



# Hydrological Modelling Dataset

Report 2a: 2015 HMD Flow Series Comparison with  
SPECTRA 2010





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## Report 2a: 2015 HMD Flow Series Comparison with SPECTRA 2010

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# Preface

A large proportion of 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 relied upon 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 some 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 2010 SPECTRA data and the 2015 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 SPECTRA/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.

**Table 1.1:** North Island flow dataset names and mean values derived from the previous SPECTRA update (2010) and this HMD update (2015). “N” denotes a natural flow, uncontrolled flow (i.e. D1), “A” denotes an actual flow (i.e. D2), “N+A” denotes a flow that is both actual and natural

Flow	Model flow name	Flow site number	Mean flow (m <sup>3</sup> /s)		Type
			1 Jul 1931 to 30 June 2010	1 Jan 1932 to 31 Dec 2014	
Arapuni Tribs	Arapuni	92724 (1)	80.9	81.1	A
Karapiro Tribs	Karapiro	92714 (1)	92.9	92.7	A
Tokaanu	TokaanuTPD	92790 (3)	53.9	53.4	A
Tokaanu	Toka_Linear	22790 (3)	53.9	53.2	A
Taupo	TaupoTPD	92790 (1)	158.7	157.7	A
Taupo	Taupo_Linear	22790 (1)	154.9	153.6	A
Taupo	Taupo_Oper	42790 (1)	152.8	152.5	A
Rangipo	RangipoTPD	92790 (2)	35.8	35.6	A
Rangipo	Rangi_linear	22790 (2)	29.0	28.5	A
Waikaremoana	Waikaremoana	3650 (1)	17.7	17.7	N+A
Matahina	Matahina	93254 (1)	64.6	64.4	A
Wheao	Wheao	15462(1)	13.0	12.9	A
Mangahao	Mangahao	97502(1)	8.6	8.6	A
Patea	Patea	34300(1)	18.7	19.0	A
Kaimai	Wairoa	14130(1)	11.8	11.9	A
Ngaruroro	Whanawhana	123103 (1)	35.2	35.3	N+A
	Kuripapango	123104 (1)	17.7	17.7	N+A
	Chesterhope	123150 (1)	43.8	43.8	N+A
Mohaka	Raupunga	121801 (1)	78.8	79.9	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 Tideda file

Table 1.2: South Island flow dataset names and mean values derived from the previous SPECTRA update (2010) and this HMD update (2015). “N” denotes a natural flow, uncontrolled flow, “A” denotes an actual flow, “N+A” denotes a flow that is both actual and natural.

Flow	Model flow name	Flow site number	Mean flow (m <sup>3</sup> /s)		Type
			1 Jul 1931 to 30 June 2010	1 Jan 1932 to 31 Dec 2014	
Waitaki P.S. Tribs	Waitaki	98714 (2)	152.0	152.5	A
Benmore	Benmore	98614 (4)	125.4	125.8	A
	Ben_tp	98615 (2)	123.5	124.0	A
Ohau (separate Tekapo model)	OhauRes	98614 (6)	70.5	70.6	A
	Ohau	98614 (3)	80.5	80.6	N+A
Pukaki, Tekapo	Tek_puk	98615 (1)	207.5	208.5	N
Pukaki	Pukaki	98614 (2)	206.0	206.7	A
Natural Pukaki	Nat_Puk	98770 (1)	126.4	126.6	N
Tekapo	Tekapo	98614 (1)	79.6	80.2	A
Natural Tekapo	Nat_Tek	98770 (2)	81.1	82.0	N+A
Manapouri	Manawmara	99551 (1)	137.1	137.1	A
	Manapouri	99550 (1)	122.2	122.6	N
	Manareduced	99552 (1)	120.8	120.8	A
Te Anau	Teanau	9570 (1)	283.5	283.1	N+A
Monowai	Mono_Inflow	199540 (1)	13.0	13.0	N+A
Roxburgh	Roxburgh	99110 (1)	444.4	445.3	A
Wanaka	Wanaka	9154 (1)	196.5	196.7	N+A
Hawea	Hawea	9170 (1)	64.9	64.8	N+A
Cobb	Cobb	97904 (2)	5.4	5.4	N+A
Coleridge	Coleridge	97904 (1)	24.5	24.7	A
Highbank	Highbank	7968(1)	13.4	13.4	A
Waipori	Waipori	174395(1)	7.2	7.4	A
Grey+Taramakau-Taipo	Grey_tara	77106(1)	435.5	436.2	A
Waiiau	Clarence	162105 (1)	14.5	14.5	N+A
	Glenhope	164604 (1)	33.2	33.4	N+A
	Marble Point	164602 (1)	94.5	94.4	N+A
Wairau	Dip Flat	160114 (1)	26.4	26.5	N+A
Hurunui	Mandamus	165104 (1)	51.3	51.4	N+A
	SH 1 Bridge	165101 (1)	66.3	66.6	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 Tideda file

## 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	Yes
92714 (1)	Karapiro Tributary inflows	Yes
22790 (1)	Taupo Inflows	Yes
22790 (2)	Rangipo	Yes
22790 (3)	Tokaanu	Yes
92790 (1)	Taupo	Yes
92790 (2)	Rangipo	Yes
92790 (3)	Tokaanu	Yes
42790 (1)	Taupo operational inflows	NA
3650 (1)	Waikaremoana inflows	Yes
93254 (1)	Matahina Outflows	NA
15462 (1)	Wheao/Flaxy Outflows	NA
97502 (1)	Mangahao	No
34300 (1)	Patea Outflows	NA
14130 (1)	Kaimai Outflows at Ruahihi	NA
123103 (1)	Ngaruroro - Whanawhana	No
123104 (1)	Ngaruroro - Kuripapango	Yes
123150 (1)	Ngaruroro - Chesterhope	Yes
121801 (1)	Mohaka - Raupunga	Yes

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

### 3 North Island Flow Sites

#### 3.1 92724 (1) Arapuni Tributaries

There are very small differences starting on 13 April 2010 (Figure 3.1). The cumulative differences are shown in Figure 3.2. In 2010, the Power Archive had 3-hourly data at Taupo Outflows (flow site 2974) that was recorded on 15-mins past the hour (i.e., 12:15, 15:15, etc) during this time. This data was recalculated and amended on the archive after the 2010 SPECTRA report was completed. Taupo Outflow is one of the input flow sites for the Arapuni Tributaries series.

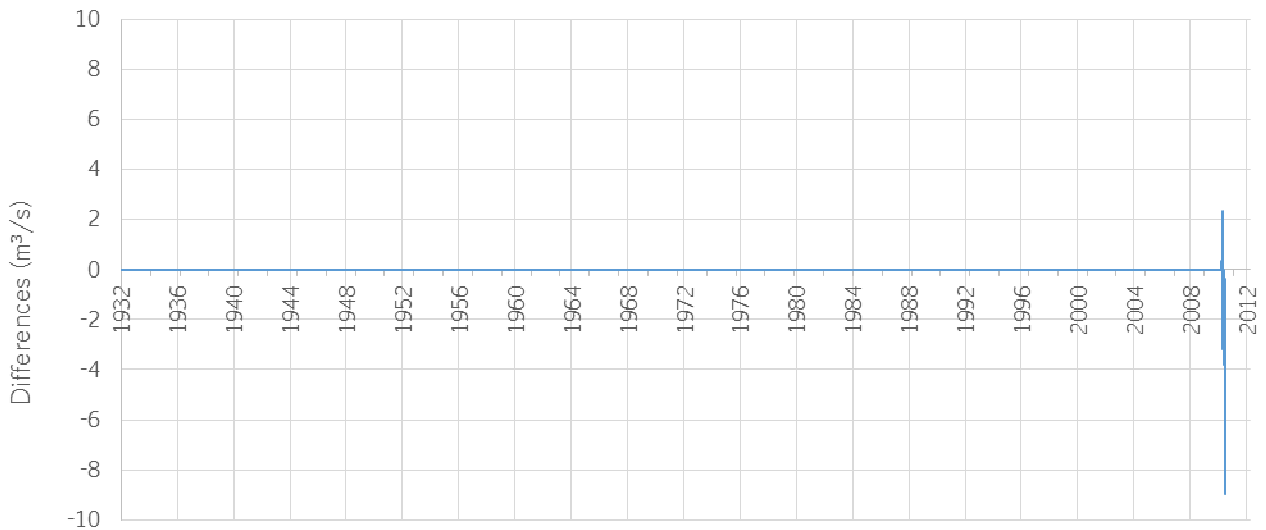


Figure 3.1: 92724 (1) Arapuni tributaries data difference plot

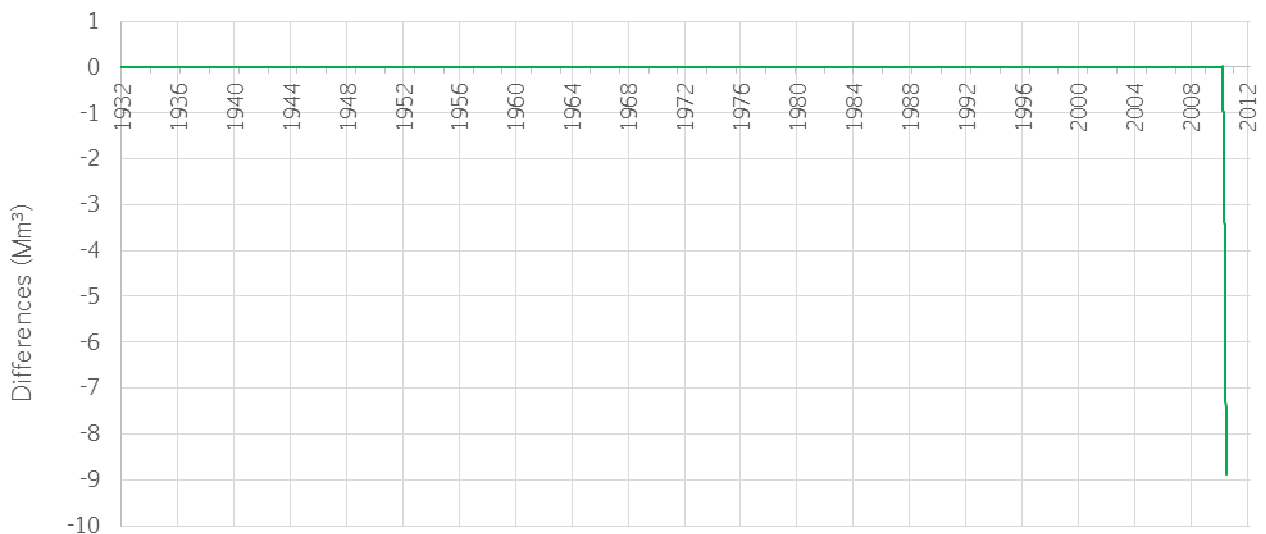


Figure 3.2: 91724 (1) Arapuni Tributaries cumulative data differences

## 3.2 92714 (1) Karapiro Tributaries

There are very small differences starting on 13 April 2010 (Figure 3.3). The cumulative differences are shown in Figure 3.4. In 2010, the Power Archive had 3-hourly data at Taupo Outflows (flow site 2974) that was recorded on 15-mins past the hour (i.e., 12:15, 15:15, etc) during this time. This data was recalculated and amended on the archive after the 2010 SPECTRA report was completed. Taupo Outflow is one of the input flow sites for the Karapiro Tributaries series.

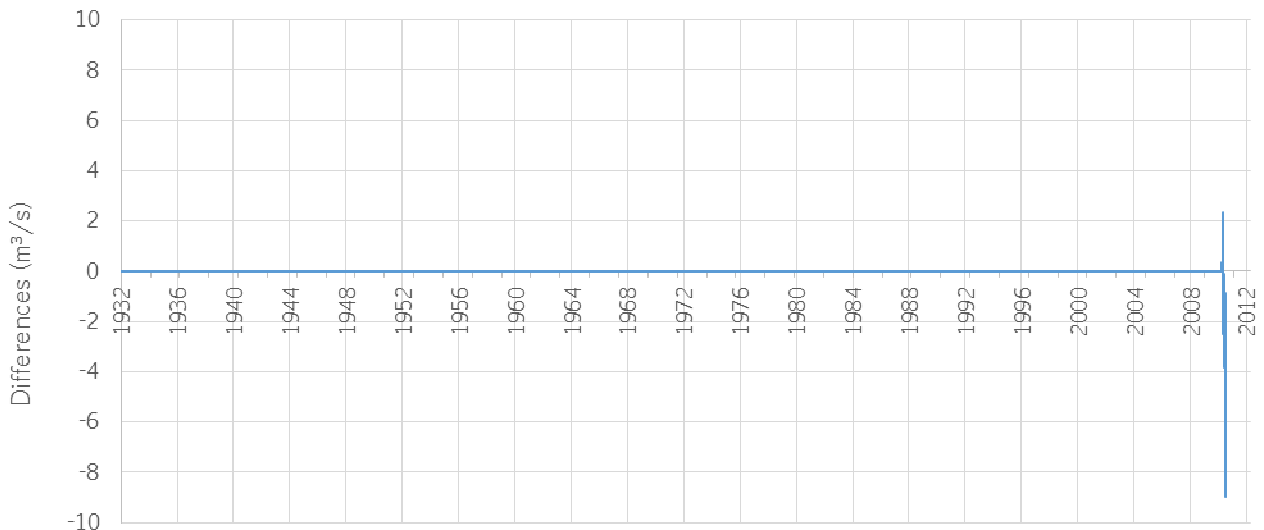


Figure 3.3: 92714 (1) Karapiro tributaries data difference plot

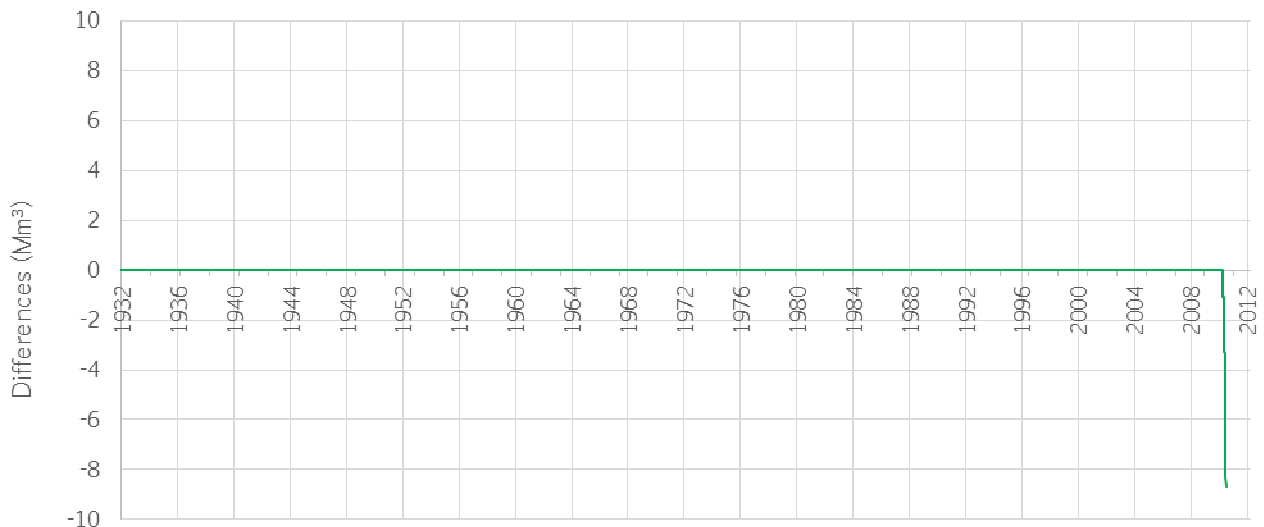


Figure 3.4: 91714 (1) Karapiro Tributaries cumulative data differences

### 3.3 22790 (1) – Taupo Inflow Linear

The differences in the Taupo Linear series that start from 23-Sep-1969 are due to Mighty River Power Ltd editing and transforming the Reid's Farm flow data after some irregularities were found. Consequently, Taupo Outflow, Inflow and Natural Inflow data were recalculated from 1969-2009 (Figure 3.5). This dataset change occurred in 2013. These differences are more apparent when viewed as cumulative differences Figure 3.6).

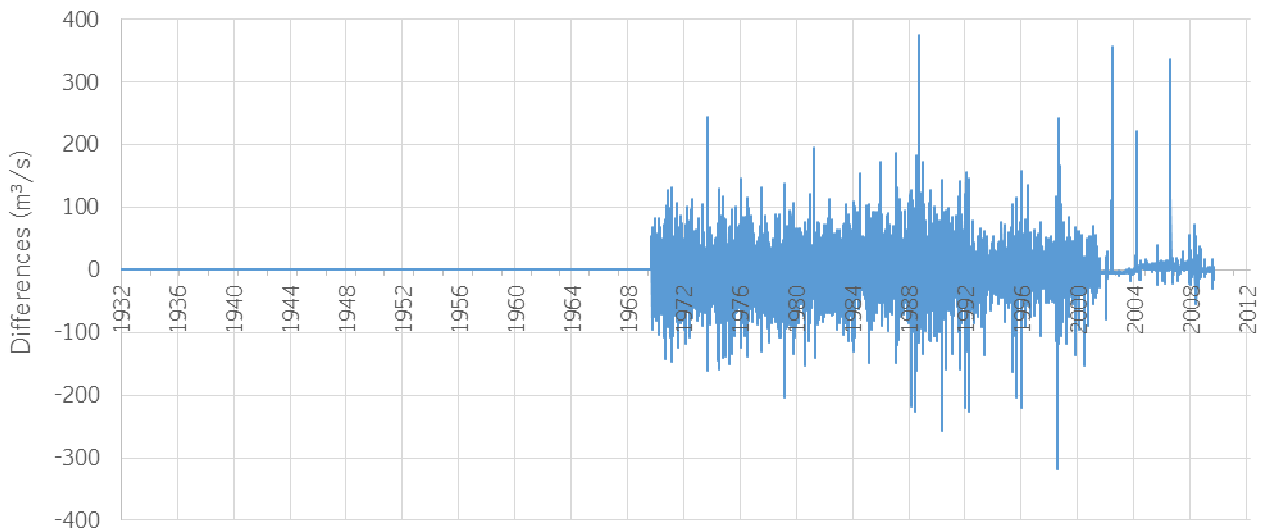


Figure 3.5: 22790 (1) Taupo Inflow Linear data differences

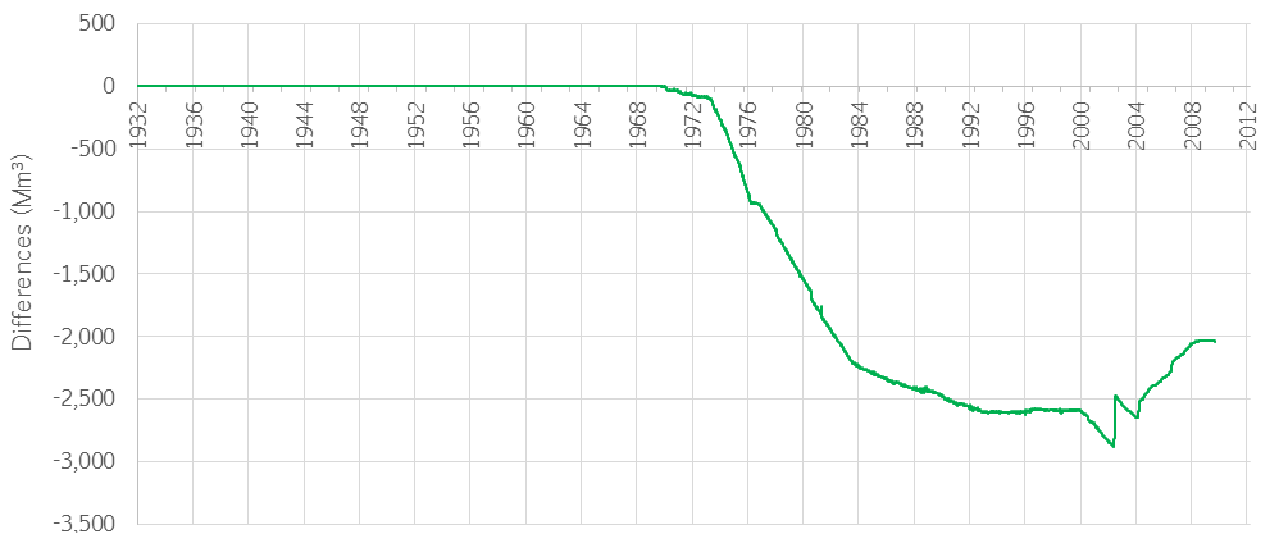


Figure 3.6: 22790 (1) Taupo Inflow Linear cumulative data differences

### 3.4 22790 (2) – Rangipo Linear

The differences in the Rangipo Linear series that start from 23-Sep-1969 are due to Mighty River Power Ltd editing and transforming the Reid’s Farm flow data after some irregularities were found. Consequently, Taupo Outflow, Inflow and Natural Inflow data were recalculated from 1969-2009 (Figure 3.7). This dataset change occurred in 2013. Taupo Inflow is one of the inputs to the Rangipo Linear series. The reduction in flow is more apparent when viewed as cumulative differences (Figure 3.8).

