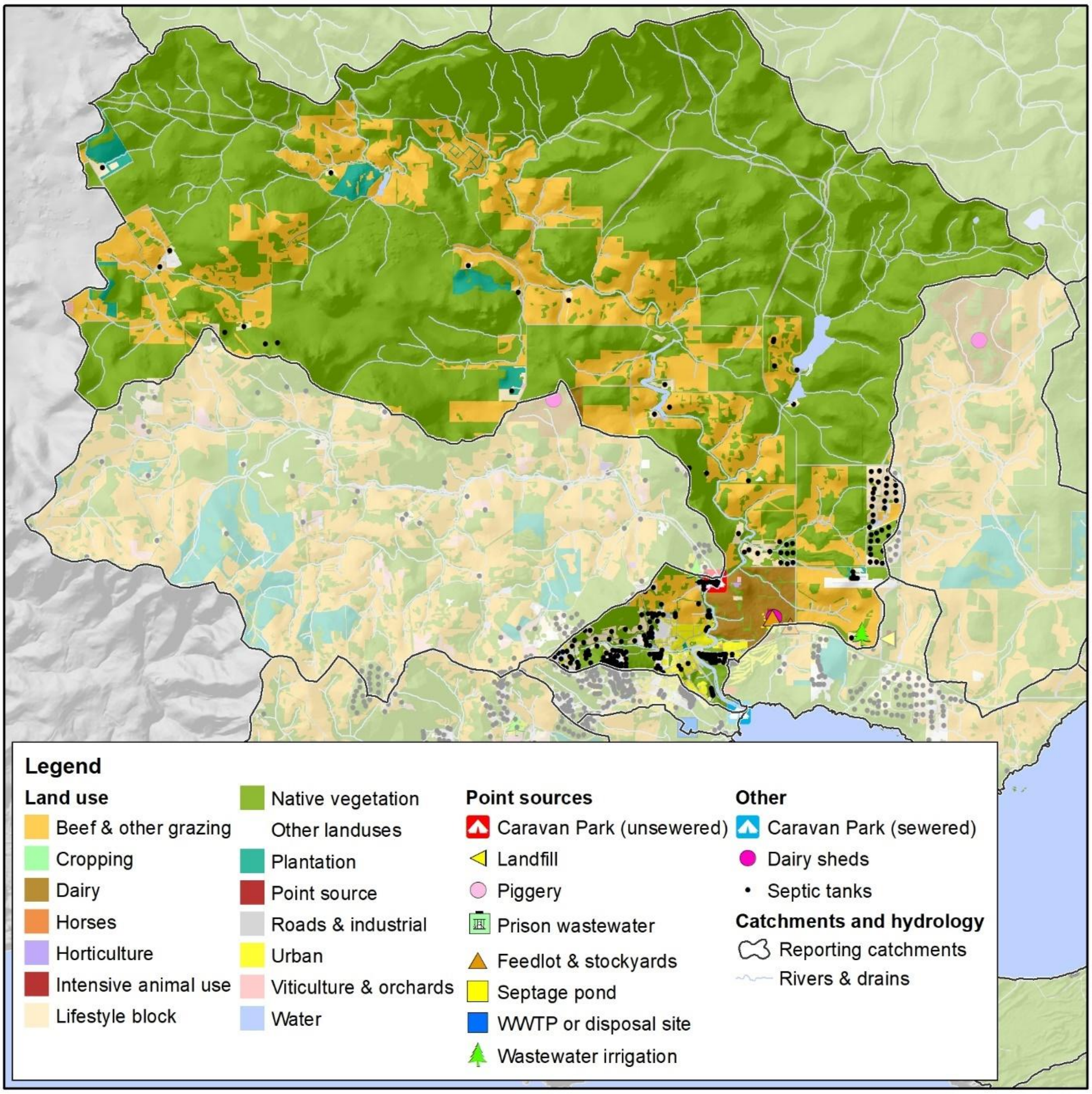
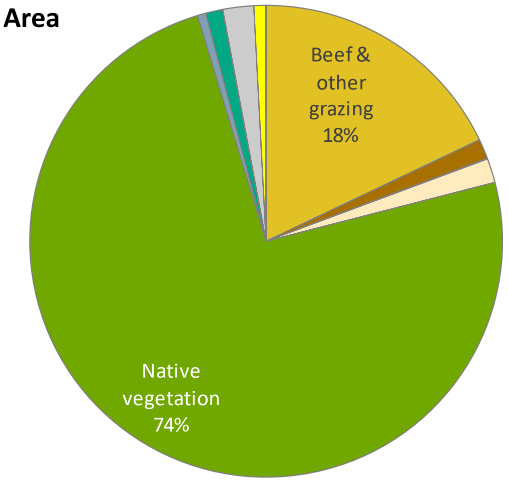
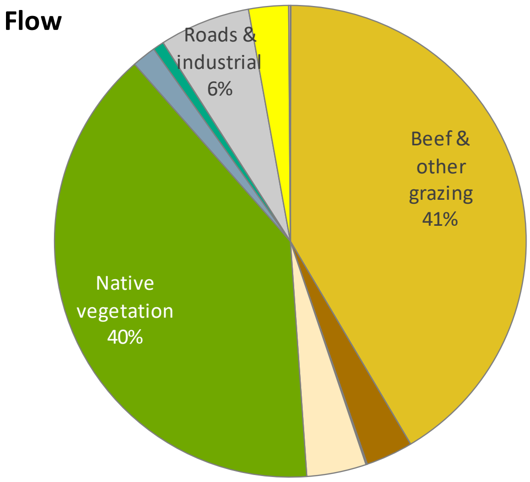


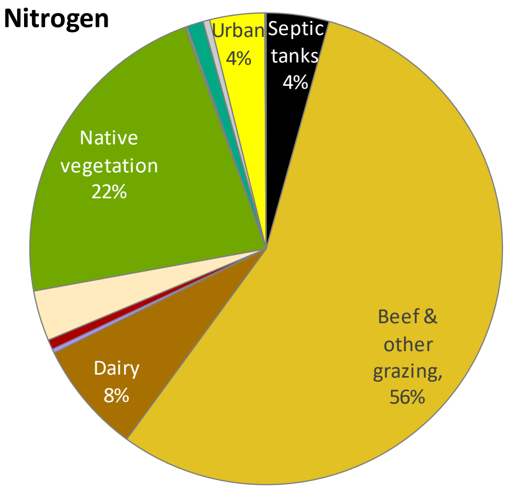

*Figure D.4: Land uses of the Lower Denmark reporting catchment*

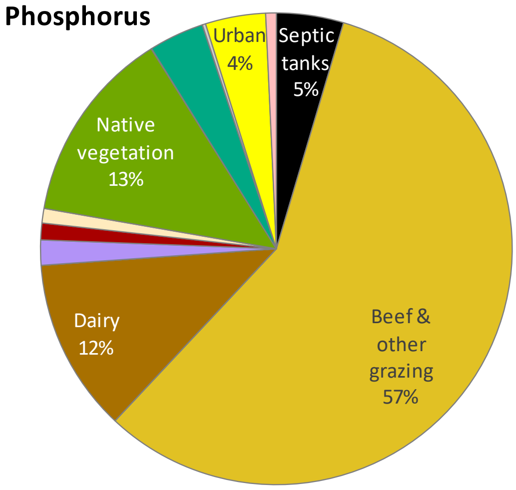
Lower Denmark River source separation

| Landuse name | Colour | Area (ha) | Area (%) | Flow (ML/yr) | Flow (%) | Nitrogen (kg/yr) | Nitrogen (%) | Phosphorus (kg/yr) | Phosphorus (%) |
|---|---|---|---|---|---|---|---|---|---|
| Septic tanks | | 293 | - | 3 | 0% | 335 | 4% | 10 | 5% |
| Beef & other grazing | | 2 869 | 18% | 3 726 | 41% | 4 340 | 56% | 120 | 57% |
| Cropping | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Dairy | | 217 | 1% | 291 | 3% | 597 | 8% | 25 | 12% |
| Horses | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Horticulture | | 2 | 0% | 3 | 0% | 21 | 0% | 4 | 2% |
| Intensive animal use | | 5 | 0% | 5 | 0% | 52 | 1% | 2 | 1% |
| Lifestyle block | | 266 | 2% | 367 | 4% | 269 | 3% | 2 | 1% |
| Native vegetation | | 11 893 | 74% | 3 564 | 40% | 1 736 | 22% | 28 | 13% |
| Other landuses | | 93 | 1% | 148 | 2% | 11 | 0% | 0 | 0% |
| Plantation | | 186 | 1% | 68 | 1% | 87 | 1% | 8 | 4% |
| Point source | | 1 | 0% | 0 | 0% | 1 | 0% | 0 | 0% |
| Roads & industrial | | 338 | 2% | 559 | 6% | 36 | 0% | 0 | 0% |
| Urban | | 126 | 1% | 246 | 3% | 292 | 4% | 9 | 4% |
| Viticulture & orchards | | 8 | 0% | 10 | 0% | 7 | 0% | 2 | 1% |
| Total: Generated by catchment | | 16 002 | 100% | 8 992 | 100% | 7 785 | 100% | 209 | 100% |
| Removal (-) or gain (+) | | - | | - 601 | -7% | - 294 | -4% | - 9 | -4% |
| Total: Leaving catchment | | 16 002 | 100% | 8 391 | 93% | 7 491 | 96% | 200 | 96% |



# D.5 Upper Denmark

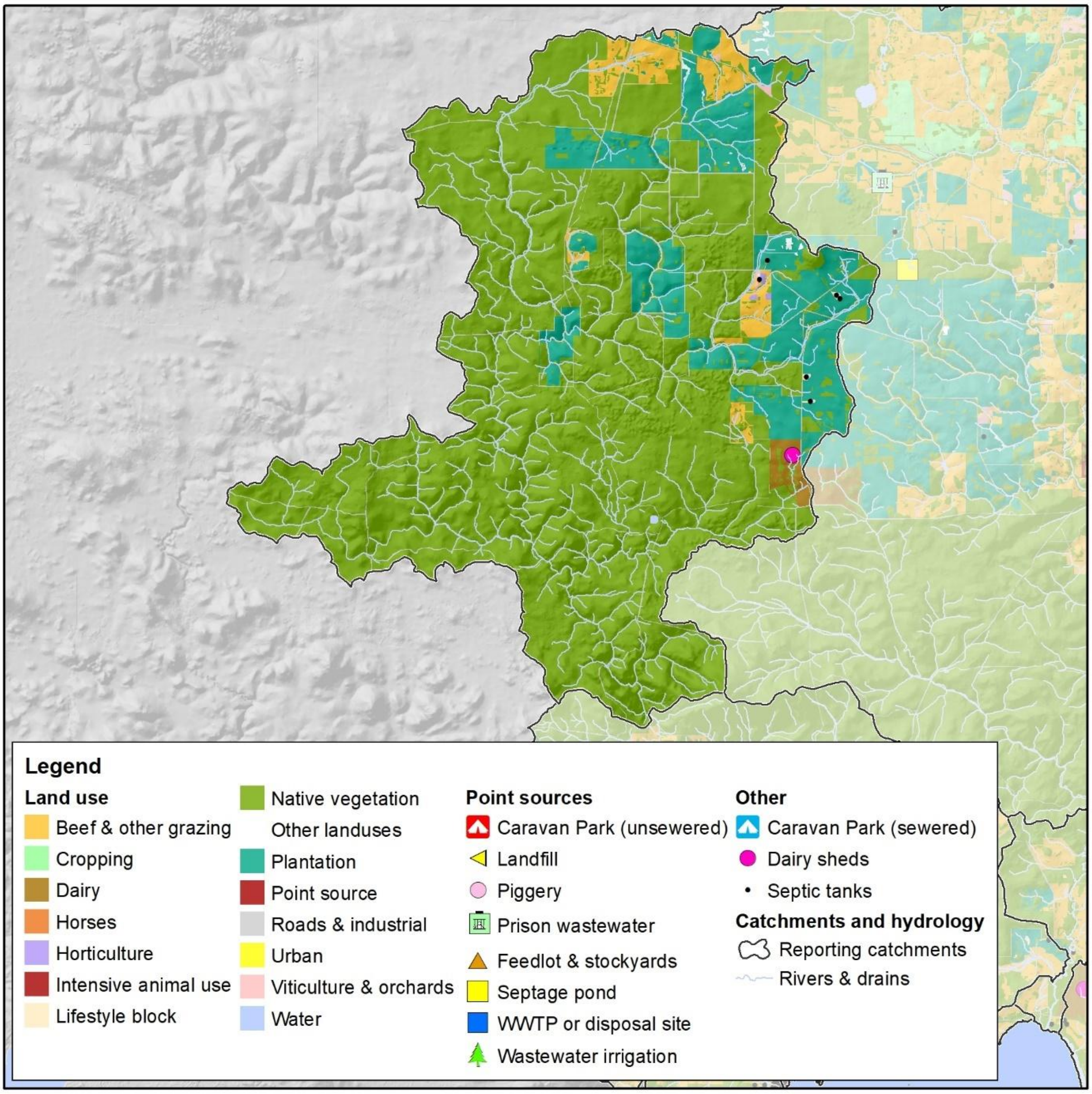
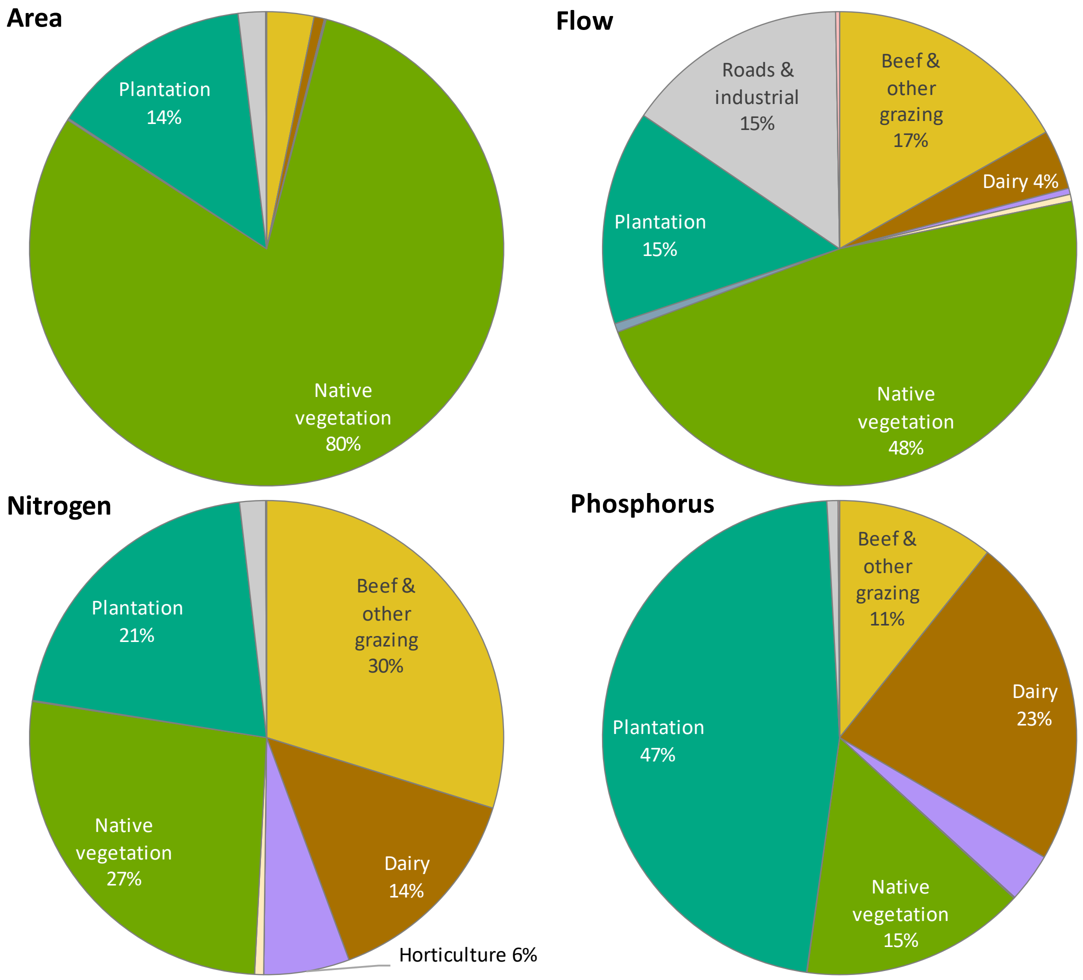



*Figure D.5: Land uses of the Upper Denmark reporting catchment*

Upper Denmark River source separation

| Landuse name | Colour | Area (ha) | Area (%) | Flow (ML/yr) | Flow (%) | Nitrogen (kg/yr) | Nitrogen (%) | Phosphorus (kg/yr) | Phosphorus (%) |
|---|---|---|---|---|---|---|---|---|---|
| Septic tanks | | 6 | - | 0 | 0% | 0 | 0% | 0 | 0% |
| Beef & other grazing | | 1 432 | 3% | 900 | 17% | 1 383 | 30% | 15 | 11% |
| Cropping | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Dairy | | 314 | 1% | 218 | 4% | 674 | 15% | 32 | 23% |
| Horses | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Horticulture | | 24 | 0% | 22 | 0% | 271 | 6% | 5 | 3% |
| Intensive animal use | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Lifestyle block | | 26 | 0% | 25 | 0% | 28 | 1% | 0 | 0% |
| Native vegetation | | 35 564 | 80% | 2 541 | 48% | 1 235 | 27% | 22 | 15% |
| Other landuses | | 53 | 0% | 32 | 1% | 3 | 0% | 0 | 0% |
| Plantation | | 6 131 | 14% | 783 | 15% | 958 | 21% | 66 | 47% |
| Point source | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Roads & industrial | | 829 | 2% | 814 | 15% | 82 | 2% | 1 | 1% |
| Urban | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Viticulture & orchards | | 27 | 0% | 15 | 0% | 3 | 0% | 0 | 0% |
| Total: Generated by catchment | | 44 399 | 100% | 5 350 | 100% | 4 639 | 100% | 141 | 100% |
| Removal (-) or gain (+) | | - | | 0 | 0% | 0 | 0% | 0 | 0% |
| Total: Leaving catchment | | 44 399 | 100% | 5 350 | 100% | 4 639 | 100% | 141 | 100% |



