

## Appendix A. Flow Data

A range of flow monitoring data was available in both the Kaituna and Rangitāiki WMAs. Available flow monitoring data from sites with a continuous or long-term data record were separated from sites where available data was limited. Flow monitoring locations were considered discrete if the available data displayed any of the following features:

- Infrequent temporal sampling;
- Large gaps in the monitoring data (i.e. year long periods);
- Records ending prior to 1995; and
- Records beginning after January 2015; and if the population size was less than 5.

Sites with continuous or long-term monitoring data were typically utilised in the flow calibration process (**Section 6**). The continuous flow monitoring sites that were considered appropriate and utilised in this project are outlined in **Table A-1** and **Table A-2**. A summary of the methods used to fill in periods of missing data within the continuous records are detailed in **Table A-3** and **Table A-4**.

Discrete flow monitoring sites were generally used as secondary 'check' locations. The discrete flow monitoring sites that were considered satisfactory and utilised in this project are outlined in **Tables A-5** and **Table A-6**.

Sites that were not located at the outlet of a SOURCE catchment or had fewer than 5 sample points were not considered satisfactory for secondary flow calibration checks.

**Table A-1. Continuous measured flow data in the Kaituna WMA.**

River	Site Name	Source Catchment	Record Type <sup>1</sup>	Data Range
Kaituna River	Kaituna at Taaheke	SC 015	Rated	21/10/1981 to 16/08/2016
Paraiti (Mangorewa) River	Paraiti (Mangorewa) at Saunders	SC 010	Rated & Synthetic	18/07/1967 to 10/02/2017
Kaituna River	Kaituna at Te Matai	SC 026	Rated & Synthetic <sup>2</sup>	02/05/1955 to 10/02/2017
Waiari River	Waiari at Muttons	SC 036	Rated & Synthetic	10/11/1966 to 15/07/1995
Pongakawa River	Pongakawa at Old Coach Road	SC 096	Rated	25/06/1997 to 14/08/2013
Waitahanui River	Waitahanui at Otamarakau	SC 113	Rated	04/09/2012 to 11/02/2017
Raparapahoe River	Raparapahoe at Above Drop Structure	SC 044	Rated & Synthetic	24/09/1991 to 11/02/2017
Puanene River	Puanene at SH2	SC 077	Rated	21/07/2013 to 10/03/2017

<sup>1</sup> Rated data refers to data from stage discharge rating curves, excluding Waiohou River which is an index – velocity rating. Synthetic data refers to data that has been calculated to fill in gaps in the time series. Synthetic data has been calculated using correlations with nearby sites, based on the behaviour of the water level during the data gap, or interpolated using the volume of precipitation that fell during the data gap.

<sup>2</sup> Due to changes in the downstream channel conditions and the tidal influence at the Te Matai recording site from 6 August 1986 onwards, the flow data series is derived from synthesised water levels.

**Table A-2. Continuous measured flow data in the Rangitāiki WMA.**

River	Site Name	Source Catchment	Record Type	Data Range
Rangitāiki River	Rangitāiki at SH5	SC 01	Rated	09/06/2004 to 05/12/2016
Rangitāiki River	Rangitāiki at Murupara	SC 026	Rated & Synthetic	01/01/1967 to 05/12/2016
Whirinaki River	Whirinaki at Galatea	SC 047	Rated & Synthetic	03/12/1952 to 02/06/2016
Pokairoa River	Pokairoa at Railway Culvert	SC 073	Rated & Synthetic	23/09/1993 to 07/03/2002
Waihua River	Waihua at Gorge	SC 090	Rated	20/12/1979 to 08/03/2017
Rangitāiki River	Rangitāiki at Waiohou Bridge	SC 032	Rated	30/07/2015 to 10/02/2017
Rangitāiki River	Rangitāiki at Te Teko	SC 037	Rated	02/06/1948 to 02/06/2016

**Table A-3 Summary of rated and synthetic data developed for the Kaituna WMA.**

Site Name	Source Catchment	Record Type	Method
Paraiti (Mangorewa) at Saunders	SC 010	Rated & Synthetic	<p>Synthetic data from 13/03/72 to 06/04/72.</p> <p>Synthetic data from 09/10/72 to 27/10/72, 03/12/72 to 29/12/72 record correlated with Waiari at Muttons.</p> <p>Synthetic data from 31/10/83 to 07/12/83, 20/04/84 to 01/05/84. Synthetic data derived by comparison with neighbouring site 14627.</p> <p>Synthetic data from 28/12/85 to 05/01/86 synthetic hydrograph has been derived by comparison with neighbouring site 14627.</p> <p>Gap from 08/02/86 to 11/02/86 due to instrument failure.</p> <p>Synthetic data. As no rain fell during this period a gradual recession is considered adequate.</p> <p>Gap from 14/02/86 to 17/02/86, 08/06/86 to 11/06/86 synthetic data derived from comparison with neighbouring site 14627.</p> <p>Due to intermittent recorder failure, the record between 11/07/86 and 18/07/86, 18/09/87 to 25/09/87 is synthetic in places. As no rain fell during these periods a gradual recession is considered appropriate.</p> <p>Gap from 05/02/90 to 13/02/90, 10/08/90 to 16/08/90, 02/09/90 to 05/09/90. A synthetic hydrograph was derived by comparison with neighbouring site 14627</p> <p>Synthetic record compiled from 22/11/90 to 22/11/90 due to maintenance.</p> <p>Synthetic data is from 04/12/91 to 06/12/91, 09/09/92 to 11/09/92 during this period no rainfall was recorded so a linear recession was considered adequate.</p> <p>Synthetic data 27/02/98 to 01/03/98, 02/03/98 to 24/03/98, 06/04/98 to 08/04/98.</p> <p>Gap from 10/09/09 to 14/09/09 due to iBridge comms failure.</p>

