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Taihoro Nukurangi

Droughts in Northland: A Local and Regional Analysis

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Prepared by:
Shailesh Singh, Rasool Porhemmat, Hisako Shiona, George Griffiths

For any information regarding this report please contact:

Shailesh Singh
Hydrologist
Hydrological Processes
+64-3-343 8053
shailesh.singh@niwa.co.nz

National Institute of Water & Atmospheric Research Ltd
PO Box 8602
Riccarton
Christchurch 8440

Phone +64 3 348 8987

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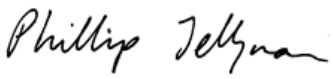	Approved for release by:	Phillip Jellyman

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Executive summary

Drought is a significant and recurring hazard in Northland, where eight severe droughts have been recorded since 1900. Historic drought records enable us to manage future drought incidents more effectively by providing critical data for understanding patterns and trends relating to the frequency, duration, and intensity of past droughts. As part of its responsibilities to manage water resources, Northland Regional Council wishes to increase understanding of the development, occurrence and severity of droughts in its region. The cause of drought is usually the persistence of slow moving or blocking high pressure systems over Northland during the summer seasons. Reasons for this behaviour are poorly understood as are links between severe drought occurrence and natural climate fluctuation caused by El-Niño Southern Oscillation, Interdecadal Pacific Oscillation and the Southern Annual Mode.

This report examines drought for the whole Northland region. Analysis is restricted to meteorological droughts characterised by severity, duration and frequency or return period. Severity is measured by the Standardised Precipitation Index. Severity-duration-return period relationships are presented for each of 298 rain gauge sites.

Based on severity alone, the three worst drought years (with the first year the worst) were: 1987, 1913 and 1990. Based on duration alone the three worst drought years (with the first year the worst) were: 2019, 1993 and 1913.

Tests of Standardised Precipitation Index values showed no consistent and significant temporal trend in drought occurrence. Visual analysis aided by a clustering technique demonstrated that severity duration frequency relationships are not spatially dependent, implying that there are no specific drought-prone areas and that drought may occur at any locale and time in the Northland Region. Monitoring of drought indices using the New Zealand Drought Monitor is recommended along with further investigation into drivers of severe drought and persistence effects.

We also explored the relationship between severe droughts and climate indices including the Pacific Decadal Oscillation, El Niño-Southern Oscillation and Southern Oscillation Index (SOI). Key findings revealed that 65% of severe droughts coincide with negative monthly SOI values, predominantly occurring during El Niño events, with 82% of the most severe droughts linked to these conditions. Just over half (56%) of severe droughts are during the months with negative Pacific Decadal Oscillation; however, the top five most severe droughts are coincident with positive monthly Pacific Decadal Oscillation values. Even though these large-scale climate patterns influence New Zealand's climate and contribute to drought events, they are just one component of a complex set of factors that can lead to drought conditions. Local climate variability, topography, and other regional influences also play a significant role in shaping weather patterns and drought risk which require further investigation at regional scales.

1 Introduction

Drought is a significant and recurring hazard in Northland, often having serious and widespread social, economic and environmental impacts. Northland has experienced both regional and localised drought. Eight major droughts have been recorded since 1900 (Keyte, 1993; Porteous and Mullan, 2013; Woods and McKerchar, 2010), with the most severe in 1914–15, 1945–46, 1982–83 and 2009–10 (Pham and Donaghy, 2017).

Historic drought records enable us to manage future drought incidents more effectively. Northland Regional Council (NRC) wishes, in dealing with drought, to "increase understanding of the development, occurrence and severity of localised dry conditions to enable informed decisions to be made concerning sustainable water resources management". In 2018, NIWA carried out at-site and regional analysis of drought for western Northland (Singh and Griffiths, 2018). In 2019 NIWA carried out a similar study for eastern Northland. The current work is an update of these two studies for Northland as a whole, using the same methodology and updated data.

NRC employs the Standardised Precipitation Index (SPI) (McKee et al. 1993) as recommended by the World Meteorological Organisation (Svoboda et al. 2012; WMO, 2011) as a measure of drought severity. As this index is determined from a precipitation record, SPI is a measure of meteorological drought; analysis of drought in this report is based on data from rain gauges in the whole region of Northland.

Section 2 of this report examines reasons for the occurrence of dry spells and droughts in Northland including the effects of natural factors which cause fluctuations in climate patterns.

Section 3 describes the methodology employed to define drought and to analyse severity, duration and frequency of droughts and temporal trends in their occurrence.

Section 4 (and Appendix A) summarises the manual and automatic rain gauge data for the Northland region.

Section 5 presents the results of the drought analysis for all rain gauges as well as regional patterns. Results from an analysis of temporal and spatial trends are also detailed. Note, to improve the readability of this report section, three large results tables (i.e., each contains 297 data rows) are contained in Appendix C.

Section 6 presents the teleconnection between drought and climate indices.

Section 7 gives recommendations for future work, mainly concerning warning of the onset of drought and further climatological investigations.

Section 8 lists the conclusions of the analysis regarding spatial and temporal patterns of the severity, duration and return period of droughts.

2 Background

Northland has a Mediterranean climate which is generally warm, intermittently dry and humid in summer and mild in winter and rather windy. Rainfall is normally plentiful all year round with occasional heavy falls. Annual rainfall varies significantly throughout the Northland Region. Hilly areas north of Dargaville and Kaikohe receive the most rain at 2000 mm per year on average while the driest part near Cape Reinga receives about 900 mm per year on average (Figure 2-1). There is substantial year to year variation in rainfall. For example, Dargaville has annual rainfall totals varying from 800 mm to 1600 mm (1951–1985) with a trend showing reduction in rainfall (NIWA, 2016). In contrast at Waimatenui, south of Kaikohe, no long-term trend from 1914–2000 is evident. Often in summer Northland experiences two to three weeks of dry weather owing to persistent anticyclones. An anticyclone becomes stationary east of Australia then weakens and a following cold front moves along the southern edge of the anticyclone and over New Zealand bringing cloudy conditions with little or no rainfall. The original anticyclone disappears and is replaced by another and the whole process may repeat several times (Chappell, 2013). This behaviour produces dry spells of about 20 days duration usually between December and March, perhaps a decade apart on average. The proximate cause of more severe dry spells, that is drought, is often the persistence of slow moving or blocking high pressure systems over the Tasman Sea and Northland during the summer season. The reason for the persistence is still poorly understood but high pressures do not always lead to drought conditions (NIWA, 2013).

While three natural fluctuations lead to long term quasi-cyclic variations in climate in Northland, short term variations are effectively random, they are the El Niño-Southern Oscillation (ENSO), the Interdecadal Pacific Oscillation (IPO)[1] and the Southern Annual mode (SAM). ENSO involves movement of warm ocean water across the Pacific coupled with the movement of rainfall associated with this warm water. It can be a factor in drought. During La Niña conditions, which occur on an average three to seven years apart, spring and summer easterly anomalies predominate and dry conditions can evolve in the west of the North Island (NIWA, 2013). However, drought may still happen when the El Niño-Southern Oscillation is in neutral phase as occurred in the 2012–2013 Northland drought. IPO is a large scale, long period oscillation that affects climate variability in New Zealand (Salinger et al. 2001). It operates at a multi-decadal scale with phases lasting 20 to 30 years. Positive periods when westerly winds are stronger tend to produce drier conditions in Northland. The IPO has been in negative phase since 1999. SAM is a ring of atmospheric pressure variability between Antarctic and the mid-latitudes. Positive and negative phases of SAM mainly only last a few weeks. In its positive phase it is associated with relatively light winds and the settled weather that occurs during droughts.