## D.6 Scotsdale Brook

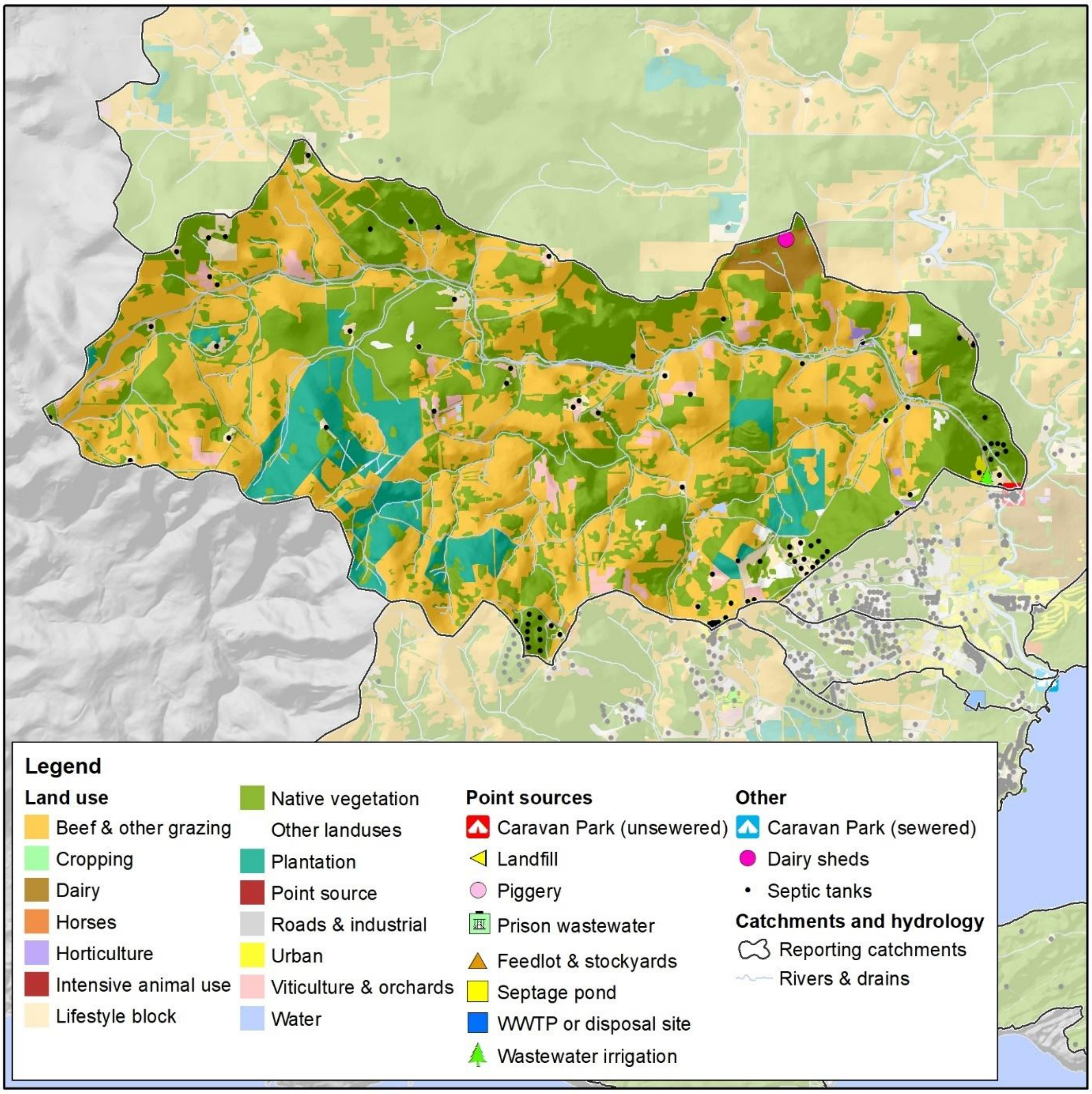
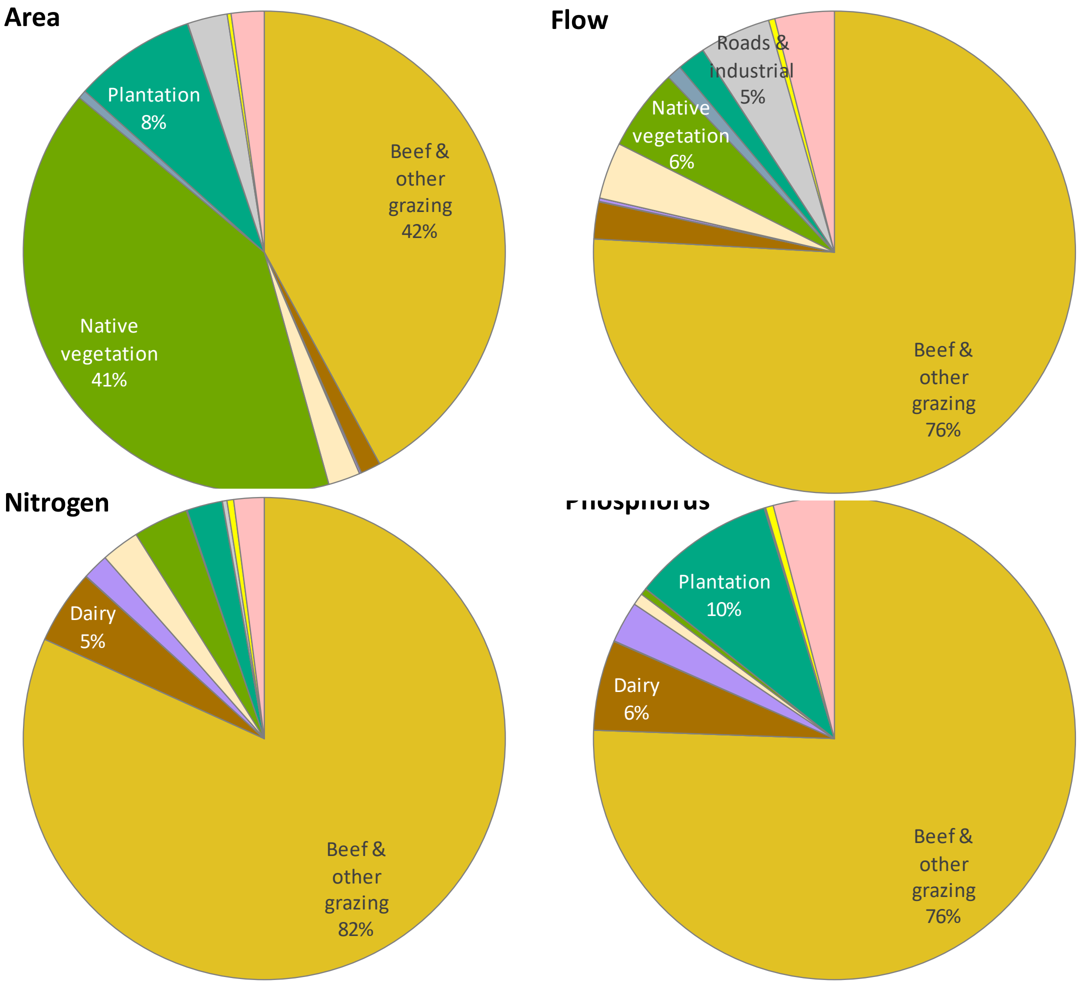



*Figure D.6: Land uses of the Scotsdale Brook reporting catchment*

Scotsdale Brook source separation

| Landuse name | Colour | Area (ha) | (%) | Flow (ML/yr) | (%) | Nitrogen (kg/yr) | (%) | Phosphorus (kg/yr) | (%) |
|---|---|---|---|---|---|---|---|---|---|
| Septic tanks | | 100 | - | 0 | 0% | 0 | 0% | 0 | 0% |
| Beef & other grazing | | 2 786 | 42% | 8 442 | 76% | 9 526 | 82% | 369 | 76% |
| Cropping | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Dairy | | 89 | 1% | 276 | 2% | 579 | 5% | 30 | 6% |
| Horses | | 1 | 0% | 4 | 0% | 3 | 0% | 0 | 0% |
| Horticulture | | 8 | 0% | 25 | 0% | 204 | 2% | 14 | 3% |
| Intensive animal use | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Lifestyle block | | 142 | 2% | 423 | 4% | 297 | 3% | 4 | 1% |
| Native vegetation | | 2 677 | 40% | 613 | 6% | 430 | 4% | 2 | 0% |
| Other landuses | | 37 | 1% | 111 | 1% | 7 | 0% | 0 | 0% |
| Plantation | | 543 | 8% | 210 | 2% | 277 | 2% | 47 | 10% |
| Point source | | 2 | 0% | 1 | 0% | 2 | 0% | 0 | 0% |
| Roads & industrial | | 177 | 3% | 532 | 5% | 35 | 0% | 0 | 0% |
| Urban | | 17 | 0% | 47 | 0% | 52 | 0% | 3 | 1% |
| Viticulture & orchards | | 146 | 2% | 443 | 4% | 237 | 2% | 20 | 4% |
| Total: Generated by catchment | | 6 626 | 100% | 11 126 | 100% | 11 651 | 100% | 488 | 100% |
| Removal (-) or gain (+) | | - | | 0 | 0% | 0 | 0% | 0 | 0% |
| Total: Leaving catchment | | 6 626 | 100% | 11 126 | 100% | 11 651 | 100% | 488 | 100% |



# D.7 Foreshore

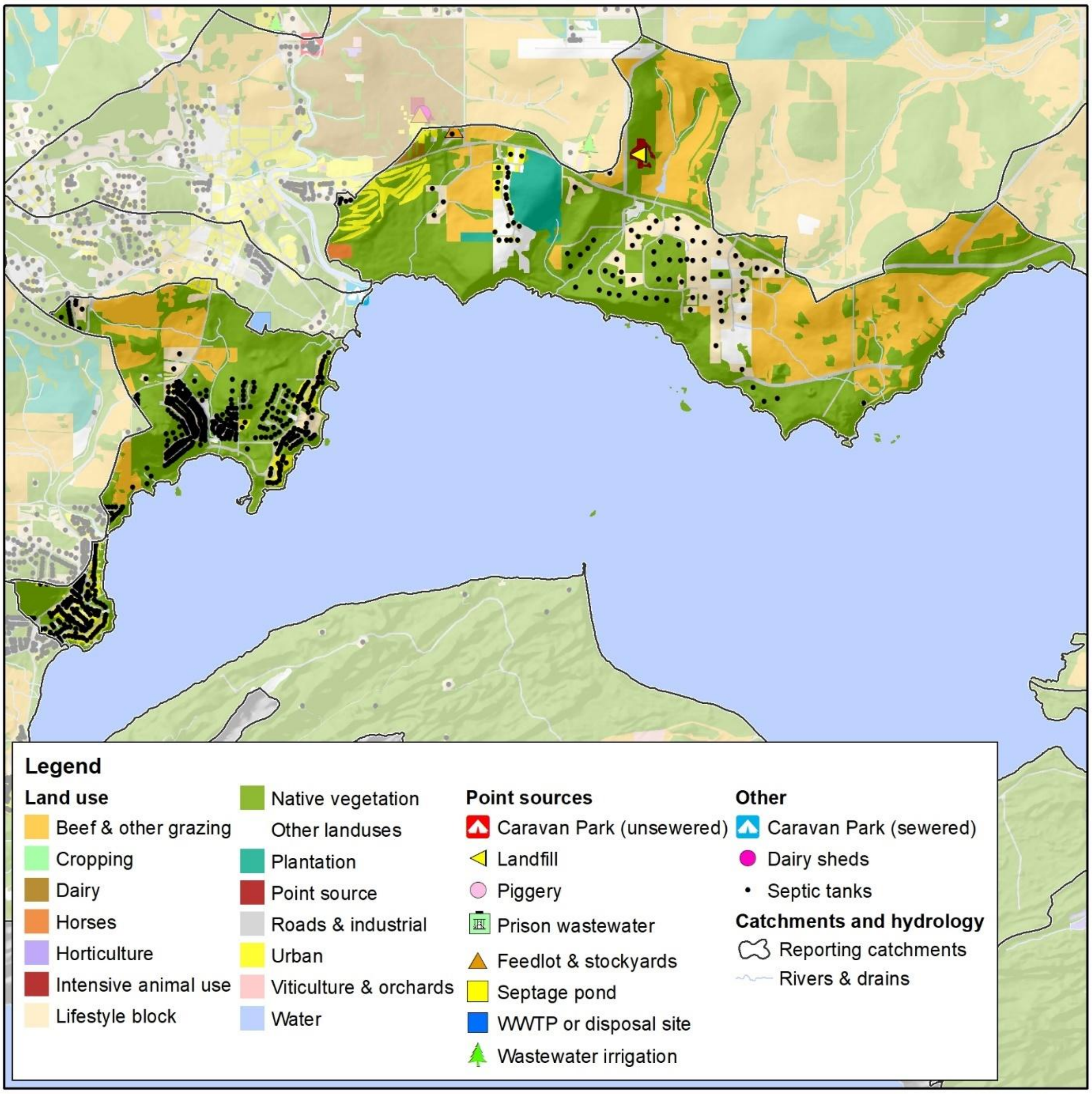
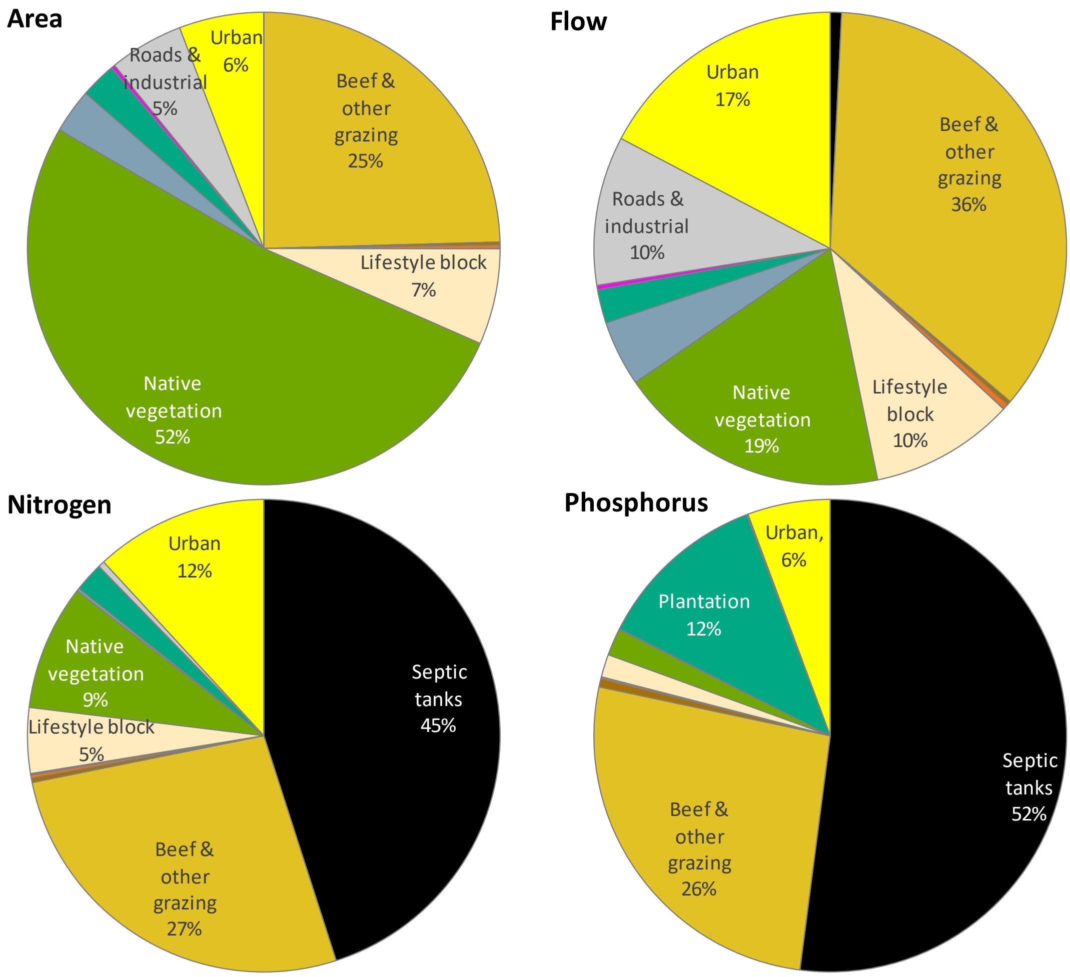



*Figure D.7: Land uses of the Foreshore reporting catchment*

Foreshore source separation

| Landuse name | Colour | Area | | Flow | | Nitrogen | | Phosphorus | |
|---|---|---|---|---|---|---|---|---|---|
| | | (ha) | (%) | (ML/yr) | (%) | (kg/yr) | (%) | (kg/yr) | (%) |
| Septic tanks | | 688 | - | 18 | 1% | 1 747 | 45% | 105 | 52% |
| Beef & other grazing | | 490 | 25% | 831 | 35% | 1 038 | 27% | 53 | 26% |
| Cropping | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Dairy | | 4 | 0% | 6 | 0% | 11 | 0% | 1 | 1% |
| Horses | | 5 | 0% | 9 | 0% | 9 | 0% | 0 | 0% |
| Horticulture | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Intensive animal use | | 0 | 0% | 0 | 0% | 3 | 0% | 0 | 0% |
| Lifestyle block | | 131 | 7% | 232 | 10% | 174 | 4% | 3 | 2% |
| Native vegetation | | 1 034 | 52% | 437 | 19% | 333 | 9% | 4 | 2% |
| Other landuses | | 61 | 3% | 105 | 4% | 8 | 0% | 0 | 0% |
| Plantation | | 49 | 2% | 54 | 2% | 77 | 2% | 24 | 12% |
| Point source | | 5 | 0% | 7 | 0% | 0 | 0% | 0 | 0% |
| Roads & industrial | | 102 | 5% | 239 | 10% | 17 | 0% | 0 | 0% |
| Urban | | 116 | 6% | 405 | 17% | 460 | 12% | 11 | 6% |
| Viticulture & orchards | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Total: Generated by catchment | | 1 996 | 100% | 2 344 | 100% | 3 878 | 100% | 202 | 100% |
| Removal (-) or gain (+) | | - | | 0 | 0% | 0 | 0% | 0 | 0% |
| Total: Leaving catchment | | 1 996 | 100% | 2 344 | 100% | 3 878 | 100% | 202 | 100% |



