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Hydrological Modelling Dataset

Report 2a: HMD Flow Series Comparison

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PREFACE

A large proportion of Aotearoa New Zealand's electricity needs are met by generation from hydro power. Information about the distribution of inflows and the capability of the various hydro systems is necessary to ensure a reliable, competitive, and efficient market and electricity system.

The Hydrological Modelling Dataset (HMD) is a dataset of hydrological information made available by the Electricity Authority. The dataset was known as the SPECTRA update until 2010. In 2015 the dataset was revised to become the HMD, a comprehensive dataset that can be used by modellers and analysts to test scenarios, provide commentary, and inform decisions.

The HMD is comprised of data provided by hydro generators and supplemented with data information from other sources. These parties are acknowledged for their contribution and for making this data available.

The HMD consists of three main components:

1. **Infrastructure and hydrological constraint attributes:**
    - This dataset records standing information about the capability of the main hydro schemes.
2. **Flows:**
    - This time series dataset records data for inflows for reservoirs and flows at various existing or potential hydro generating sites.
3. **Storage and spill:**
    - This time series dataset records storage for the main hydro schemes.

This report describes the differences between the 2022 and 2024 HMD flow series data.

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1 INTRODUCTION

1.1 DATASETS AND MEAN FLOWS

Care is taken to ensure consistency of data between successive HMD updates. A comparison of the mean flows for each flow series is listed in Table 1.1 for the North Island and Table 1.2 for the South Island. The data from the 2024 update (1 July 1931 – 31 December 2024) is compared to data from the previous full update (2022) which contains data from 1 July 1931 to 31 December 2022.

Table 1.1 North Island flow dataset names and mean values derived from the previous HMD update (2022) and this HMD update (2024).

Flow	Model flow name	Flow site number	Mean flow (m^3/s)		Type
			1 July 1931 to 31 Dec 2022	1 Jul 1931 to 31 Dec 2024	
Arapuni Tribs	Arapuni	92724 (1)	81.69	82.05	A
Karapiro Tribs	Karapiro	92714 (1)	90.90	90.85	A
Tokaanu	TokaanuTPD	92790 (3)	52.54	52.52	A
Tokaanu	Toka_Linear	22790 (3)	53.19	53.10	A
Taupō	TaupoTPD	92790 (1)	155.95	155.86	A
Taupō	Taupo_Linear	22790 (1)	154.17	154.01	A
Taupō	Taupo_Actual	42790 (1)	140.14	140.27	A
Taupō	Taupo_Infrastructure	72790 (1)	149.23	149.15	A
Taupō	Nat_Taupo	62790 (1)	126.00	125.91	N
Rangipō	RangipoTPD	92790 (2)	34.68	34.68	A
Rangipō	Rangi_linear	22790 (2)	28.76	28.73	A
Waikaremoana	Waikaremoana	3650 (1)	17.71	17.72	N+A
Matahina	Matahina	93254 (1)	64.35	64.41	A
Wheao	Wheao	15462 (1)	12.61	12.59	A
Mangahao	Mangahao	97502 (1)	8.96	9.00	A
Pātea	Patea	34300 (1)	19.87	19.94	A
Kaimai	Wairoa	14130 (1)	11.88	11.93	A
Ngaruroro	Whanawhana	123103 (1)	34.85	34.90	N+A
	Kuripapango	123104 (1)	17.72	17.75	N+A
	Chesterhope	123150 (1)	43.57	43.94	N+A
Mohaka	Raupunga	121801 (1)	79.02	79.26	N+A

“N” denotes a natural flow, uncontrolled flow

“A” denotes an actual flow

“N+A” denotes a flow that is both actual and natural

(*) Denotes item number of historic Tideda file, data is now stored in Hilltop Manager and uses the primary number

Table 1.2 South Island flow dataset names and mean values derived from the previous HMD update (2022) and this HMD update (2024).