Links between severe drought occurrence and ENSO, IPO and SAM behaviour are difficult to establish quantitatively as all operate at different frequencies. Much further climatological investigation is required to understand in detail at a sub-regional scale the cause of droughts and their persistence. Given the present state of knowledge, the ability to predict drought severity, duration and frequency with a reasonable degree of certainty is perhaps decades away. Regarding climate change effects, an increase in drought frequency is projected in Northland to be about 7% for 2030–2050 and 10% for 2070–2090 (NIWA, 2016).

[1] The IPO is essentially the same as the Pacific Decadal Oscillation – the PDO covers the mid-latitudes of the Pacific Ocean in the northern hemisphere, whereas the IPO covers the southern and northern hemispheres.

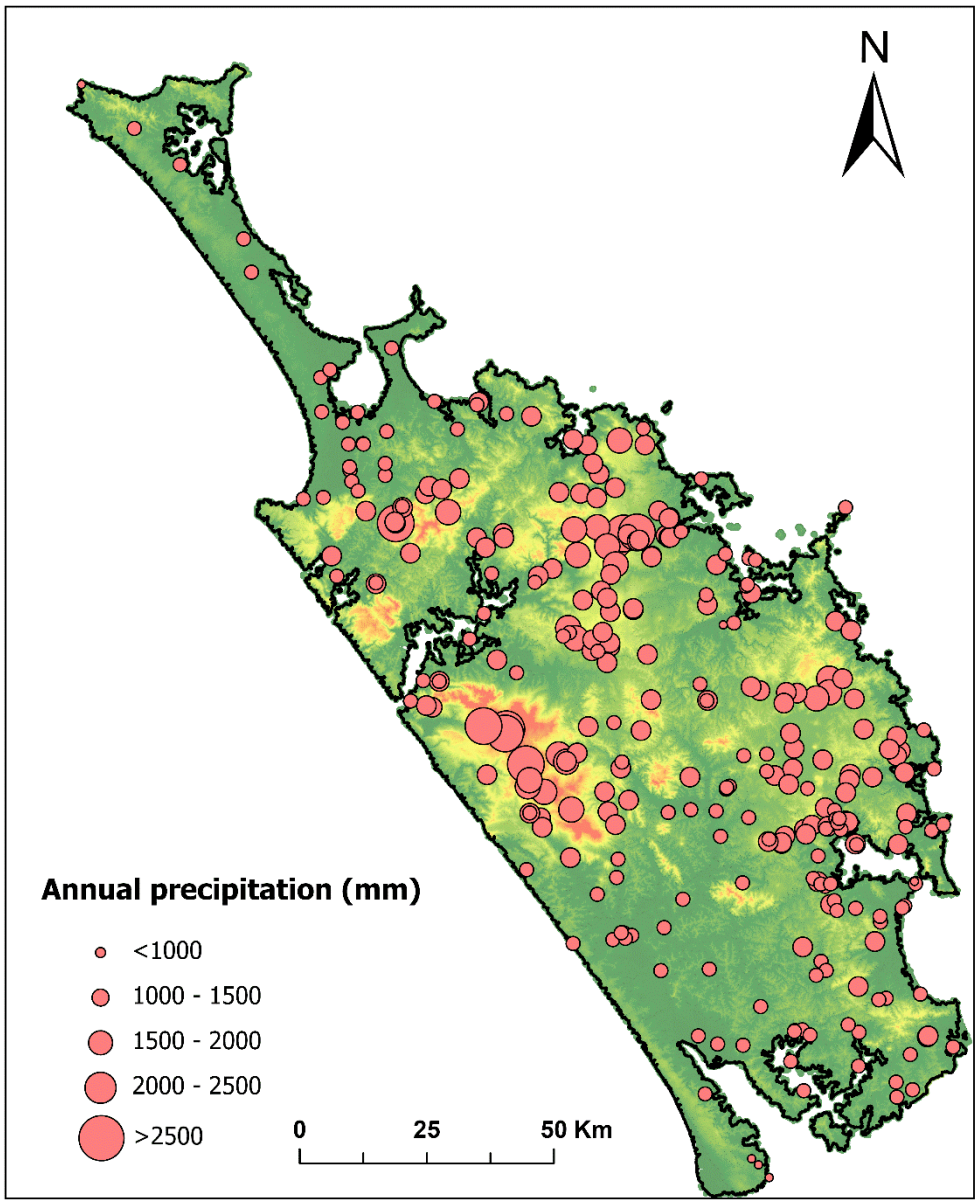

Figure 2-1: Distribution of mean annual rainfall in Northland.

3 Methodology

Meteorological, agricultural and hydrological droughts are often represented in terms of drought indices using precipitation, river flow, potential evapotranspiration or soil moisture data. There are many definitions of drought depending upon whether a meteorological, agricultural or hydrological drought is to be investigated. For example, in an analysis of the 2012-13 drought in New Zealand which affected southern Northland the drought index employed was based on accumulated potential evapotranspiration deficit (NIWA, 2013). Meteorological drought depends on the amount and duration of the precipitation deficit. The choice of an appropriate drought index depends on available information, type of drought and purpose of drought assessment. A large number of drought indices for meteorological drought (defined on the basis of degree of dryness) exist. These indices are simply expressed in terms of a rainfall deficit in relation to some average. Widely used indices include Standardised Precipitation Index (SPI), Palmer Drought Severity Index (PDSI), Surface water supply index (SWSI), Crop Moisture Index (CMI) and rainfall anomalies. Every index has its own advantage and limitations in terms of assumptions and data requirements. Among these, those that have been most commonly used are PDSI and SPI. For these drought indices the value is typically a single number which is interpreted on a scale of abnormally wet, average, and abnormally dry.

In this study we employ the Standardised Precipitation Index (SPI) (McKee et al. 1993) as recommended by the World Meteorological Organisation (Svoboda et al. 2012; WMO, 2011) as a measure of drought severity. Because this index is determined from a precipitation record only, it is a measure of meteorological drought.

A drought event is defined here as a period in which the SPI is continuously negative and the SPI reaches a value of -1.0 or less and ends with the positive value of the SPI (McKee et al. 1993) . Figure 3-1 illustrates the definition of drought events from an SPI time series.

A drought is usually described by employing a combination of three variables namely severity, duration and frequency (Clausen and Pearson, 1995). These are separately defined and described below along with the methods used to calculate them.

3.1 Severity

The Standardised Precipitation Index (SPI) is a probability (statistical) index that gives a representation of abnormal wetness and dryness. The SPI is obtained by fitting a Gamma or Pearson Type III distribution to monthly precipitation values.

Advantages of the SPI include:

- it requires only monthly precipitation values.
- it can be compared across regions with markedly different rainfall regimes.
- standardisation of the SPI allows determination of the rarity of a drought.
- it can be created for differing periods.

Shortcomings of the SPI, as noted by (Trenberth et al. 2013) are:

- SPI values are based on precipitation alone and provide a measure only for water supply. They are very useful as a measure of precipitation deficits or meteorological drought but are limited because they do not deal with evapotranspiration.

- long records of rainfall data are needed.

The value of SPI is indicative of dryness or wetness. Positive SPI indicates that the observed precipitation is above median (wet condition), whereas negative SPI indicates precipitation is below median (dry/drought). The wet and drought conditions are further classified as shown in Table 3-1. A drought event is defined as a period during which SPI is continuously below 0 (McKee et al. 1993). In this report, we term any event with negative SPI (SPI < -1) as a drought, and when SPI falls below -2 we term it a severe drought. Figure 3-1 illustrates an example of an SPI time series indicating wet and drought events.

To be consistent with the study by NRC (Pham and Donaghy, 2017), the latest SPI program (SPI_SL_6.exe) developed by Colorado State University, USA was used in this study. To automate the process the SPI program was sourced through Python scripts. This program can provide 1, 3 ,6 and 12 monthly SPI values.

Table 3-1: SPI categories, based on McKee et al. (1993).