# D.8 Sunny Glen Creek

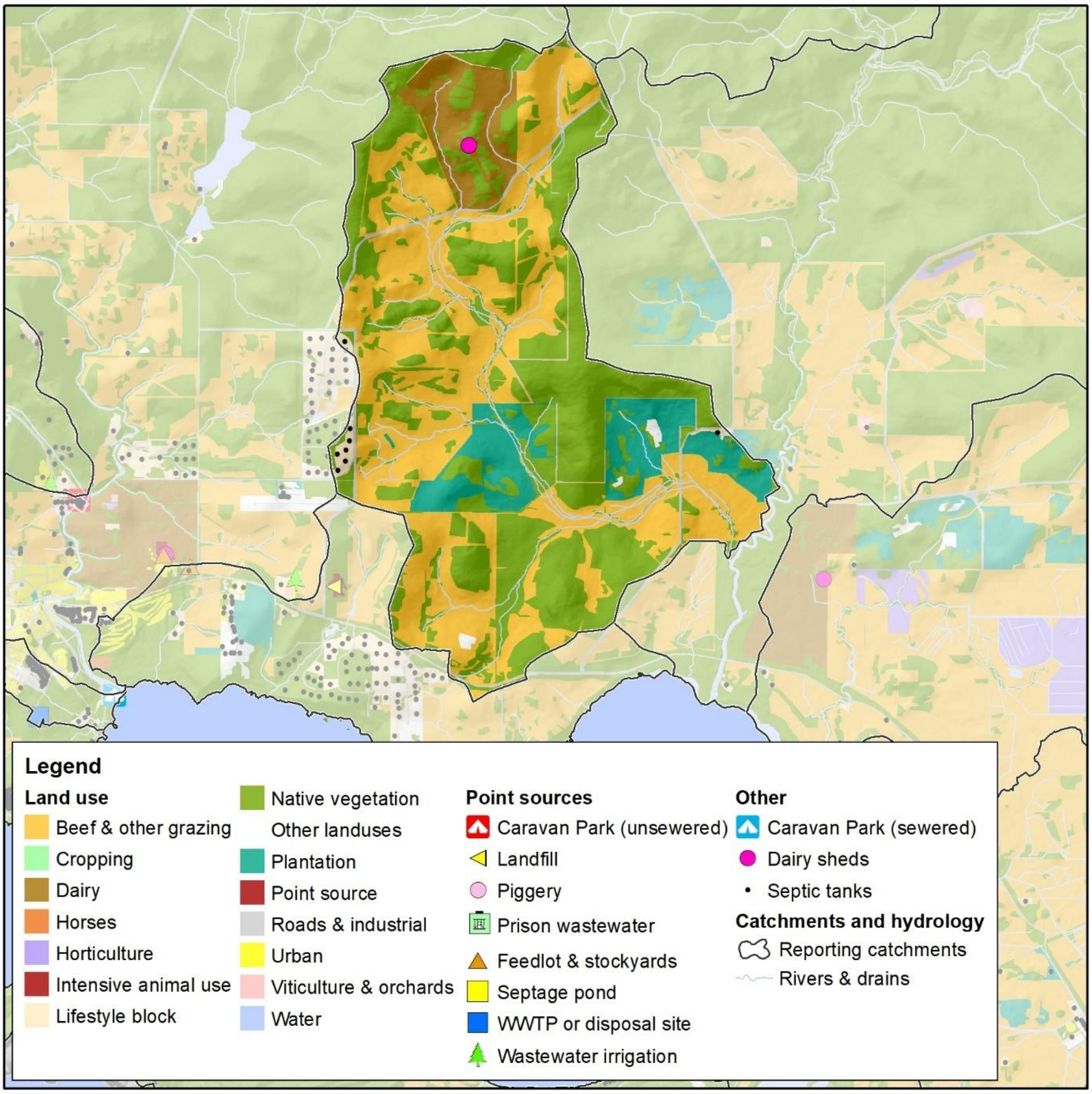
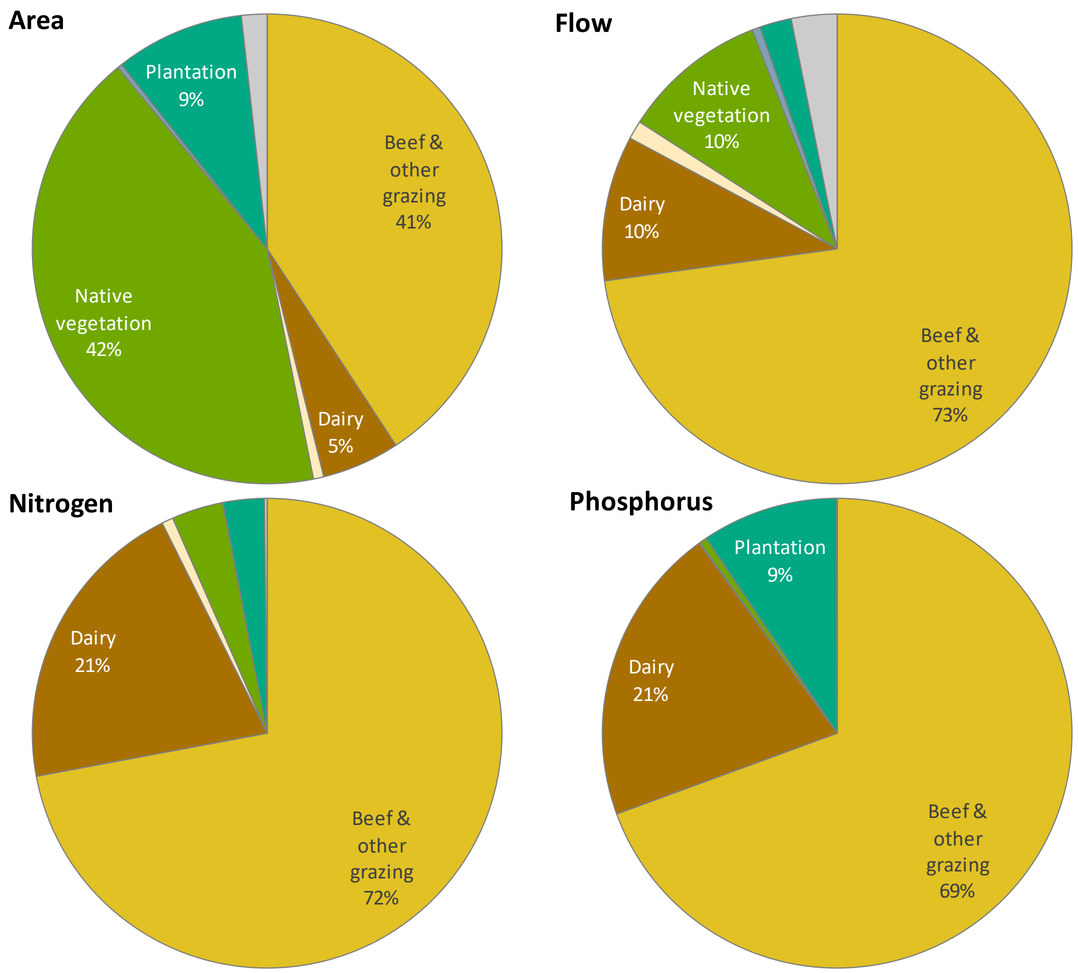



*Figure D.8: Land uses of the Sunny Glen Creek reporting catchment*

Sunny Glen Creek source separation

| Landuse name | Colour | Area | | Flow | | Nitrogen | | Phosphorus | |
|---|---|---|---|---|---|---|---|---|---|
| | | (ha) | (%) | (ML/yr) | (%) | (kg/yr) | (%) | (kg/yr) | (%) |
| Septic tanks | | 8 | - | 0 | 0% | 0 | 0% | 0 | 0% |
| Beef & other grazing | | 1 457 | 41% | 1 536 | 73% | 3 156 | 72% | 477 | 69% |
| Cropping | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Dairy | | 192 | 5% | 211 | 10% | 900 | 21% | 142 | 21% |
| Horses | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Horticulture | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Intensive animal use | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Lifestyle block | | 25 | 1% | 27 | 1% | 34 | 1% | 0 | 0% |
| Native vegetation | | 1 509 | 42% | 211 | 10% | 155 | 4% | 4 | 1% |
| Other landuses | | 11 | 0% | 12 | 1% | 1 | 0% | 0 | 0% |
| Plantation | | 318 | 9% | 46 | 2% | 124 | 3% | 64 | 9% |
| Point source | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Roads & industrial | | 63 | 2% | 66 | 3% | 8 | 0% | 0 | 0% |
| Urban | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Viticulture & orchards | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Total: Generated by catchment | | 3 575 | 100% | 2 109 | 100% | 4 379 | 100% | 687 | 100% |
| Removal (-) or gain (+) | | - | | 0 | 0% | 0 | 0% | 0 | 0% |
| Total: Leaving catchment | | 3 575 | 100% | 2 109 | 100% | 4 379 | 100% | 687 | 100% |



# D.9 Lower Hay River

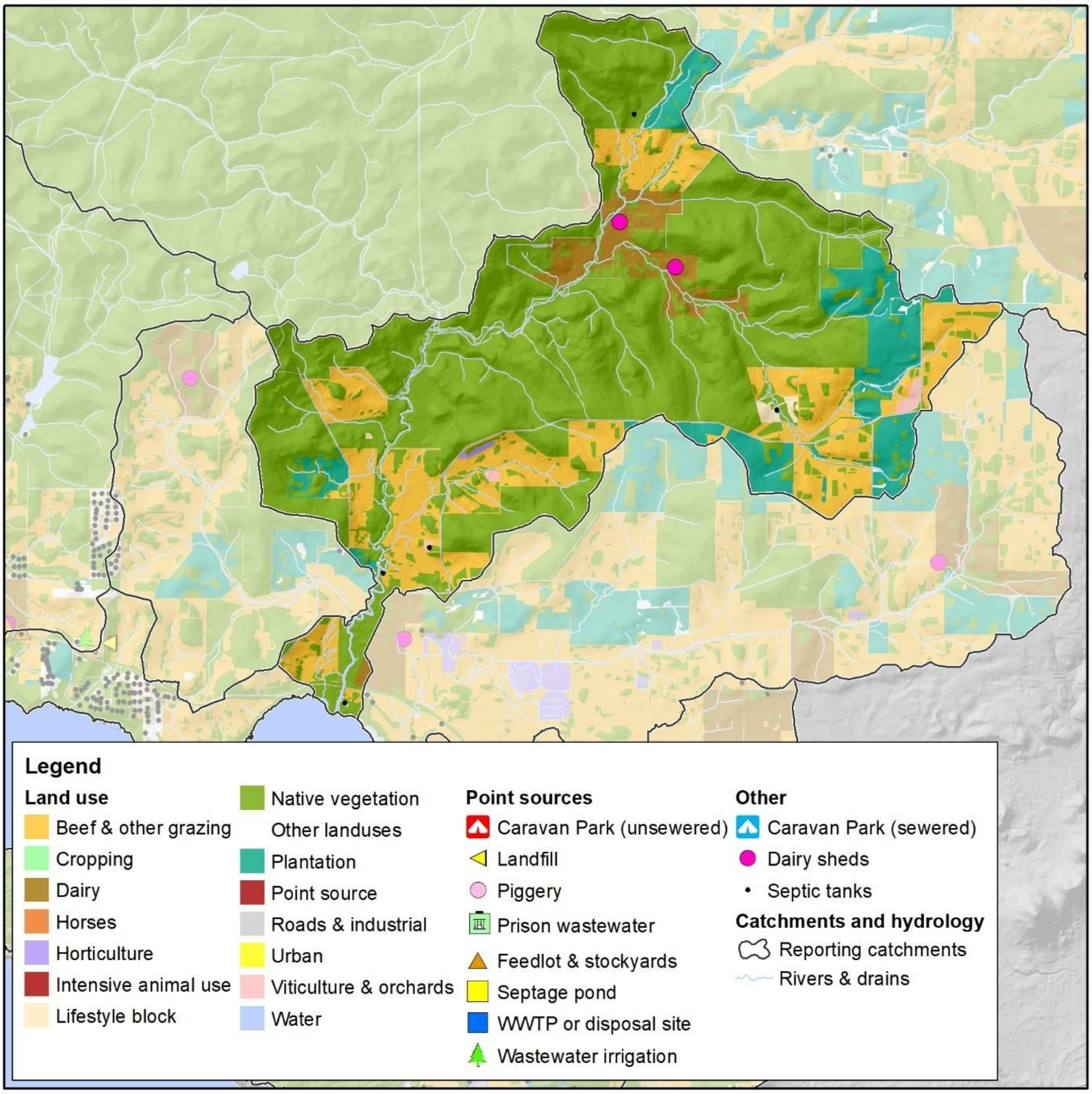
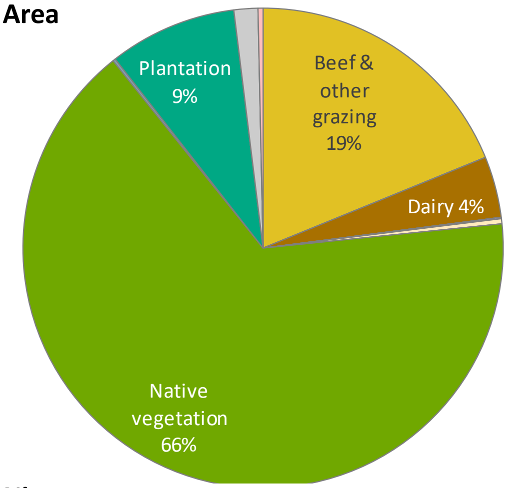
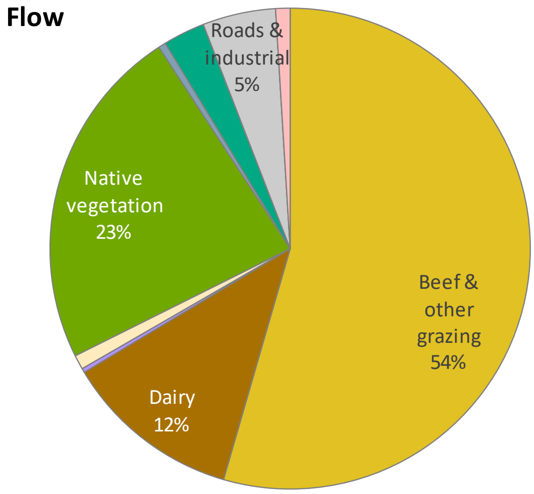


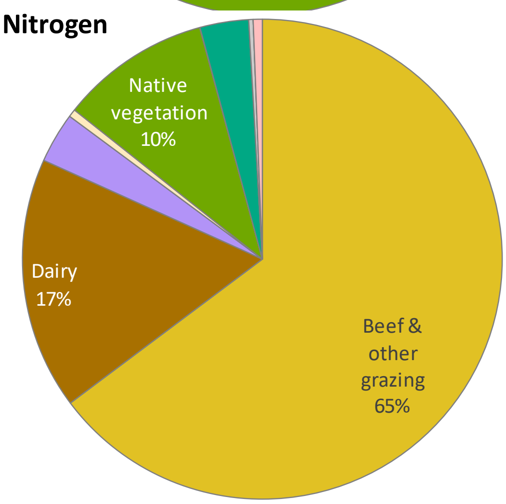

*Figure D.9: Land uses of the Lower Hay River reporting catchment*

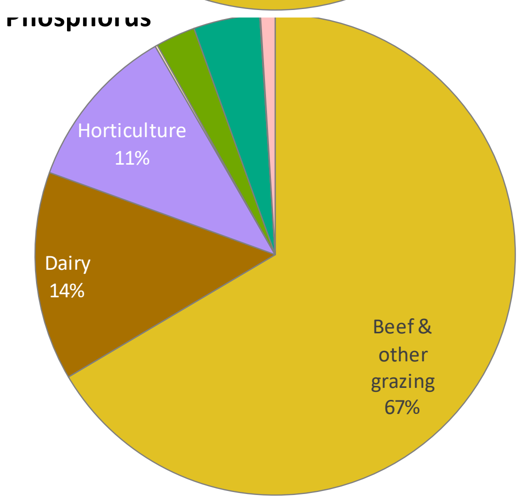
Lower Hay River source separation

| Landuse name | Colour | Area | | Flow | | Nitrogen | | Phosphorus | |
|---|---|---|---|---|---|---|---|---|---|
| | | (ha) | (%) | (ML/yr) | (%) | (kg/yr) | (%) | (kg/yr) | (%) |
| Septic tanks | | 5 | - | 0 | 0% | 0 | 0% | 0 | 0% |
| Beef & other grazing | | 2 290 | 19% | 2 341 | 54% | 3 486 | 65% | 374 | 67% |
| Cropping | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Dairy | | 501 | 4% | 512 | 12% | 914 | 17% | 79 | 14% |
| Horses | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Horticulture | | 11 | 0% | 12 | 0% | 183 | 3% | 63 | 11% |
| Intensive animal use | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Lifestyle block | | 41 | 0% | 42 | 1% | 28 | 1% | 1 | 0% |
| Native vegetation | | 8 012 | 66% | 995 | 23% | 544 | 10% | 15 | 3% |
| Other landuses | | 22 | 0% | 21 | 0% | 1 | 0% | 0 | 0% |
| Plantation | | 1 048 | 9% | 121 | 3% | 176 | 3% | 25 | 4% |
| Point source | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Roads & industrial | | 196 | 2% | 211 | 5% | 16 | 0% | 0 | 0% |
| Urban | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Viticulture & orchards | | 41 | 0% | 42 | 1% | 33 | 1% | 6 | 1% |
| Total: Generated by catchment | | 12 162 | 100% | 4 298 | 100% | 5 382 | 100% | 563 | 100% |
| Removal (-) or gain (+) | | - | | 0 | 0% | 0 | 0% | 0 | 0% |
| Total: Leaving catchment | | 12 162 | 100% | 4 298 | 100% | 5 382 | 100% | 563 | 100% |