Flow	Model flow name	Flow site number	Mean flow (m^3/s)		Type
			1 July 1931 to 31 Dec 2022	1 Jul 1931 to 31 Dec 2024	
Waitaki P.S. Tribs	Waitaki	98714 (2)	149.61	166.01	A
Benmore	Benmore	98614 (4)	132.95	132.91	A
	Ben_tp	98615 (2)	123.44	123.42	A
Ōhau (separate Tekapo model)	OhauRes	98614 (6)	70.27	70.22	A
	Ohau	98614 (3)	80.25	80.20	N+A
Pūkaki	Pukaki	98614 (2)	196.01	196.14	A
Natural Pūkaki	Nat_Puk	98770 (1)	126.94	126.97	N
Natural Tekapo	Nat_Tek	98770 (2)	83.89	83.94	N
Tekapo	Tekapo	98614 (1)	83.43	69.33	A
Manapōuri	Manawmara	99551 (1)	138.01	137.85	A
	Manapouri	99550 (1)	123.92	123.76	N
	Manareduced	99552 (1)	126.31	126.16	A
Te Anau	Teanau	9570 (1)	284.14	284.61	N+A
Monowai	Mono_Inflow	199540 (1)	12.93	12.91	N+A
Roxburgh	Roxburgh	99110 (1)	446.80	447.19	A
Wānaka	Wanaka	9154 (1)	197.80	198.20	N+A
Hāwea	Hawea	9170 (1)	64.42	64.60	N+A
Cobb	Cobb	97904 (2)	5.37	5.34	N+A
Coleridge	Coleridge	97904 (1)	24.67	24.69	A
Highbank	Highbank	7968 (1)	13.44	13.47	A
Waipori	Waipori	174395 (1)	7.36	7.38	A
Grey+Taramakau-Taipo	Grey_tara_closed	77106 (1)	436.84	436.79	A
Grey+Taramakau-Taipo	Grey_tara	77106 (2)	354.14	432.87	A
Waiau	Clarence	162105 (1)	14.48	14.39	N+A
	Glenhope	164604 (1)	34.06	33.77	N+A
	Marble Point	164602 (1)	94.41	93.99	N+A
Wairau	Dip Flat	160114 (1)	26.72	26.64	N+A
Hurunui	Mandamus	165104 (1)	51.49	51.29	N+A
	SH 1 Bridge	165101 (1)	66.72	66.46	N+A
Lake Onslow	Onslow	175237 (1)	2.92	2.93	N+A

“N” denotes a natural flow, uncontrolled flow
“A” denotes an actual flow
“N+A” denotes a flow that is both actual and natural
(*) Denotes item number of historic Tideda file, data is now stored in Hilltop Manager and uses the primary number

2 DATA DIFFERENCES FOR CALCULATED FLOW SITES

Differences between datasets may occur from one update to the next for a variety of reasons. These include rating changes; data modifications; inflows being recalculated, and various other reasons. Table 2.1 shows if there were any differences in the data between the previous and current updates for North Island flow sites and Table 2.2 shows if there were any differences for South Island flow sites. The following sections highlight the reasons for these differences.

Table 2.1 Data differences for previous and current updates for North Island flow sites.

Flow site number and item number	Flow site name	Data differs
92724 (1)	Arapuni Tributary inflows	N
92714 (1)	Karapiro Tributary inflows	N
22790 (1)	Taupo linear Inflows	N
22790 (2)	Rangipo linear Inflows	Y
22790 (3)	Tokaanu linear Inflows	N
92790 (1)	Taupo non-linear Inflows	N
92790 (2)	Rangipo non-linear Inflows	N
92790 (3)	Tokaanu non-linear Inflows	N
42790 (1)	Taupo operational inflows	N
72790 (1)	Taupo infrastructure inflows	Y
62790 (1)	Taupo natural inflows	N
3650 (1)	Waikaremoana inflows	Y
93254 (1)	Matahina Outflows	Y
15462 (1)	Wheao/Flaxy Outflows	N
97502 (1)	Mangahao Inflows	N
34300 (1)	Patea Outflows	N
14130 (1)	Kaimai Outflows at Ruahihi	N
123103 (1)	Ngaruroro - Whanawhana	Y
123104 (1)	Ngaruroro - Kuripapango	Y
123150 (1)	Ngaruroro - Chesterhope	Y
121801 (1)	Mohaka - Raupunga	Y

Table 2.2 Data differences for previous and current updates for South Island flow sites.

Flow site number and item number	Flow site name	Data differs
98714 (2)	Waitaki Tributaries (Benmore)	N
98614 (4)	Benmore Tributary Flows	Y
98615 (2)	Benmore_tp	Y
98614 (6)	Ohau Residual Flows	Y
98614 (3)	Ohau (Ohau B and C)	N
98614 (2)	Pukaki	Y
98770 (1)	Pukaki natural inflows	N
98614 (1)	Tekapo	N
98770 (2)	Tekapo natural inflows	N
99550 (1)	Manapouri local inflow (no Mararoa)	Y
99551 (1)	Manapouri local inflow (incl. Mararoa)	Y
99552 (1)	Manapouri local inflow (no Mararoa + water right reduction)	Y
9570 (1)	Lake Te Anau inflow	Y
199540 (1)	Monowai Inflow	N
99110 (1)	Roxburgh tributary flows	N
9154 (1)	Wanaka Outflow	N
9170 (1)	Hawea Inflow	N
97904 (2)	Cobb Inflow	N
97904 (1)	Coleridge Inflow	N
7968 (1)	Highbank Outflows	N
174395 (1)	Waipori Outflows	N
77106 (1)	Grey + Taramakau - Taipo	N
77106 (2)	Grey + Taramakau - Taipo	Y
162105 (1)	Waiau - Jollies	Y
164604 (1)	Waiau - Glenhope	Y
164602 (1)	Waiau - Marble Point	Y
160114 (1)	Wairau - Dip Flat	Y
165104 (1)	Hurunui - Mandamus	Y
165101 (1)	Hurunui - SH1 Bridge	Y
175237 (1)	Lake Onslow inflows	N

3 NORTH ISLAND FLOW SITES

3.1 22790 (2) RANGIPO LINEAR

There are minor changes as new data was provided from Genesis, as well as rating changes occurring for several input sites. Data differences are summarised in Table 3.1.