SPI	Category
2 & above	Extremely wet
1.5 - 1.99	Very wet
1 - 1.49	Moderately wet
−0.99 - 0.99	Near Normal
−1.00 - −1.49	Moderately dry
−1.50 - −1.99	Severely dry
−2.00 & below	Extremely dry

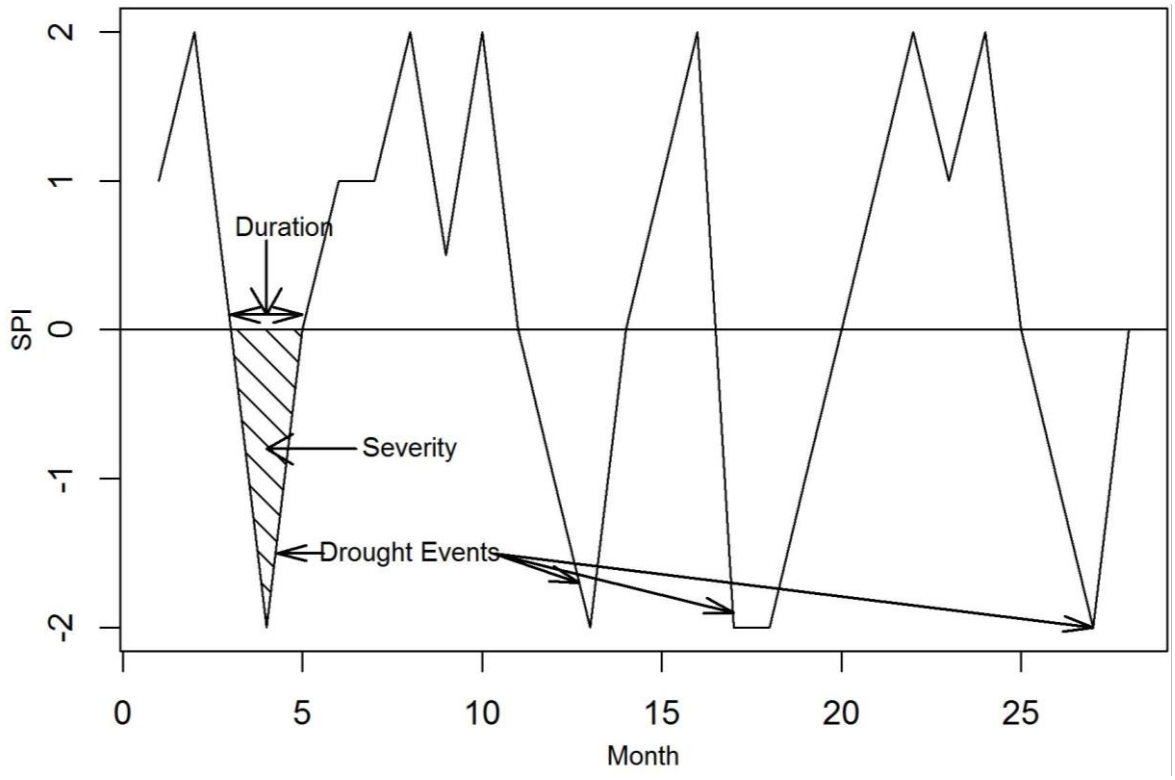

Figure 3-1: Example of duration and severity of dry and wet events based on Standardised Precipitation Index (SPI) (Singh et al. 2017).

Drought severity is quantified by the cumulative SPI for the duration of a drought, as in Equation 1:

$$S = -\sum_{i=1}^{D} SPI(i) \qquad (1)$$

where D is drought duration (in this case, months), S is drought severity and i is time step (in this case, monthly). A Python script was written to calculate drought severity.

3.2 Duration

Drought duration, D, or length is taken as the number of consecutive months where the SPI remains below a specified threshold value (SPI < -1, in this report) (Figure 3-1). Herein SPI was calculated at monthly intervals. Accordingly, the minimum duration of a drought is one month. A Python script was written to calculate drought duration.

3.3 Frequency

The frequency of drought events in a given number of years is measured by the arrival rate, that is, the number of drought events divided by the number of years. Arrival rate is independent of severity and duration and is a measure of the propensity of an area to experience dry conditions over time. In drought description we also use return period which is related to the reciprocal of arrival rate or the reciprocal of the frequency. A rare drought has a low arrival rate and a large return period.

Drought severity, S, and duration, D, are not independent as severe drought normally lasts a long time (Singh et al. 2017). Generally, drought duration and severity are analysed separately and modelled using different distributions. Such separate analyses of duration and severity cannot reveal the significant associations between them. As return period is dependent on S and D, return period

was calculated using copula, an approach widely employed elsewhere (Chen et al. 2012; Halwatura et al. 2015a; Masud et al. 2015; Saghafian et al. 2003; Shiau, 2006; Singh et al. 2017).

Copula theory, a statistical tool, offers functions that join or couple multivariate distribution functions into one-dimensional marginal distribution functions, or as multivariate distribution functions whose one-dimensional margins are uniformly distributed on the unit interval [0, 1].

In general terms, for n-dimensional space a copula, c, is a multivariate distribution defined on the Cartesian product I^nas

$$C: I^n \rightarrow I$$

$$(u_1, \dots u_n) \rightarrow v \qquad (2)$$

where

I = [0,1]

$u, v \in [0,1]$

In 2-dimensional space we can write,

$$C: I^2 \rightarrow I$$

$$(u_1, u_2) \rightarrow v \qquad (3)$$

The interdependence structure of S and D can be described by 2-dimensional copula by joining their corresponding marginal distributions. Let us assume u_1 and u_2 are S and D, respectively, representing the transformed values from the real observations into a univariate distribution function of drought severity and duration.

Given two random variables (S and D), Sklar's theorem (Sklar, 1959), can be used to express a joint multivariate distribution function in terms of univariate marginal distributions. If $\mathrm{F(x)}$ is a joint distribution function with marginals $\mathrm{F_1(x_1)}, \dots, \mathrm{F_p(x_p)}$ and $\mathrm{x} = (\mathrm{x_1}, \dots, \mathrm{x_p})$, then there exists a copula as given by Equation 4:

$$F_{\boldsymbol{X}}(\boldsymbol{x}) = C\left(F_1(x_1), \dots, F_p(x_p)\right) \qquad (4)$$

If the marginal is continuous then C is unique. Comprehensive reviews of copulas can be found in Cherubini et al. (2004), Nelsen (1999) and Nelsen (2007).

The joint return period of severity and duration can be calculated in several ways. For example, it can be estimated by considering the event $D \geq d$ **and** $S \geq s$, or the event $D \geq d$ **or** $S \geq s$ where D and S refer to a specific event. The first is expressed in terms of the marginal and joint distribution of D and S, whilst the second depends solely on the joint distribution function. We carried out the analysis considering the second case as suggested by (Shiau, 2003) and given by the following equation:

$$T(S, D) = \frac{1}{\gamma\{1-F(s,d)\}} = \frac{1}{\gamma\{1-C(u,v)\}} \qquad (6)$$

where $C(u, v)$ represents the bivariate copula and γ the arrival rate. For further details about the derivation of joint return period, refer to (Shiau, 2003).

Halwatura et al. (2015b) illustrate the application of drought SDF curves as a risk-based planning tool in the rehabilitation of post-mining landscapes in Australia. Several other examples of the application of SDF curves of drought are available in the literature (Dalezios et al. 2000; Janga Reddy and Ganguli, 2012; Kim et al. 2011; Miller and Durnford, 2005; Reddy and Singh, 2014; Saghafian et al. 2003; Shiau and Modarres, 2009; Todisco et al. 2013).

At-site return periods were calculated using a MATLAB program. The programme uses S and D calculated from SPIs using Python script. The output is SDF curves for various return periods. This programme can also be used to define the return period of any event if S and D are known.