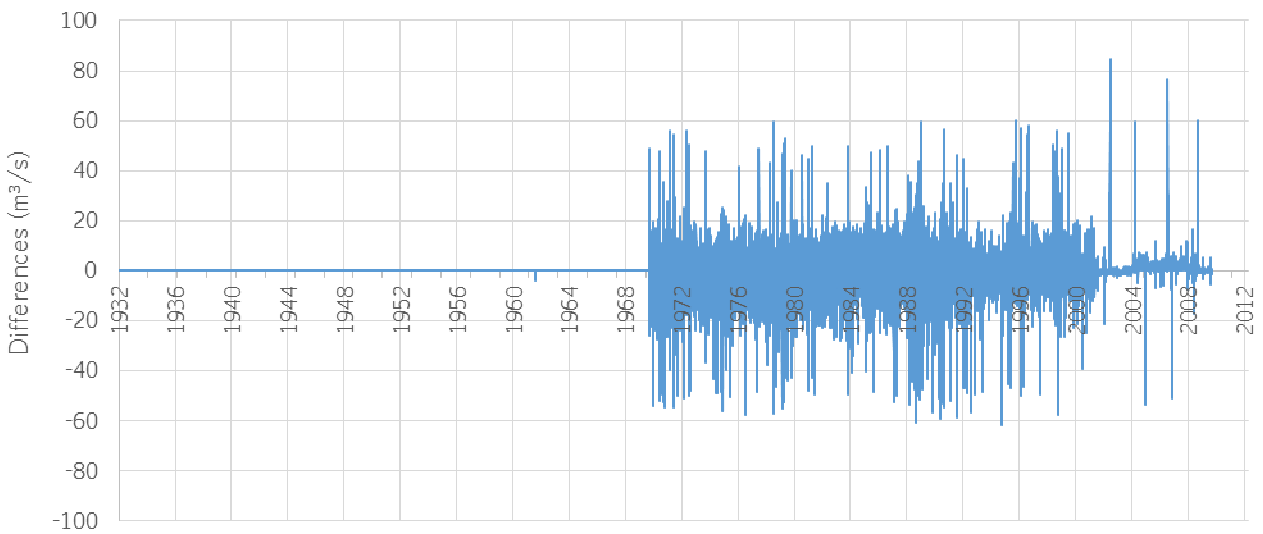


Figure 3.7 22790 (2) Rangipo Linear data differences

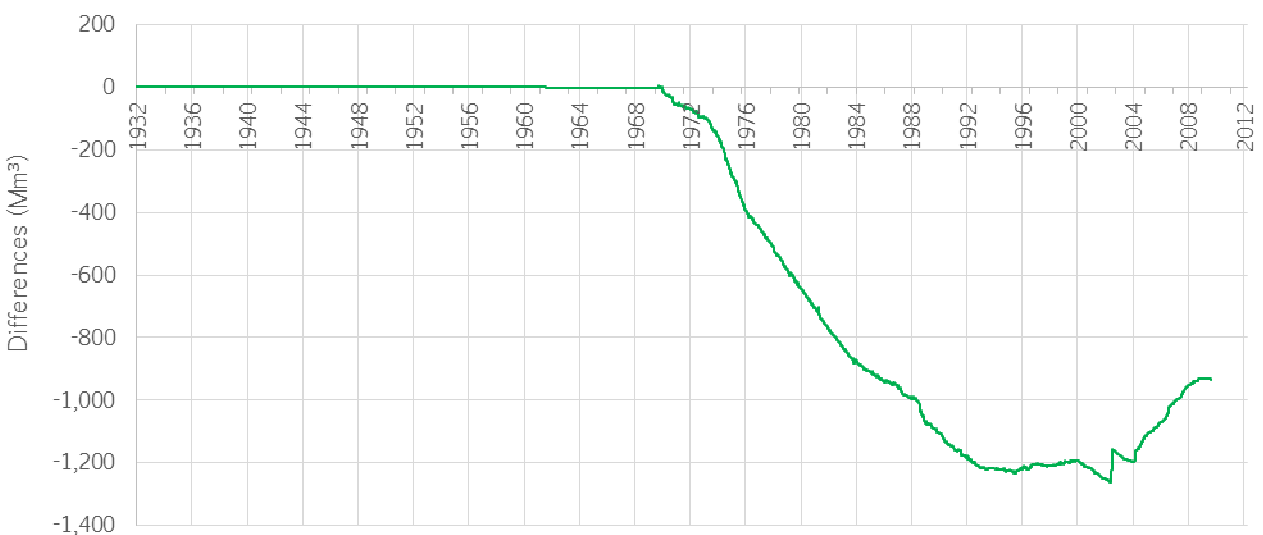


Figure 3.8 22790 (2) Rangipo Linear cumulative data differences



### 3.5 22790 (3) – Tokaanu Linear

The differences in the Tokaanu Linear series that start from 23-Sep-1969 are due to Mighty River Power Ltd editing and transforming the Reid’s Farm flow data after some irregularities were found. Consequently, Taupo Outflow, Inflow and Natural Inflow data were recalculated from 1969-2009 (Figure 3.9). This dataset change occurred in 2013. Taupo Inflow is one of the inputs to the Tokaanu Linear series. The reduction in flow is more apparent when viewed as cumulative differences (Figure 3.10).

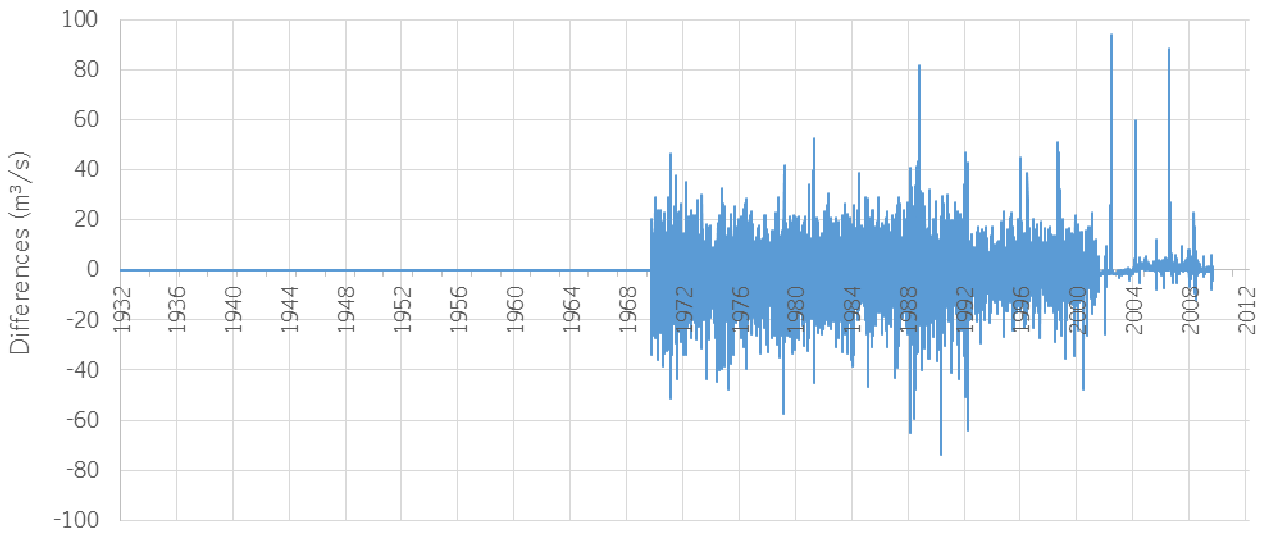


Figure 3.9 22790 (3) Tokaanu Linear data differences

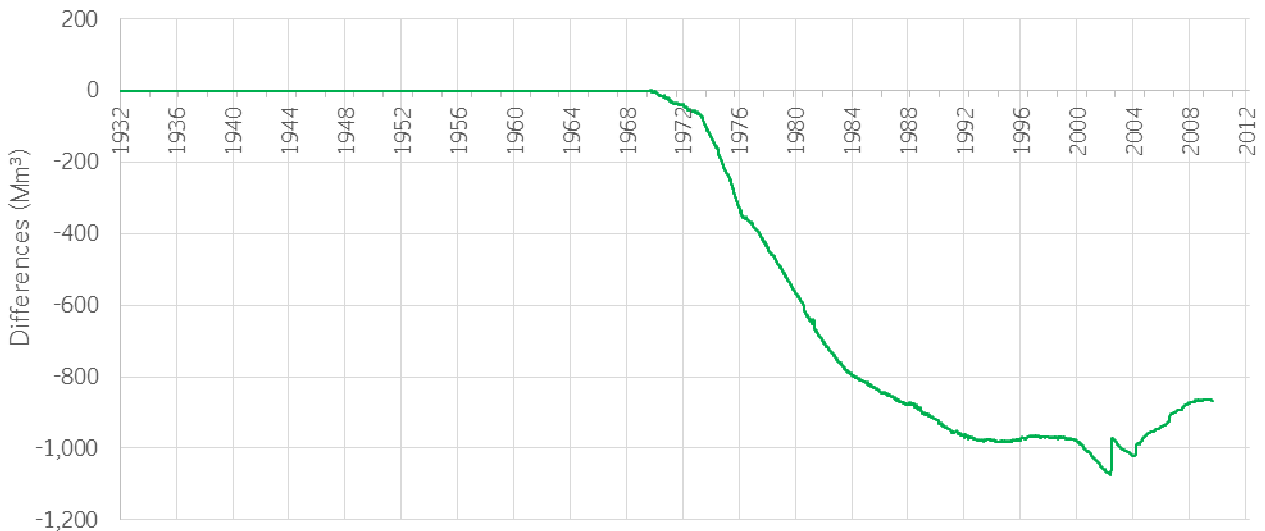


Figure 3.10 22790 (3) Tokaanu Linear cumulative data differences

## 3.6 92790 (1) – Taupo

The main input to the HMD Taupo Inflows data set (92790-1) is a Taupo Natural Inflows series. Prior to 2010 the Taupo Natural Inflows dataset was created using a complicated process involving a vast number of tributary flows and station flows in the Tongariro Power Development (TPD). These were then processed through an executable file developed for the SPECTRA modelling dataset.

Since 2008, when a new version of Windows was installed, the Taupoin.exe file no longer runs. The Taupoin.exe file created a temporary flow site (82790) which was the Taupo Natural Inflow site created for SPECTRA. Taupo Natural Inflows are now being calculated as part of the Power Archive for MRP as flow site 62790.

For the 2010 update, after the Taupoin.exe file no longer worked, a distribution rating correlation (1931-2008) was used to extend the Taupo Natural Inflow (82790) site to 1-Jul-2010.

For this 2015 update, the Taupo Natural Inflows (62790) site was used in place of the old 82790 flow site as the input to the PSIMs. This was done because the process used to create the Power Archive Taupo Natural Inflows dataset is audited and certified and the process is robust. The 82790 flow site used for SPECTRA was created using a number of flow sites that have subsequently closed, ratings have changed, and includes gaps that have to be filled in datasets. Therefore, rather than correlating a known dataset to one with potentially unquantifiable uncertainties, the dataset of known quality and origin (62790) was used as the input flow site for the PSIMs. The 62790 flow site is the input for the flow site 92790 - items 1, 2, and 3.

Changing the input flow site to the PSIM routines back to 1932 has caused some differences when compared with the 2010 update (Figure 3.11). The cumulative differences up to 1969 are, however, not particularly large (Figure 3.12).

Differences in the Taupo series starting from 23-Sep-1969 are not only due to the different input dataset (62790), but also due to Mighty River Power Ltd editing and transforming the Reid's Farm flow data after some irregularities were found. Consequently, Taupo Outflow, Inflow and Natural Inflow data were recalculated from 1969-2009. This dataset change occurred in 2013. These differences are more apparent when viewed as cumulative differences (Figure 3.12).

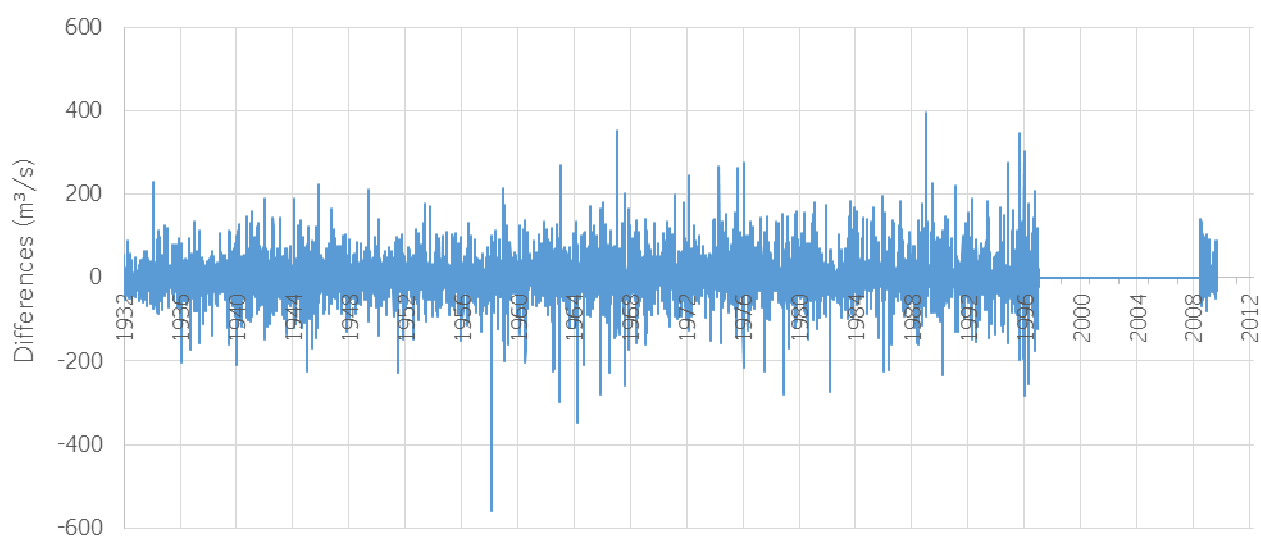


Figure 3.11 92790 (1) Taupo data differences

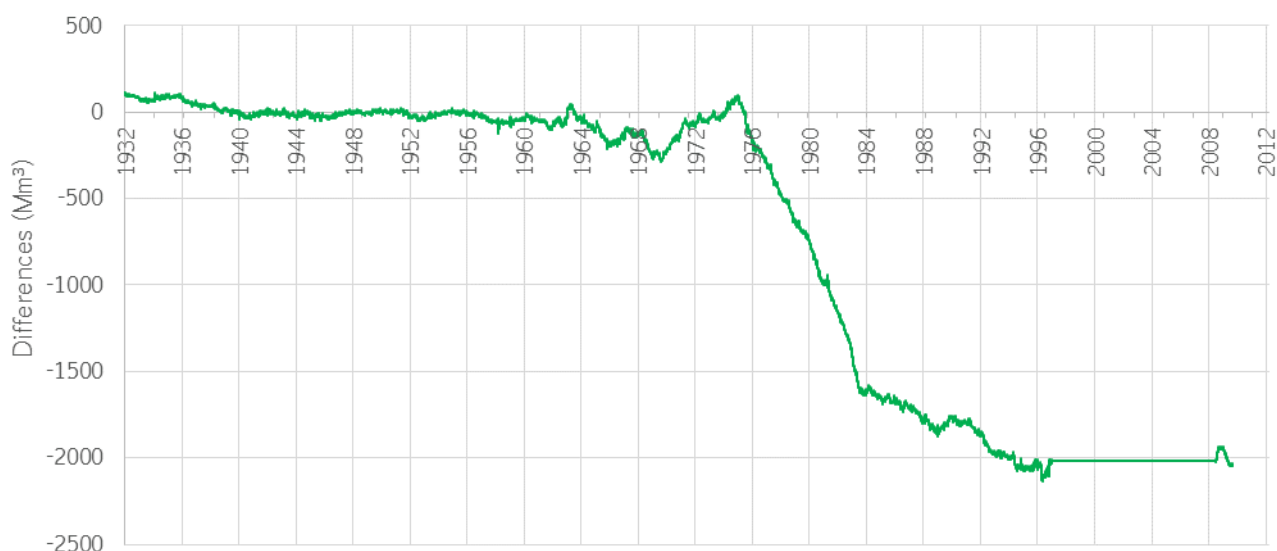


Figure 3.12: 92790(1) Taupo - cumulative data differences

### 3.7 92790 (2) – Rangipo

Similarly to Taupo Inflows data set (92790-1), the main input to the HMD Rangipo Inflows data set (92790-2) is a Taupo Natural Inflows series. Prior to 2010 this Taupo Natural Inflows dataset was created using a complicated process involving a vast number of tributary flows and station flows in the Tongariro Power Development (TPD). These were then processed through an executable file (Taupoin.exe) developed for the SPECTRA modelling dataset.

Since 2008, when a new version of Windows was installed, the Taupoin.exe file no longer runs. The Taupoin.exe file created a temporary flow site (82790) which was the Taupo Natural Inflow

site created for SPECTRA. Taupo Natural Inflows are now being calculated as part of the Power Archive for Mighty River Power Ltd as flow site 62790.

For the 2010 update, after the Taupoin.exe file no longer worked, a distribution rating correlation (1931-2008) was used to extend the Taupo Natural Inflow (82790) site to 1-Jul-2010.

For this 2015 update, the Taupo Natural Inflows (62790) site was used in place of the old 82790 flow site as the input to the PSIMs. This was done because the process used to create the Power Archive Taupo Natural Inflows dataset is audited and certified and the process is robust. The 82790 flow site used for SPECTRA was created using a number of flow sites that have subsequently closed, ratings have changed, and includes gaps in datasets that have to be filled. Therefore, rather than correlating a known dataset to one with potentially unquantifiable uncertainties, the dataset of known quality and origin (62790) was used as the input flow site for the PSIMs. The 62790 flow site is the input for the flow site 92790 - items 1, 2, and 3.

Changing the input flow site to the PSIM routines back to 1932 has caused some differences in the HMD Rangipo dataset when compared with the 2010 update (Figure 3.13). The cumulative differences up to 1969 are, however, not particularly large (Figure 3.14).

The apparent maximum and minimum differences of  $63\text{m}^3/\text{s}$  or  $-63\text{m}^3/\text{s}$  are related to the maximum flow through Rangipo being set to  $63\text{m}^3/\text{s}$  in the PSIM routine. This difference is caused by a 1-day offset and is consequently not apparent in the cumulative differences plot (Figure 3.14).

Differences in the Taupo series starting from 23-Sep-1969 are not only due to the different input dataset (62790), but also due to Mighty River Power Ltd editing and transforming the Reid's Farm flow data after some irregularities were found. Consequently, Taupo Outflow, Inflow and Natural Inflow data were recalculated from 1969-2009. This dataset change occurred in 2013. These differences are more apparent when viewed as cumulative differences (Figure 3.14).