# D.10 Upper Hay River

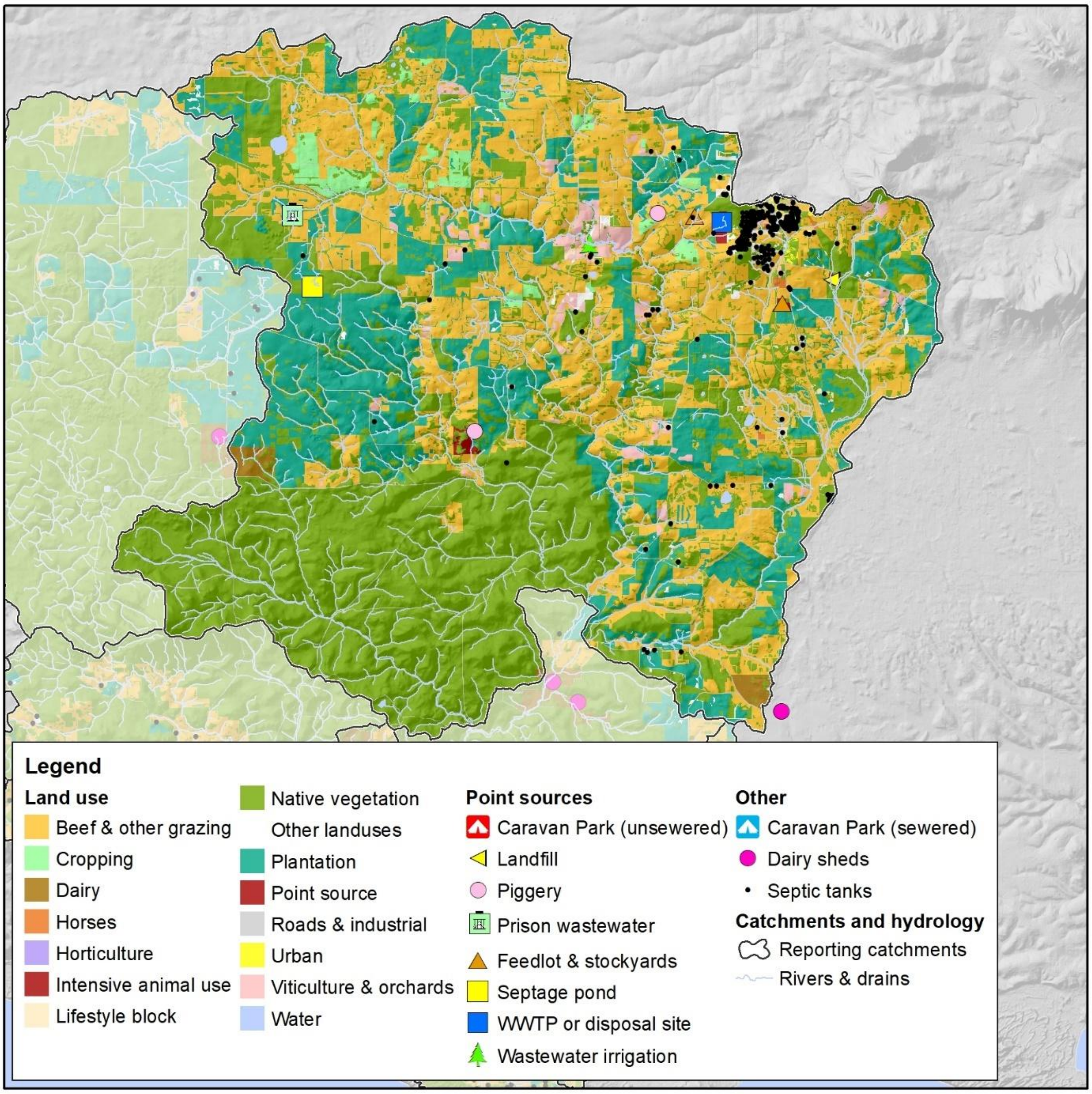
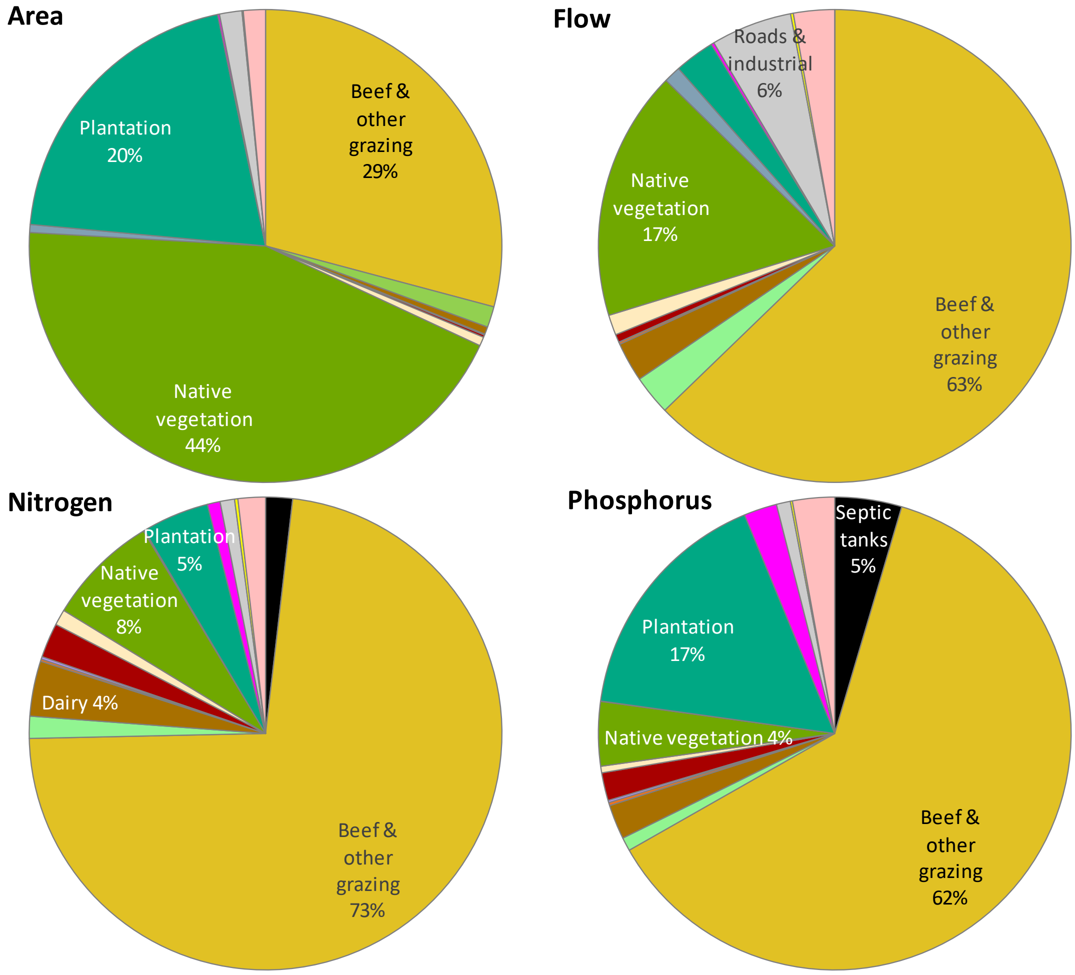



*Figure D.10: Land uses of the Upper Hay River reporting catchment*

Upper Hay River source separation

| Landuse name | Colour | Area (ha) | Area (%) | Flow (ML/yr) | Flow (%) | Nitrogen (kg/yr) | Nitrogen (%) | Phosphorus (kg/yr) | Phosphorus (%) |
|---|---|---|---|---|---|---|---|---|---|
| Septic tanks | | 327 | - | 4 | 0% | 378 | 2% | 22 | 5% |
| Beef & other grazing | | 32 698 | 29% | 13 378 | 63% | 14 973 | 73% | 293 | 62% |
| Cropping | | 1 601 | 1% | 578 | 3% | 310 | 2% | 4 | 1% |
| Dairy | | 568 | 1% | 573 | 3% | 776 | 4% | 11 | 2% |
| Horses | | 71 | 0% | 31 | 0% | 31 | 0% | 1 | 0% |
| Horticulture | | 10 | 0% | 4 | 0% | 35 | 0% | 1 | 0% |
| Intensive animal use | | 181 | 0% | 116 | 1% | 486 | 2% | 9 | 2% |
| Lifestyle block | | 687 | 1% | 295 | 1% | 222 | 1% | 2 | 0% |
| Native vegetation | | 49 342 | 44% | 3 643 | 17% | 1 573 | 8% | 21 | 4% |
| Other landuses | | 609 | 1% | 247 | 1% | 17 | 0% | 0 | 0% |
| Plantation | | 22 763 | 20% | 585 | 3% | 945 | 5% | 78 | 17% |
| Point source | | 145 | 0% | 45 | 0% | 180 | 1% | 11 | 2% |
| Roads & industrial | | 1 717 | 2% | 1 182 | 6% | 203 | 1% | 5 | 1% |
| Urban | | 97 | 0% | 41 | 0% | 47 | 0% | 1 | 0% |
| Viticulture & orchards | | 1 693 | 2% | 598 | 3% | 385 | 2% | 14 | 3% |
| Total: Generated by catchment | | 112 181 | 100% | 21 318 | 100% | 20 561 | 100% | 472 | 100% |
| Removal (-) or gain (+) | | - | | 0 | 0% | 0 | 0% | 0 | 0% |
| Total: Leaving catchment | | 112 181 | 100% | 21 318 | 100% | 20 561 | 100% | 472 | 100% |



# D.11 Sleeman River

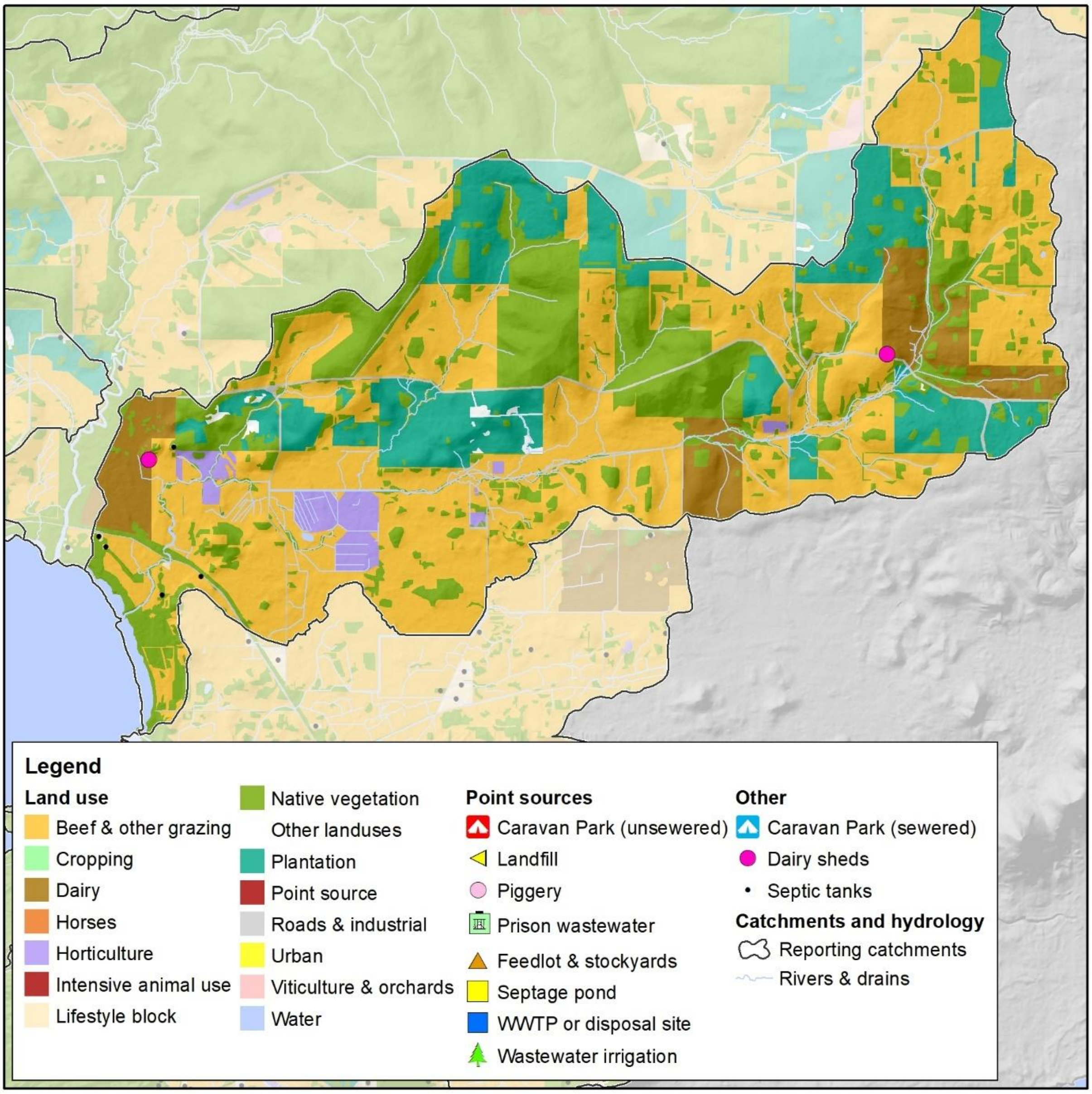
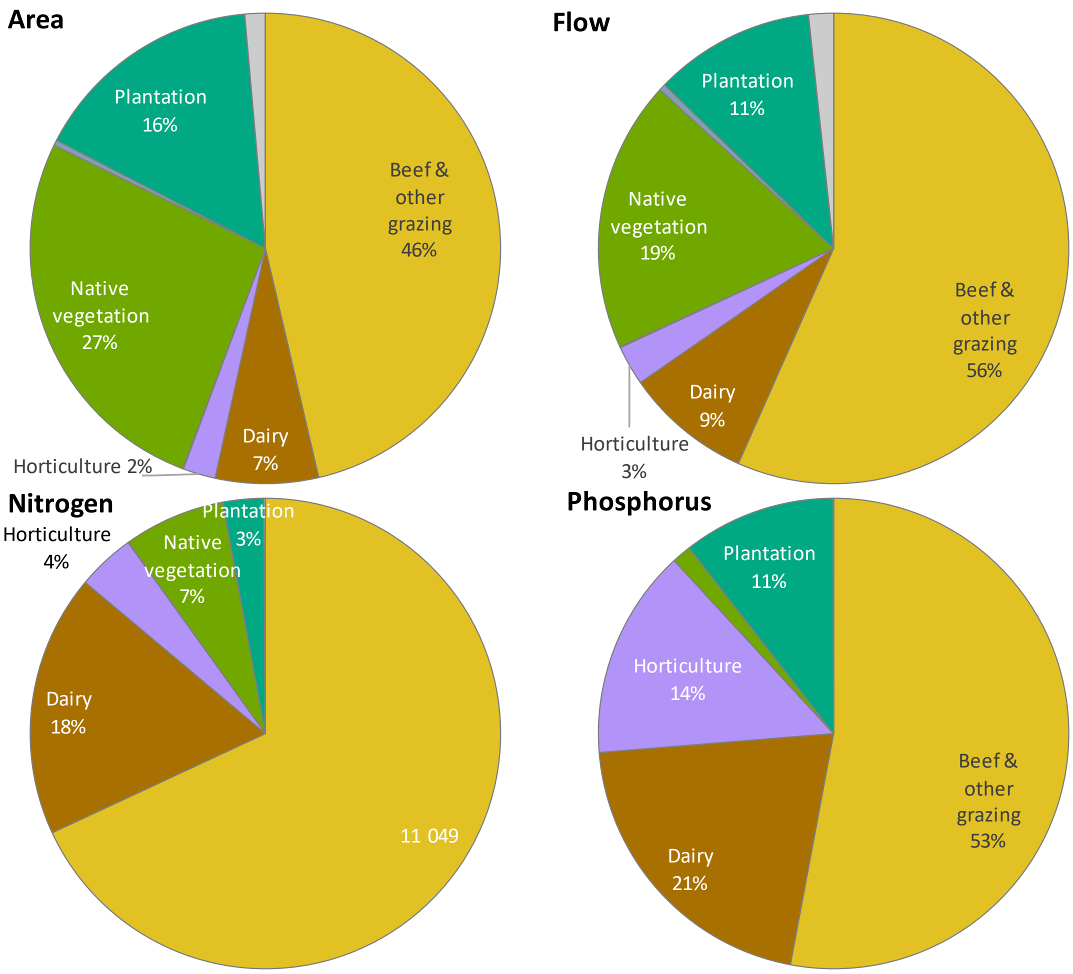



*Figure D.11: Land uses of the Sleeman River reporting catchment*

Sleeman River source separation

| Landuse name | Colour | Area (ha) | Area (%) | Flow (ML/yr) | Flow (%) | Nitrogen (kg/yr) | Nitrogen (%) | Phosphorus (kg/yr) | Phosphorus (%) |
|---|---|---|---|---|---|---|---|---|---|
| Septic tanks | | 5 | - | 0 | 0% | 0 | 0% | 0 | 0% |
| Beef & other grazing | | 4 374 | 46% | 5 231 | 57% | 11 049 | 68% | 1 110 | 53% |
| Cropping | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Dairy | | 668 | 7% | 804 | 9% | 2 928 | 18% | 436 | 21% |
| Horses | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Horticulture | | 211 | 2% | 252 | 3% | 644 | 4% | 303 | 14% |
| Intensive animal use | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Lifestyle block | | 5 | 0% | 6 | 0% | 7 | 0% | 0 | 0% |
| Native vegetation | | 2 501 | 27% | 1 722 | 19% | 1 128 | 7% | 28 | 1% |
| Other landuses | | 35 | 0% | 42 | 0% | 5 | 0% | 0 | 0% |
| Plantation | | 1 509 | 16% | 1 021 | 11% | 451 | 3% | 220 | 10% |
| Point source | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Roads & industrial | | 132 | 1% | 158 | 2% | 20 | 0% | 1 | 0% |
| Urban | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Viticulture & orchards | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Total: Generated by catchment | | 9 435 | 100% | 9 236 | 100% | 16 232 | 100% | 2 097 | 100% |
| Removal (-) or gain (+) | | - | | 0 | 0% | 0 | 0% | 0 | 0% |
| Total: Leaving catchment | | 9 435 | 100% | 9 236 | 100% | 16 232 | 100% | 2 097 | 100% |