To assess return periods on a regional basis we first grouped sites using a hierarchical Affinity Propagation clustering technique (Frey and Dueck, 2007) which employs S, D, standard deviations of S and D and arrival rate as parameters.

Clustering is the process of classifying objects into different groups based on their similarity. Many clustering methods are agglomerative, that is they start by defining small groups. Then they proceed based on a fusion technique, by combining objects with objects or with groups, or groups with groups. The technique can be displayed by a dendogram where the vertical axis shows the level of fusion. There are many agglomerative clustering methods available. In this study we used Affinity Propagation (AP) clustering (Frey and Dueck, 2007). An advantage of AP clustering is that it both partition the objects of a data set into groups of similar objects, and identifies a single object (the "exemplar") that is most representative for each group. Exemplar-based AP clustering provides an

additional advantage for finding the right number of clusters (Bodenhofer et al. 2011). AP clustering does not need the user to define the number of clusters prior to the classification. The designers describe the method as follows: "Each object in a dataset is considered as a node in a network; real-value messages are recursively transmitted along the edges of the network until a good set of exemplars gradually emerges. At each iteration, the magnitude of each message reflects the current affinity that one object has for choosing another object as its exemplar, hence the term affinity propagation" (Ali et al. 2012; Frey and Dueck, 2007). The R package "apcluster" (Bodenhofer et al. 2011) was used in this study. The square similarity matrices of mutual pairwise similarities of data vectors were computed using negative square distance, i.e., given distance, d, the resulting similarity is computed as S = -dr. we used r=2 to obtain the negative square distance as described in (Frey and Dueck, 2007).

Next, we combined all the S and D values for each site in the group and calculated the return period. The clustering was done using an apcluster R package (Frey and Dueck, 2007). The return period was calculated using a MATLAB programme which can also be used to define return period of any event if S and D are known. The output is an SDF curve for each group.

3.4 Trend

To ascertain if there were any trends increasing or decreasing month by month in the magnitude of the SPI we used the non-parametric Mann-Kendall test. This is commonly employed to detect monotonic trends in series of environmental data, climate data or hydrological data. The significance of the detected trends can be obtained at different levels of significance (generally taken as 0.05). It

has been recommended by the World Meteorological Organisation (WMO) for determining the existence of statistically significant trends in climate and hydrologic data time series.

The null hypothesis, H0, is that the data come from a population with independent realisations and are identically distributed. The alternative hypothesis, HA, is that the data follow a monotonic trend.

The purpose of the Mann-Kendall (MK) test (Mann 1945, Kendall 1955, Gilbert 1987) is to statistically assess if there is a monotonic upward or downward trend of the variable of interest over time. A monotonic upward (downward) trend means that the variable consistently increases (decreases) through time, but the trend may or may not be linear. The MK test can be used in place of a parametric linear regression analysis, which can be used to test if the slope of the estimated linear regression line is different from zero. The regression analysis requires that the residuals from the fitted regression line be normally distributed; an assumption not required by the MK test, that is, the MK test is a non-parametric (distribution-free) test.

Hirsch et al. (1982) state that the MK test is best viewed as exploratory analysis and is most appropriately used to identify stations where changes are significant or of large magnitude and to quantify these findings.

To perform the test, we employed the Mann-Kendall test in the Kendall R software package.

3.4.1 Assumptions

The following assumptions underlie the MK test:

- When no trend is present, the measurements (observations or data) obtained over time are independent and identically distributed. The assumption of independence means that the observations are not serially correlated over time.
- The observations obtained over time are representative of the true conditions at sampling times.
- The sample collection, handling, and measurement methods provide unbiased and representative observations of the underlying populations over time.

There is no requirement that the measurements be normally distributed or that the trend, if present, is linear. The MK test can be computed if there are missing values and values below the one or more limits of detection (LD), but the performance of the test will be adversely affected by such events. The assumption of independence requires that the time between samples be sufficiently large so that there is no correlation between measurements collected at different times.

4 Data

Rainfall measurement sites or rain gauges and their attributes are listed in Table 4-1 and details of data availability and sources are given in Appendix A. There were 338 sites but data availability at some sites is less than 10 years. A total of 298 sites were employed in this study with a minimum record length of 5 years and a maximum record length of 118 years with a mean of 28 years. Mean annual rainfall and number of rain gauges is given in Figure 4-1. Location of the rain gauges is shown in Figure 4-2. The rainfall data were obtained from NIWA, NRC and New Zealand Meteorological Service (NZMS). They were accumulated at a monthly time scale. Gaps of three months or less in the data were filled by the mean value from the record for the relevant missing month. For example, if the record for August 2018 at some site was missing then we would insert the mean of the values for August for all years of the site record as the values for the August 2018. Longer gaps are omitted from the analysis. This operation was performed using Python script. For analysis we required a minimum 10 years of data. But on request from NRC, we included 18 sites of less than 10 years of data. From these sites we extended the data from nearest rain gauge sites. The main reasons NRC requested inclusion of sites with less than 10 years of data were that they are open sites and they have some significance for the future. Adding these sites to the analysis may add more uncertainty to the results.

Table 4-1: Details of rainfall records used.

Number of Sites	Number of years			Mean Annual Rainfall (mm)		
	max	min	mean	max	min	mean
298	118	5	28	2924	763	1564

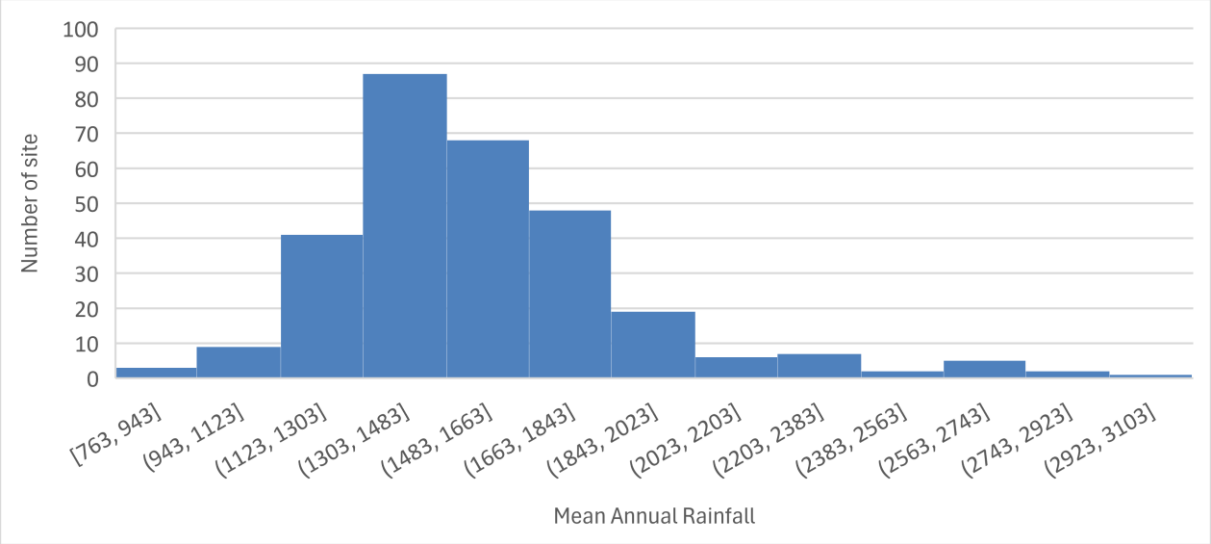

Figure 4-1: Mean annual rainfall (mm) and number of rain gauges.