			<p>Synthetic data derived from site 14703.</p> <p>Synthetic data 02/02/10 to 03/02/10, 28/02/10 to 01/03/10</p> <p>Gap from 04/06/10 to 08/06/10 synthetic data derived from site 14703.</p> <p>Synthetic data 11/03/11 to 15/03/11, 11/04/11 to 14/04/11, 27/05/11 to 02/06/11, 19/06/11 to 26/06/11, 21/07/11 to 25/07/11, 09/09/11 to 12/09/11, 07/01/12 to 09/01/12, 18/03/10 to 21/03/12, 06/07/12 to 07/06/12.</p>
Kaituna at Te Matai	SC 026	Rated & Synthetic	<p>Flow gauging between 1986 and late 90s were performed at low tide at intervals that met the immediate needs of the time. Flow data from 6 August 1986 onwards is a flow series derived from the synthesised water levels.</p> <p>Synthetic data used for periods 16/08/67 to 11/09/67, 02/07/68 to 01/10/68, 16/09/72 to 22/09/72 by correlating it with the Waiari at Muttons gauge.</p> <p>Synthetic data used for periods 23/12/69 to 31/12/69, 09/05/73 to 11/05/73.</p> <p>Due to recorder failure, there is synthetic data from 02/09/82 this period a gradual recession is considered adequate. Fischer and Porter recorder removed from site due to water level dropping below the intake pipes.</p> <p>Gaps from 07/04/90 to 08/04/90, 02/07/90 to 03/07/90, 10/10/90 to 11/10/90, 24/10/90 to 25/10/90, 09/11/90 to 21/11/90 synthetic data was created for the period, based on the behaviour of the water levels in the river before and after this gap.</p>
Waiari at Muttons	SC 036	Rated & Synthetic	<p>Synthetic data from 06/08/71 to 01/07/71, 17/05/89 to 24/05/89 synthetic data based on the records from Paraiti (Mangorewa) at Saunders.</p>
Raparapahoe at Above Drop Structure	SC 044	Rated & Synthetic	<p>Synthetic data was used for 22/11/94 to 13/12/94, 24/12/94 to 10/01/95.</p>

**Table A-4 Summary of rated and synthetic data for the Rangitāiki WMA.**

Site Name	Source Catchment	Record Type	Synthetic Period
Rangitāiki at Murupara	SC 026	Rated & Synthetic	Synthetic record from 25/07/78 to 09/08/78.
Whirinaki at Galatea	SC 047	Rated & Synthetic	24/10/77 to 01/11/77 are synthetic recession 133000.
Pokairoa at Railway Culvert	SC 073	Rated & Synthetic	Synthetic record from 15/08/95 to 16/08/95 a straight line recession has been assumed.

**Table A-5 Discrete measured flow data locations in the Kaituna WMA.**

Site Name	Site Code	SC#	Latitude	Longitude	Start Date	End Date	Count (n)
Raparapahoe at No. 4 Road Bridge	FO005113	43	-37.8011	176.2944	19/02/1993	31/01/2008	8
Morepara at u/s Pikowai Road	HM688516	110	-37.9359	176.6055	10/11/2015	05/12/2016	9
Waitahanui at u/s Campbell Road	HM319871	105	-37.9053	176.5621	10/11/2015	05/12/2016	11
Kopuaroa at Above Waikoura Confluence	FO073670	49	-37.7508	176.2999	09/09/2009	01/04/2010	11
Waitahanui at Otamarakau Marae	HN674689	114	-37.8304	176.5988	01/01/1980	13/02/2015	12
Kirikiri at Manoeka Rd	FO085675	43	-37.7951	176.2832	10/11/2015	05/12/2016	13
Pokopoko at Black Rd	GN178816	73	-37.8241	176.4286	16/02/1978	05/12/2016	15
Paraiti (Mangorewa) at Old Tauranga Road	DM860350	2	-37.9633	176.1713	28/03/2007	05/12/2016	18
Waiari R/B Tributary at U/S Waiari Confluence	GN198111	69	-37.8874	176.4338	31/01/1995	25/02/2015	18
Ohineangaanga at SH2	FO210321	41	-37.7818	176.3168	13/02/1978	05/12/2016	21
Wharere at SH 2 Bridge	GN647803	82	-37.8234	176.4816	16/02/1978	05/12/2016	25
Kopuaroa at SH2	FO085678	49	-37.75	176.3012	01/03/1966	05/12/2016	36
Waitahanui at SH 2	HN643644	114	-37.8346	176.5955	08/07/1966	14/06/2004	38

**Table A-6. Discrete measured flow data locations in the Rangitāiki WMA.**

Site Name	Site Code	SC#	Latitude	Longitude	Start Date	End Date	Count (n)
Whirinaki u/s Waiparera confluence	IE250425	41	-38.66	176.71	20/01/2016	20/01/2016	6
Mangamate at U/S Ruarepuae Confluence	IH791208	75	-38.41	176.76	22/03/1995	08/05/2003	7
Horomanga at Galatea Rd	IH893640	52	-38.37	176.76	22/03/1995	27/03/2003	7
Waikuku d/s Galatea Rd	JJ633547	32	-38.20	176.84	19/11/2015	22/11/2016	11
Ngatamawahine u/s Kopuriki Rd	IH701900	70	-38.35	176.74	19/11/2015	08/12/2016	12
Horomanga at Above Quarry	JH447165	51	-38.41	176.83	22/03/1995	11/01/2006	14
Otamatea at Wairere Rd	FD445529	6	-38.75	176.39	21/04/2010	06/07/2015	16