



Otago  
Regional  
Council

# Flow naturalisation of the Shag/Waihemo River

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This document describes how the naturalised flow statistics for the Shag/Waihemo River at Craig Road, and Goodwood Pump are derived.

## The Shag/Waihemo River at the Craig Road flow recorder

### Method

Daily flows and water take time series data were used to derive naturalised flows for the Shag/Waihemo River at Craig Road. The sum of water take data was added to corresponding Craig Road flow records to estimate naturalised flows at this site.

The following table (**Table 1**) shows the data availability of the existing flows records around the Shag/Waihemo River

Table 1: The daily flow time series and instantaneous gauging data available for analysis for the Shag/Waihemo River.

Site	Start	End	Length (year)
Shag/Waihemo at Dunback Domain	25/03/1976	29/03/1990	14.0
Deepdell Creek at Golden Point Weir	31/07/1985	25/09/2001	16.2
Shag/Waihemo at Collins Bridge	12/12/1985	23/10/2013	27.9
Shag/Waihemo at The Grange	11/10/1989	24/05/2023	33.6
Shag/Waihemo at Craig Road	23/09/1993	24/05/2023	29.7
Shag/Waihemo at Switchback Road	6/12/1985	11/07/2018	32.6
Shag/Waihemo at Goodwood Pump (instantaneous gaugings only)	16/02/1971	17/01/2018	47
Deepdell Creek at Site L	5/02/1988	7/03/1989	1.1
Pigroot Creek at SH85	12/10/2011	11/09/2012	0.9
McCormick's Creek at SH85	12/10/2011	30/09/2013	2.0
Shag/Waihemo at Shakey Bridge	18/07/2017	28/05/2020	2.9

## Total water use

There have been 105 historical consents issued in the upstream area of the flow recorder at Craig Road on the Shag/Waihemo River. After auditing these consents, 71<sup>1</sup> (see **Table 3** in the HTML file in the **Appendix**) are used for flow naturalisation in this study. As shown in the table, 12 consents are currently active.

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<sup>1</sup> 71 consents used in this study are listed in the HTML file listed in the **Appendix**. They are the consents left by filtering out:

- Groundwater takes with no effect on the nearby water body (refer to the attribute of *Stream depletion rate*)
- Non-consumptive takes
- Retakes