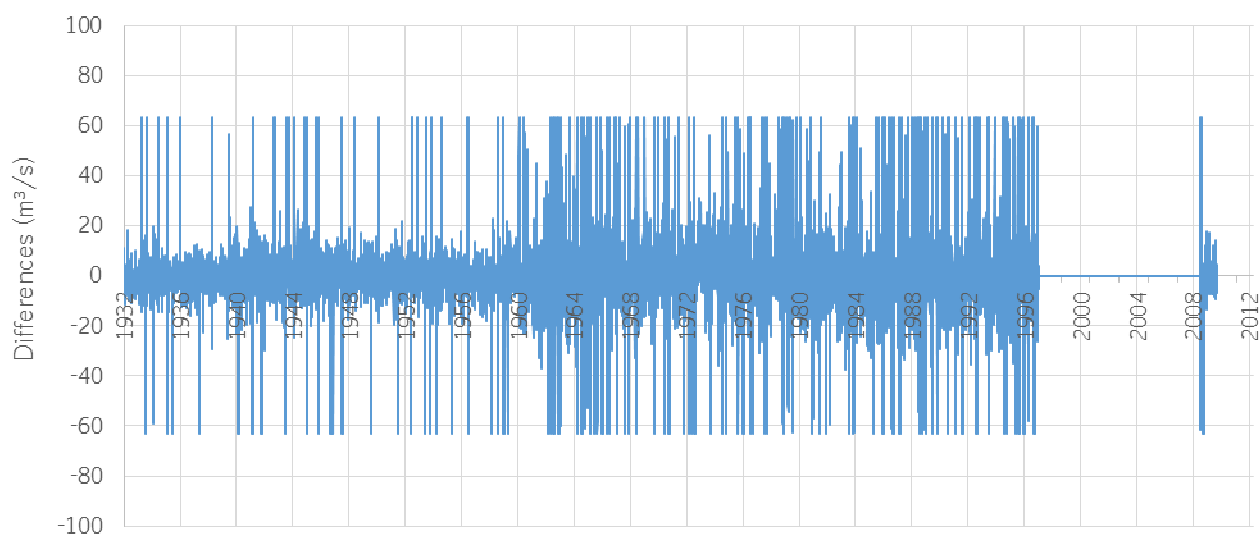


Figure 3.13 92790 (2) Rangipo data differences

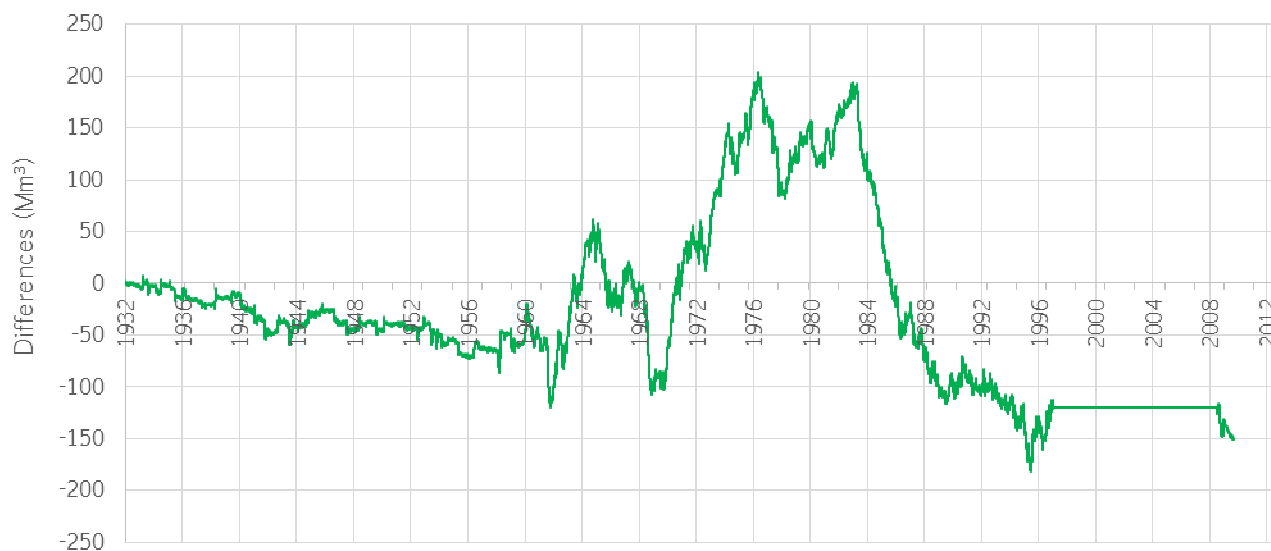


Figure 3.14: 92790 (2) Rangipo - cumulative data differences

### 3.8 92790 (3) – Tokaanu

Similarly to Taupo Inflows data set (92790-1), the main input to the HMD Tokaanu Inflows data set (92790-2) is a Taupo Natural Inflows series. Prior to 2010 this Taupo Natural Inflows dataset was created using a complicated process involving a vast number of tributary flows and station flows in the Tongariro Power Development (TPD). These were then processed through an executable file (Taupoin.exe) developed for the SPECTRA modelling dataset.

Since 2008, when a new version of Windows was installed, the Taupoin.exe file no longer runs. The Taupoin.exe file created a temporary flow site (82790) which was the Taupo Natural Inflow site created for SPECTRA. Taupo Natural Inflows are now being calculated as part of the Power Archive for Mighty River Power Ltd as flow site 62790.

For the 2010 update, after the Taupoin.exe file no longer worked, a distribution rating correlation (1931-2008) was used to extend the Taupo Natural Inflow (82790) site to 1-Jul-2010.

For this 2015 update, the Taupo Natural Inflows (62790) site was used in place of the old 82790 flow site as the input to the PSIMs. This was done because the process used to create the Power Archive Taupo Natural Inflows dataset is audited and certified and the process is robust. The 82790 site used for SPECTRA was created using a number of flow sites that have subsequently closed, ratings have changed, and includes gaps in datasets that have to be filled. Therefore, rather than correlating a known dataset to one with potentially unquantifiable uncertainties, the dataset of known quality and origin (62790) was used as the input flow site for the PSIMs. The 62790 flow site is the input for the flow site 92790 - items 1, 2, and 3.

Changing the input flow site to the PSIM routines back to 1932 has caused some differences in the HMD Tokaanu dataset when compared with the 2010 update (Figure 3.15). The cumulative differences up to 1969 are, however, not particularly large (Figure 3.16).

Differences in the Taupo series starting from 23-Sep-1969 are not only due to the different input dataset (62790), but also due to Mighty River Power Ltd editing and transforming the Reid’s Farm flow data after some irregularities were found. Consequently, Taupo Outflow, Inflow and Natural Inflow data were recalculated from 1969-2009. This dataset change occurred in 2013. These differences are more apparent when viewed as cumulative differences (Figure 3.16).

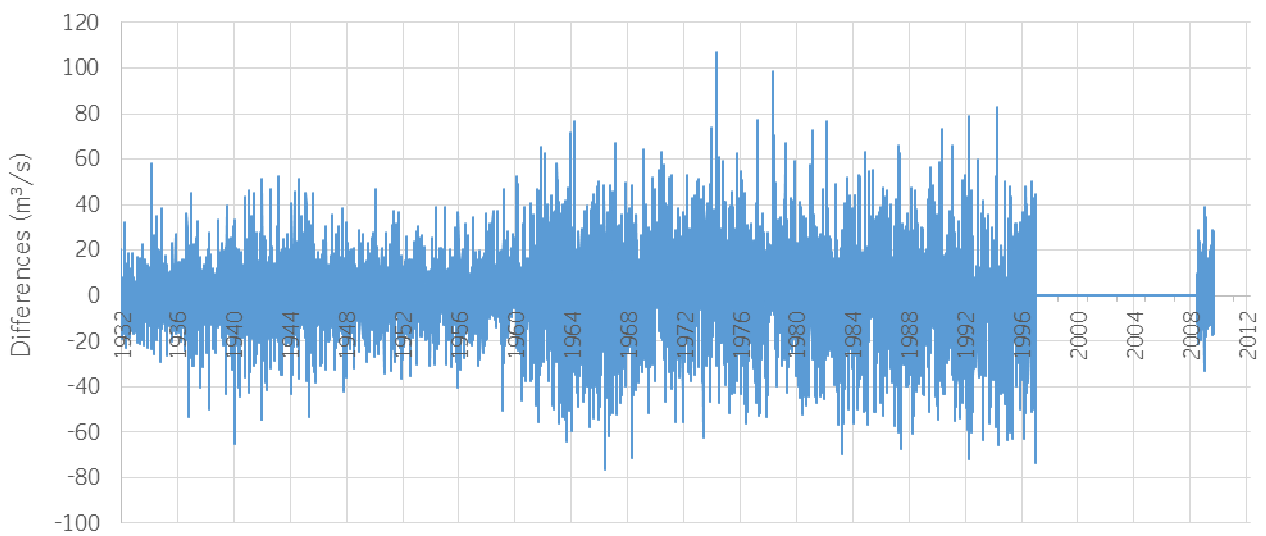


Figure 3.15 92790 (3) Tokaanu data differences

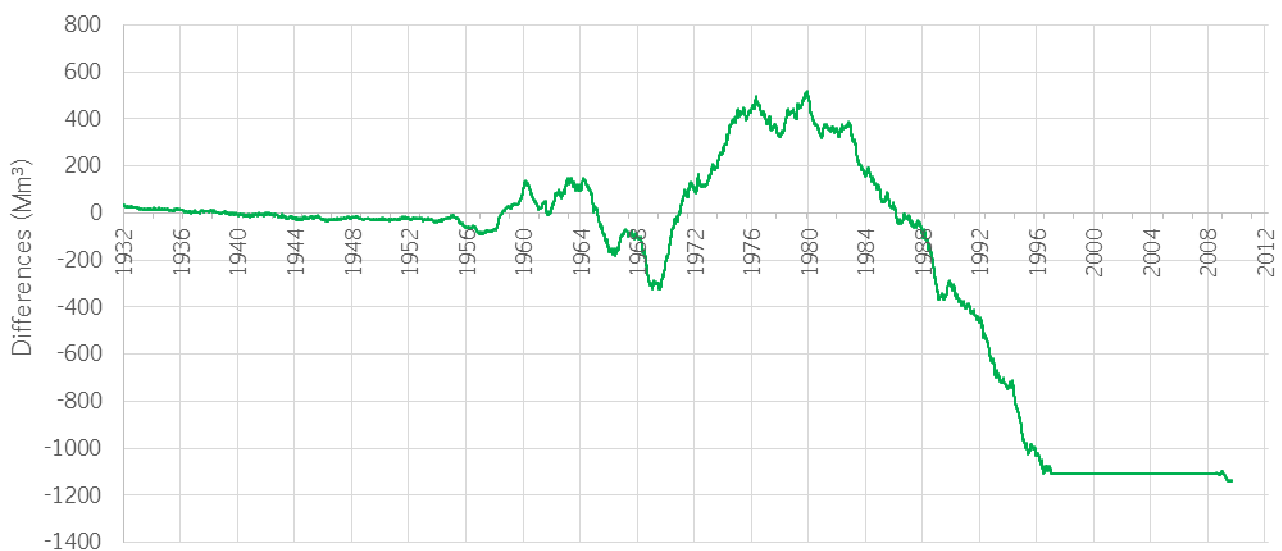


Figure 3.16: 92790 (3) Tokaanu - cumulative data differences

### 3.9 3650 (1) Waikaremoana

There are differences in the Waikaremoana inflows (Figure 3.17). The cumulative differences are shown in Figure 3.18. This data came from Genesis Energy; and is their current data.

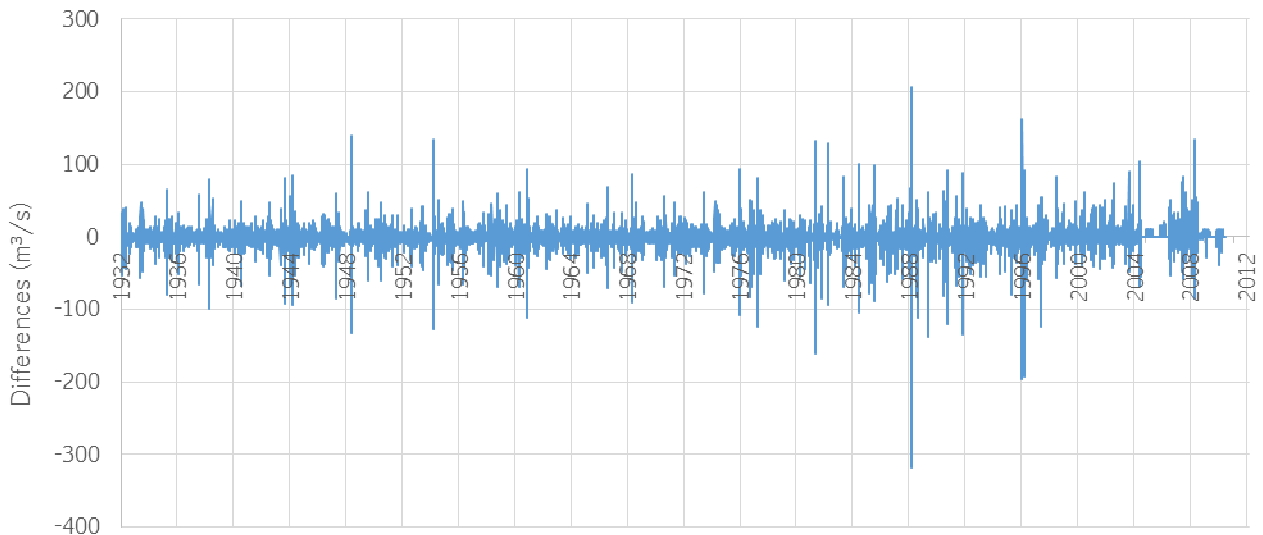


Figure 3.17 3650 (1) Waikaremoana inflows data difference plot

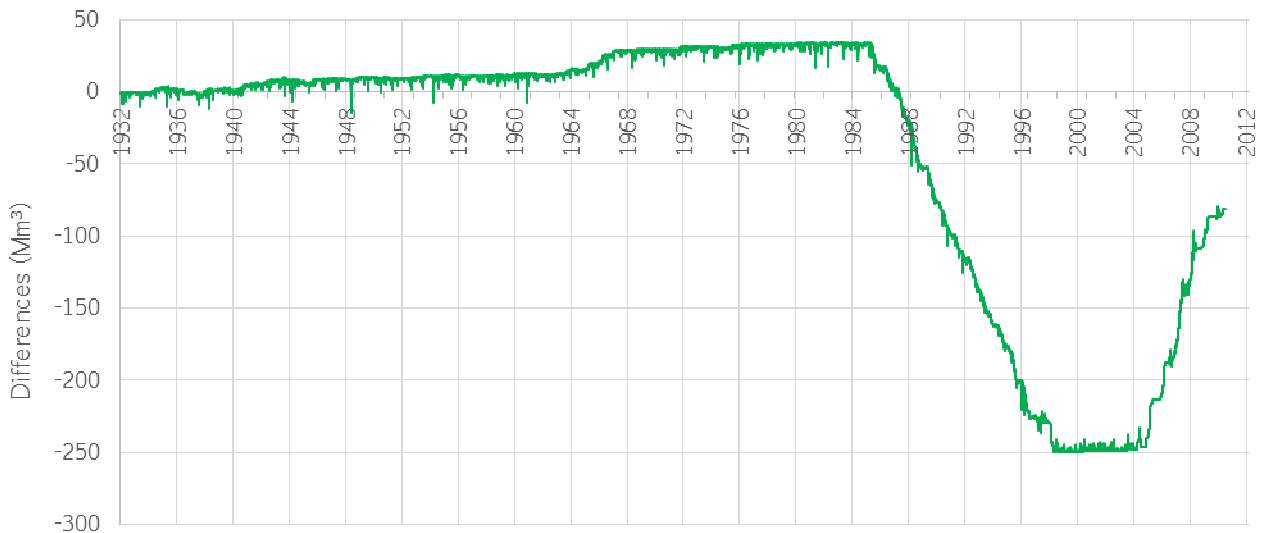


Figure 3.18: 3650 (1) Waikaremoana - cumulative data differences

### 3.10 123104 (1) Ngaruroro - Kuripapango

There are small differences in this dataset from rating additions and changes that have come from NIWA (Figure 3.19). The cumulative differences are shown in Figure 3.20.

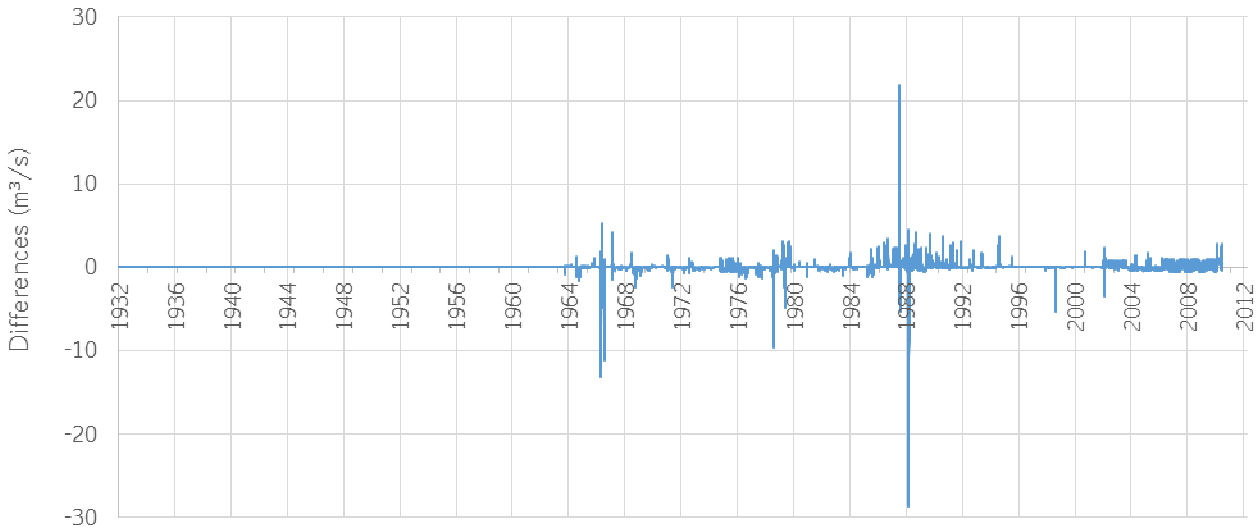


Figure 3.19 123104 (1) Kuripapango data differences

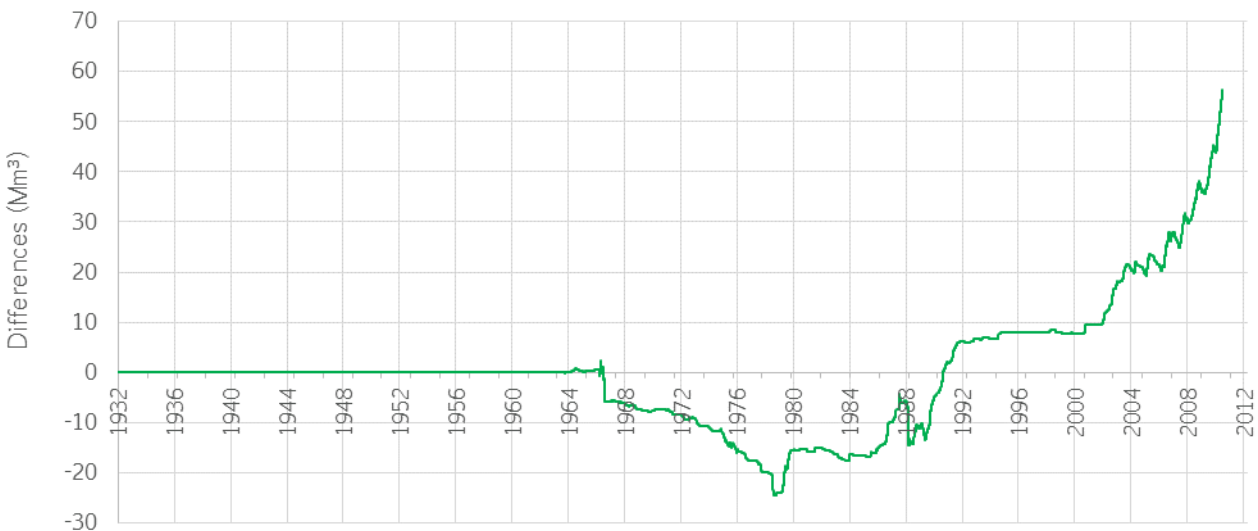


Figure 3.20: 123104 (1) Kuripapango - cumulative data differences



### 3.11 123150 (1) Ngaruroro - Chesterhope

There are differences in this dataset from rating additions and changes that have come from NIWA (Figure 3.21). The cumulative differences are shown in Figure 3.22.