# D.12 Cuppup Creek

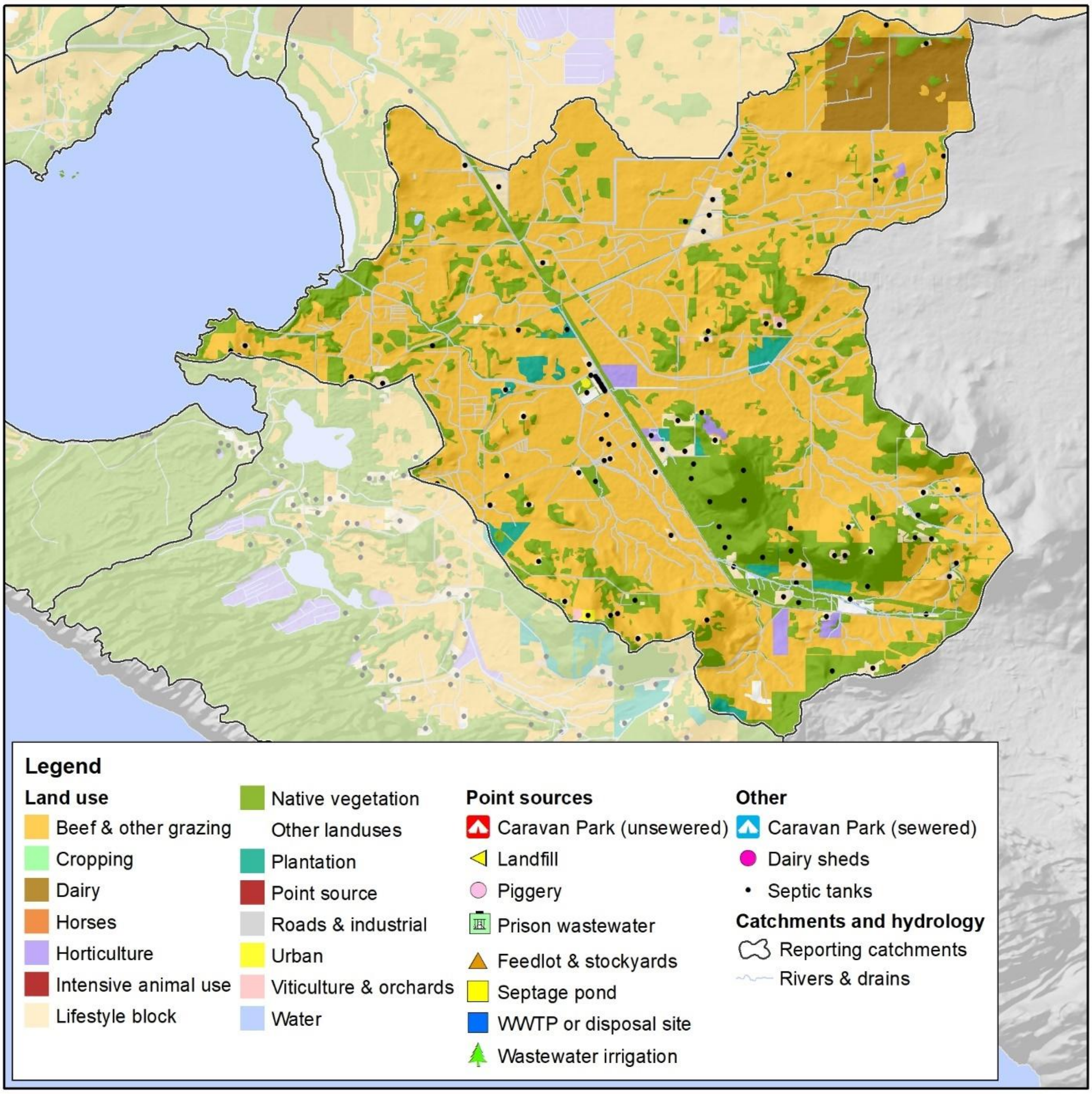
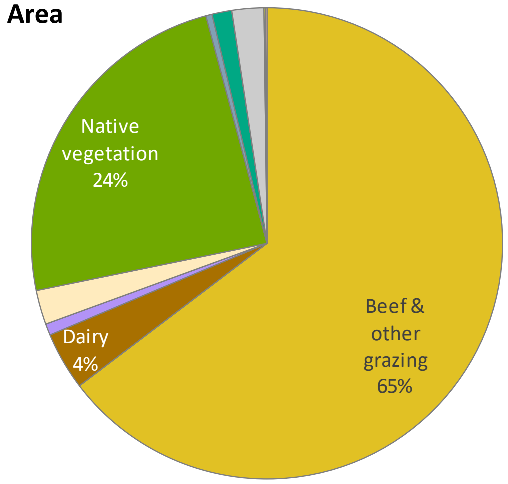
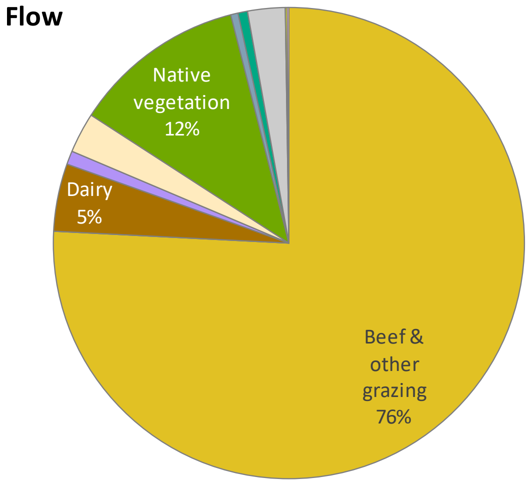


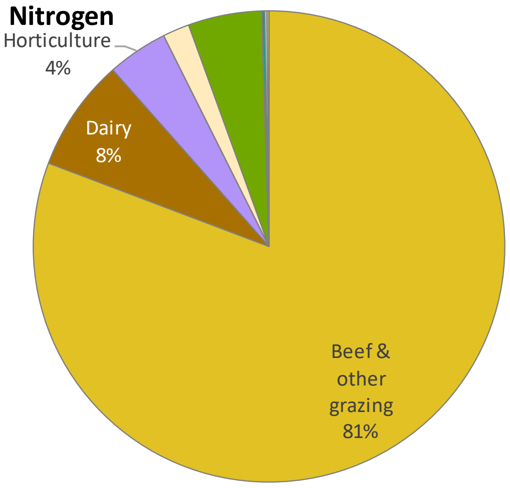

*Figure D.12: Land uses of the Cuppup Creek reporting catchment*

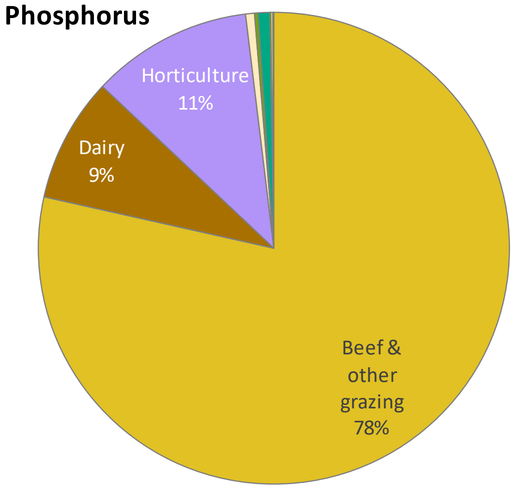
Cuppup Creek source separation

| Landuse name | Colour | Area (ha) | Area (%) | Flow (ML/yr) | Flow (%) | Nitrogen (kg/yr) | Nitrogen (%) | Phosphorus (kg/yr) | Phosphorus (%) |
|---|---|---|---|---|---|---|---|---|---|
| Septic tanks | | 109 | - | 0 | 0% | 0 | 0% | 0 | 0% |
| Beef & other grazing | | 4 461 | 65% | 7 735 | 76% | 15 389 | 81% | 2 201 | 78% |
| Cropping | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Dairy | | 274 | 4% | 473 | 5% | 1 472 | 8% | 239 | 9% |
| Horses | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Horticulture | | 54 | 1% | 95 | 1% | 790 | 4% | 310 | 11% |
| Intensive animal use | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Lifestyle block | | 162 | 2% | 282 | 3% | 349 | 2% | 17 | 1% |
| Native vegetation | | 1 658 | 24% | 1 213 | 12% | 958 | 5% | 7 | 0% |
| Other landuses | | 30 | 0% | 52 | 1% | 6 | 0% | 0 | 0% |
| Plantation | | 94 | 1% | 66 | 1% | 35 | 0% | 23 | 1% |
| Point source | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Roads & industrial | | 151 | 2% | 262 | 3% | 31 | 0% | 1 | 0% |
| Urban | | 7 | 0% | 12 | 0% | 23 | 0% | 4 | 0% |
| Viticulture & orchards | | 7 | 0% | 13 | 0% | 3 | 0% | 2 | 0% |
| Total: Generated by catchment | | 6 899 | 100% | 10 204 | 100% | 19 056 | 100% | 2 804 | 100% |
| Removal (-) or gain (+) | | - | | 0 | 0% | 0 | 0% | 0 | 0% |
| Total: Leaving catchment | | 6 899 | 100% | 10 204 | 100% | 19 056 | 100% | 2 804 | 100% |



# D.13 Lake Saide

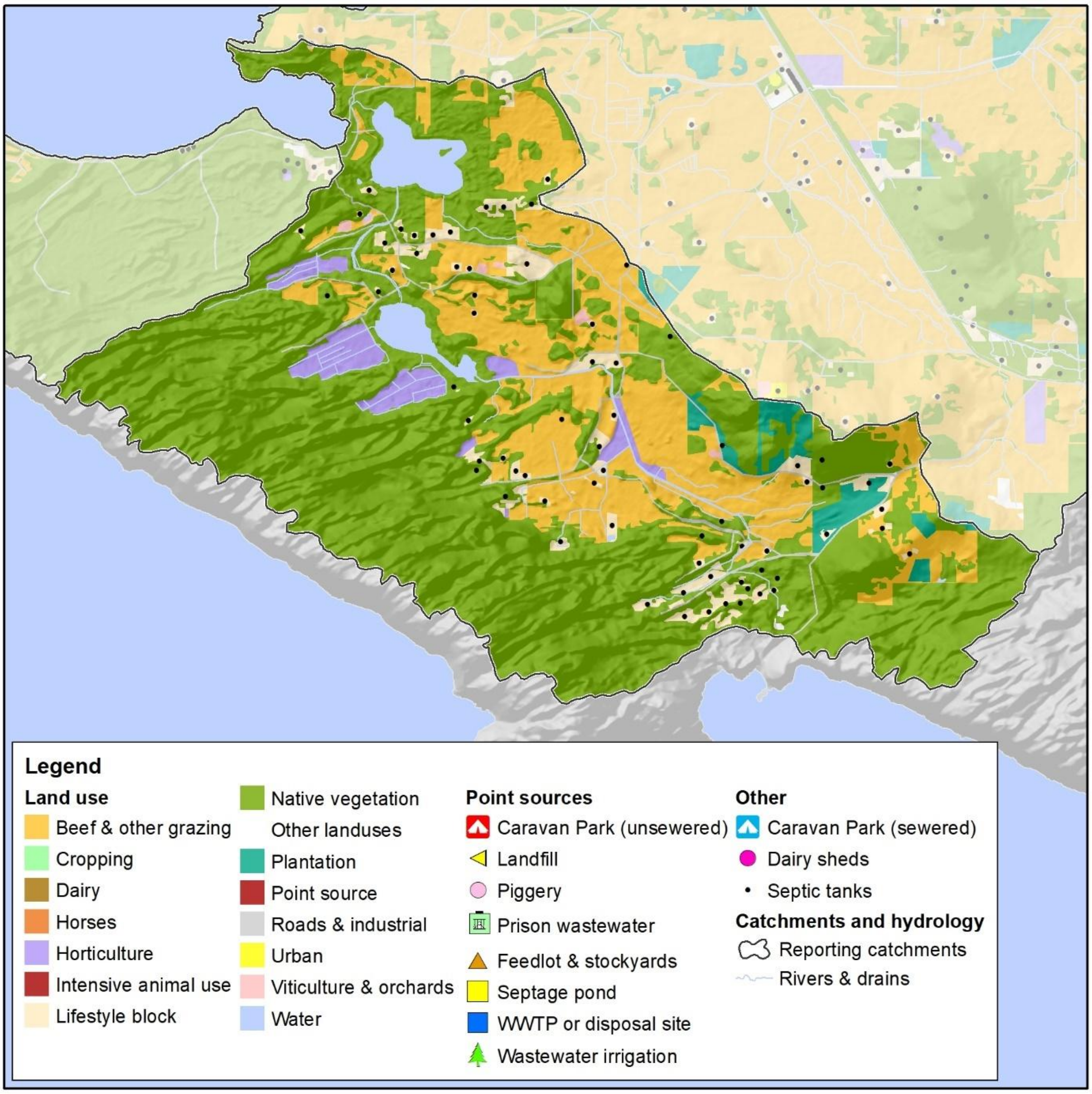
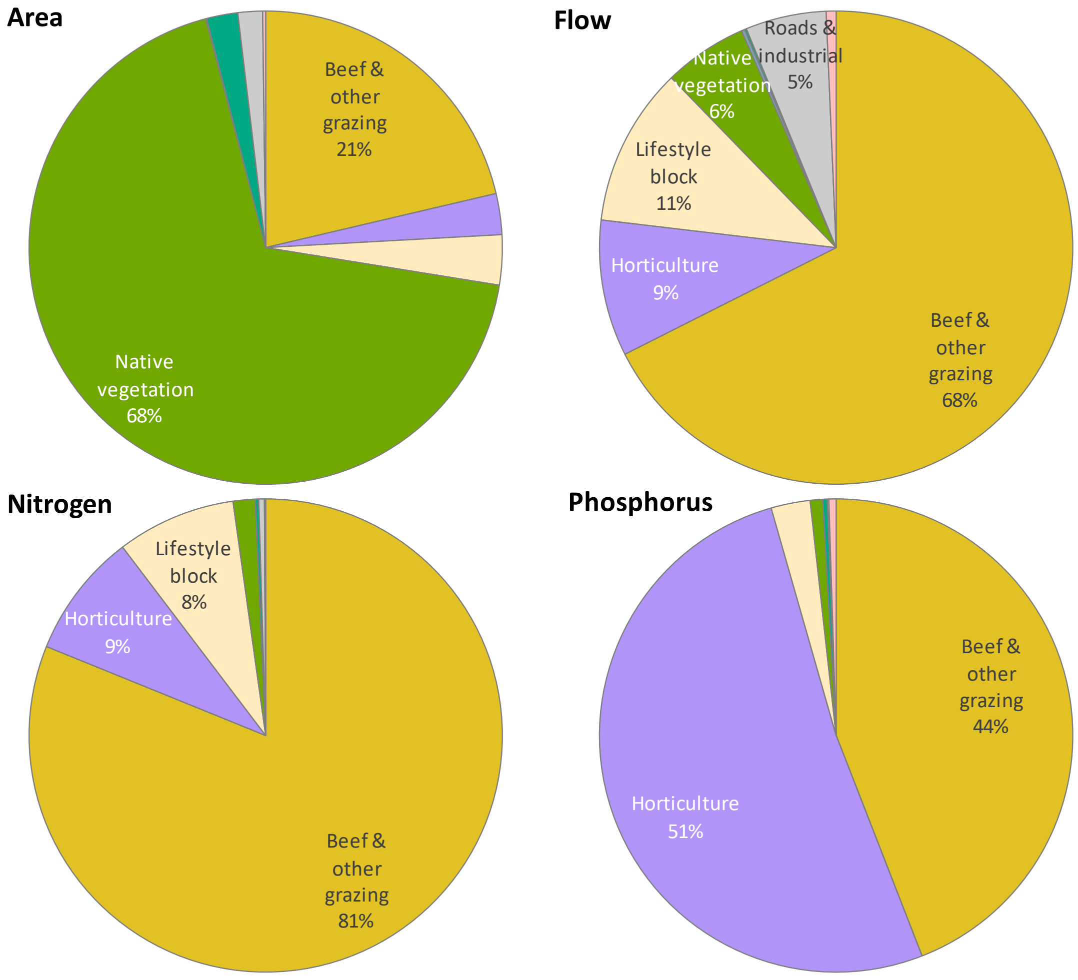



*Figure D.13: Land uses of the Lake Saide reporting catchment*

Lake Saide source separation

| Landuse name | Colour | Area (ha) | Area (%) | Flow (ML/yr) | Flow (%) | Nitrogen (kg/yr) | Nitrogen (%) | Phosphorus (kg/yr) | Phosphorus (%) |
|---|---|---|---|---|---|---|---|---|---|
| Septic tanks | | 71 | - | 0 | 0% | 0 | 0% | 0 | 0% |
| Beef & other grazing | | 841 | 21% | 1 098 | 68% | 3 731 | 81% | 112 | 44% |
| Cropping | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Dairy | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Horses | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Horticulture | | 110 | 3% | 151 | 9% | 392 | 9% | 131 | 51% |
| Intensive animal use | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Lifestyle block | | 135 | 3% | 177 | 11% | 374 | 8% | 7 | 3% |
| Native vegetation | | 2 696 | 68% | 93 | 6% | 69 | 2% | 2 | 1% |
| Other landuses | | 3 | 0% | 4 | 0% | 1 | 0% | 0 | 0% |
| Plantation | | 84 | 2% | 2 | 0% | 10 | 0% | 1 | 0% |
| Point source | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Roads & industrial | | 66 | 2% | 90 | 6% | 18 | 0% | 0 | 0% |
| Urban | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Viticulture & orchards | | 8 | 0% | 11 | 1% | 4 | 0% | 1 | 0% |
| Total: Generated by catchment | | 3 943 | 100% | 1 626 | 100% | 4 598 | 100% | 254 | 100% |
| Removal (-) or gain (+) | | - | | - 73 | -4% | -1 692 | -37% | - 161 | -63% |
| Total: Leaving catchment | | 3 943 | 100% | 1 553 | 96% | 2 906 | 63% | 94 | 37% |