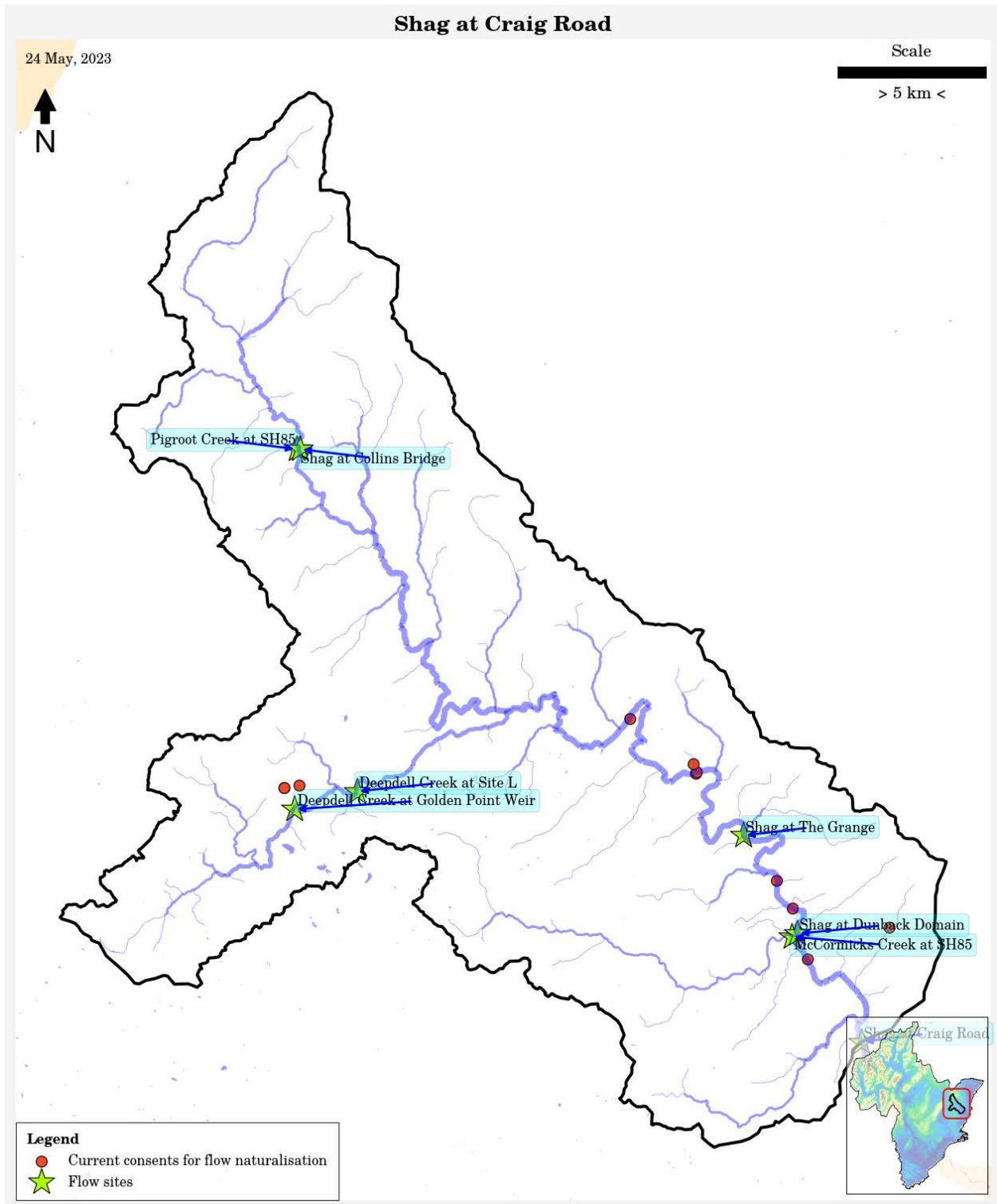


Figure 1: The current consents and flow recorders in the upstream area of the Craig Road flow recorder on the Shag/Waihemo River.

**Figure 2** shows the combined flow regime for the total water use above the Craig Road recorder. The estimated abstraction measurements began on the 15th of October 2006.