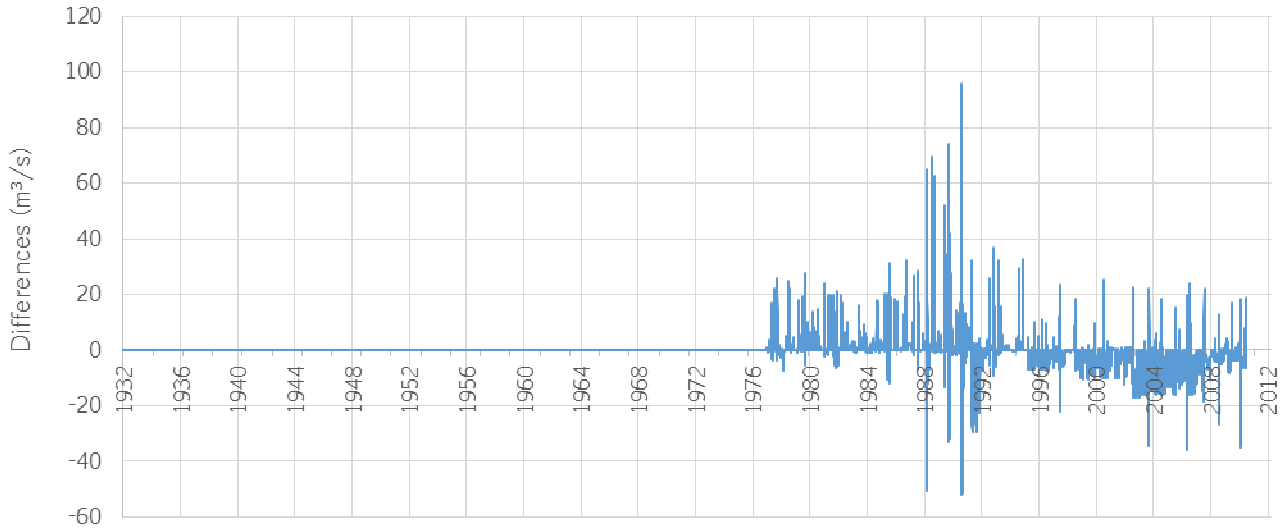


Figure 3.21 123150 (1) Chesterhope data differences

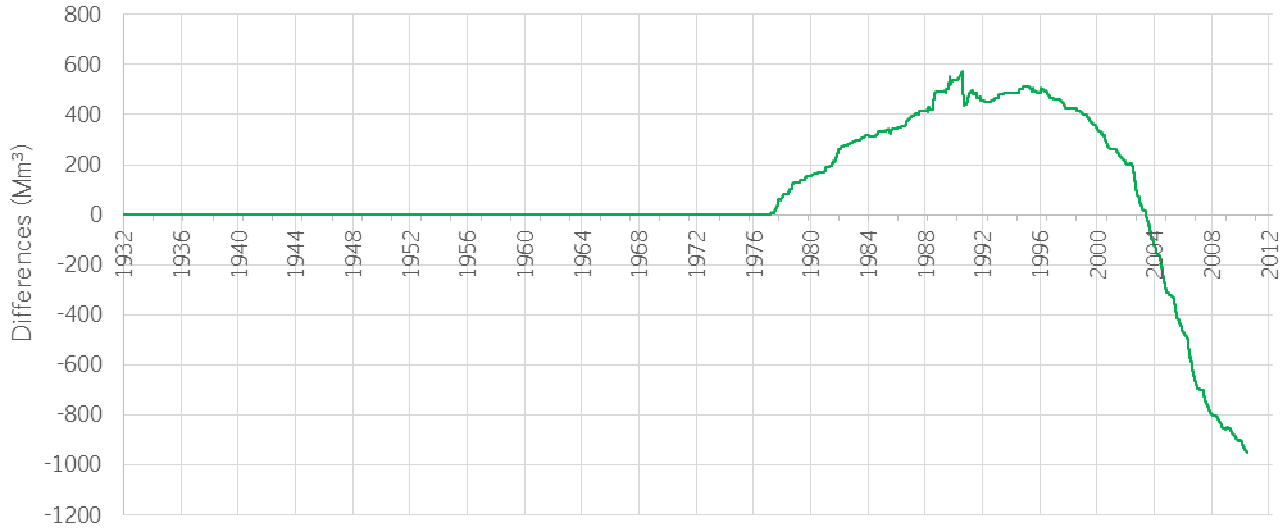


Figure 3.22: 123150 (1) Chesterhope - cumulative data differences

### 3.12 121801 (1) Mohaka - Raupunga

There are large differences in this dataset. NIWA changed/deleted and added ratings from 1957 onwards. Largest differences are from periods of gaps which needed to be filled again (Figure 3.23). The cumulative differences are shown in Figure 3.24.

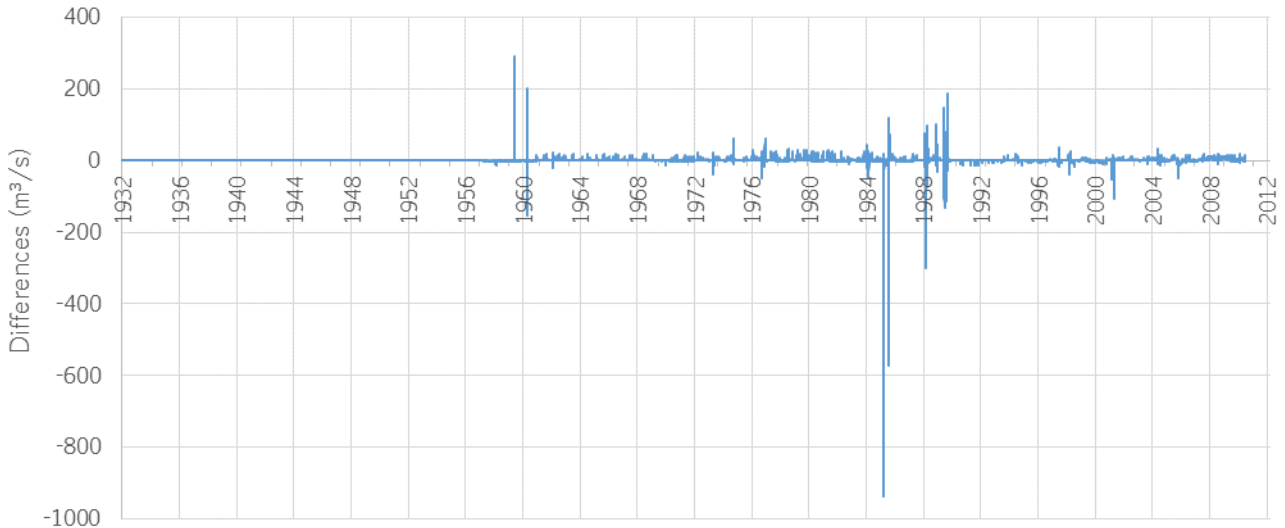


Figure 3.23 121801 (1) Raupunga data differences

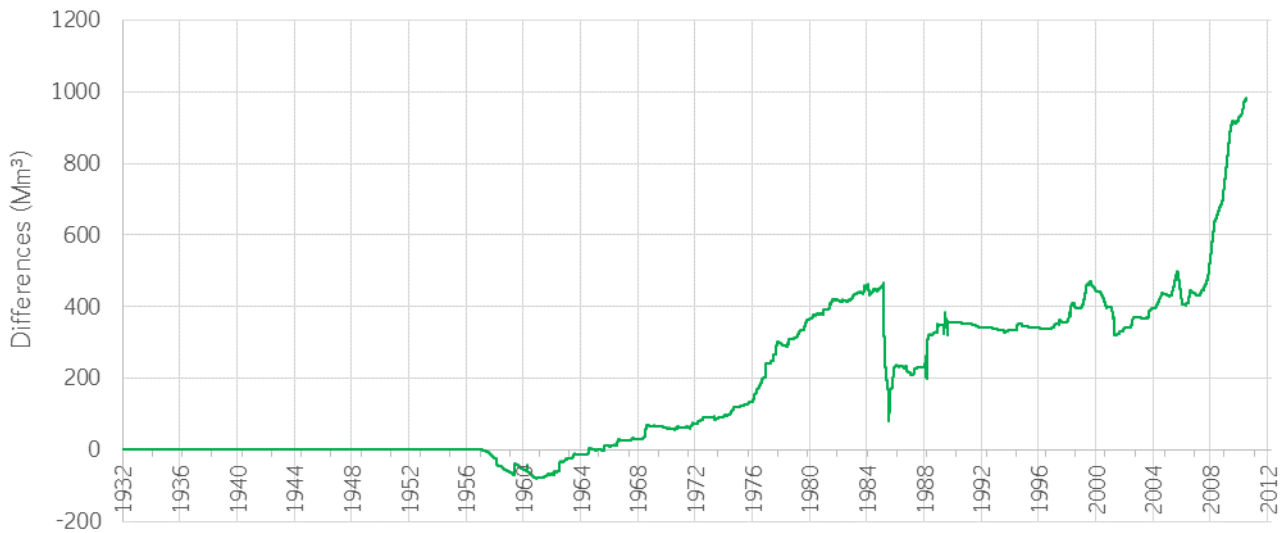


Figure 3.24 121801 (1) Raupunga - cumulative differences.

## 4 South Island Flow Sites

### 4.1 98714 (2) Waitaki Tributaries

There are very small differences in this flow site at the ends of large gaps in the Pukaki outflow series (Figure 4.1). The cumulative differences are shown in Figure 4.2. The 2015 data matches what is currently on the Power Archive.

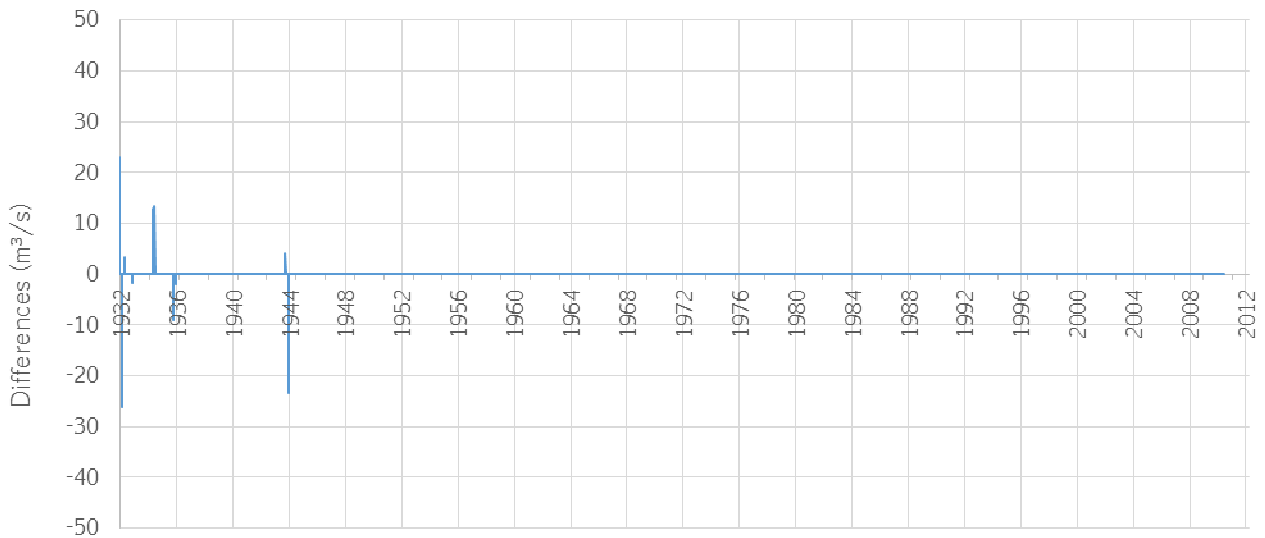


Figure 4.1 98714 (2) Waitaki tributaries (Benmore) data differences

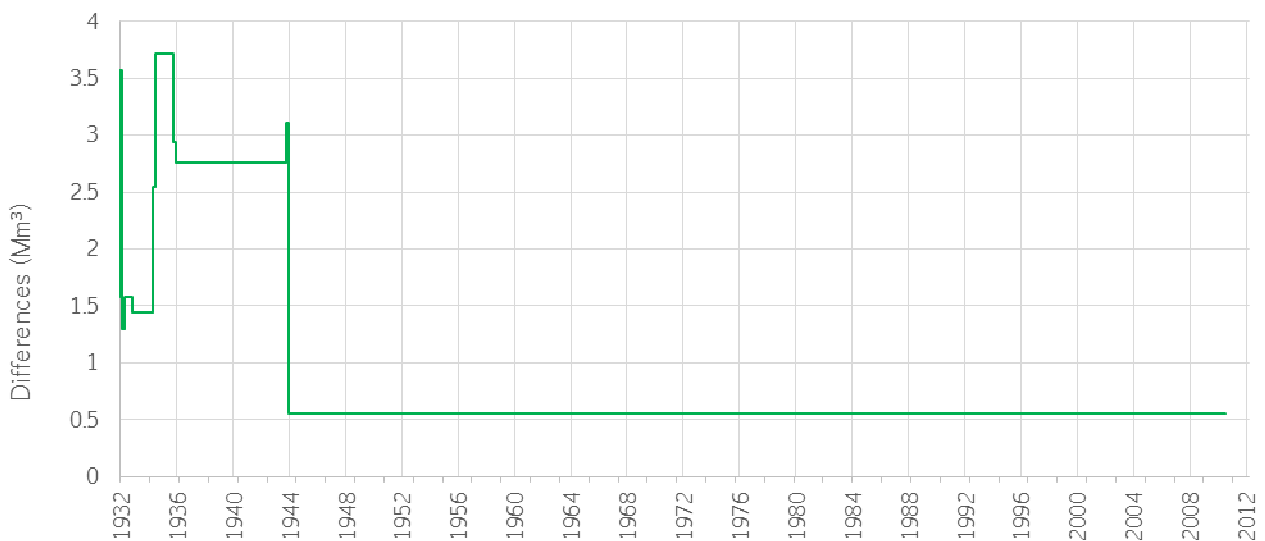


Figure 4.2: 98714 (2) Waitaki Tributaries (Benmore) - cumulative data differences

## 4.2 98614 (4) Benmore Tributary Flows

There are differences in this file that stem from new Tekapo inflows which now comes from Genesis (rather than Meridian Energy) (Figure 4.3). The cumulative differences are shown in Figure 4.4.

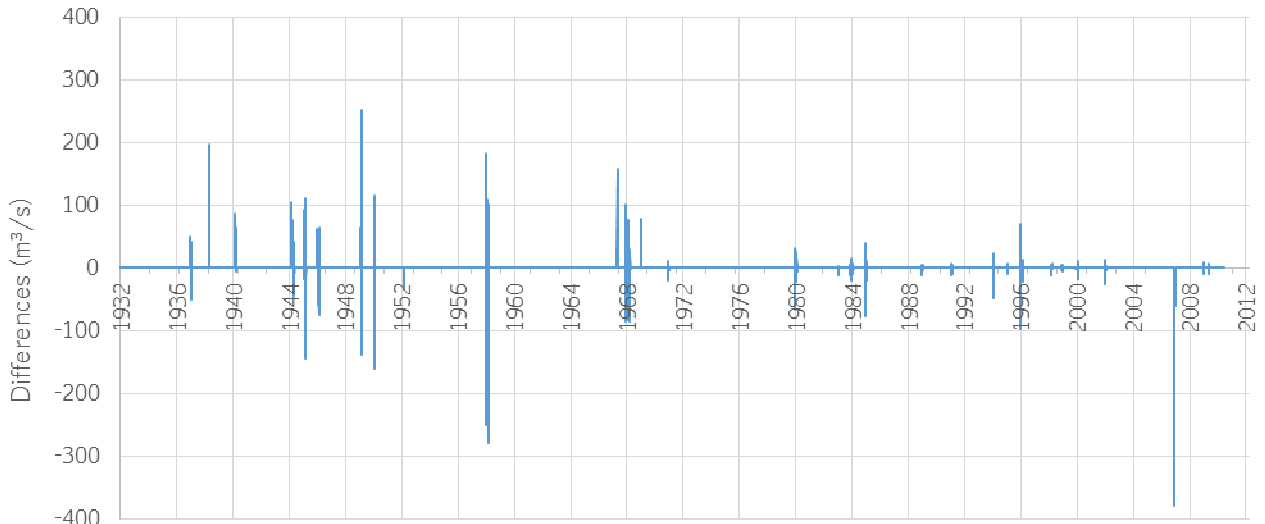


Figure 4.3 98614 (4) Benmore tributary flows data differences

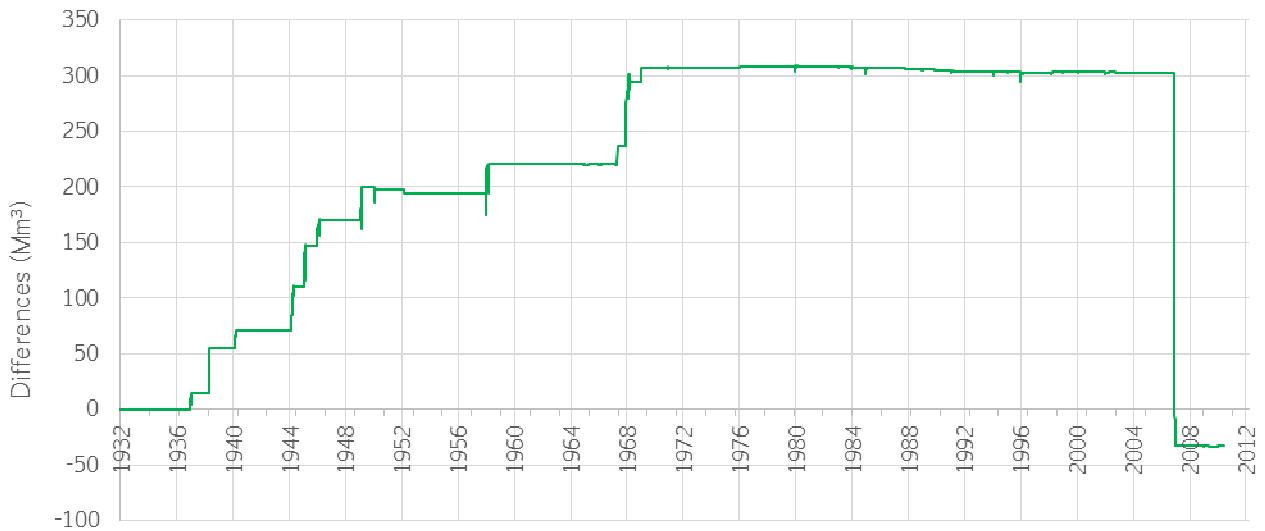


Figure 4.4: 98614 (4) Benmore - cumulative data differences

### 4.3 98615 (2) Benmore\_tp

The differences in this file are from a very small rating change occurring in 1963 (Figure 4.5). The cumulative differences are shown in Figure 4.6. The larger differences occurring in April 2010 cannot be replicated and therefore 2015 data should be used.