# D.14 Nullaki

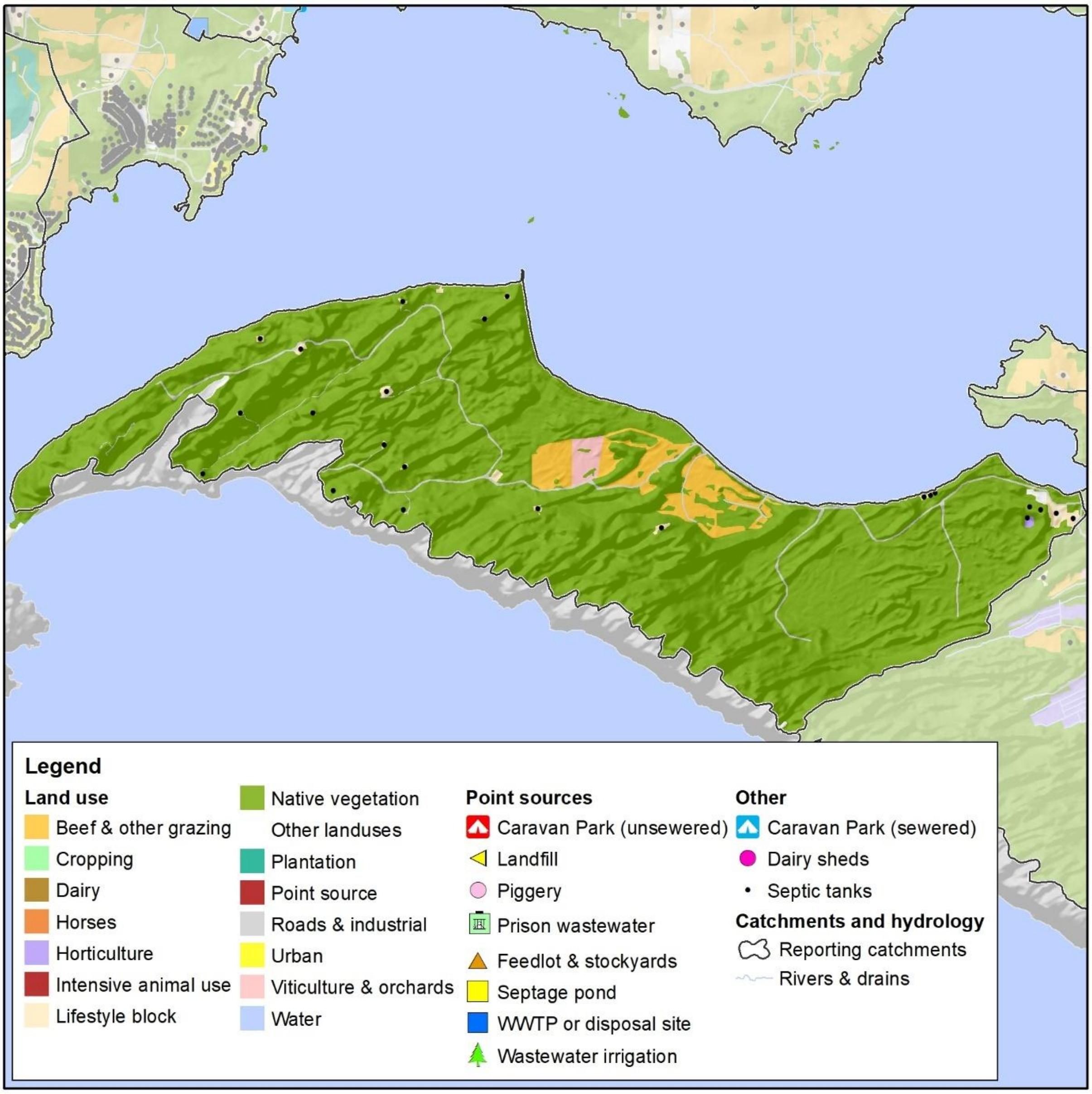
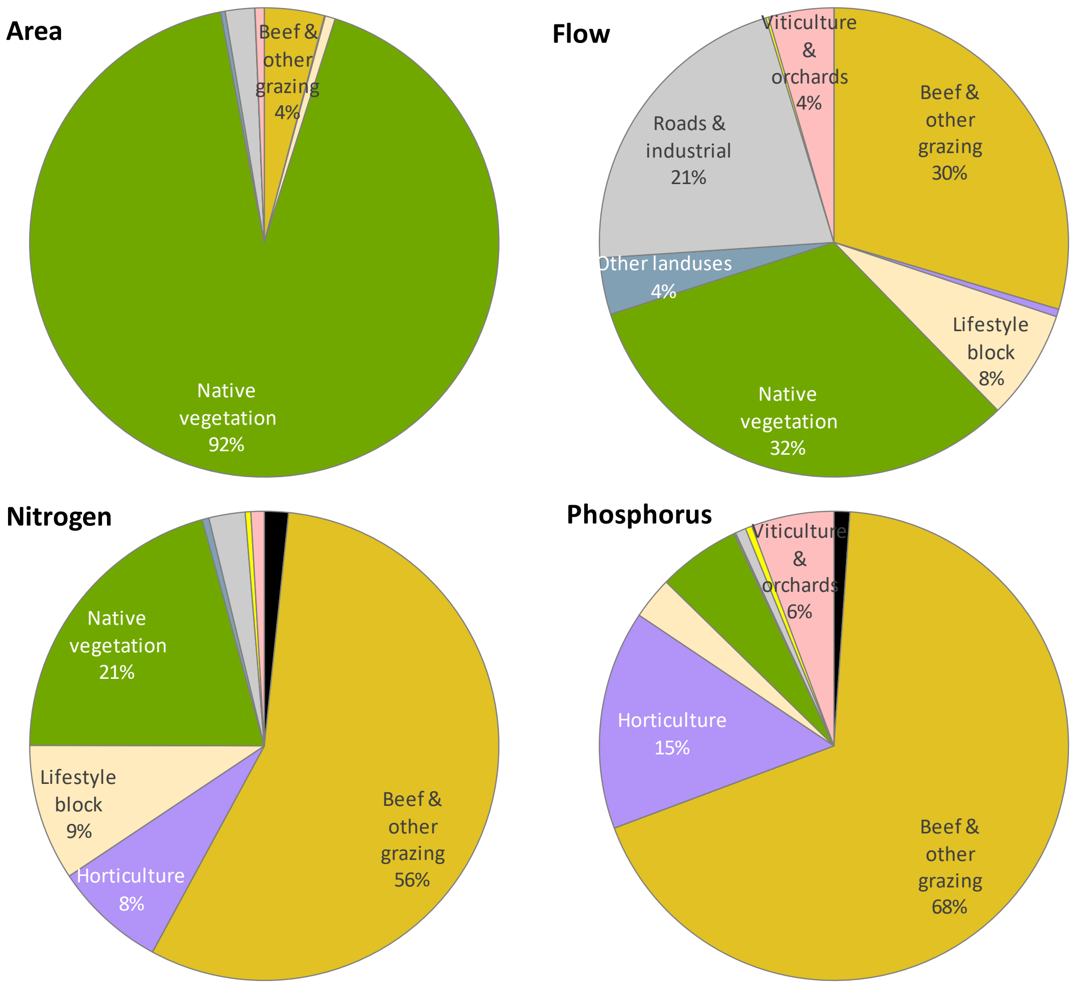



*Figure D.14: Land uses of the Nullaki reporting catchment*

Nullaki source separation

| Landuse name | Colour | Area (ha) | Area (%) | Flow (ML/yr) | Flow (%) | Nitrogen (kg/yr) | Nitrogen (%) | Phosphorus (kg/yr) | Phosphorus (%) |
|---|---|---|---|---|---|---|---|---|---|
| Septic tanks | | 24 | - | 0 | 0% | 10 | 2% | 1 | 1% |
| Beef & other grazing | | 97 | 4% | 155 | 30% | 341 | 56% | 63 | 68% |
| Cropping | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Dairy | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Horses | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Horticulture | | 1 | 0% | 3 | 1% | 47 | 8% | 14 | 15% |
| Intensive animal use | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Lifestyle block | | 16 | 1% | 40 | 8% | 57 | 9% | 3 | 3% |
| Native vegetation | | 2 160 | 92% | 170 | 32% | 126 | 21% | 5 | 6% |
| Other landuses | | 7 | 0% | 20 | 4% | 3 | 0% | 0 | 0% |
| Plantation | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Point source | | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Roads & industrial | | 47 | 2% | 112 | 21% | 15 | 2% | 1 | 1% |
| Urban | | 0 | 0% | 1 | 0% | 2 | 0% | 0 | 0% |
| Viticulture & orchards | | 15 | 1% | 24 | 5% | 6 | 1% | 5 | 6% |
| Total: Generated by catchment | | 2 345 | 100% | 524 | 100% | 607 | 100% | 92 | 100% |
| Removal (-) or gain (+) | | - | | 0 | 0% | 0 | 0% | 0 | 0% |
| Total: Leaving catchment | | 2 345 | 100% | 524 | 100% | 607 | 100% | 92 | 100% |



# Appendix E: Management scenario supporting information

## E.1 Overseer modelling

We used the Overseer Sci (version 6.4.0) lot-scale model to estimate the reduction in phosphorus loss from beef and dairy farms for two fertiliser management scenarios. We developed four Overseer models for different grazing land uses and phosphorus retention index (PRI) categories: beef low PRI, beef high PRI, dairy low PRI and dairy high PRI. The models were parameterised for the following scenarios:

- **Current management (basecase).** Highly soluble phosphorus fertilisers are applied at 'typical' rates and soil phosphorus content is based on average soil measurements from the Wilson Inlet catchment.
- **Best-practice fertiliser management using traditional fertilisers**. Farms utilise excess soil phosphorus until concentrations are optimal for growing profitable pastures. Soluble phosphorus fertilisers are then applied to maintain optimum soil phosphorus concentrations.
- **Best-practice fertiliser management using low-water-soluble phosphorus fertilisers**. We modelled the same scenario described above but used low-water-soluble phosphorus fertilisers rather than highly soluble phosphorus fertilisers.

We attempted to run the four beef and dairy models for each scenario above using soil parameters derived from the area-weighted average soil measurements of each of the 14 reporting catchments. Where there was insufficient data, we used the area-weighted average soil measurements for the entire Wilson Inlet catchment. In total there were 38 soil parameter sets for the four Overseer models per scenario.

### E.1.1 Whole-farm nutrient mapping dataset

The DPIRD whole-farm nutrient mapping dataset contains the soil test results of farms that were part of programs from 2009 to 2020 to improve fertiliser use and agricultural productivity in sensitive estuary catchments, which includes the Wilson Inlet. This dataset includes soil testing though the State Government-funded Regional Estuaries Initiative (REI) from 2016 to 2020. We used this dataset to parameterise the soil parameters of the Overseer models. We also used it to obtain the area of farmland that was part of government-funded fertiliser extension programs – required for a scenario in Section 7.3.2 in the main report.

### E.1.2 Overseer model setup for the basecase farm models (current management)

*Beef farm models*

In Overseer we modelled the farm area of beef farms as 120 ha, stocked with Angus cattle (0.86 head/ha). We populated livestock using the Overseer breeding stock tool using a breeding stock of 40. Pastures consisting of a mix of clover and ryegrass with medium levels of clover were used as the sole source of feed. No feed was exported from the farm and there was no irrigation. Livestock had access to waterways in the basecase and management scenarios.

We based nutrient inputs (e.g. feed, fertiliser) on local farm-gate nutrient budget survey data (Ovens et al. 2008; Weaver et al. 2008). Phosphorus inputs of 13 kg P/ha/yr were from single superphosphate fertiliser. Nitrogen inputs totalled 45 kg N/ha/yr and were from clover fixation (43 kg N/ha/yr) and atmospheric deposition (2 kg N/ha/yr). The modelled farm-gate nutrient budget was similar to local surveys for phosphorus (see Table E.1). However, for nitrogen, the model tended to have lower inputs (less fixation) and outputs than local surveys.

### *Dairy farm models*

Dairy farm models had a total farm area of 165 ha and were stocked with 230 Friesian milking cows (1.4 head per hectare). These areas were based on average dairy farm areas and milking herd numbers for the Peel-Harvey catchment. This 165 ha farm consisted of a 163 ha non-dairy effluent block (traditionally fertilised and used for pasture production) and a 2 ha effluent block. We used the default Overseer milk production values with a lactation length of 335 days per year. Livestock had access to waterways in the basecase and management scenarios.

We assumed dairy effluent was managed according to best practice (i.e. use of a holding pond with regular spray irrigation and annual solid spreading onto the effluent block). Hence paddocks received liquid and solid effluent in Overseer. (Note that Overseer cannot estimate the nutrient loss resulting from poorly constructed or managed dairy effluent systems.)

We based fertiliser inputs and feed on local farm-gate nutrient budget data (Table E.1). We modelled dairy farms to have total nutrient inputs of 147 kg N/ha/yr and 29 kg P/ha/yr, which consisted of:

- **Fertiliser:** 25 kg N/ha/yr and 23 kg P/ha/yr on non-effluent blocks and 8 kg P/ha/yr on effluent blocks.
- **Feed inputs:** Feed inputs to the entire farm (effluent and non-effluent blocks) were 39 kg N/ha/yr and 6 kg P/ha/yr. The feed types assumed were ‘oats’ (150 tonnes dry matter) and ‘silage’ (150 tonnes dry matter).
- **Atmospheric inputs**: 2 kg N/ha/yr (Overseer default).
- **Pasture fixation:** 39 kg N/ha/yr on the non-effluent block and 0 kg N/ha/yr on the effluent block.
- **Irrigation:** Inputs of 11 kg N/ha/yr and <1 kg P/ha/yr on all farm areas. The irrigation method used was border dyke irrigation and Overseer default values for inflow concentrations (0.2 mg/L TN and 0.1 mg/L TP).

The modelled dairy farm-gate nutrient budget was generally comparable with local surveys in terms of total inputs and outputs (Table E.1). Again, modelled nitrogen inputs from nitrogen fixation were lower than local surveys. Modelled phosphorus inputs were also higher than local surveys.

*Table E.1: Farm-gate nutrient budgets of beef and dairy farms that were modelled in Overseer and from local surveys (Ovens et al. 2008; Weaver et al. 2008)*

| Farm budget | Category | Beef | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Nitrogen | | | | Phosphorus | | | |
| | | WA surveys | | Overseer | | WA surveys | | Overseer | |
| | | kg/ha/yr | % | kg/ha/yr | % | kg/ha/yr | % | kg/ha/yr | % |
| Input | Livestock | 0.7 | 1% | 0.0 | <1% | 0.26 | 2% | 0.00 | <1% |
| | Feed | 0.3 | <1% | - | - | 0.1 | 1% | - | - |
| | **Fertiliser** | **1.7** | 2% | **0.0** | 0% | **12.3** | 96% | **13.0** | 100% |
| | Pasture | 83.6 | 97% | 43.0 | 96% | - | - | 0 | <1% |
| | Other | 0.0 | <1% | 2.0 | 4% | 0.1 | 1% | 0.0 | <1% |
| | **Total** | **86.4** | | **45.0** | | **12.7** | | **13.0** | |
| Output | Livestock & milk | 7.5 | 99% | 4.0 | 100% | 1.4 | 99% | 1.0 | 100% |
| | Feed | 0.1 | 1% | - | - | 0.01 | 1% | - | - |
| | **Total** | **7.6** | | **4.0** | | **1.4** | | **1.0** | |
| Surplus | **Total** | **78.8** | | **41.0** | | **11.3** | | **12.0** | |

| Farm budget | Category | Dairy | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Nitrogen | | | | Phosphorus | | | |
| | | WA surveys | | Overseer | | WA surveys | | Overseer | |
| | | kg/ha/yr | % | kg/ha/yr | % | kg/ha/yr | % | kg/ha/yr | % |
| Input | Livestock | 0.1 | <1% | - | - | 0.04 | <1% | - | - |
| | Feed | 54 | 37% | 39 | 34% | 9.1 | 36% | 6.0 | 21% |
| | **Fertiliser** | **25** | 17% | **25** | 22% | **15.9** | 63% | **23.0** | 79% |
| | Pasture | 65 | 45% | 39 | 34% | - | <1% | 0.0 | <1% |
| | Other | 0.4 | 0% | 13 | 11% | 0.4 | 2% | 0.0 | <1% |
| | **Total** | **145** | | **116** | | **25.5** | | **29.0** | |
| Output | Livestock & milk | 23 | 100% | 31 | 100% | 5.4 | 100% | 5.0 | 100% |
| | Feed | 0.1 | <1% | - | - | 0.01 | <1% | - | - |
| | **Total** | **24** | | **31** | | **5.4** | | **5.0** | |
| Surplus | **Total** | **122** | | **85** | | **20.1** | | **24.0** | |

## *Soil phosphorus parameterisation*

We parameterised Overseer using soil testing data (2009–20) that was intersected with our land-use spatial data for the Wilson Inlet catchment. We calculated the reporting catchment area-weighted average soil test values[1] of beef and dairy farms when their measured phosphorus buffering index (PBI) was < 35 or ≥ 35. These PBI ranges indicate low PRI and high PRI soil classes respectively. We used PBI instead of PRI classes because:

a) PBI measurements were part of all paddock measurements, whereas PRI was not commonly measured.

b) The DPIRD soil testing dataset had measured PBI values which indicated poor sandy soils, yet the soil PRI mapping showed high PRI soils. This issue was most prominent in the Cuppup catchment which has no low PRI soils, indicating the PRI mapping in this area may need to be revised.

Overseer uses Olsen P rather than Colwell P, but the latter is predominantly used in south-west Western Australia. We converted Colwell P to Olsen P using relationships for different PBI classes that were developed by DPIRD (see Table E.2). Table E.3 gives the soil

[1] Colwell P, phosphorus buffering index (PBI) and fertility index values (85% and 95%)

properties that we derived from the DPIRD database (2009–20) and used in the Overseer modelling.

Models of low PRI beef and dairy farms used 'sandy high P export' soils and had phosphorus retention (anion storage capacity) values of 1% and 2% respectively. For high PRI beef and dairy models, we used 'sedimentary' soils with phosphorus retention values of 20.