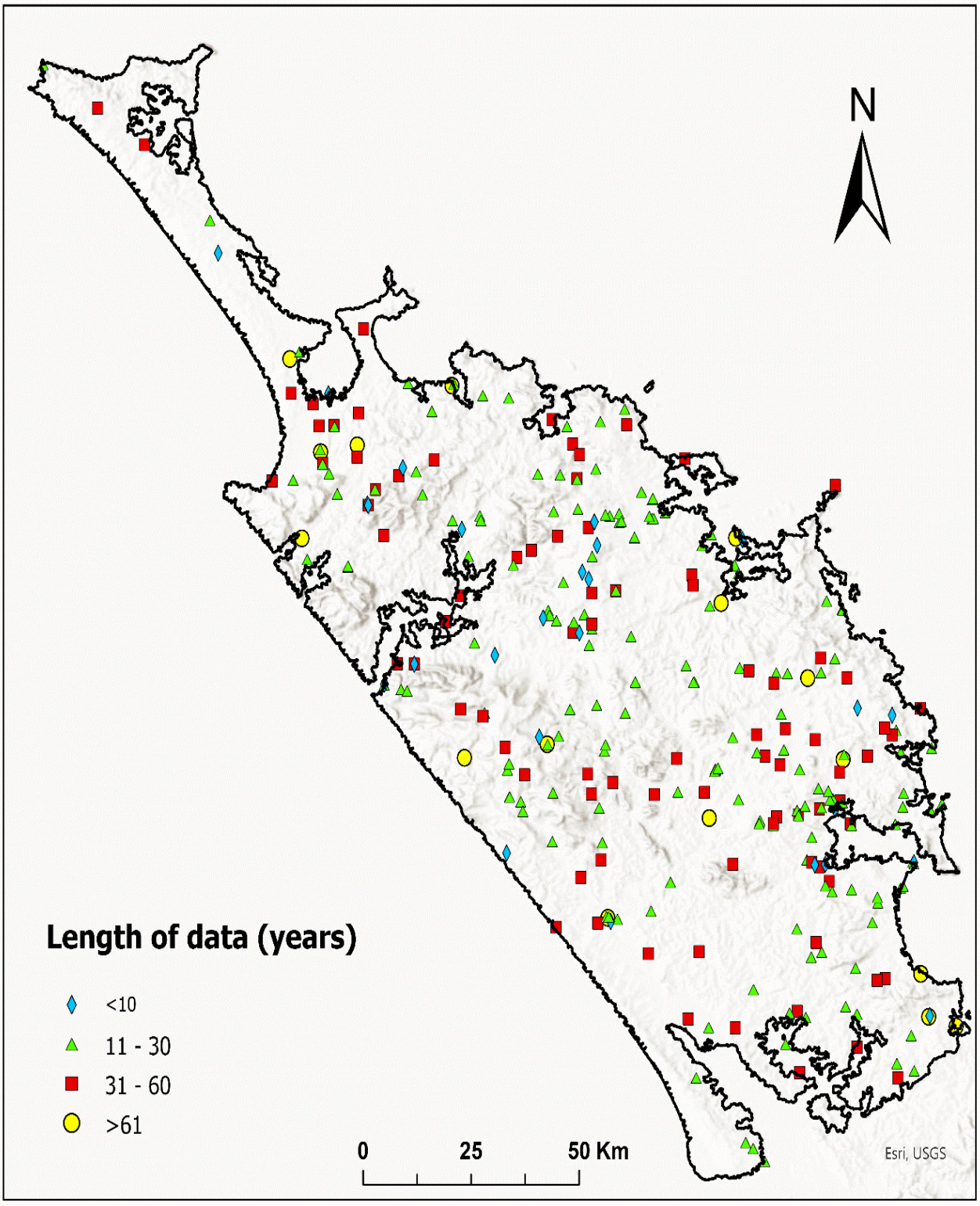

Figure 4-2: Location of rain gauges.

5 Drought analysis

There are at least seven variables involved in an at-site and regional analysis of drought. They include severity S, duration D, return period T or arrival rate gamma (Equation 6), time of occurrence within the year, time of occurrence by year, location and affected area. In the literature there is no consistent approach to the description of drought involving some or all of the variables (Cai et al. 2015; Ganguli and Ganguly, 2016; Haslinger and Blöschl, 2017; Juliani and Okawa, 2017; Raziei et al. 2009). It is however common practice to hold a number of the variables constant or allow them to range while examining the behaviour of, perhaps two. For example, the variation of severity, at say, the severely dry level (Table 3-1) with rain gauge location for a given duration for any time in a year and any return period in a given region.

The basis of modern analysis of the spatial and temporal behaviour of droughts is the establishment of S-D-T relationship for each rain gauge or site. From this information a great number of at-site or regional statistics can be derived. Among these are ranking of S and D individually for listed sites and year of occurrence along with maps of the spatial distribution of mean values at sites, of S, and D: all often displayed in the literature. Here we carry out at site and regional analyses using rain gauge data from the whole region of Northland to provide both details and an overview of the spatial and temporal properties of droughts. The main interest is firstly in locating drought prone areas or zones, if any, along with their temporal behaviour and secondly determining whether there are any spatial or temporal trends in drought occurrence. In this study we calculate the SPI at duration 1, 3, 6, 9, 12 and 24 months. Results are just presented for SPI based on 1 month duration, following the methodology presented in the previous two studies by Singh and Griffiths (2018, 2019).

5.1 At site

5.1.1 Severity, duration and frequency

SPI values were calculated for all sites using monthly data to determine drought severity, duration and frequency as described by return period. Figure 5-1 shows the typical relationship between severity, duration and return period determined for each site. These site relationships form the basis for drought analysis and can be employed directly in planning and design for drought management.

Appendix C lists all the extremely dry events with S and D values along with month and year of occurrence.

Table B-1 (Appendix B) determined from Appendix C, details the minimum monthly SPI values calculated at each site along with the month and year of occurrence. The lowest monthly SPI value for any site (-5.35) is that for September 1999 at site Dargaville Exp Farm (site 539802). Considering the whole record for Northland (1893-2024) the percentage of sites experiencing extremely dry conditions monthly (Table 3-1), from year to year is displayed in Figure 5-2 presents a ranking of sites based on S values for extremely dry conditions (Table 3-1) for the whole record. **Error! Reference source not found.** and Table C-1 is similar but based on D and S values respectively. Starting month and year of occurrence are also given. Based on S the maximum severity was 21.19 in a drought which began in May 1987 at Whangarei Harbour at NZ refining Company (site 548212) and lasted 10 months. Based on D the maximum duration of 18 months, beginning in January 2019 also occurred at Russell (site 542101). The percentage of sites affected by extremely dry conditions based on S and D separately is shown in Figure 5-3. Considering the whole record for Northland (1893-2023) the percentage of sites experiencing extremely dry conditions monthly (Table 3-1) and their locations for the three worst years, based on S and D, is displayed in Figure 5-4.

Finally, number of drought events for all sites by SPI category (Table 3-1) and arrival rate or frequency are listed in Appendix Appendix G and displayed in Figure 5-4. The moderately dry category (Table 3-1) is the most commonly occurring and 40% of all droughts are extremely dry.