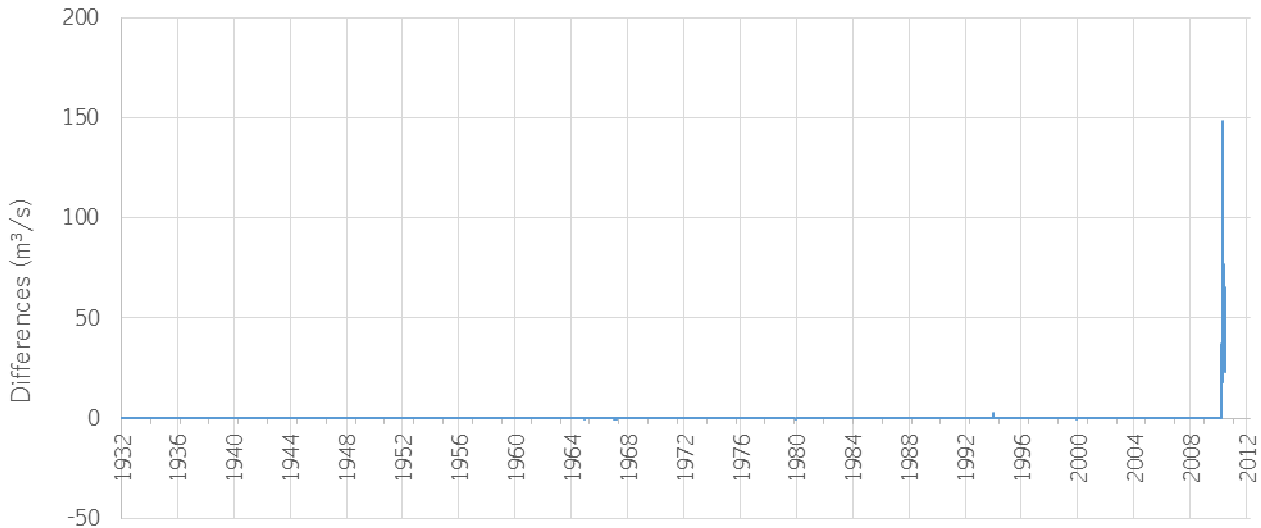


Figure 4.5 98615 (2) Benmore\_tp data differences

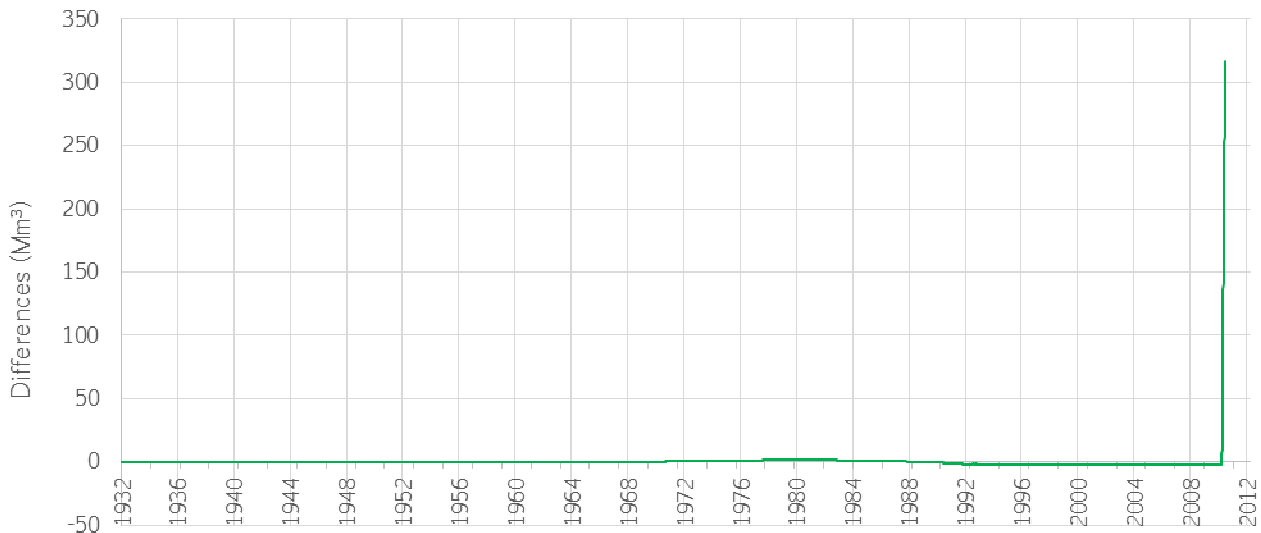


Figure 4.6: 98615 (2) Benmore\_tp - cumulative data differences

## 4.4 98615 (1) Pukaki and Tekapo

The differences in this file stem from new Tekapo data which now comes from Genesis (rather than Meridian Energy) (Figure 4.7). The cumulative differences are shown in Figure 4.8.

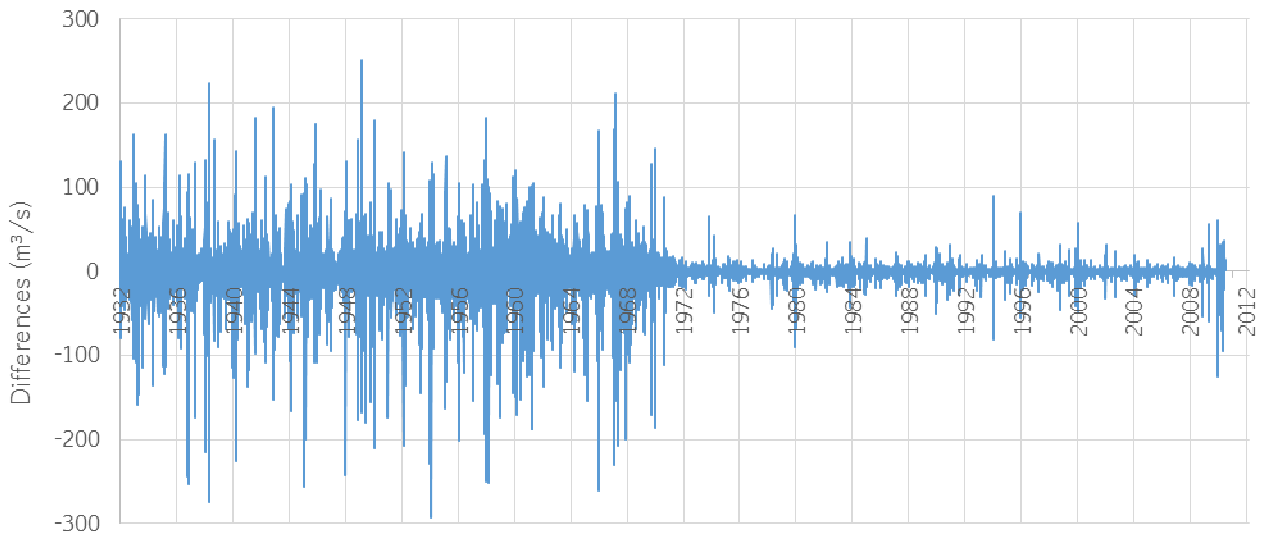


Figure 4.7 98615 (1) Pukaki and Tekapo data differences

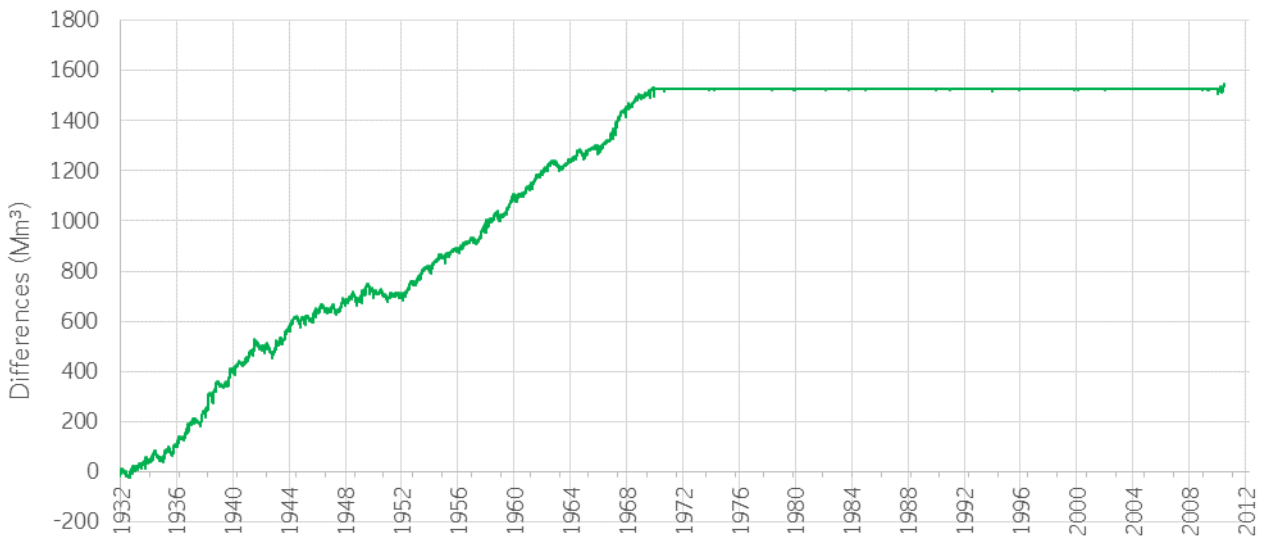


Figure 4.8: 98615 (1) Pukaki and Tekapo - cumulative data differences

## 4.5 98614 (2) Pukaki

The differences in this file stem from new Tekapo inflows which now comes from Genesis (rather than Meridian Energy) (Figure 4.9). The cumulative differences are shown in Figure 4.10.

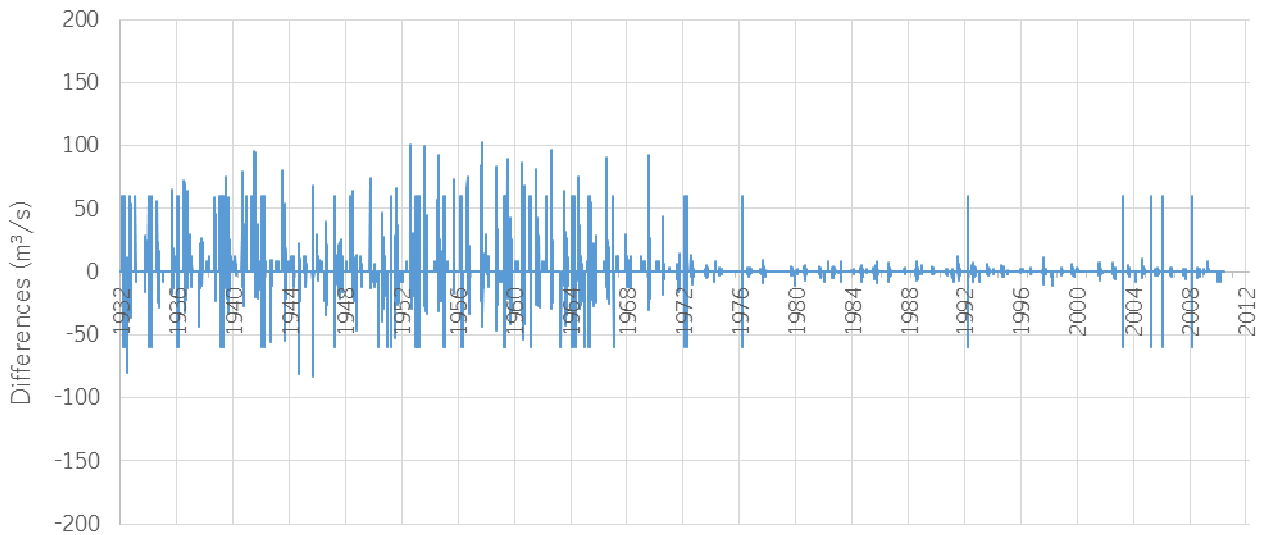


Figure 4.9 98614 (2) Pukaki data differences

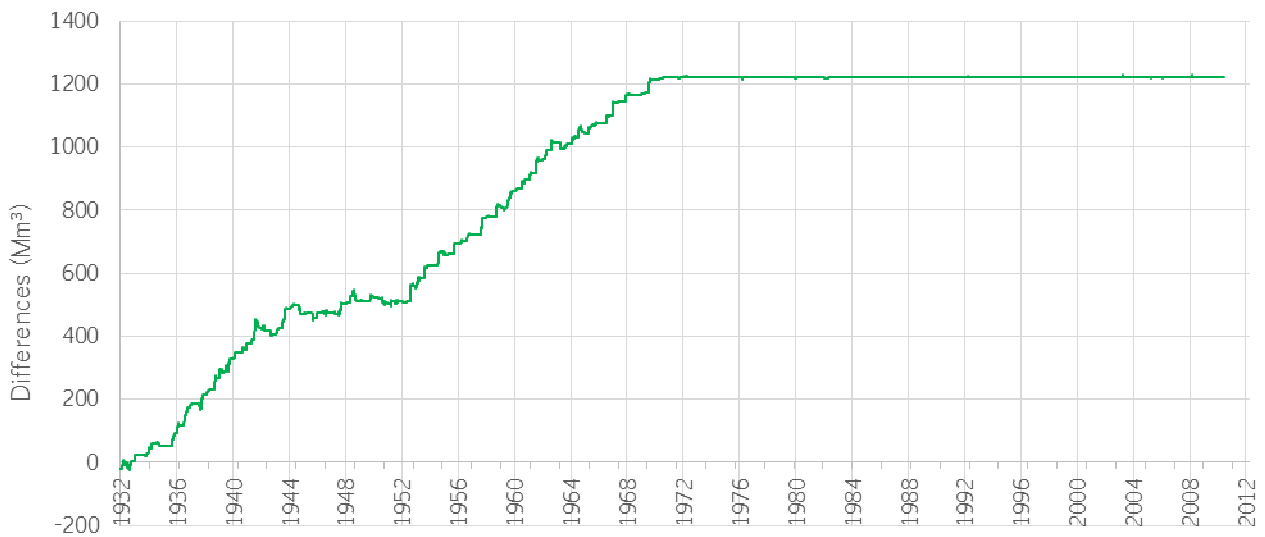


Figure 4.10: 98614 (2) Pukaki - cumulative data differences

## 4.6 98614 (1) Tekapo

The differences in this file stem from new Tekapo inflows which now comes from Genesis (rather than Meridian Energy) (Figure 4.11). The cumulative differences are shown in Figure 4.12.

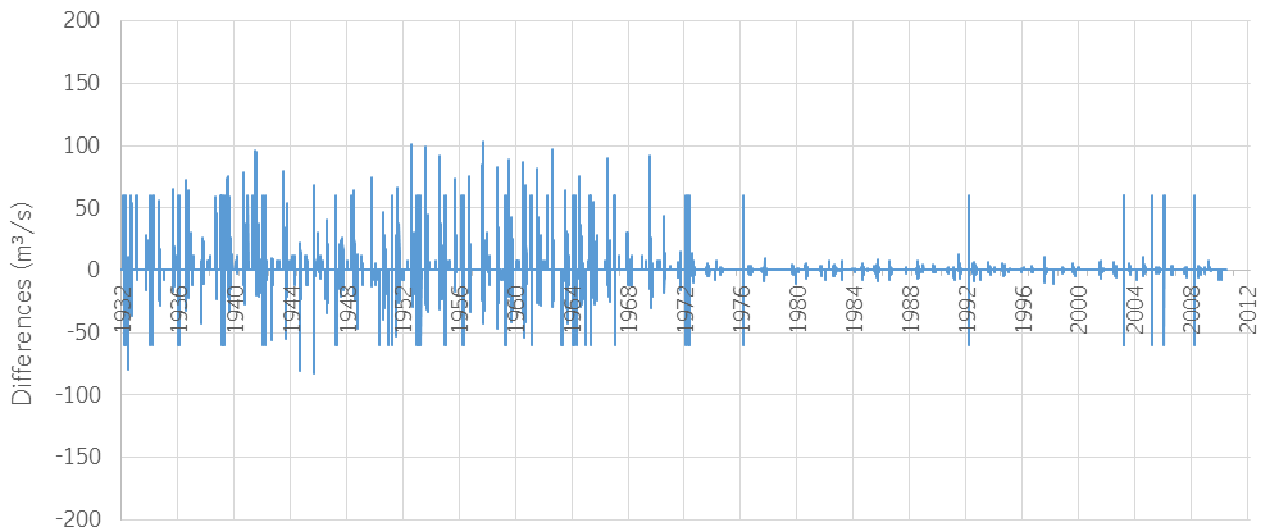


Figure 4.11 98614 (1) Tekapo data differences

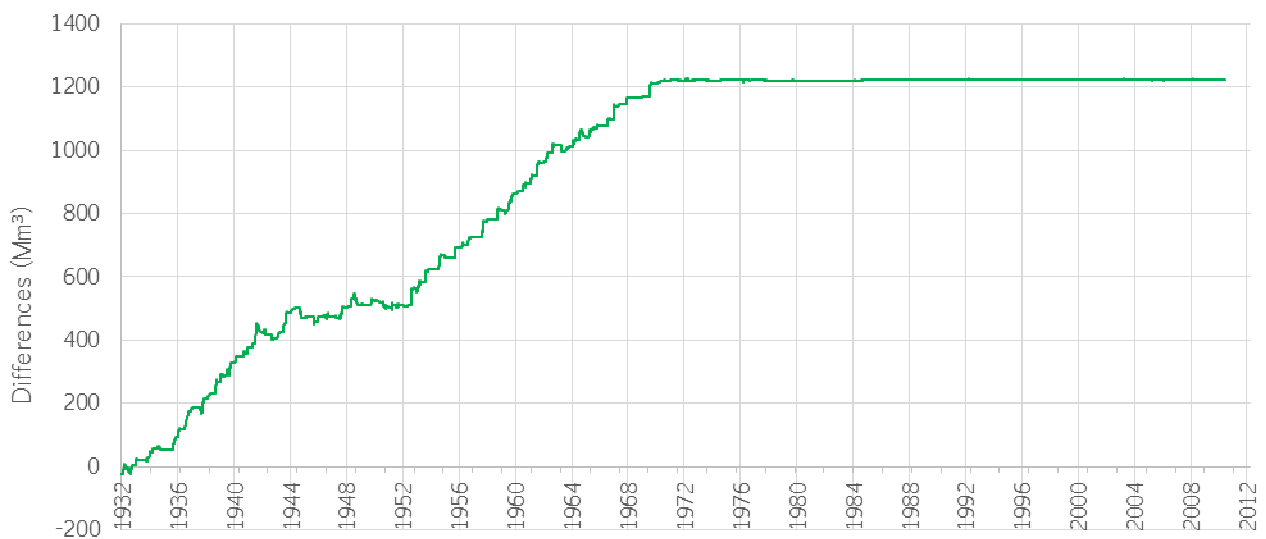


Figure 4.12: 98614 (1) Tekapo - cumulative data differences



## 4.7 98770 (2) Tekapo Naturals

The differences in this file stem from new Tekapo data which now comes from Genesis (rather than Meridian Energy) (Figure 4.13). The cumulative differences are shown in Figure 4.14.