*Table E.2: The conversion of Colwell P to Olsen P (derived by DPIRD)*

| PBI class | Equation |
|---|---|
| <35 | $10^{0.882 * \log(\text{Colwell P}) - 0.155)}$ |
| 35–139 | $10^{0.874* \log(\text{Colwell P}) - 0.23)}$ |
| 140–279 | $10^{0.89* \log(\text{Colwell P}) – 0.32)}$ |
| >280 | $10^{0.89* \log(\text{Colwell P}) – 0.38)}$ |

*Table E.3: Assumed soil properties of beef and dairy farms that were derived (area-weighted average) from the DPIRD whole-farm nutrient mapping dataset (2009–20)*

| | Reporting catchment | Phosphorus buffering index (PBI) <35 (indicative of low PRI soils) | | | | | | | Phosphorus buffering index (PBI) ≥35 (indicative of low PRI soils) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Area of testing | PBI | Current Colwell P | Target Colwell P | Fertility index (85% max) | Current Olsen P | Target Olsen P | Area of testing | PBI | Current Colwell P | Target Colwell P | Fertility index (85% max) | Current Olsen P | Target Olsen P |
| | | (ha) | (mg/kg) | (mg/kg) | (mg/kg) | | (mg/kg) | (mg/kg) | (ha) | (mg/kg) | (mg/kg) | (mg/kg) | | (mg/kg) | (mg/kg) |
| Beef | Ocean Beach | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Beef | Little River | 156 | 15 | 22 | 11 | 2.1 | 11 | 6 | 400 | 184 | 48 | 24 | 2.0 | 15 | 8 |
| Beef | Koorabup | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Beef | Lower Denmark | 89 | 25 | 22 | 16 | 1.4 | 11 | 8 | 753 | 217 | 43 | 24 | 1.8 | 14 | 8 |
| Beef | Upper Denmark | - | - | - | - | - | - | - | 29 | 176 | 29 | 23 | 1.3 | 10 | 8 |
| Beef | Scotsdale | 16 | 27 | 42 | 16 | 2.6 | 19 | 8 | 241 | 191 | 59 | 24 | 2.5 | 18 | 8 |
| Beef | Foreshore | 40 | 18 | 21 | 14 | 1.6 | 10 | 7 | 68 | 102 | 29 | 21 | 1.4 | 11 | 8 |
| Beef | Sunny Glen | 180 | 14 | 22 | 12 | 1.9 | 11 | 6 | 140 | 130 | 33 | 21 | 1.5 | 13 | 8 |
| Beef | Lower Hay | 97 | 17 | 17 | 12 | 1.5 | 9 | 6 | 60 | 118 | 20 | 20 | 1.0 | 8 | 8 |
| Beef | Upper Hay | 1 805 | 17 | 18 | 13 | 1.5 | 9 | 7 | 7 258 | 166 | 36 | 23 | 1.6 | 12 | 8 |
| Beef | Sleeman | 535 | 19 | 20 | 13 | 1.5 | 10 | 7 | 643 | 73 | 33 | 19 | 1.7 | 13 | 8 |
| Beef | Cuppup | 208 | 16 | 24 | 12 | 2.0 | 12 | 6 | 797 | 243 | 39 | 25 | 1.6 | 12 | 8 |
| Beef | Lake Saide | 34 | 7 | 14 | 9 | 1.6 | 7 | 5 | 18 | 191 | 29 | 24 | 1.2 | 10 | 8 |
| Beef | Nullaki | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Beef | Wilson Inlet | 3 161 | 17 | 19 | 12 | 1.6 | 9 | 6 | 10 406 | 170 | 37 | 23 | 1.6 | 12 | 8 |
| Dairy | Ocean Beach | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Dairy | Little River | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Dairy | Koorabup | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Dairy | Lower Denmark | 92 | 25 | 35 | 26 | 1.4 | 16 | 12 | 94 | 83 | 38 | 31 | 1.2 | 14 | 12 |
| Dairy | Upper Denmark | 2 | 34 | 16 | 27 | 0.6 | 8 | 13 | 289 | 230 | 28 | 40 | 0.7 | 9 | 13 |
| Dairy | Scotsdale | 6 | 21 | 22 | 24 | 0.9 | 11 | 12 | 75 | 147 | 51 | 36 | 1.4 | 16 | 12 |
| Dairy | Foreshore | 2 | 20 | 25 | 23 | 1.1 | 12 | 11 | - | - | - | - | - | - | - |
| Dairy | Sunny Glen | 104 | 15 | 29 | 19 | 1.5 | 14 | 9 | 72 | 79 | 48 | 31 | 1.5 | 17 | 12 |
| Dairy | Lower Hay | 97 | 14 | 17 | 19 | 0.9 | 9 | 9 | 324 | 137 | 32 | 36 | 0.9 | 12 | 13 |
| Dairy | Upper Hay | 30 | 34 | 17 | 28 | 0.6 | 9 | 13 | 260 | 169 | 26 | 36 | 0.7 | 9 | 12 |
| Dairy | Sleeman | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Dairy | Cuppup | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Dairy | Lake Saide | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Dairy | Nullaki | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Dairy | Wilson Inlet | 334 | 19 | 26 | 22 | 1.2 | 12 | 11 | 1 115 | 161 | 33 | 36 | 0.9 | 11 | 12 |

### E.1.3 Overseer scenario model setup

#### *Best-practice fertiliser management using traditional fertilisers*

We assumed that beef and dairy farms run down their available soil phosphorus content to critical values (fertility index of 1) by applying lower (or no) phosphorus fertilisers. This is represented by changing soil Olsen parameters to target concentrations (see Table E.3). Farms used single superphosphate fertilisers to apply phosphorus at 'maintenance rates', which were derived from Overseer when sedimentary soils were selected. Phosphorus inputs in this scenario were:

- **Beef**: **6 kg P/ha/yr** as single superphosphate.
- **Dairy**: **12 kg P/ha/yr** as single superphosphate (feed and irrigation inputs were unchanged in this scenario and amounted to 7 kg P/ha/yr).

#### *Best-practice fertiliser management using slow-release fertilisers*

This scenario is identical to the previous scenario except that we used low-water-soluble phosphorus (LWSP) fertilisers in place of single superphosphate. Overseer allows uses to input multiple fertiliser sources, including reactive phosphate rock, which has a low solubility and is the only fertiliser type that reduces phosphorus loss in the model. We used an approximate blend of **60% reactive phosphate rock** and **40% highly soluble phosphorus** (as elemental phosphorus) to represent low-water-soluble phosphorus fertilisers. Phosphorus inputs in this scenario were:

- **Beef**: **6 kg P/ha/yr** as low-water-soluble phosphorus fertiliser.
- **Dairy**: **12 kg P/ha/yr** as low-water-soluble phosphorus fertiliser (feed and irrigation inputs were unchanged in this scenario and amounted to 7 kg P/ha/yr).

### E.1.4 Overseer parameter and result summaries

*Table E.4: Overseer beef (low PRI) parameterisation and results*

| Variable | Units | Basecase | | Fertiliser management (traditional fertilisers) | | Low water soluble phosphorus fertilisers | |
|---|---|---|---|---|---|---|---|
| Area | ha | 120 | | Same as basecase | | Same as basecase | |
| Number of cows | # | 104 (Black angus) | | Same as basecase | | Same as basecase | |
| Irrigation method | | No irrigation | | Same as basecase | | Same as basecase | |
| Animal access to streams? | Yes/no | Yes | | Same as basecase | | Same as basecase | |
| Pasture and clover | | Ryegrass/white clover | | Same as basecase | | Same as basecase | |
| **Soils & drainage** | | | | | | | |
| Soil description | - | Sand (high P export) | | Same as basecase | | Same as basecase | |
| Soil drainage class and characteristics | - | Moderately well - Drainage always soaks in | | Same as basecase | | Same as basecase | |
| Top soil texture | - | Sand | | Same as basecase | | Same as basecase | |
| Maximum rooting depth | cm | 20 | | Same as basecase | | Same as basecase | |
| Soil phosphate retention (PR) | % | 1 | | Same as basecase | | Same as basecase | |
| PBI | mg/kg | AWA of 18 (7 to 27 by catchment) | | Same as basecase | | Same as basecase | |
| Colwell P | mg/kg | AWA of 19 (14 to 42 by catchment) | | AWA of 12 (9 to 16 by catchment) | | AWA of 12 (9 to 16 by catchment) | |
| Fertiliser index (85% productivity) | Fraction | AWA of 1.6 (1.4 to 2.6 by catchment) | | 1.0 | | 1.0 | |
| **Current Olsen P** | mg/kg | AWA of 9 (7 to 19 by catchment) | | AWA of 6 (5 to 8 by catchment) | | AWA of 6 (5 to 8 by catchment) | |
| **Target Olsen P** | mg/kg | AWA of 6 (5 to 8 by catchment) | | - | | - | |
| **Farm nutrient budget (for AWA soil test results)** | | **N** | **P** | **N** | **P** | **N** | **P** |
| Timing and amount of fertilisation: SSP =single super phosphate, RPR= reactive phosphate rock | Apr (kg/ha/yr) | 0 | 13 (SSP) | 0 | 6 (SSP) | 0 | 1 (SSP) 4 (RPR) |
| **Maintenance rate** | kg/ha/yr | NA | 12 | NA | 12 | NA | 12 |
| **Nutrient inputs** | | N | P | N | P | N | P |
| **Fertiliser** | **kg/ha/yr** | **0.0** | **13.0** | **0.0** | **6.0** | **0.0** | **5.0** |
| **Rain/clover fixation** | **kg/ha/yr** | **44.0** | **0.0** | **44.0** | **0.0** | **44.0** | **0.0** |
| Rainfall | kg/ha/yr | 2.0 | 0.0 | 2.0 | 0.0 | 2.0 | 0.0 |
| Biological fixation | kg/ha/yr | 42.0 | 0.0 | 42.0 | 0.0 | 42.0 | 0.0 |
| **Nutrients removed** | | N | P | N | P | N | P |
| **Leached from root zone** | **kg/ha/yr** | **18.0** | **0.3** | **18.0** | **0.2** | **18.0** | **0.2** |
| Leaching - urine patches | kg/ha/yr | 7.0 | 0.0 | 7.0 | 0.0 | 7.0 | 0.0 |
| Runoff | kg/ha/yr | 0.0 | 0.2 | 0.0 | 0.1 | 0.0 | 0.1 |
| Direct (animals, drains) | kg/ha/yr | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Leaching - other | kg/ha/yr | 10.0 | 0.0 | 10.0 | 0.0 | 10.0 | 0.0 |
| **As product** | **kg/ha/yr** | **4.0** | **1.0** | **4.0** | **1.0** | **4.0** | **1.0** |
| **To atmosphere** | **kg/ha/yr** | **23.0** | **0.0** | **23.0** | **0.0** | **23.0** | **0.0** |
| Denitrification - background | kg/ha/yr | 4.0 | 0.0 | 4.0 | 0.0 | 4.0 | 0.0 |
| Volatilisation - urine | kg/ha/yr | 11.0 | 0.0 | 11.0 | 0.0 | 11.0 | 0.0 |
| Denitrification - urine | kg/ha/yr | 8.0 | 0.0 | 8.0 | 0.0 | 8.0 | 0.0 |
| **Change in plant and soil stores** | | N | P | N | P | N | P |
| **Organic pool** | **kg/ha/yr** | **0.0** | **17.0** | **0.0** | **13.0** | **0.0** | **13.0** |
| Immobilisation | kg/ha/yr | 0.0 | 17.0 | 0.0 | 13.0 | 0.0 | 13.0 |
| **Inorganic mineral** | **kg/ha/yr** | **0.0** | **-2.0** | **0.0** | **-2.0** | **0.0** | **-2.0** |
| Adsorption | kg/ha/yr | 0.0 | 1.0 | 0.0 | 1.0 | 0.0 | 1.0 |
| Slow release | kg/ha/yr | 0.0 | -3.0 | 0.0 | -3.0 | 0.0 | -3.0 |
| **Inorganic soil pool** | **kg/ha/yr** | **0.0** | **-4.0** | **0.0** | **-6.0** | **0.0** | **-7.0** |

**Note:** AWA = area-weighted average

## *Table E.5: Overseer beef (high PRI) parameterisation and results*

| Variable | Units | Basecase | | Fertiliser management (traditional fertilisers) | |
|---|---|---|---|---|---|
| Area | ha | 120 | | Same as basecase | |
| Number of cows | # | 104 (Black angus) | | Same as basecase | |
| Irrigation method | | No irrigation | | Same as basecase | |
| Animal access to streams? | Yes/no | Yes | | Same as basecase | |
| Pasture and clover | | Ryegrass/white clover | | Same as basecase | |
| **Soils & drainage** | | | | | |
| Soil description | - | Sedimentary | | Same as basecase | |
| Soil drainage class and characteristics | - | Poor (default with naturally high groundwater) | | Same as basecase | |
| Top soil texture | - | Clay loam (heavy) | | Same as basecase | |
| Maximum rooting depth | cm | 20 | | Same as basecase | |
| Soil phosphate retention (PR) | % | 20 | | Same as basecase | |
| PBI | | AWA of 170 (73 to 243 by catchment) | | Same as basecase | |
| Colwell P | mg/kg | AWA of 37 (20 to 59 by catchment) | | AWA of 23 (19 to 25 by catchment) | |
| Fertiliser index (85% productivity) | Fraction | AWA of 1.6 (1.0 to 2.5 by catchment) | | 2 | |
| **Current Olsen P** | mg/kg | AWA of 12 (8 to 18 by catchment) | | AWA of 8 (8 for all catchments) | |
| **Target Olsen P** | mg/kg | AWA of 8 (8 for all catchments) | | 8 | |
| **Farm nutrient budget (for AWA soil test results)** | | **N** | **P** | **N** | **P** |
| Timing and amount of fertilisation: SSP =single super phosphate, RPR= reactive phosphate rock | Apr (kg/ha/yr) | 0 | 13 (SSP) | 0 | 6 (SSP) |
| **Maintenance rate** | kg/ha/yr | NA | 9 | NA | 6 |
| **Nutrient inputs** | | N | P | N | P |
| **Fertiliser** | **Kg/ha/yr** | **0.0** | **13.0** | **0.0** | **6.0** |
| Rain/clover fixation | Kg/ha/yr | **45.0** | **0.0** | **45.0** | **0.0** |
| **Rainfall** | **Kg/ha/yr** | 2.0 | 0.0 | 2.0 | 0.0 |
| Biological fixation | Kg/ha/yr | 43.0 | 0.0 | 43.0 | 0.0 |
| **Nutrients removed** | | N | P | N | P |
| **Leached from root zone** | **Kg/ha/yr** | **17.0** | **0.2** | **17.0** | **0.1** |
| Leaching - urine patches | Kg/ha/yr | 7.0 | 0.0 | 7.0 | 0.0 |
| Runoff | Kg/ha/yr | 0.0 | 0.1 | 0.0 | 0.0 |
| Direct (animals, drains) | Kg/ha/yr | 0.0 | 0.1 | 0.0 | 0.1 |
| Leaching - other | Kg/ha/yr | 10.0 | 0.0 | 10.0 | 0.0 |
| **As product** | **Kg/ha/yr** | **4.0** | **1.0** | **4.0** | **1.0** |
| **To atmosphere** | **Kg/ha/yr** | **25.0** | **0.0** | **25.0** | **0.0** |
| Denitrification - background | Kg/ha/yr | 4.0 | 0.0 | 4.0 | 0.0 |
| Volatilisation - urine | Kg/ha/yr | 11.0 | 0.0 | 11.0 | 0.0 |
| Denitrification - urine | Kg/ha/yr | 10.0 | 0.0 | 10.0 | 0.0 |
| **Change in plant and soil stores** | | N | P | N | P |
| **Organic pool** | **Kg/ha/yr** | **-1.0** | **8.0** | **-1.0** | **6.0** |
| Immobilisation | Kg/ha/yr | -1.0 | 8.0 | -1.0 | 6.0 |
| **Inorganic mineral** | **Kg/ha/yr** | **0.0** | **-1.0** | **0.0** | **-1.0** |
| Adsorption | Kg/ha/yr | 0.0 | 2.0 | 0.0 | 1.0 |
| Slow release | Kg/ha/yr | 0.0 | -3.0 | 0.0 | -3.0 |
| **Inorganic soil pool** | **Kg/ha/yr** | **0.0** | **5.0** | **0.0** | **0.0** |

**Note:** AWA = area-weighted average

## *Table E.6: Overseer dairy (low PRI) parameterisation and results*

| Variable | Units | Basecase | | Fertiliser management (traditional fertilisers) | | Low water soluble phosphorus fertilisers | |
|---|---|---|---|---|---|---|---|
| Area | ha | Non-effluent block | 163 | Same as basecase | | Same as basecase | |
| | ha | Effluent block | 2 | | | | |
| | ha | **Farm total** | **165** | | | | |
| Number of milking cows and type | | 230 milking cows (Friesian) | | Same as basecase | | Same as basecase | |
| Effluent management | - | Holding pond: Irrigation & spreading solids to effluent block in April | | Same as basecase | | Same as basecase | |
| Effluent irrigation (effluent block) | mm/day | >24 mm | | Same as basecase | | Same as basecase | |
| Irrigation method | | Boarder dyke with overseer default nutrient concentrations | | Same as basecase | | Same as basecase | |
| Months irrigated and amount | | Nov–March (65-80 mm/month) | | Same as basecase | | Same as basecase | |
| Animal access to streams? | Yes/no | Yes | | Same as basecase | | Same as basecase | |
| **Pasture and clover** | | Ryegrass/white clover | | Same as basecase | | Same as basecase | |
| **Soils & drainage** | | | | | | | |
| Soil description | - | Sand (high P export) | | Same as basecase | | Same as basecase | |
| Soil drainage class and characteristics | - | Moderately well - Drainage always soaks in | | Same as basecase | | Same as basecase | |
| Top soil texture | - | Sand | | Same as basecase | | Same as basecase | |
| Maximum rooting depth | cm | 20 | | Same as basecase | | Same as basecase | |
| Soil phosphate retention (PR) | % | 2 | | Same as basecase | | Same as basecase | |
| PBI | mg/kg | AWA of 19 (14 to 34 by catchment) | | Same as basecase | | Same as basecase | |
| Colwell P | mg/kg | AWA of 26 (16 to 35 by catchment) | | AWA of 22 (19 to 28 by catchment) | | AWA of 22 (19 to 28 by catchment) | |
| Fertiliser index (95% productivity) | Fraction | AWA of 1.2 (0.6 to 1.5 by catchment) | | 1.0 | | 1.0 | |
| **Current Olsen P** | mg/kg | AWA of 12 (8 to 16 by catchment) | | AWA of 12 (9 to 13 by catchment) | | AWA of 12 (9 to 13 by catchment) | |
| **Target Olsen P** | mg/kg | AWA of 12 (9 to 13 by catchment) | | - | | - | |
| **Farm nutrient budget (for AWA soil test results)** | | N | P | N | P | N | P |
| Timing and amount of fertilisation: **Non-effluent block** | Apr (kg/ha/yr) | 25 | 15.5 (SSP) | 25 | 6 (SSP) | 25 | 2 (SSP) 3.5 (RPR) |
| SSP =single super phosphate, RPR= reactive phosphate rock | Sep (kg/ha/yr) | 0 | 8.2 (SSP) | 0 | 6 (SSP) | 0 | 2 (SSP) 3.5 (RPR) |
| **Effluent block** | Sep (kg/ha/yr) | 0 | 8.2 (SSP) | | 0 | 0 | 0 |
| Maintenance rate | kg/ha/yr | NA | 12 | NA | 12 | NA | 12 |
| **Nutrient inputs** | | N | P | N | P | N | P |
| **Fertiliser** | **Kg/ha/yr** | **25.0** | **24.0** | **25.0** | **12.0** | **25.0** | **11.0** |
| **Irrigation** | **Kg/ha/yr** | **11.0** | **0.0** | **11.0** | **0.0** | **11.0** | **0.0** |
| **Supplements** | **Kg/ha/yr** | **39.0** | **6.0** | **39.0** | **6.0** | **39.0** | **6.0** |
| Imported | Kg/ha/yr | 39.0 | 6.0 | 39.0 | 6.0 | 39.0 | 6.0 |
| **Rain/clover fixation** | **Kg/ha/yr** | **41.0** | **0.0** | **41.0** | **0.0** | **41.0** | **0.0** |
| Rainfall | Kg/ha/yr | 2.0 | 0.0 | 2.0 | 0.0 | 2.0 | 0.0 |
| Biological fixation | Kg/ha/yr | 39.0 | 0.0 | 39.0 | 0.0 | 39.0 | 0.0 |
| **Nutrients removed** | | N | P | N | P | N | P |
| **Leached from root zone** | **Kg/ha/yr** | **36.0** | **4.0** | **36.0** | **3.3** | **36.0** | **2.9** |
| Leaching - urine patches | Kg/ha/yr | 20.0 | 0.0 | 20.0 | 0.0 | 20.0 | 0.0 |
| Runoff | Kg/ha/yr | 0.0 | 2.4 | 0.0 | 1.8 | 0.0 | 1.4 |
| Direct (animals, drains) | Kg/ha/yr | 1.0 | 0.1 | 1.0 | 0.1 | 1.0 | 0.1 |
| Leaching - other | Kg/ha/yr | 8.0 | 0.2 | 8.0 | 0.2 | 8.0 | 0.2 |
| Border dyke outwash | Kg/ha/yr | 6.0 | 1.2 | 6.0 | 1.2 | 6.0 | 1.2 |
| **As product** | **Kg/ha/yr** | **31.0** | **5.0** | **31.0** | **5.0** | **31.0** | **5.0** |
| **To atmosphere** | **Kg/ha/yr** | **49.0** | **0.0** | **49.0** | **0.0** | **49.0** | **0.0** |
| **Change in plant and soil stores** | | N | P | N | P | N | P |
| **Organic pool** | **Kg/ha/yr** | **0.0** | **24.0** | **0.0** | **23.0** | **0.0** | **23.0** |
| Immobilisation | Kg/ha/yr | 0.0 | 24.0 | 0.0 | 23.0 | 0.0 | 23.0 |
| **Inorganic mineral** | **Kg/ha/yr** | **0.0** | **-3.0** | **0.0** | **-3.0** | **0.0** | **-3.0** |
| Slow release | Kg/ha/yr | 0.0 | -3.0 | 0.0 | -3.0 | 0.0 | -3.0 |
| **Inorganic soil pool** | **Kg/ha/yr** | **0.0** | **-1.0** | **0.0** | **-9.0** | **0.0** | **-11.0** |