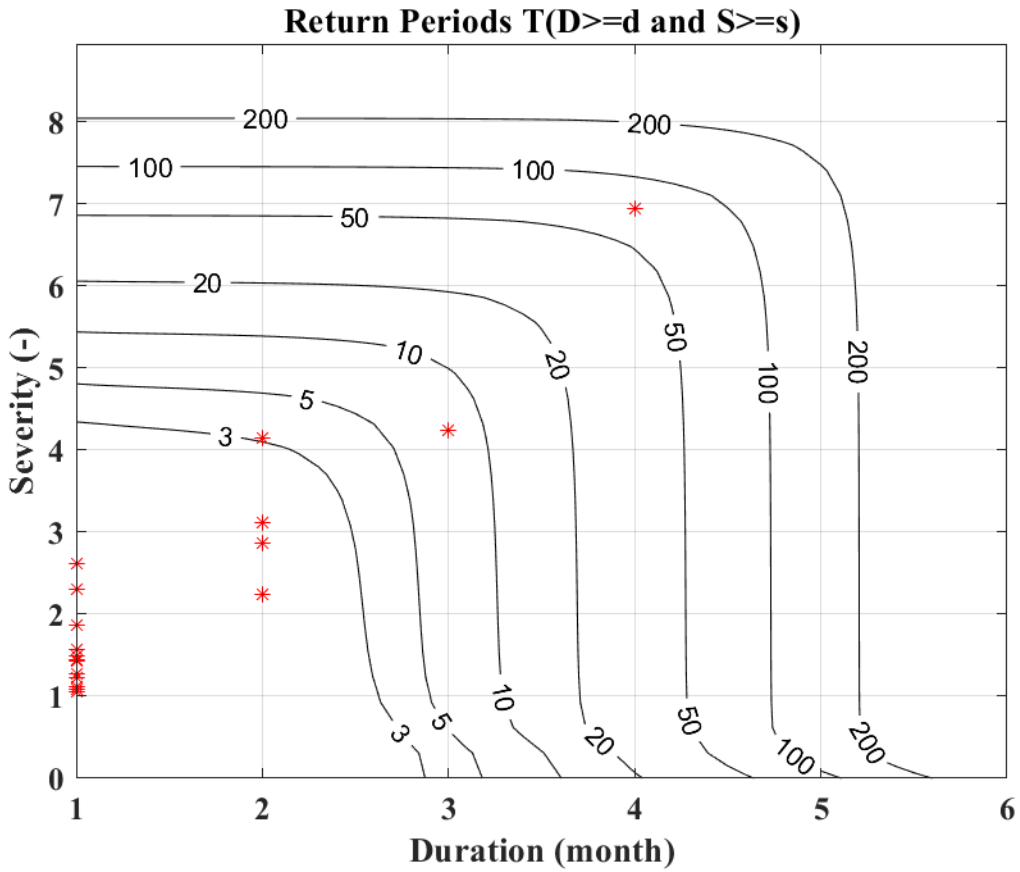

Figure 5-1: Example of SDF relationship for Pukepoto (Site 531209).

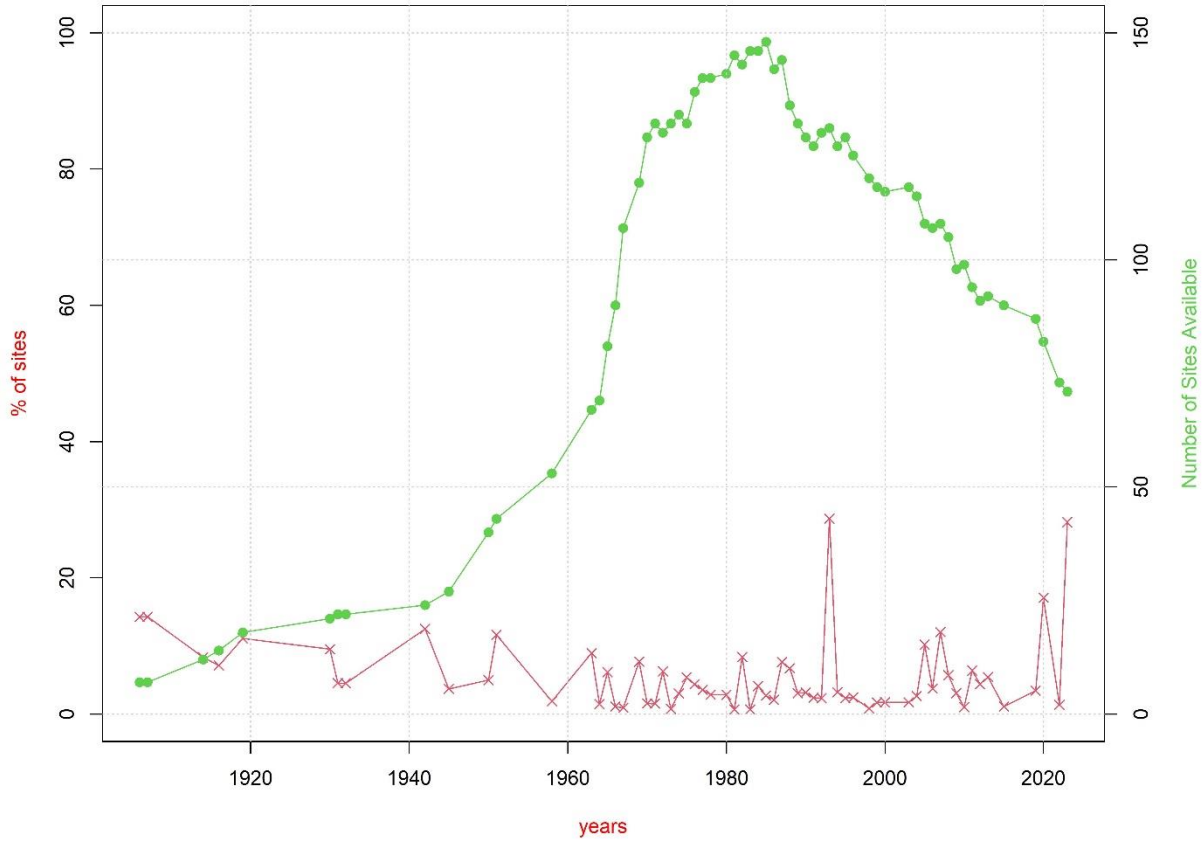

Figure 5-2: Percentage of sites with extreme dry conditions for different drought events. Red line is percentage of sites and green line is number of available sites.