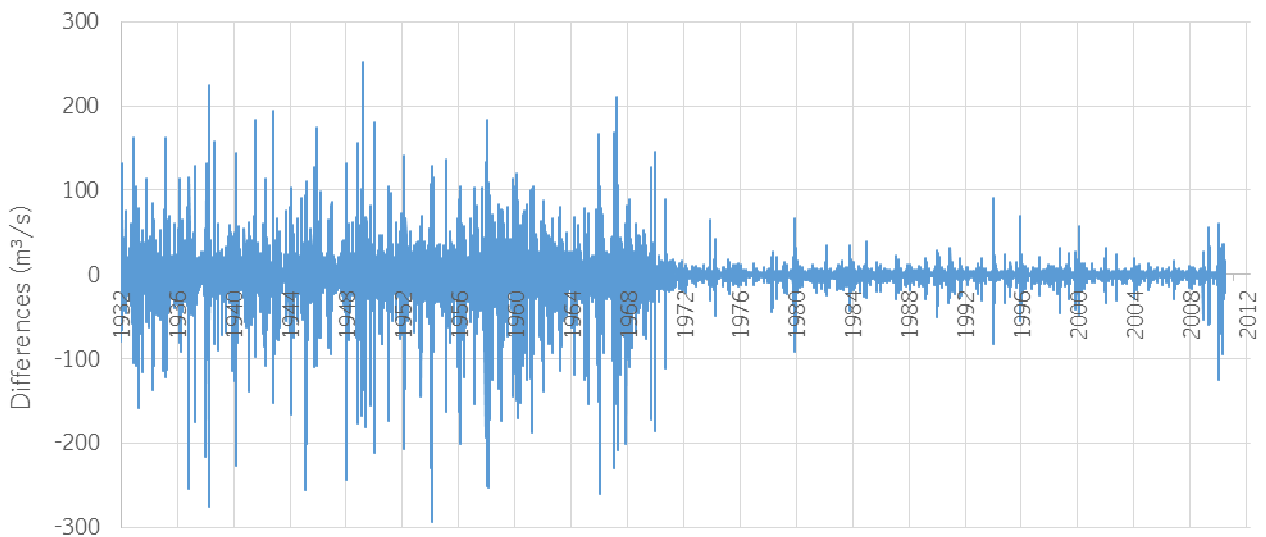


Figure 4.13 98770 (2) Tekapo natural data differences

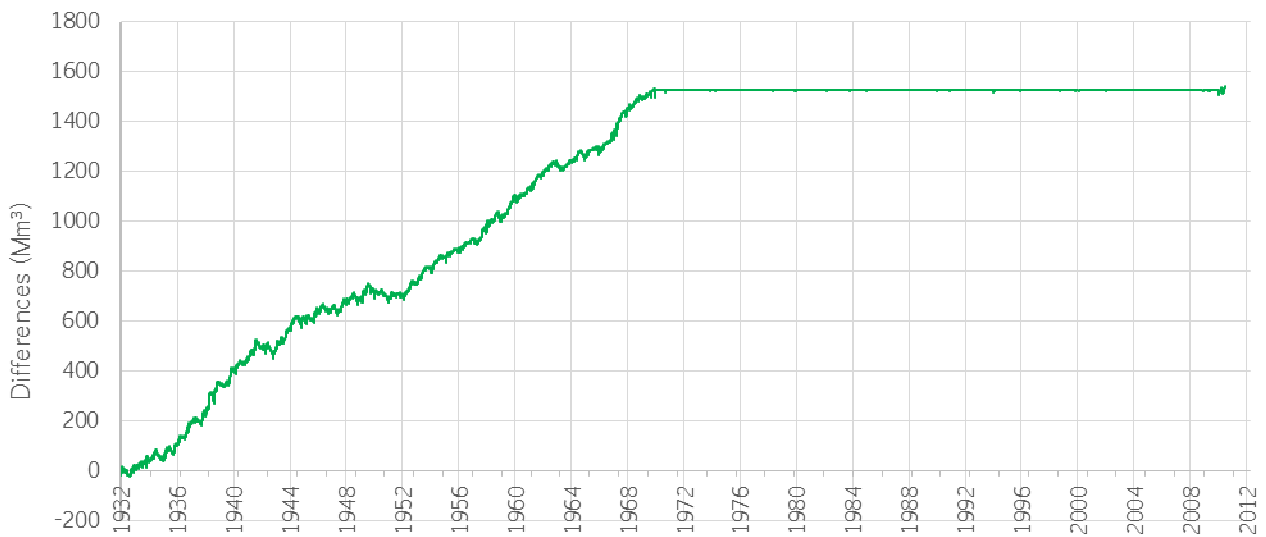


Figure 4.14: 98770 (2) Tekapo Natural - cumulative data differences

## 4.8 99550 (1) Manapouri local inflow (no Mararoa)

The differences occurring in this file are because of numerous rating changes and deletions in data from NIWA (Figure 4.15). The cumulative differences are shown in Figure 4.16.

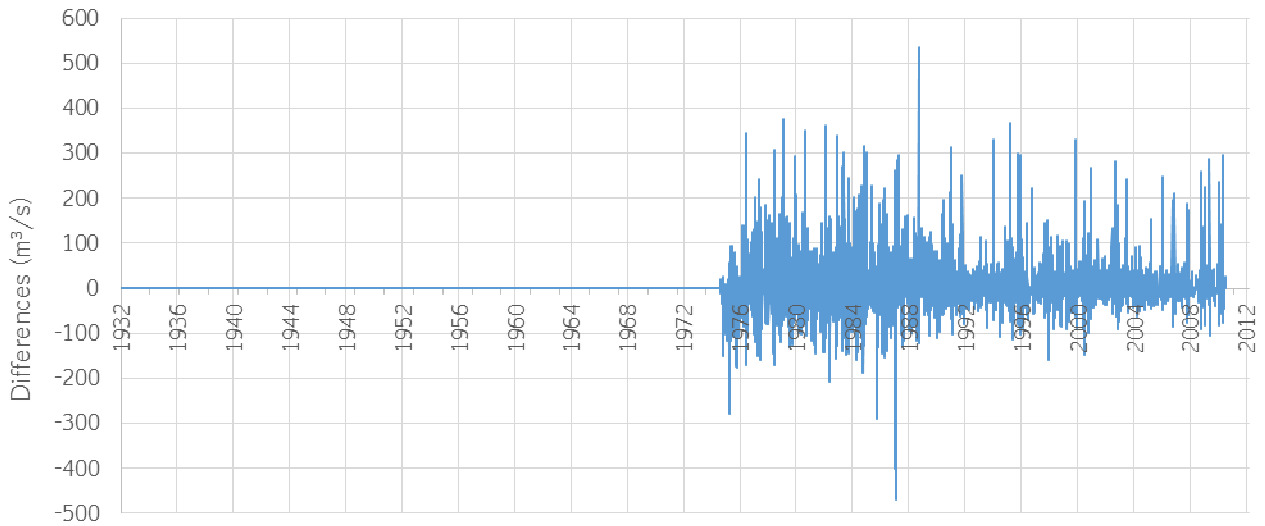


Figure 4.15 99550 (1) Manapouri local inflow data differences

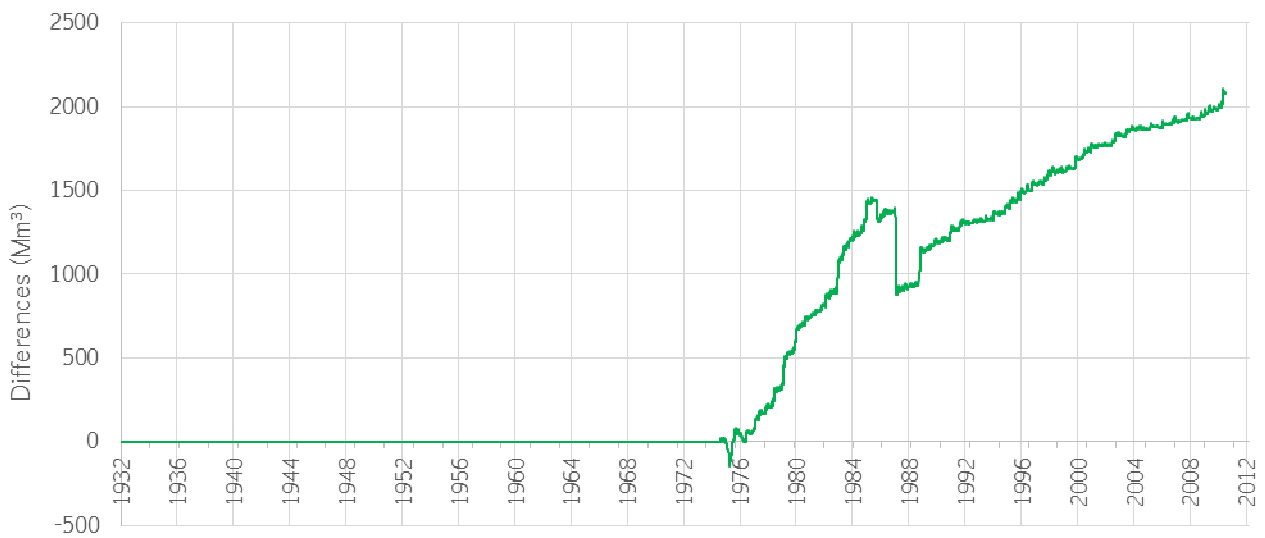


Figure 4.16: 99550 (1) Manapouri Local inflows - cumulative data differences

## 4.9 99551 (1) Manapouri local inflow (incl. Mararoa)

The differences occurring in this file are because of numerous rating changes and deletions in data from NWA (Figure 4.17). The cumulative differences are shown in Figure 4.18.

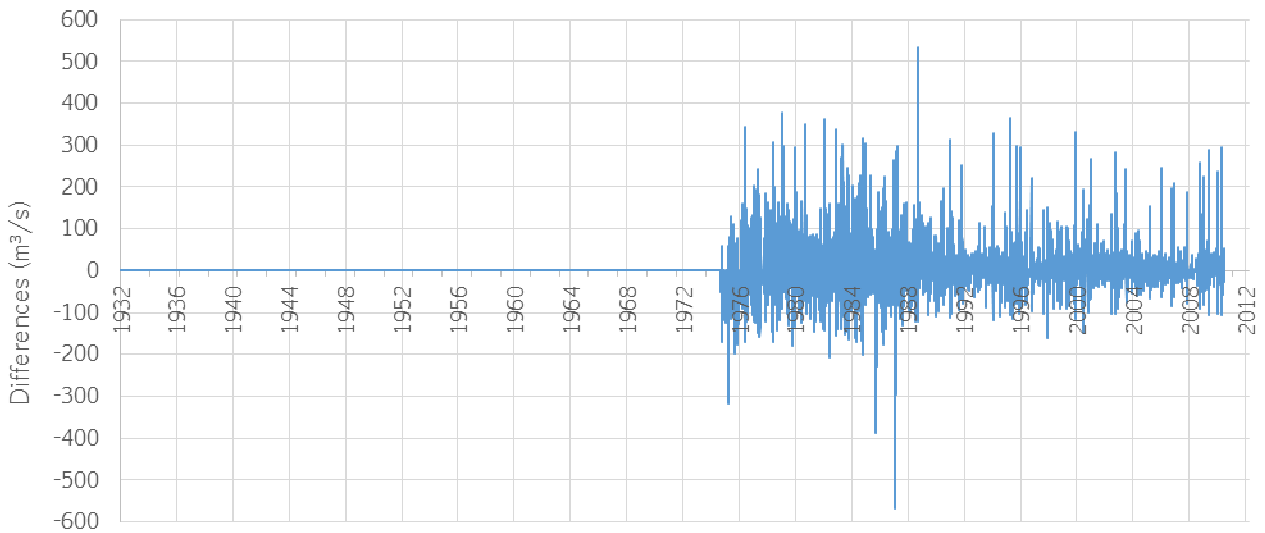


Figure 4.17 99551 (1) Manapouri local inflow data differences

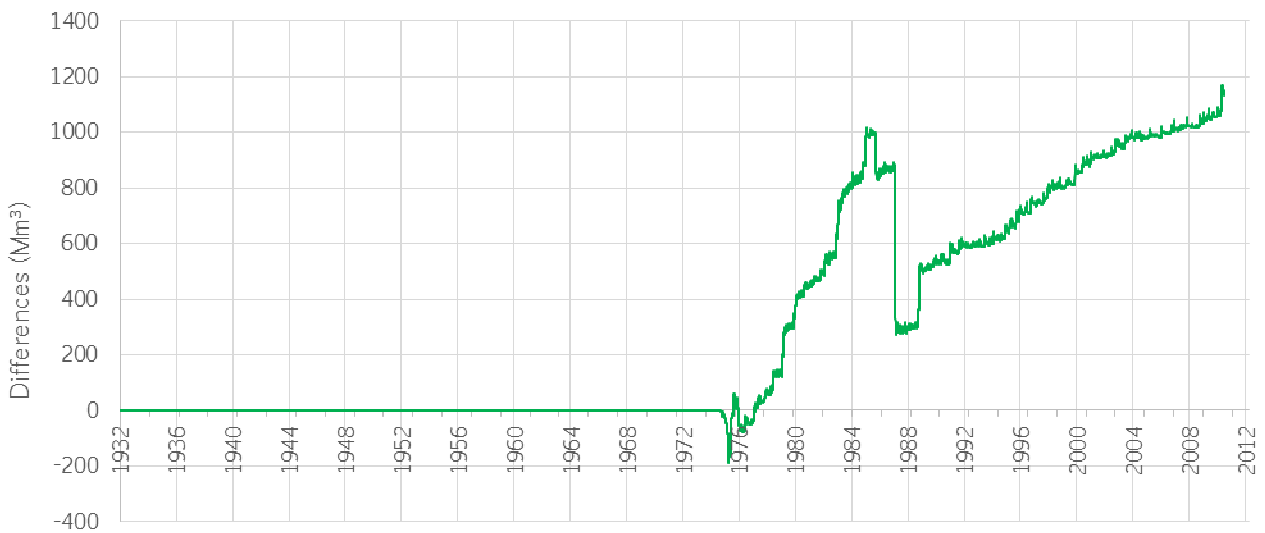


Figure 4.18: 99551 (1) Manapouri Local inflows - cumulative data differences

### 4.10 99552 (1) Manapouri local inflow (no Mararoa + water right reduction)

The differences occurring in this file are because of numerous rating changes and deletions in data from NIWA (Figure 4.19). The cumulative differences are shown in Figure 4.20.

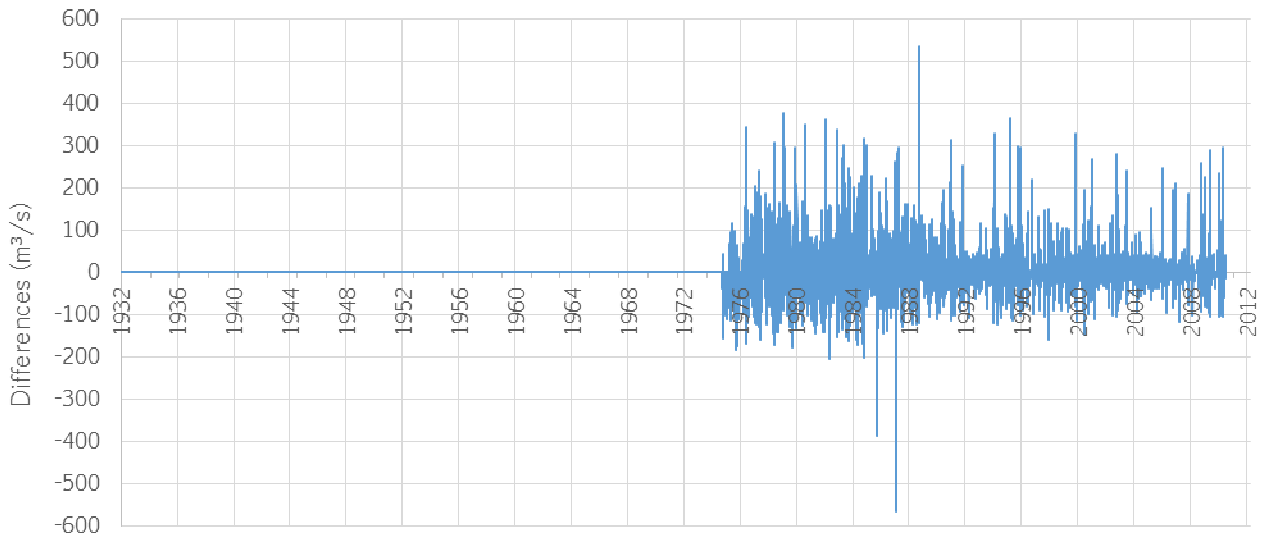


Figure 4.19 99552 (1) Manapouri local inflow data differences

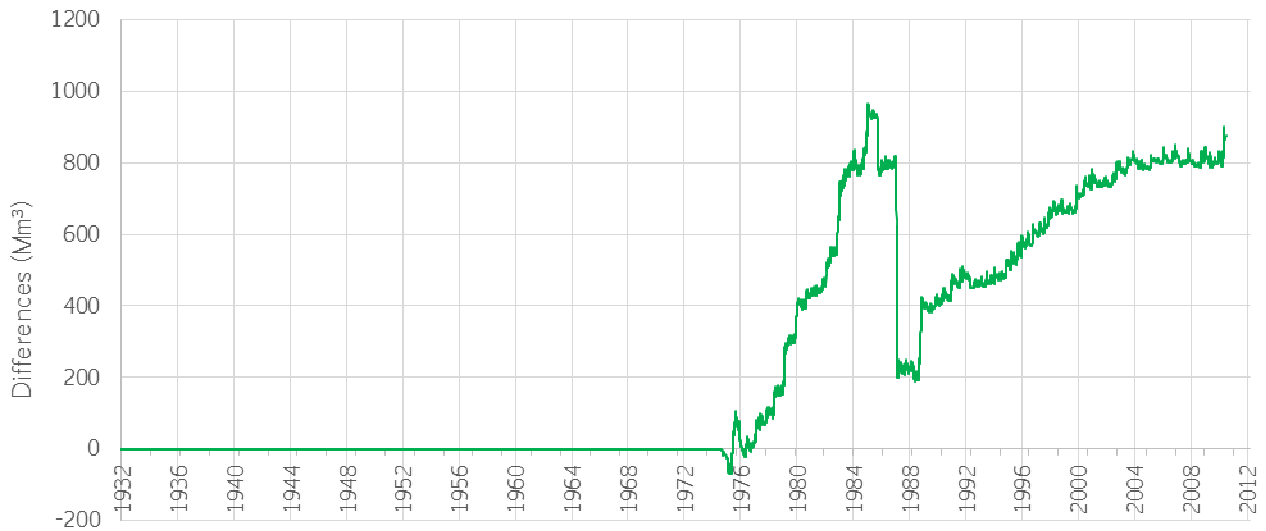


Figure 4.20: 99552 (1) Manapouri Local inflows - cumulative data differences

## 4.11 199540 (1) Monowai inflows

There are some data differences from NIWA rating changes as they moved to the Aquarius programme (1976-2010). Some differences are also from incorrect averaging processes in previous updates (Figure 4.21). The cumulative differences are shown in Figure 4.22.