**Note:** AWA = area-weighted average

## *Table E.7: Overseer dairy (high PRI) parameterisation and results*

| Variable | Units | Basecase | | Fertiliser management (traditional fertilisers) | |
|---|---|---|---|---|---|
| Area | ha | Non-effluent block | 163 | Same as basecase | |
| | ha | Effluent block | 2 | | |
| | ha | **Farm total** | **165** | | |
| Number of milking cows and type | | 230 milking cows (Friesian) | | Same as basecase | |
| Effluent management | - | Holding pond: Irrigation & spreading solids to effluent block in April | | Same as basecase | |
| Effluent irrigation | mm/day | >24 mm | | Same as basecase | |
| Irrigation method | | Boarder dyke with overseer default nutrient concentrations | | Same as basecase | |
| Months irrigated and amount | | Nov–March (65-80 mm/month) | | Same as basecase | |
| Animal access to streams? | Yes/no | Yes | | Same as basecase | |
| **Pasture and clover** | | Ryegrass/white clover | | Same as basecase | |
| **Soils & drainage** | | | | | |
| Soil description | - | Sedimentary | | Same as basecase | |
| Soil drainage class and characterist | - | Poor - Rainfall mostly runs off | | Same as basecase | |
| Top soil texture | - | Clay loam - Heavy texture | | Same as basecase | |
| Maximum rooting depth | cm | 20 | | Same as basecase | |
| Soil phosphate retention (PR) | % | 20 | | Same as basecase | |
| PBI | mg/kg | AWA of 161 (79 to 230 by catchment) | | Same as basecase | |
| Colwell P | mg/kg | AWA of 33 (26 to 51 by catchment) | | AWA of 36 (31 to 40 by catchment) | |
| Fertiliser index (95% productivity) | Fraction | AWA of 0.9 (0.7 to 1.5 by catchment) | | 1.0 | |
| **Current Olsen P** | mg/kg | AWA of 11 (9 to 17 by catchment) | | AWA of 12 (9 to 13 by catchment) | |
| **Target Olsen P** | mg/kg | AWA of 12 (12 to 13 by catchment) | | - | |
| **Farm nutrient budget (for AWA soil test results** | | **N** | **P** | **N** | **P** |
| Timing and amount of fertilisation: **Non-effluent block** | Apr (kg/ha/yr) | 25 | 15.5 (SSP) | 25 | 6 (SSP) |
| SSP =single super phosphate, RPR= reactive phosphate rock | Sep (kg/ha/yr) | 0 | 8.2 (SSP) | 0 | 6 (SSP) |
| **Effluent block** | Sep (kg/ha/yr) | 0 | 8.2 (SSP) | 0 | 0 |
| Maintenance rate | kg/ha/yr | NA | 12 | NA | 12 |
| **Nutrient inputs** | | N | P | N | P |
| **Fertiliser** | **Kg/ha/yr** | **25.0** | **23.0** | **25.0** | **12.0** |
| **Irrigation** | **Kg/ha/yr** | **11.0** | **0.0** | **11.0** | **0.0** |
| **Supplements** | **Kg/ha/yr** | **39.0** | **6.0** | **39.0** | **6.0** |
| Imported | Kg/ha/yr | 39.0 | 6.0 | 39.0 | 6.0 |
| **Rain/clover fixation** | **Kg/ha/yr** | **41.0** | **0.0** | **41.0** | **0.0** |
| Rainfall | Kg/ha/yr | 2.0 | 0.0 | 2.0 | 0.0 |
| Biological fixation | Kg/ha/yr | 39.0 | 0.0 | 39.0 | 0.0 |
| **Nutrients removed** | | N | P | N | P |
| **Leached from root zone** | **Kg/ha/yr** | **32.0** | **2.3** | **32.0** | **2.2** |
| Leaching - urine patches | Kg/ha/yr | 16.0 | 0.0 | 16.0 | 0.0 |
| Runoff | Kg/ha/yr | 0.0 | 0.7 | 0.0 | 0.6 |
| Direct (animals, drains) | Kg/ha/yr | 1.0 | 0.1 | 1.0 | 0.1 |
| Leaching - other | Kg/ha/yr | 8.0 | 0.2 | 8.0 | 0.2 |
| Border dyke outwash | Kg/ha/yr | 6.0 | 1.2 | 6.0 | 1.2 |
| **As product** | **Kg/ha/yr** | **31.0** | **5.0** | **31.0** | **5.0** |
| **To atmosphere** | **Kg/ha/yr** | **52.0** | **0.0** | **52.0** | **0.0** |
| **Change in plant and soil stores** | | N | P | N | P |
| **Organic pool** | **Kg/ha/yr** | **0.0** | **10.0** | **0.0** | **11.0** |
| Immobilisation | Kg/ha/yr | 0.0 | 10.0 | 0.0 | 11.0 |
| **Inorganic mineral** | **Kg/ha/yr** | **0.0** | **-3.0** | **0.0** | **-3.0** |
| Slow release | Kg/ha/yr | 0.0 | -3.0 | 0.0 | -3.0 |
| **Inorganic soil pool** | **Kg/ha/yr** | **0.0** | **15.0** | **0.0** | **4.0** |

**Note:** AWA = area-weighted average

## E.2 Summary of management scenario results

*Table E.8: Nitrogen load removal from all individual and combined management scenarios*

| Reporting catchment | Basecase | Load reduction target (excess load) | | Urban expansion | | Maintain 2020 plantation area | | Extensive plantation reversion | | Riparian fencing | | Riparian fencing & revegetation | | Dairy effluent management | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | kg/yr | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) |
| Ocean Beach | 2,581 | 1,150 | -45% | 162 | 6.3% | - | - | - | - | -253 | -10% | -318 | -12% | - | - |
| Little River | 6,188 | - | - | 23 | 0.4% | - | - | 93 | 1.5% | -590 | -10% | -590 | -10% | - | - |
| Koorabup | 2,077 | 830 | -40% | 116 | 5.6% | - | - | - | - | -79 | -3.8% | -79 | -3.8% | - | - |
| Lower Denmark | 7,491 | - | - | -10 | -0.1% | 50 | 0.7% | 171 | 2.3% | -613 | -8.2% | -647 | -8.6% | -38 | -0.5% |
| Upper Denmark | 4,639 | 2,362 | -51% | - | - | -14 | -0.3% | 2,165 | 47% | -372 | -8.0% | -375 | -8.1% | -44 | -0.9% |
| Scotsdale | 11,651 | - | - | -6 | -0.1% | 321 | 2.8% | 1,532 | 13% | -831 | -7.1% | -1,299 | -11% | -21 | -0.2% |
| Foreshore | 3,878 | 1,065 | -27% | 821 | 21% | 1 | 0.0% | 10 | 0.2% | -224 | -5.8% | -271 | -7.0% | - | - |
| Sunny Glen | 4,379 | 1,848 | -42% | - | - | - | - | 612 | 14% | -705 | -16% | -794 | -18% | -64 | -1.5% |
| Lower Hay | 5,382 | 224 | -4% | - | - | 21 | 0.4% | 938 | 17% | -643 | -12% | -780 | -14% | -35 | -0.7% |
| Upper Hay | 20,561 | 9,038 | -44% | 3,541 | 17% | 179 | 0.9% | 10,363 | 50% | -2,408 | -12% | -2,460 | -12% | - | - |
| Sleeman | 16,232 | 5,148 | -32% | - | - | - | - | 268 | 1.7% | -2,168 | -13% | -3,181 | -20% | -57 | -0.3% |
| Cuppup | 19,056 | 6,811 | -36% | - | - | 4 | 0.0% | 40 | 0.2% | -2,548 | -13% | -5,112 | -27% | - | - |
| Lake Saide | 2,906 | 1,043 | -36% | - | - | 15 | 0.5% | 179 | 6.2% | -447 | -15% | -543 | -19% | - | - |
| Nullaki | 607 | - | - | - | - | - | - | - | - | -45 | -7.5% | -96 | -16% | - | - |
| **Wilson Inlet** | **107,627** | **29,519** | **-27%** | **4,645** | **4.3%** | **577** | **0.5%** | **16,371** | **15%** | **-11,926** | **-11%** | **-16,545** | **-15%** | **-258** | **-0.2%** |

| Reporting catchment | Basecase | Load reduction target (excess load) | | Septic tank removal (690 tanks) | | Denmark WWTP (2015 upgrades) | | Combined actions: Agricultural actions | | Combined actions: Non-agricultural actions | | Combined actions: All actions | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | kg/yr | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) |
| Ocean Beach | 2,581 | 1,150 | -45% | -398 | -15% | - | - | - | - | -716 | -28% | -716 | -28% |
| Little River | 6,188 | - | - | -233 | -3.8% | - | - | - | - | -822 | -13% | -822 | -13% |
| Koorabup | 2,077 | 830 | -40% | - | - | - | - | - | - | -498 | -24% | -498 | -24% |
| Lower Denmark | 7,491 | - | - | - | - | -419 | -6% | -38 | -0.5% | -647 | -8.6% | -686 | -9.2% |
| Upper Denmark | 4,639 | 2,362 | -51% | - | - | - | - | -44 | -0.9% | -375 | -8.1% | -419 | -9.0% |
| Scotsdale | 11,651 | - | - | - | - | - | - | -21 | -0.2% | -1,299 | -11% | -1,320 | -11% |
| Foreshore | 3,878 | 1,065 | -27% | -1,161 | -30% | - | - | - | - | -1,433 | -37% | -1,433 | -37% |
| Sunny Glen | 4,379 | 1,848 | -42% | - | - | - | - | -64 | -1.5% | -794 | -18% | -858 | -20% |
| Lower Hay | 5,382 | 224 | -4% | - | - | - | - | -35 | -0.7% | -780 | -14% | -815 | -15% |
| Upper Hay | 20,561 | 9,038 | -44% | - | - | - | - | - | - | -2,460 | -12% | -2,460 | -12% |
| Sleeman | 16,232 | 5,148 | -32% | - | - | - | - | -28 | -0.2% | -3,181 | -20% | -3,237 | -20% |
| Cuppup | 19,056 | 6,811 | -36% | - | - | - | - | - | - | -5,112 | -27% | -5,112 | -27% |
| Lake Saide | 2,906 | 1,043 | -36% | - | - | - | - | - | - | -543 | -19% | -543 | -19% |
| Nullaki | 607 | - | - | - | - | - | - | - | - | -96 | -16% | -96 | -16% |
| **Wilson Inlet** | **107,627** | **29,519** | **-27%** | **-1,792** | **-1.7%** | **-419** | **0%** | **-230** | **-0.2%** | **-18,757** | **-17%** | **-19,015** | **-18%** |

*Table E.9: Phosphorus load removal from all individual and combined management scenarios*

| Reporting catchment | Basecase | Load reduction target (excess load) | | Urban expansion | | Maintain 2020 plantation area | | Extensive plantation reversion | | Riparian fencing | | Riparian fencing & revegetation | | Fertiliser management | | Fertiliser management with LWSP | | Dairy effluent management | | Soil ammendment | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | kg/yr | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) |
| Ocean Beach | 230 | 110 | -48% | 2 | 1.0% | - | - | - | - | -5 | -2.3% | -5 | -2.3% | -43 | -19% | -51 | -22% | - | - | -79 | -35% |
| Little River | 526 | - | - | -1 | -0.3% | - | - | 40 | 7.6% | -51 | -10% | -51 | -10% | -132 | -25% | -132 | -25% | - | - | - | - |
| Koorabup | 133 | 30 | -22% | 45 | 34% | - | - | - | - | -1 | -1.0% | -1 | -1.0% | -1 | -0.5% | -1 | -0.5% | - | - | - | - |
| Lower Denmark | 200 | - | - | 1 | 1% | 6 | 3.2% | 18 | 8.8% | -16 | -7.8% | -17 | -8.3% | -35 | -17% | -38 | -19% | -3 | -1.4% | -35 | -17% |
| Upper Denmark | 141 | 47 | -34% | - | - | -1 | -1.0% | 141 | 100% | -11 | -7.6% | -11 | -7.7% | 1 | 0.7% | -1 | -0.6% | -3 | -2.2% | -7 | -5.2% |
| Scotsdale | 488 | - | - | -1 | -0.1% | 59 | 12% | 274 | 56% | -35 | -7.1% | -54 | -11% | -141 | -29% | -142 | -29% | -1 | -0.3% | -1 | -0.1% |
| Foreshore | 202 | - | - | 58 | 29% | 0.1 | <0.1% | 1 | 0.4% | -3 | -1.7% | -3 | -1.7% | -17 | -8.5% | -19 | -10% | - | - | -22 | -11% |
| Sunny Glen | 687 | 476 | -69% | - | - | - | - | 310 | 45% | -19 | -2.8% | -19 | -2.8% | -225 | -33% | -259 | -38% | -5 | -0.7% | -344 | -50% |
| Lower Hay | 563 | 133 | -24% | - | - | 4 | 0.7% | 150 | 27% | -15 | -2.6% | -15 | -2.6% | -111 | -20% | -139 | -25% | -3 | -0.4% | -280 | -50% |
| Upper Hay | 472 | 94 | -20% | 194 | 41% | 28 | 5.9% | 937 | 199% | -53 | -11% | -54 | -11% | -89 | -19% | -97 | -21% | - | - | -84 | -18% |
| Sleeman | 2,097 | 1,173 | -56% | - | - | - | - | 135 | 6.4% | -63 | -3.0% | -63 | -3.0% | -485 | -23% | -569 | -27% | -4 | -0.2% | -836 | -40% |
| Cuppup | 2,804 | 1,783 | -64% | - | - | 2 | 0.1% | 26 | 0.9% | -113 | -4.0% | -113 | -4.0% | -578 | -21% | -578 | -21% | - | - | -2 | -0.1% |
| Lake Saide | 94 | - | - | - | - | 1 | 0.7% | 7 | 7.8% | -2 | -2.5% | -2 | -2.5% | -8 | -8.5% | -10 | -10% | - | - | -67 | -72% |
| Nullaki | 92 | 39 | -43% | - | - | - | - | - | - | -3 | -2.8% | -3 | -2.8% | -20 | -21% | -23 | -26% | - | - | -46 | -50% |
| **Wilson Inlet** | **8,729** | **3,886** | **-45%** | **299** | **3.4%** | **98** | **1.1%** | **2,038** | **23%** | **-389** | **-4.5%** | **-410** | **-4.7%** | **-1,884** | **-22%** | **-2,059** | **-24%** | **-18** | **-0.2%** | **-1,804** | **-21%** |

| Reporting catchment | Basecase | Load reduction target (excess load) | | Septic tank removal (690 tanks) | | Denmark WWTP (2015 upgrades) | | Combined actions: Agricultural actions | | Combined actions: Non-agricultural actions | | Combined actions: All actions | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | kg/yr | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) | kg/yr | (%) |
| Ocean Beach | 230 | 110 | -48% | 0.1 | 0.0% | - | - | -107 | -47% | -5 | -2.2% | -113 | -49% |
| Little River | 526 | - | - | -23 | -4.4% | - | - | -132 | -25% | -74 | -14% | -206 | -39% |
| Koorabup | 133 | 30 | -22% | - | - | - | - | -1 | -0.5% | -29 | -22.1% | -30 | -23% |
| Lower Denmark | 200 | - | - | - | - | -28 | -14% | -66 | -33% | -17 | -8.3% | -83 | -41% |
| Upper Denmark | 141 | 47 | -34% | - | - | - | - | -9 | -6.7% | -11 | -7.7% | -20 | -14% |
| Scotsdale | 488 | - | - | - | - | - | - | -143 | -29% | -54 | -11% | -198 | -40% |
| Foreshore | 202 | - | - | -54 | -27% | - | - | -38 | -19% | -57 | -28% | -95 | -47% |
| Sunny Glen | 687 | 476 | -69% | - | - | - | - | -461 | -67% | -19 | -2.8% | -480 | -70% |
| Lower Hay | 563 | 133 | -24% | - | - | - | - | -346 | -61% | -15 | -2.6% | -360 | -64% |
| Upper Hay | 472 | 94 | -20% | - | - | - | - | -157 | -33% | -54 | -11% | -211 | -45% |
| Sleeman | 2,097 | 1,173 | -56% | - | - | - | - | -1,151 | -55% | -63 | -3.0% | -1,216 | -58% |
| Cuppup | 2,804 | 1,783 | -64% | - | - | - | - | -579 | -21% | -113 | -4.0% | -692 | -25% |
| Lake Saide | 94 | - | - | - | - | - | - | -72 | -77% | -2 | -2.5% | -74 | -79% |
| Nullaki | 92 | 39 | -43% | - | - | - | - | -57 | -63% | -3 | -2.8% | -60 | -65% |
| **Wilson Inlet** | **8,729** | **3,886** | **-45%** | **-77** | **-0.9%** | **-28** | **0.0%** | **-3,321** | **-38%** | **-516** | **-5.9%** | **-3,838** | **-44%** |