Table 3.1 Rangipo Linear (22790 (2)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	0.00	28.73	25.98	90.79
2022	0.00	28.76	26.02	90.71

3.2 72790 TAUPO INFRASTRUCTURE INFLOWS

There are minor changes as new data was provided from Genesis, as well as rating changes occurring for several input sites. Data differences are summarised in Table 3.2.

Table 3.2 Taupo infrastructure inflows (72790 (1)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	2.00	149.15	130.34	1426.25
2022	2.00	149.23	130.47	1426.69

3.3 3650 (1) WAIKAREMOANA

Minor differences to the ‘apparent’ mean and median differences which appear to be due to software rounding, the actual data has not changed. Data differences are summarised in Table 3.3.

Table 3.3 Waikaremoana (3650 (1)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	0.00	17.72	11.08	686.14
2022	0.00	17.71	11.07	686.14

3.4 123103 (1) NGARURORO – WHANAWHANA

There are very minor differences due to updated ratings provided for the flow data between updates. Data differences are summarised in Table 3.4.

Table 3.4 Ngaruroro at Whanawhana (123103 (1)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	1.40	34.90	25.73	837.36
2022	1.40	34.85	25.73	837.36

3.5 123104 (1) NGARURORO – KURIPAPANGO

There are very minor differences due to updated ratings provided for the flow data between updates. The maximum values differ because of Cyclone Gabrielle and the recorded high flows. Data differences are summarised in Table 3.5.

Table 3.5 Ngaruroro at Kuripapango (123104 (1)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	0.85	17.75	12.68	412.45
2022	0.85	17.72	12.67	385.09

3.6 123150 (1) NGARURORO – CHESTERHOPE

There are minor differences in the flow data due to updated ratings between updates. The maximum values differ because of Cyclone Gabrielle and the recorded high flows. Data differences are summarised in Table 3.6.

Table 3.6 Ngaruroro at Chesterhope (123150 (1)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	1.00	43.94	28.08	2152.00
2022	1.00	43.57	27.99	1698.97

3.7 121801 (1) MOHAKA – RAUPUNGA

There are minor differences in the flow data due to updated ratings between updates. The maximum values differ because of Cyclone Gabrielle and the recorded high flows. Data differences are summarised in Table 3.7.

Table 3.7 Mohaka (121801 (1)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	14.87	79.26	59.89	2031.32
2022	13.72	79.02	59.82	1619.11

3.8 93254 (1) MATAHINA OUTFLOWS

There are no differences between updates; the ‘apparent’ median differences appear due to software rounding and the actual data has not changed. Data differences are summarised in Table 3.8.

Table 3.8 Matahina Outflows (93254 (1)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	0.00	64.41	59.01	621.62
2022	0.00	64.35	58.98	622.00

4 SOUTH ISLAND FLOW SITES

4.1 98614 (4) BENMORE TRIBUTARY FLOWS

There are very minor differences due to an updated interpolation of historical data. Data differences are summarised in Table 4.1.

Table 4.1 Benmore tributaries (98614 (4)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	7.66	132.91	98.64	2962.93
2022	7.66	132.95	98.82	2962.93

4.2 98615 (2) BENMORE_TP

Minor changes are due to rating changes of the input sites, but do not significantly cause changes between updates. Data differences are summarised in Table 4.2.

Table 4.2 Benmore tributaries (98615 (2)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	7.66	123.42	98.59	2019.61
2022	7.66	123.44	98.72	2019.61

4.3 98614 (2) PUKAKI

Very minor differences due to new data received from Genesis this update. Data differences are summarised in Table 4.3.

Table 4.3 Pukaki (98614 (2)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	0.00	196.14	162.61	2828.37
2022	0.00	196.01	162.65	2828.37

4.4 98614 (1) TEKAPO

Very minor differences due to new data received from Genesis this update. Data differences are summarised in Table 4.4.

Table 4.4 Tekapo (98614 (1)) data difference table

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	4.48	69.33	62.30	130.00
2022	4.48	69.21	62.33	130.00

4.5 99550 (1) MANAPOURI LOCAL INFLOW (NO MARAROA)

Minor changes are due to rating changes of the input sites, but do not significantly cause changes between updates. Data differences are summarised in Table 4.5.