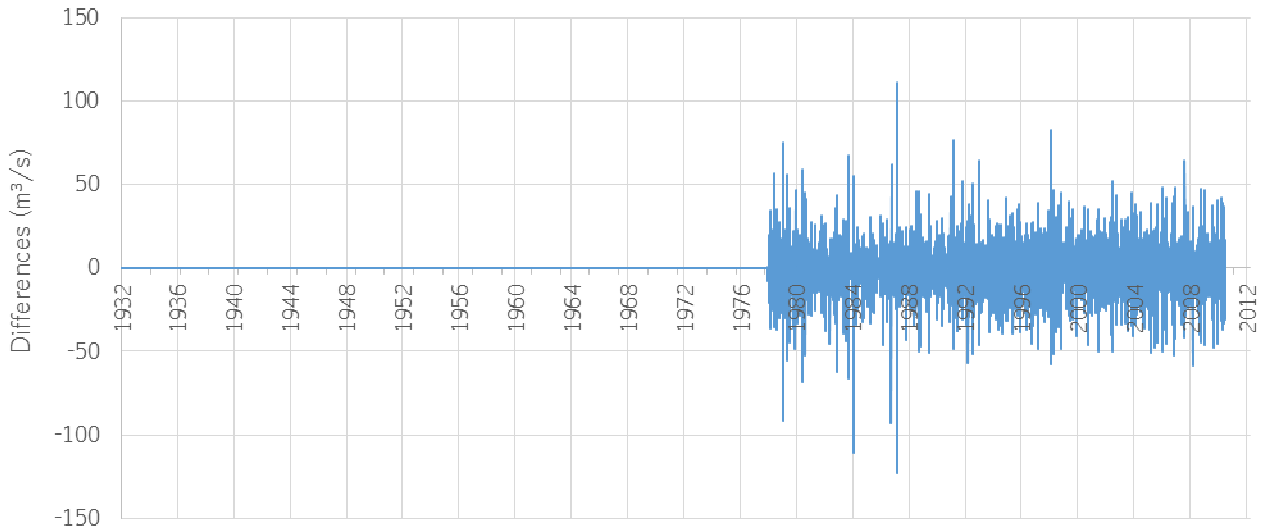


Figure 4.21 199540 (1) Monowai inflow data differences

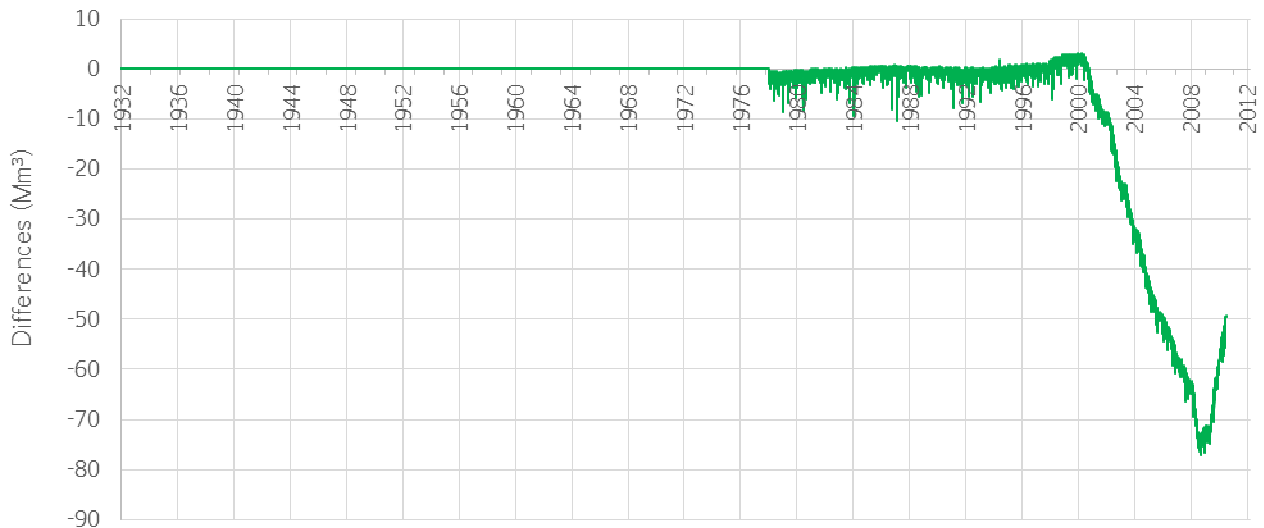


Figure 4.22 199540 (1) Monowai inflow - cumulative differences

## 4.12 99110 (1) Roxburgh tributary flows

The differences occurring in this data are due to a change in the dataset on the Power Archive (Figure 4.23). The cumulative differences are shown in Figure 4.24. These differences are very minor in comparison to the total flow.

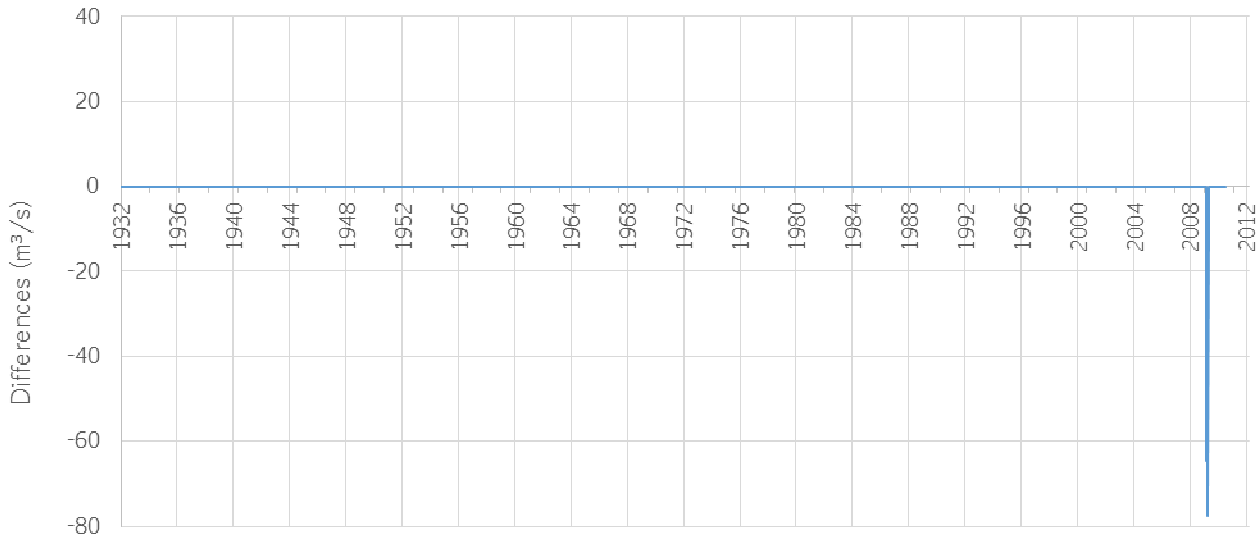


Figure 4.23 99110 (1) Roxburgh tributary flow data differences

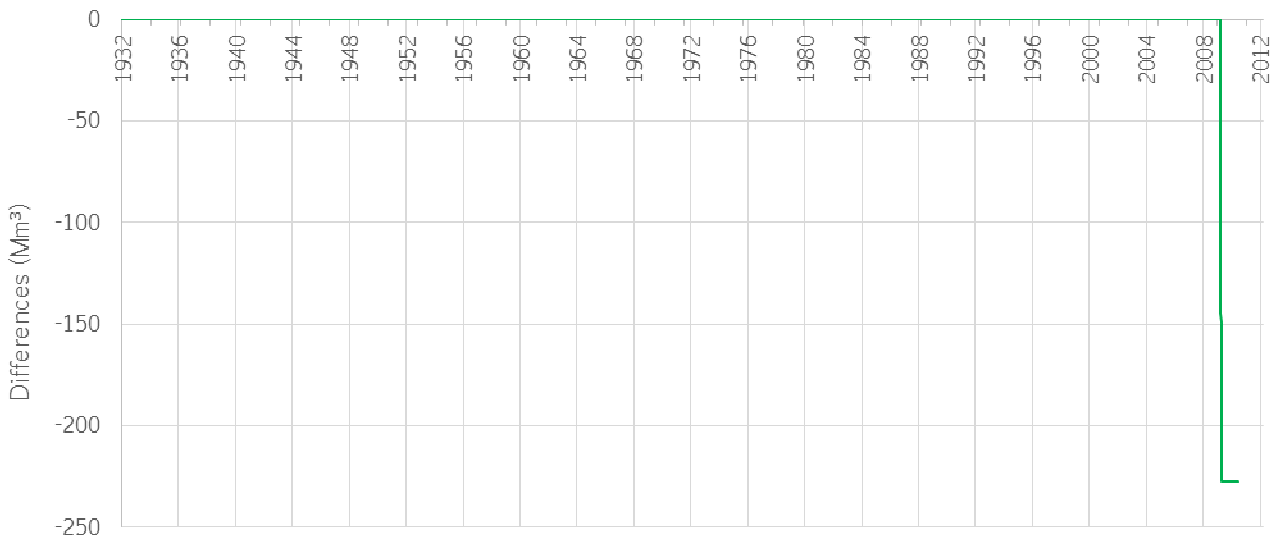


Figure 4.24: 91100 (1) Roxburgh tributary flows - cumulative data differences

### 4.13 77106 (1) Grey and Taramakau - Taipo

Differences have occurred in all three input flow sites that make this dataset because NIWA has moved to a new system (Aquarius) and has added many more points to their ratings (Figure 4.25). This causes small differences in each flow site and when calculated together causes large changes. The cumulative differences are shown in Figure 4.26.

Data from the start of the datasets (1979) to 1997 has been copied from an older update as this data was routinely created and stored on the archive and has a much higher quality.

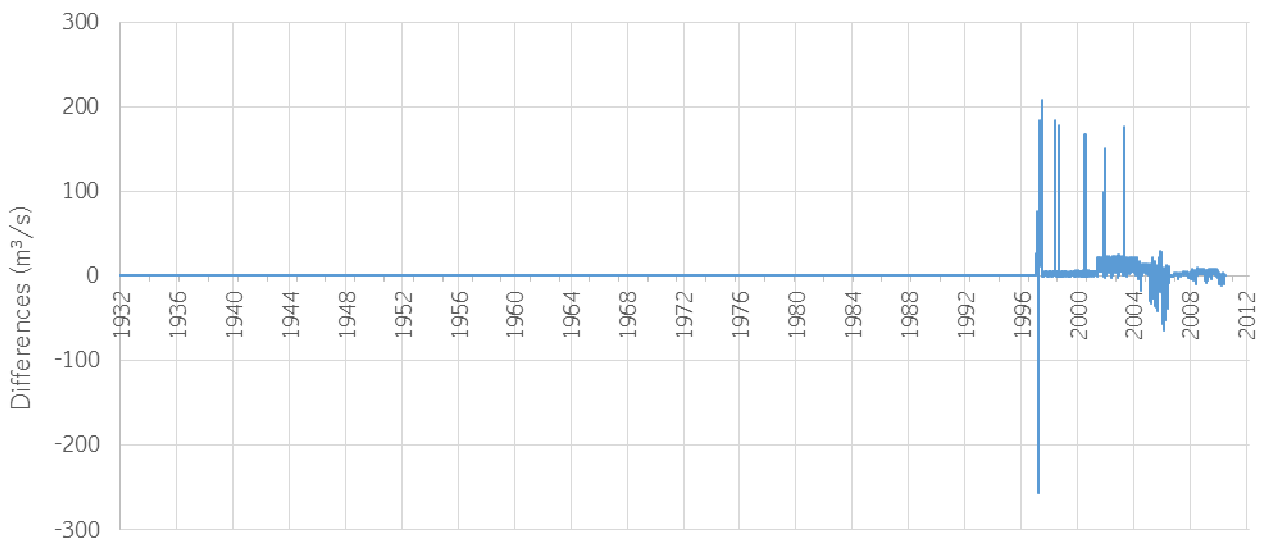


Figure 4.25: 77106 (1) Grey + Taramakau - Taipo data difference plot



Figure 4.26: 77106 (1) Grey + Taramakau - Taipo - cumulative data differences

## 4.14 162105 (1) Waiiau - Jollies

These small differences occurred as all ratings have changed slightly as an artefact of NIWA moving their programming to Aquarius (Figure 4.27). The first rating starts on 1/1/1960. The cumulative differences are shown in Figure 4.28.

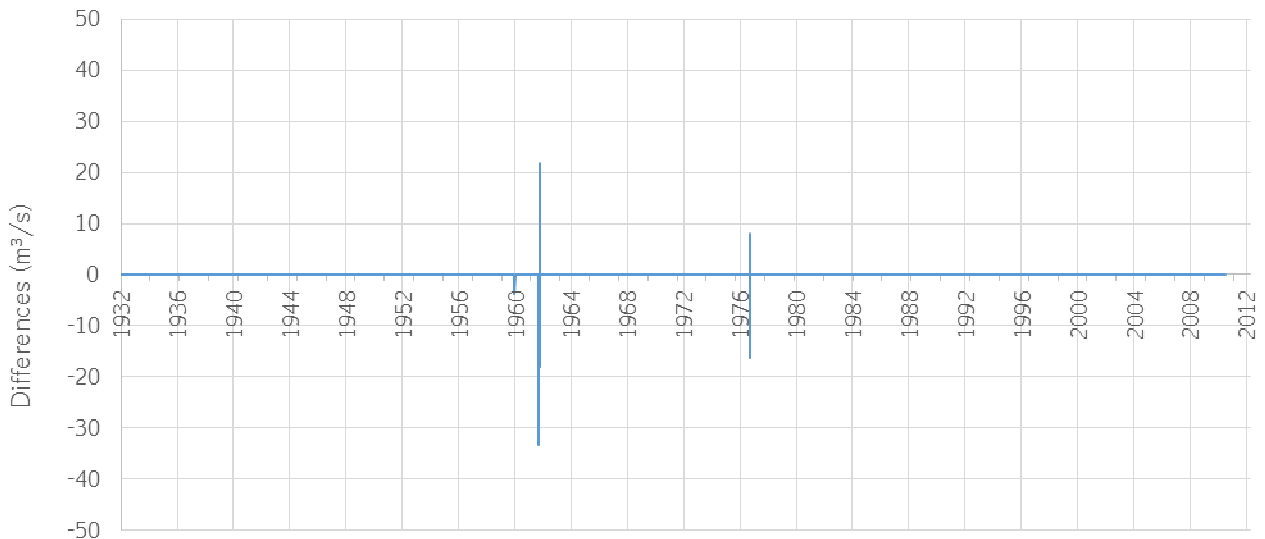


Figure 4.27 162105 (1) Jollies data differences

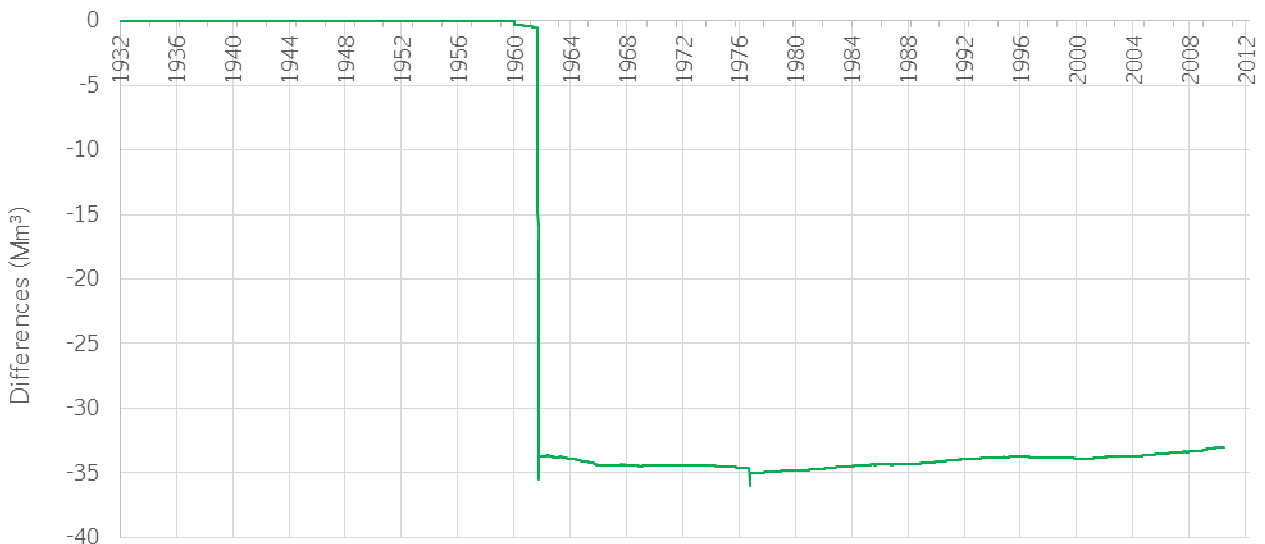


Figure 4.28: 162105 (1) Jollies - cumulative data differences



## 4.15 164604 (1) Waiiau – Glenhope

These differences occurred because a different rating was used to calculate the data (Figure 4.29). This flow site is not rated anymore so a rating is created from a correlation with a local flow site. The cumulative differences are shown in Figure 4.30.

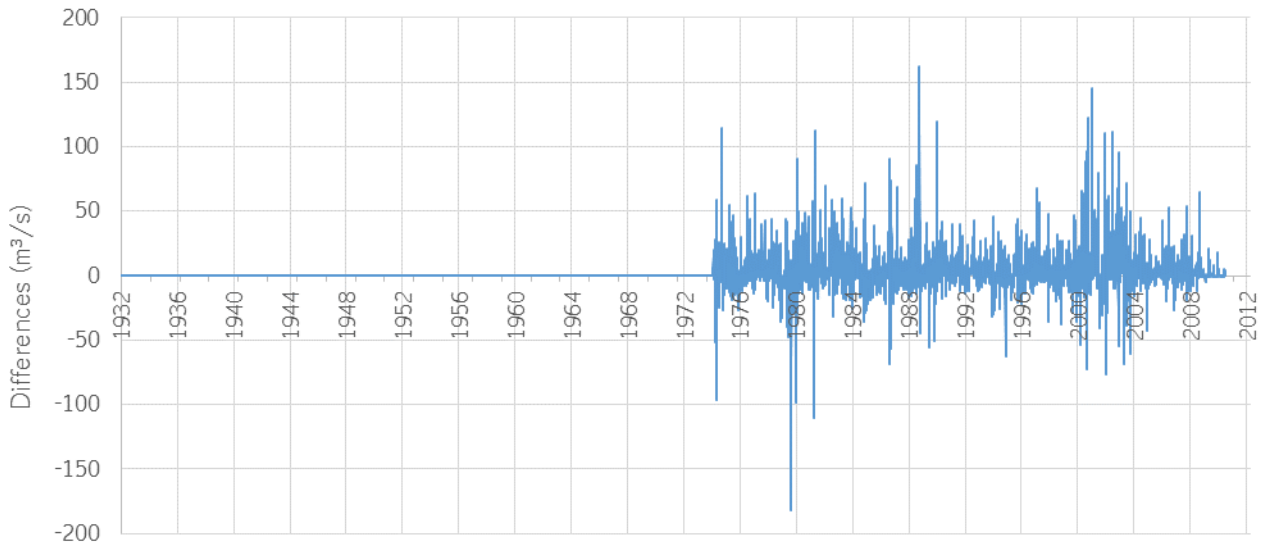


Figure 4.29 164604 (1) Glenhope data differences

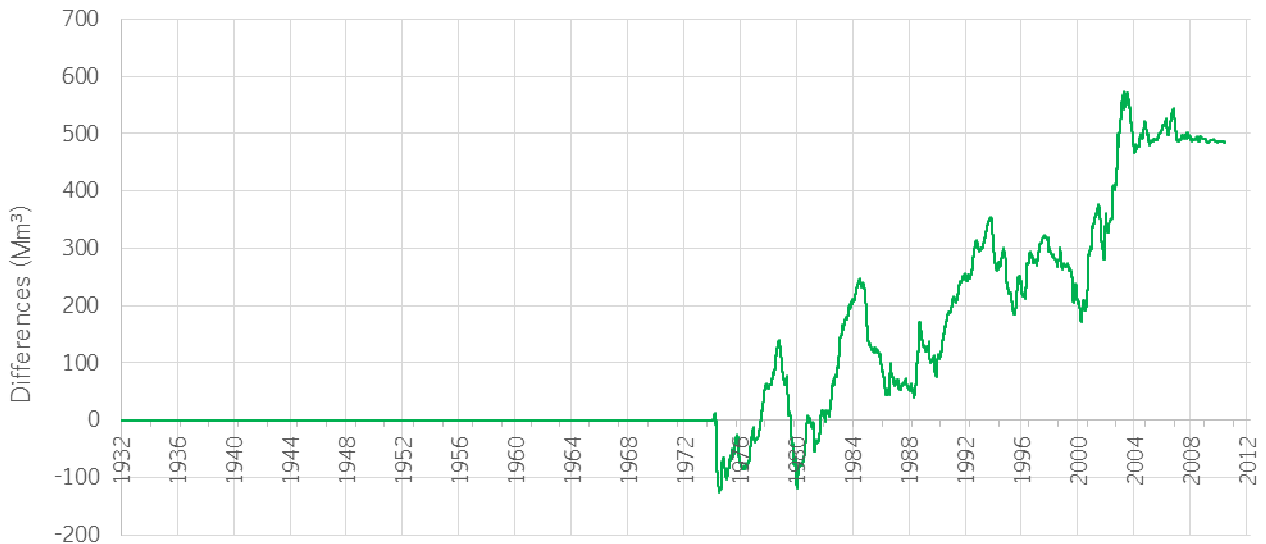


Figure 4.30: 164604 (1) Glenhope - cumulative data differences

### 4.16 164602 (1) Waiau - Marble Point

A rating change at this flow site in 2002 has caused changes when compared with the 2010 update. A number of ratings have been altered and changed from 2002 to 2015 (Figure 4.31). The cumulative differences are shown in Figure 4.32.