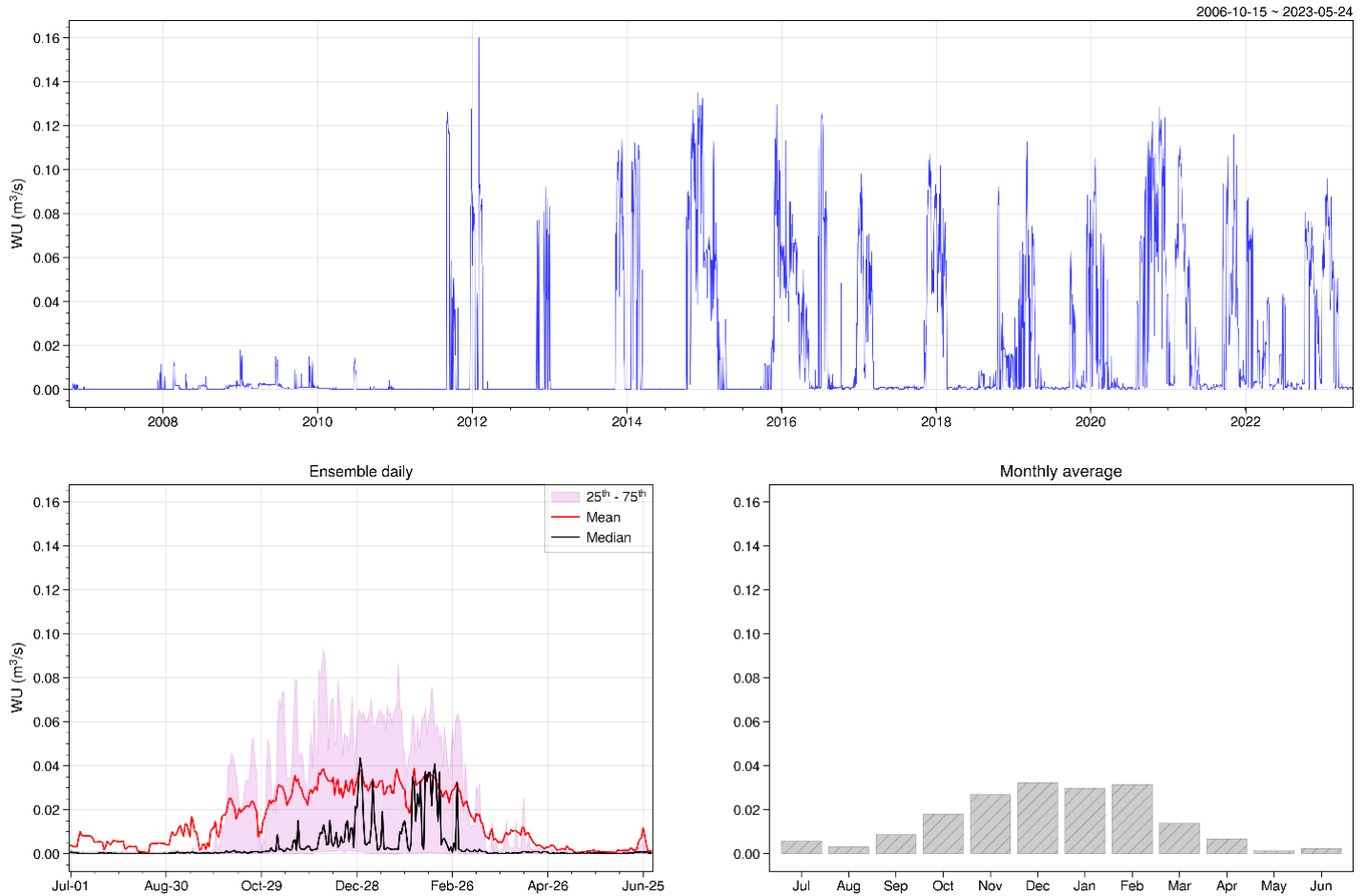


Figure 2: The total water use regime above the Craig Road recorder on the Shag/Waihemo River.

The water use pattern is quite different before and after the water year 2011/12. Therefore, in this study, only the total water use records after the water year 2011/12 are used. The water use pattern indicates that the irrigation season is between September and April. The water use during this season is 29 L/s on average (after 2011/12).

## Naturalised flow statistics for the Shag/Waihemo River at Craig Road

Table 2: Flow statistics for the observed and naturalised flows at Craig Road site after 2011/12.

Site	Mean (m <sup>3</sup> /s)	Min (m <sup>3</sup> /s)	Median (m <sup>3</sup> /s)	Max (m <sup>3</sup> /s)	7dMALF (m <sup>3</sup> /s)	FRE3 (year <sup>-1</sup> )
Shag/Waihemo at Craig Road (observed)	2.367	0.050	0.814	330.908	0.176	5.8
Shag/Waihemo at Craig Road (naturalised)	2.388	0.104	0.825	330.908	0.223	5.7

## The Shag/Waihemo River at the Goodwood Pump Site

The observed flow records at the Goodwood Pump site on the Shag/Waihemo River are limited to a series of one-off instantaneous gauging's over about 50 years. It is not continuous data that can be converted to a daily time series, and the gauging site has changed several times. Therefore, the flow records are not usable in this study.

Due to the limited data, the goal is to produce naturalised flow statistics for this site using alternative data. The Goodwood Pump gauging location and its location in relation to the Craig Road recorder are shown in **Figure 3**.