Table 4.5 Manapouri local inflow (99550 (1)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	0.00	123.76	78.92	2313.26
2022	0.00	123.92	79.13	2313.26

4.6 99551 (1) MANAPOURI LOCAL INFLOW (INCL. MARAROA)

Minor changes are due to rating changes of the input sites, but do not significantly cause changes between updates. Data differences are summarised in Table 4.6.

Table 4.6 Manapouri local inflow (99551 (1)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	0.00	137.85	96.12	2313.26
2022	0.00	138.01	96.39	2313.26

4.7 99552 (1) MANAPOURI LOCAL INFLOW (NO MARAROA + WATER RIGHT REDUCTION)

Minor changes are due to rating changes for the input sites, but do not significantly cause changes between updates. Data differences are summarised in Table 4.7.

Table 4.7 Manapouri local inflow (99552 (1)) data difference table

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	0.00	126.16	83.39	2532.31
2022	0.00	126.31	83.74	2532.31

4.8 77106 (2) GREY + TARAMAKAU – TAIPO

There are considerable differences between the 2024 and 2022 updates for this site, as the methodology used to calculate this dataset has changed (from 2023 onwards). This was as a result of the Taipo at SH1 Br site full record becoming available for use within the HMD, allowing an extended correlated record to be generated for Taramakau. See Report 2 for a full explanation of the changes. Data differences are summarised in Table 4.8.

Table 4.8 Grey River (77106 (1)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	40.19	432.87	323.60	7663.52
2022	8.59	435.80	318.88	8404.03

4.9 162105 (1) WAIAU – JOLLIES

Very minor differences due to slight changes in flow ratings. Data differences are summarised in Table 4.9.

Table 4.9 Waiau at Jollies (162105 (1)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	1.71	14.39	10.69	405.65
2022	1.71	14.48	10.76	405.65

4.10 164604 (1) WAIAU – GLENHOPE

Change in flow ratings means the correlation of flows between sites was updated, resulting in statistical differences between the previous and current update. Data differences are summarised in Table 4.10.

Table 4.10 Waiau at Glenhope (164604 (1)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	4.87	33.77	26.18	611.71
2022	4.91	34.06	26.40	617.68

4.11 164602 (1) WAIAU – MARBLE POINT

Minor differences due to changes in the flow ratings at this site. Data differences are summarised in Table 4.11.

Table 4.11 Waiau at Marble Point (164602 (1)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	18.57	93.99	72.80	1578.58
2022	18.97	94.41	73.20	1578.58

4.12 160114 (1) WAIRAU – DIP FLAT

Minor differences due to changes in the flow ratings at this site. Data differences are summarised in Table 4.12.

Table 4.12 Wairau at Dip Flat (160114 (1)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	4.01	26.64	20.28	587.88
2022	4.01	26.72	20.35	587.88

4.13 165104 (1) HURUNUI – MANDAMUS

Minor differences due to changes in the flow ratings at this site. Data differences are summarised in Table 4.13.

Table 4.13 Hurunui at Mandamus (165104 (1)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	7.91	51.29	39.42	1066.08
2022	7.91	51.49	39.54	1066.08

4.14 165101 (1) HURUNUI – SH1 BRIDGE

There are differences due to changes in the flow ratings at this site, and a change to how gaps were filled compared to the previous update. Data differences are summarised in Table 4.14.

Table 4.14 Hurunui at SH1 Bridge (165101 (1)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	9.01	66.46	51.72	1827.52
2022	7.00	66.72	52.01	1827.52

4.15 9570 (1) LAKE TE ANAU

Minor differences due to changes in the flow ratings at this site. Data differences are summarised in Table 4.15.

Table 4.15 Lake Te Anau (9570 (1)) data difference table.

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	0.03	284.61	185.28	4830.50
2022	0.03	284.14	185.16	4830.50

4.16 98614 (2) OHAU RESIDUAL INFLOWS

Minor differences due to changes in the flow ratings at this site, which are used in this simulated dataset. Data differences are summarised in Table 4.16.

Table 4.16 Ohau Residual Inflows (98614 (2)) data difference table

Update year	Minimum (m^3/s)	Mean (m^3/s)	Median (m^3/s)	Maximum (m^3/s)
2024	0.00	70.22	52.80	1593.93
2022	0.00	70.27	52.93	1593.93

5 NEGATIVE FLOWS IN DATASETS

The HMD series are derived to indicate potential generation. Therefore, a negative value implies that there is no water for generation. Negative data cannot exist as this implies that water is being lost from the system. Therefore, although a negative data value is not incorrect it shows that there is no water available for generation. For clarity, where negative values are either provided or initially calculated in scripts have been ‘zeroed’ out to prevent any confusion.