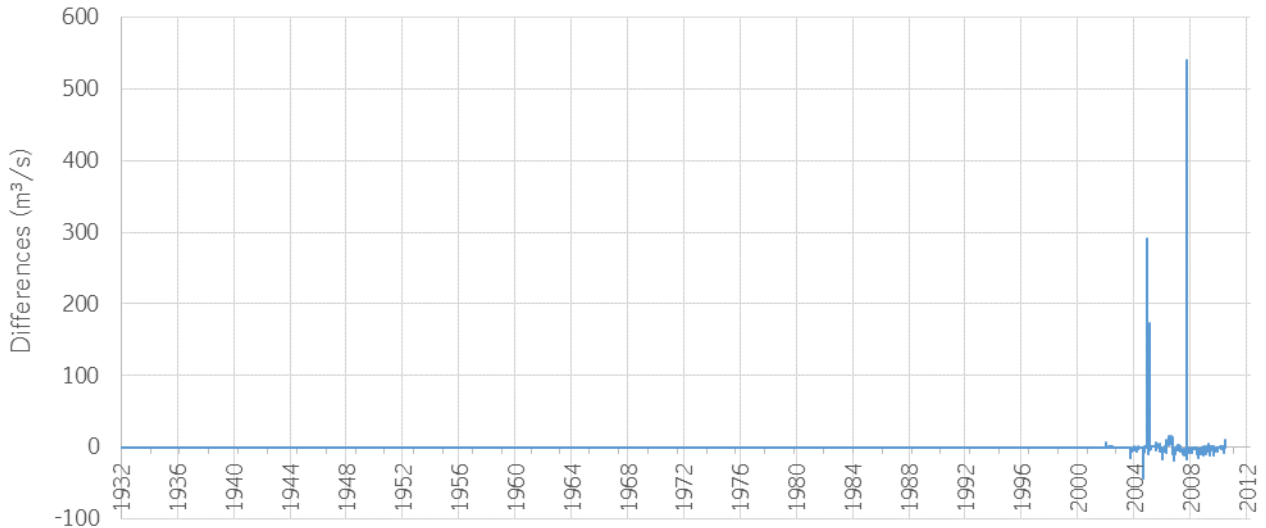


Figure 4.31: 164602 (1) Marble Point data difference plot

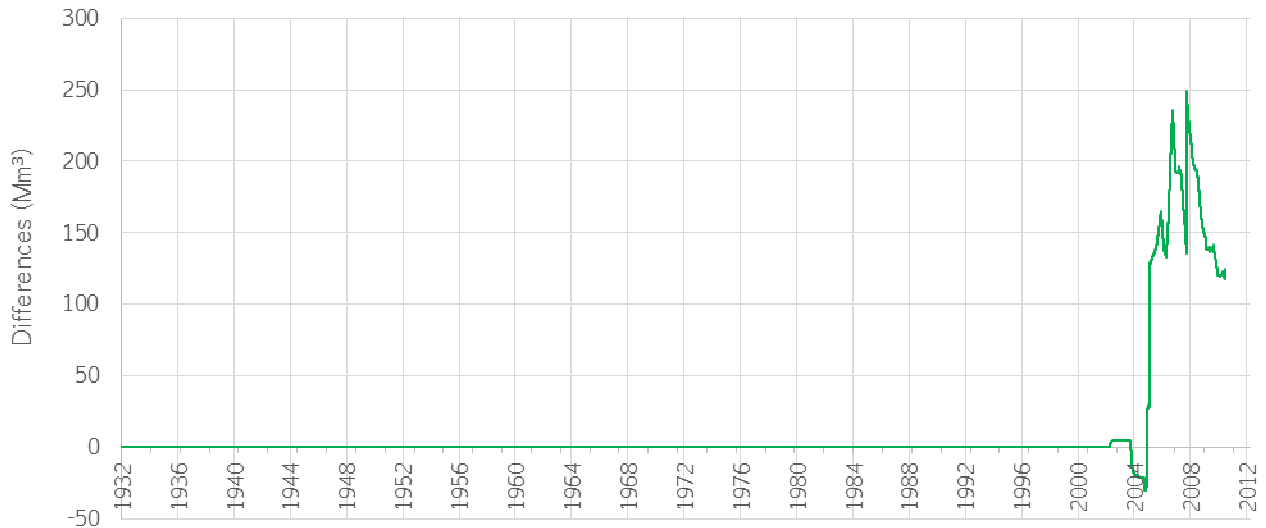


Figure 4.32: 164602 (1) Marble Point - cumulative data differences

### 4.17 160114 (1) Wairau – Dip Flat

There are small differences in this dataset from rating deletions and changes that have come from NIWA (Figure 4.33). The cumulative differences are shown in Figure 4.34.

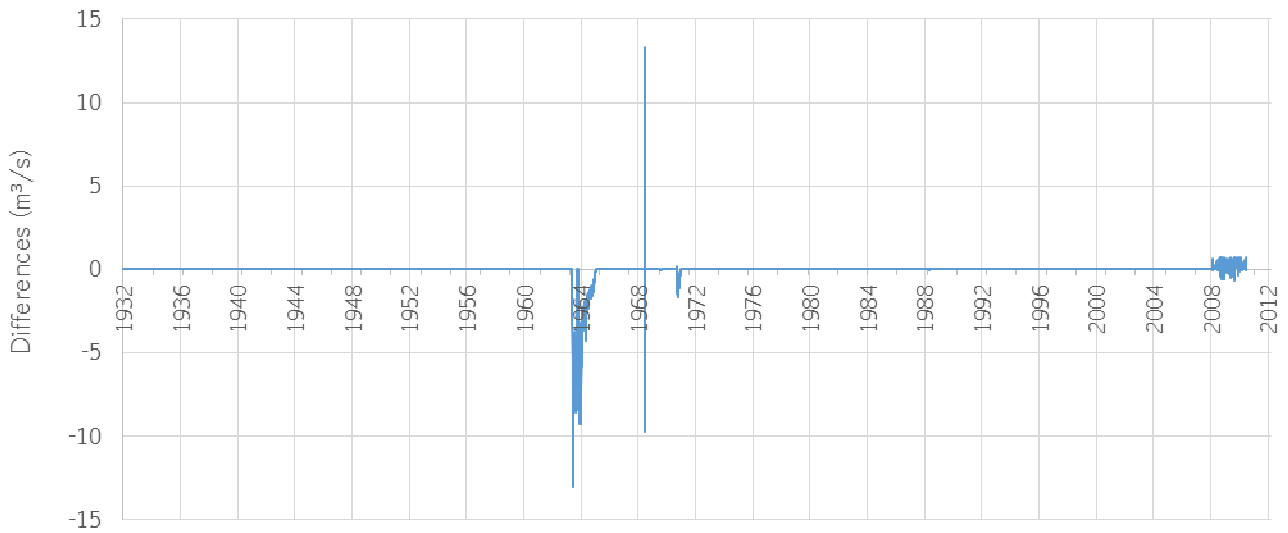


Figure 4.33 160114 (1) Dip Flat data differences

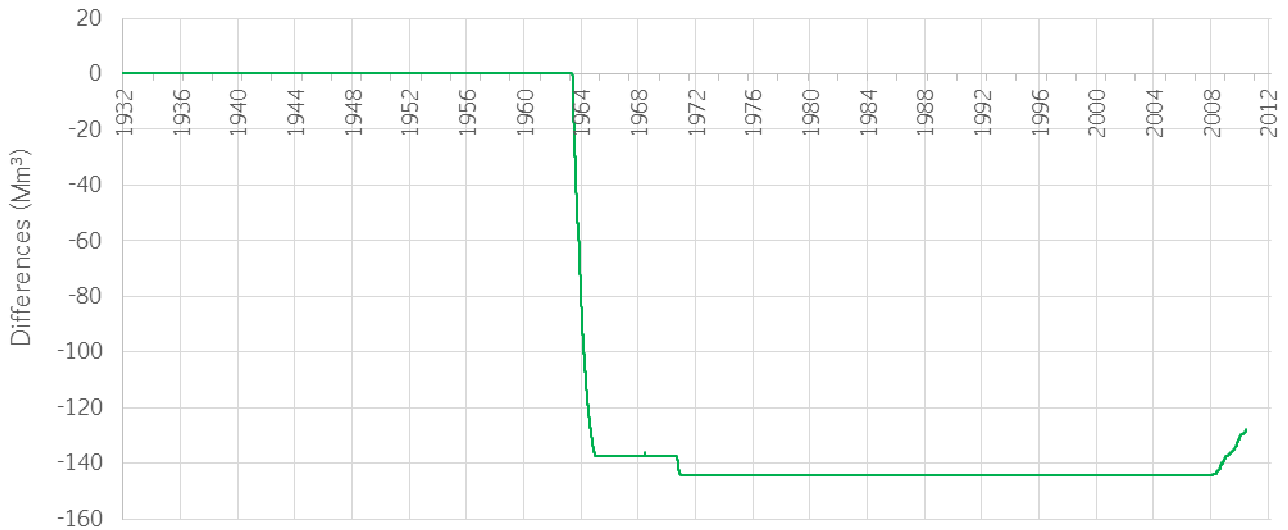


Figure 4.34 160114 (1) Dip Flat – cumulative differences

### 4.18 165104 (1) Hurunui – Mandamus

There are differences in this dataset from rating deletions, additions and changes that have come from NIWA (Figure 4.35). The cumulative differences are shown in Figure 4.36. The largest difference occurs where the gap has been filled by correlation.

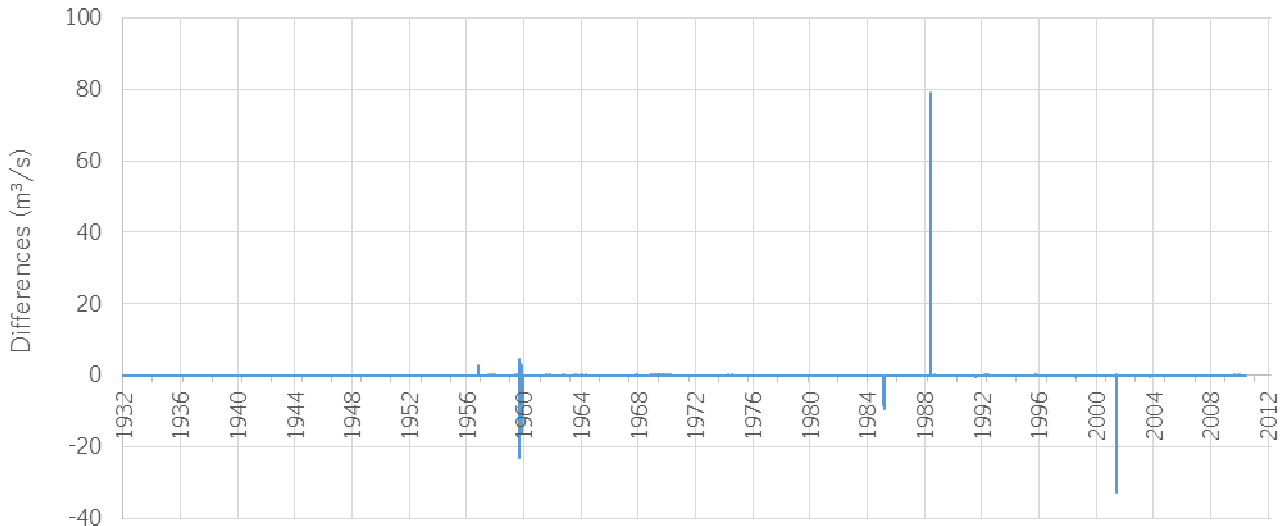


Figure 4.35 165104 (1) Mandamus data differences

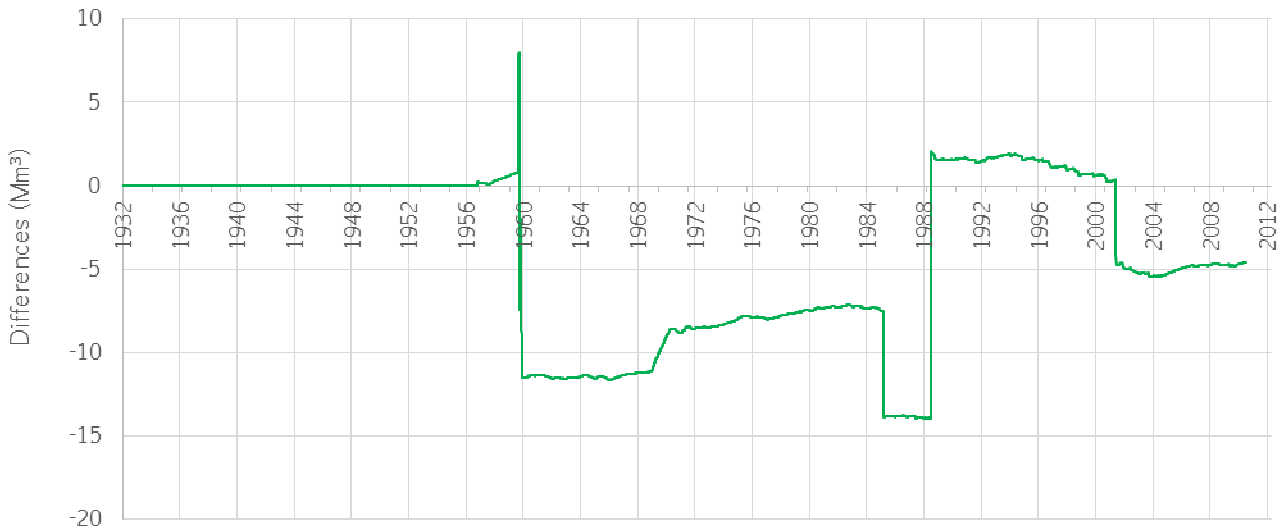


Figure 4.36 165104 (1) Mandamus – cumulative differences

### 4.19 165101 (1) Hurunui – SH1 Bridge

There are differences in this dataset from rating deletions, additions and changes that have come from NIWA (Figure 4.37). The cumulative differences are shown in Figure 4.38. The largest differences occur where the gaps have been filled by correlation.

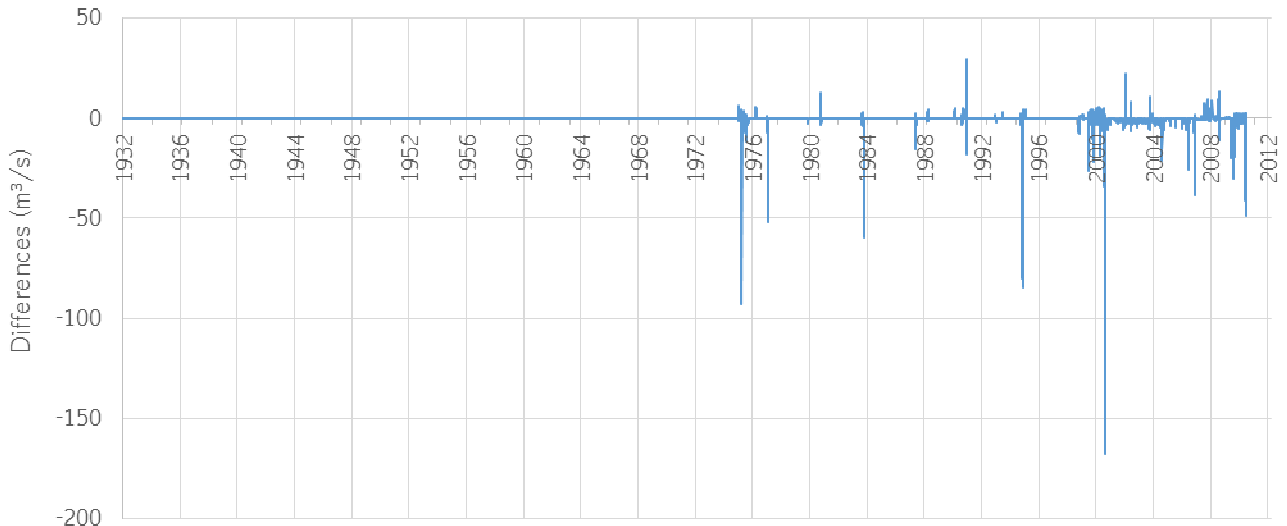


Figure 4.37 165101 (1) SH1 Bridge data differences

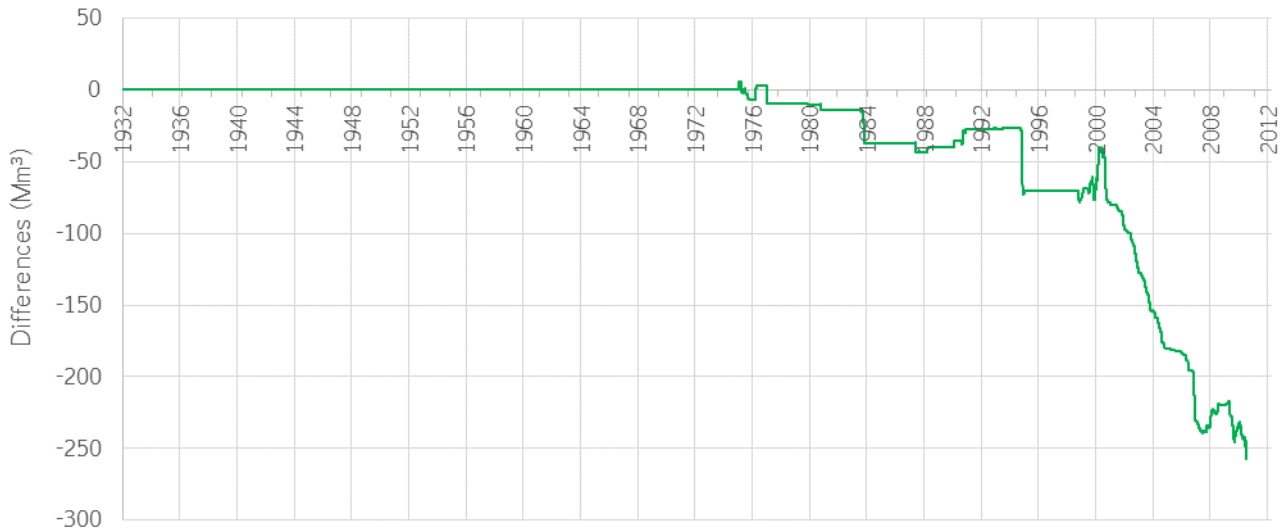


Figure 4.38 165101 (1) SH1 Bridge – cumulative differences

## 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. In reality, 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.

The following four flow sites have negative flows in their dataset.

- Lake Waikaremoana - 3650: Waikaremoana inflows has negatives because of leakage from Lake Waikaremoana. Opus, who previously calculated Waikaremoana inflows on behalf of Genesis, had a minimum inflow value to ensure that no negative inflows were calculated. Genesis prefers to have negative inflows in the data until a solution can be found to quantify and resolve lake leakage.
- OhauRes - 98614(6): This dataset has negative data values when the inflow to Lake Ohau drops below the required residual consent flow of 8m<sup>3</sup>/s for 1 May to 31 October and 12m<sup>3</sup>/s for 1 November to 30 April.
- Manareduced - 99552: This dataset simulates the effects of minimum flow regimes, Mararoa dirty water spill, and flushing and recreational flows. The dataset will have negative values if the inflow to Lake Manapouri is less than the required 150m<sup>3</sup>/s flushing and recreational consent flows. In some instances when the Mararoa is in flood, and the spill of dirty water is required (if flow is greater than 40m<sup>3</sup>/s), because of the outflows timing issues inflows to Manapouri will be less than outflows resulting in negative water.
- Manawmara - 99551: This dataset only simulates the effects of dirty water flows. In some instances, when the Mararoa is in flood and the spill of dirty water is required (if the flow is greater than 40m<sup>3</sup>/s), because of timing issues inflows to Manapouri will be less than outflows resulting in negative water.





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