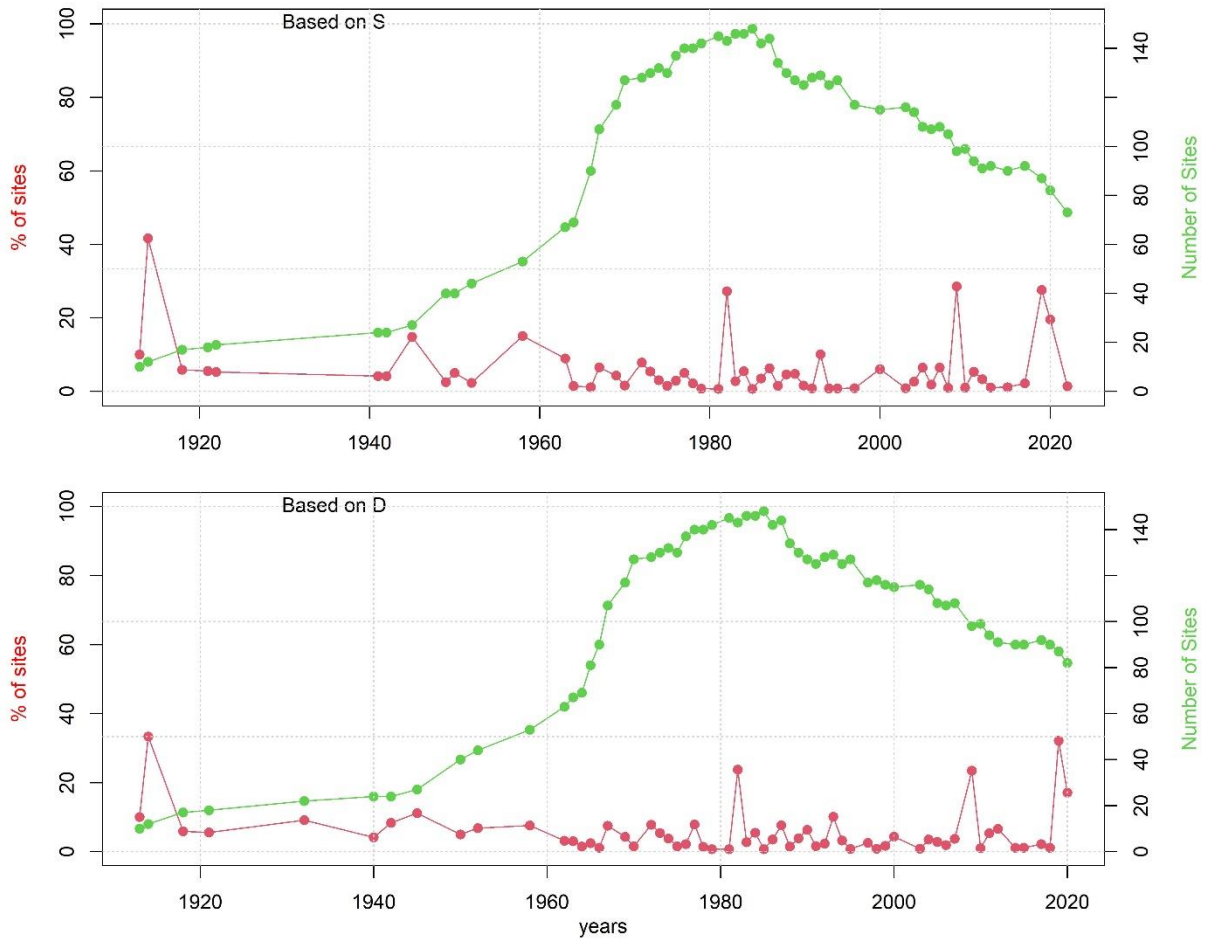

Figure 5-3: Percentage of sites under extremely dry conditions based on S and D. Red line is percentage of sites and green line is number of available sites.

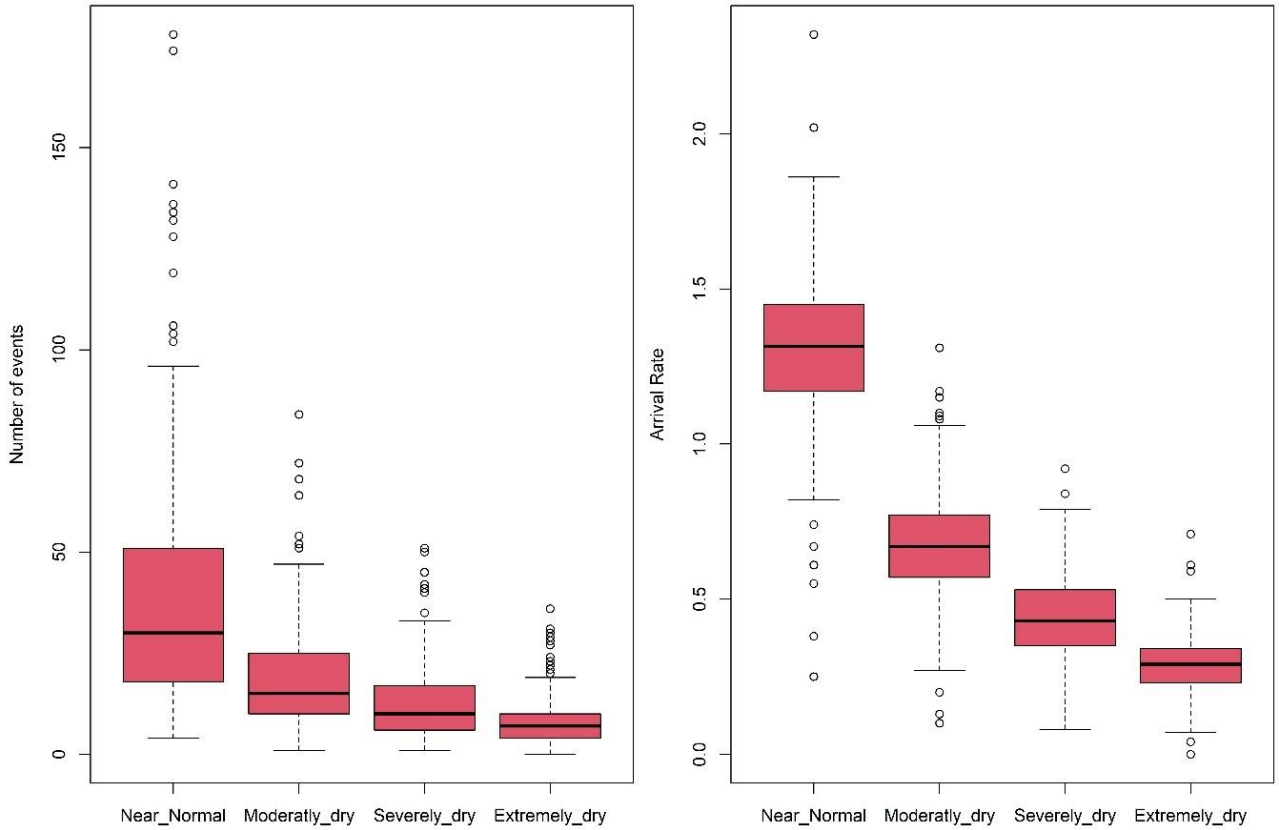

Figure 5-4: Number of drought events and arrival rate in each category (Table 3-1).

5.1.2 Temporal trend

The statistical significance of upward or downward temporal trends was evaluated using the Mann-Kendall test at significance levels of 95% or α =0.05. The test was applied to monthly values of SPI listed in time order for all months of a site's record. Examples of these trends at different sites are shown in Figure 5-5. No significant trend was found for 87% of the sites. Some 7% of sites show a downward trend and 6% of sites show an upward trend in SPI Table E-1. Note that the decrease in trend of SPI time series indicates an increase in the number of drought occurrences. We could detect no spatial clustering of temporal trends and hence no evidence of a coherent monotonic change in drought occurrence. Although some of these trends might be statistically robust, they should not be interpreted as indicating regional long-term climate trends.