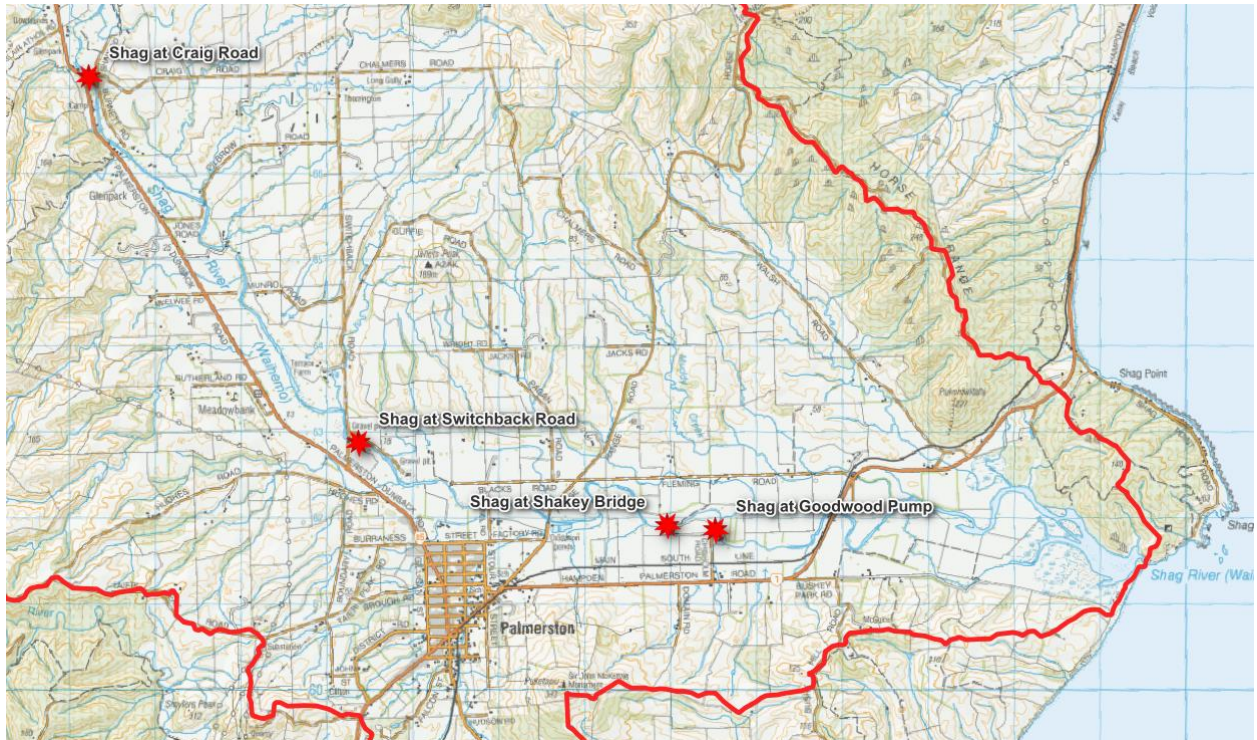


Figure 3. The relative locations of the Shag/Waihemo River recorder at Craig Road and the Goodwood Pump gauging site.

## Method

An estimate of the flow contribution in the catchment area between the sites at the Craig Road recorder and the Goodwood Pump (86 km<sup>2</sup>) was required to evaluate the long-term natural flow statistics at the Goodwood Pump flow site.

After viewing the rainfall isohyetal map for the Shag Catchment, an assumption was made that the flow yield/km<sup>2</sup> in the lower section of the catchment would be similar to that for the area between the Shag at the Grange and Shag at Craig Road sites (total of 123km<sup>2</sup>).

The naturalised mean and 7dMALF's calculated for the Grange and Craig Road sites were 1.799m<sup>3</sup>/s and 0.197m<sup>3</sup>/s for the Grange and 2.388m<sup>3</sup>/s and 0.223m<sup>3</sup>/s for Craig Road.

The reach between the two flow sites yielded 0.589m<sup>3</sup>/s for mean flow at a rate of 4.8 l/s/km<sup>2</sup> and for the 7dMALF it yielded 0.026m<sup>3</sup>/s at a rate of 0.21 l/s/km<sup>2</sup>.

Using these rates, the calculated mean flow for the Goodwood Pump site is 2.800 m<sup>3</sup>/s and the 7dMALF for that site is 0.241m<sup>3</sup>/s.

## Naturalised flow statistics for the Shag/Waihemo River at Goodwood Pump

The above results are shown in Table 3.



Table 3. The naturalised mean, 7dMALF,  $Q_{7,5}$ , and  $Q_{7,10}$  summary.

Site	Mean (m <sup>3</sup> /s)	7dMALF (m <sup>3</sup> /s)	Q <sub>7,5</sub> (m <sup>3</sup> /s)	Q <sub>7,10</sub> (m <sup>3</sup> /s)
Shag/Waihemo at The Grange (naturalised)	1.799	0.197	0.130	0.124
Shag/Waihemo at Craig Road (naturalised)	2.388	0.223	0.133	0.124
Shag/Waihemo at Goodwood pump (naturalised)	2.800	0.241	NA	NA

It must be noted that the  $Q_{7,5}$  and  $Q_{7,10}$  values were estimated using a relatively shorter naturalised time series and they may vary dramatically when more data is available in the future. Using different distributions could also vary the results.

## Appendix

The details in the complete consent lists and data processing can be found in [this HTML file](#).