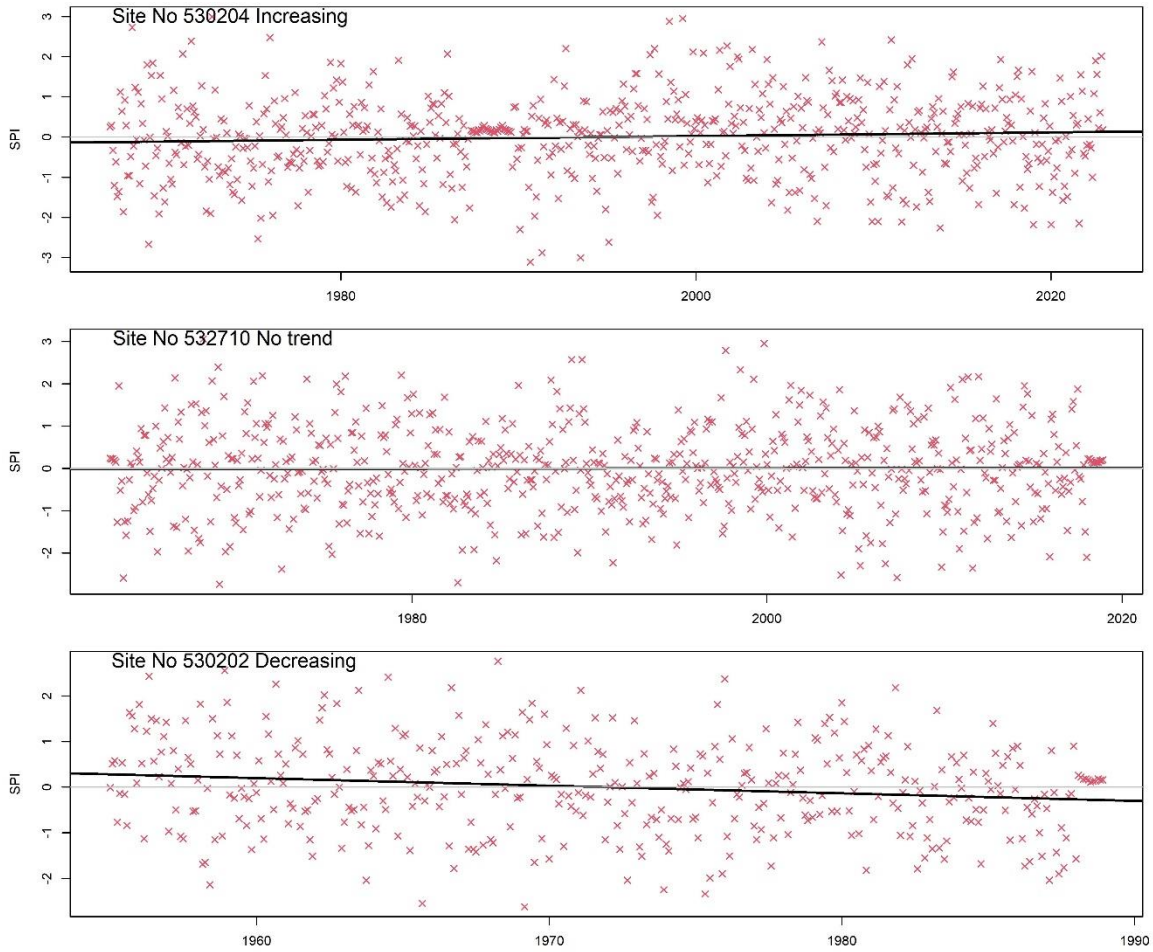

Figure 5-5: Example of sites with increasing, no and decreasing temporal trend in SPI.

5.2 Regional

We supposed at first that there would be a relationship between drought and locality, and that locality might correlate with climate zones based on the spatial distribution of the mean annual rainfall (Figure 2-1). The presumed zones were Dargaville (low rainfall area), Kaitaia (medium rainfall area) and Kaikohe (high rainfall area). However the spatial distribution of mean severity that is the average of all the severity values from moderately dry to extremely dry (Table 3-1) at a site, displayed in Figure 5-6 exhibits no evidence of local or regionwide pattern, that is, no geographical dependence nor any matching of magnitude with climate zone (Figure 2-1). The same behaviours also occur with mean duration (Figure 5-7) and mean arrival rate (Figure 5-8). In short, the record does not show the presence of any persistent drought prone areas in Northland.

In support of this outcome we also examined the spatial distribution of site drought for the three worst occurrences in the record. The worst years in order of severity S were 1987, 1913 and 1990, and based on duration D were 2019, 1993 and 1913. Figure 5-9 displays no regional patterns or spatial trends for these six worst drought years. These results differ from those of Pham (2017) and Keyte (1993) because of different definitions of drought.

We then employed a hierarchical Affinity Propagation clustering technique (Frey and Dueck, 2007) to analyse the regional distribution of drought in terms of severity, duration and arrival rate jointly. The results were a division of this cluster of three variables into 25 distinct groups of sites (Figure 5-13).

Figure 5-9 shows the locations of sites where the three most severe and prolonged drought years occurred in the record. However, there is no discernible spatial pattern evident from the Figure 5-9.Figure 5-9: Location of sites where the three worst droughts occurred in the record based on severity. S (top) (1913, 1987, 1990) and on duration D (bottom) (1913, 1993, 2019).

Table 5-1 lists a representative site for each group. These representative sites were obtained based on exemplar sites given by the hierarchical Affinity Propagation clustering technique.

In Figure 5-10, again as previously, there is no spatial dependence of the various groups. This means that droughts cannot be partitioned geographically or related to the spatial distribution of mean annual rainfall in general.

The severity-duration-return period relationships for all 25 groups are shown in Figure 5- to Figure 5-21. Different return periods are represented by contour lines. If S and D are specified then the return period can be determined from the figures. For example, Figure 5-11 for Group 1, D = 3 months and S = -4 implies T = 100 years. These relationships will be useful in planning and design for drought management.

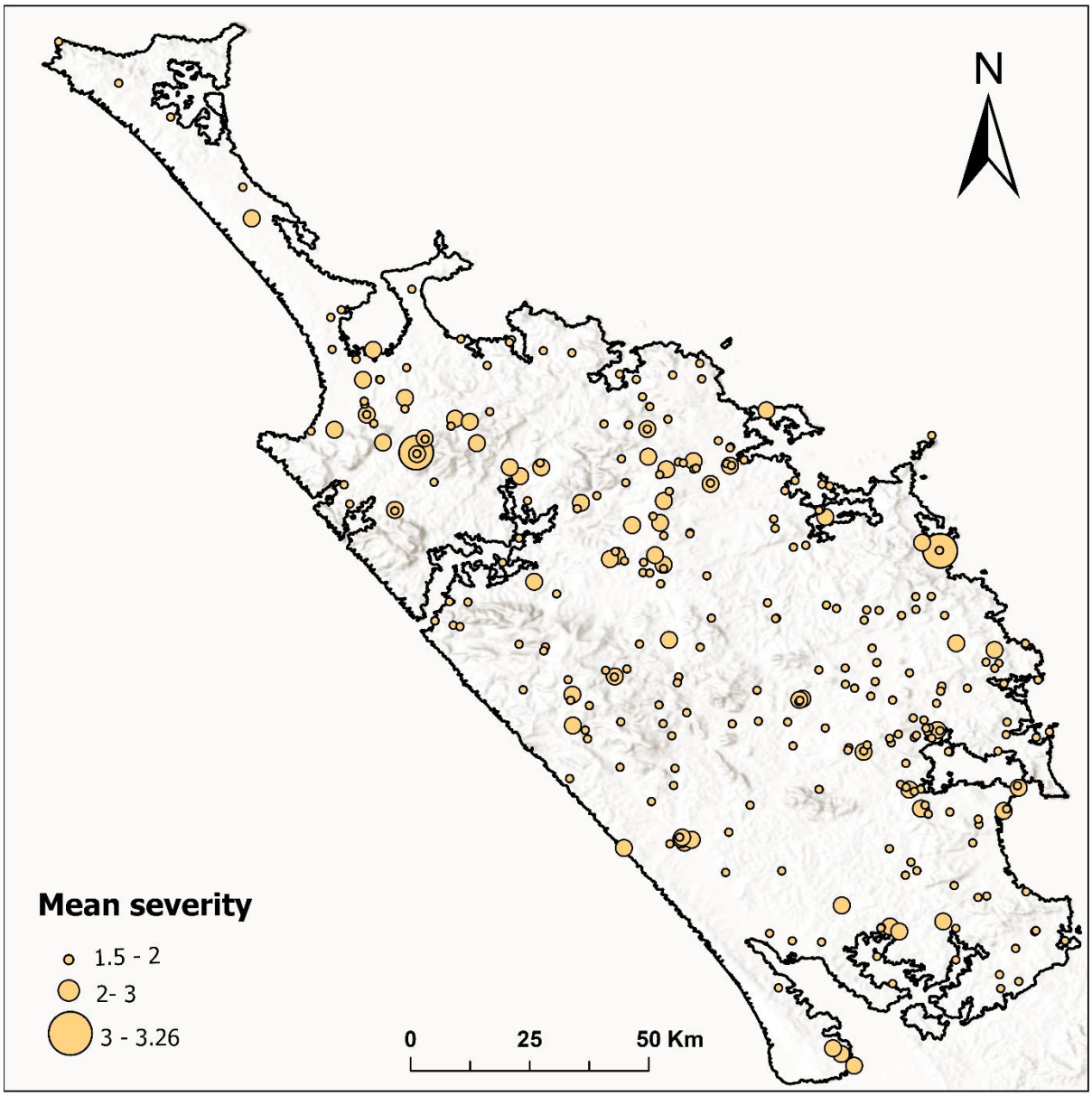

Figure 5-6: Mean drought severity S for all sites.

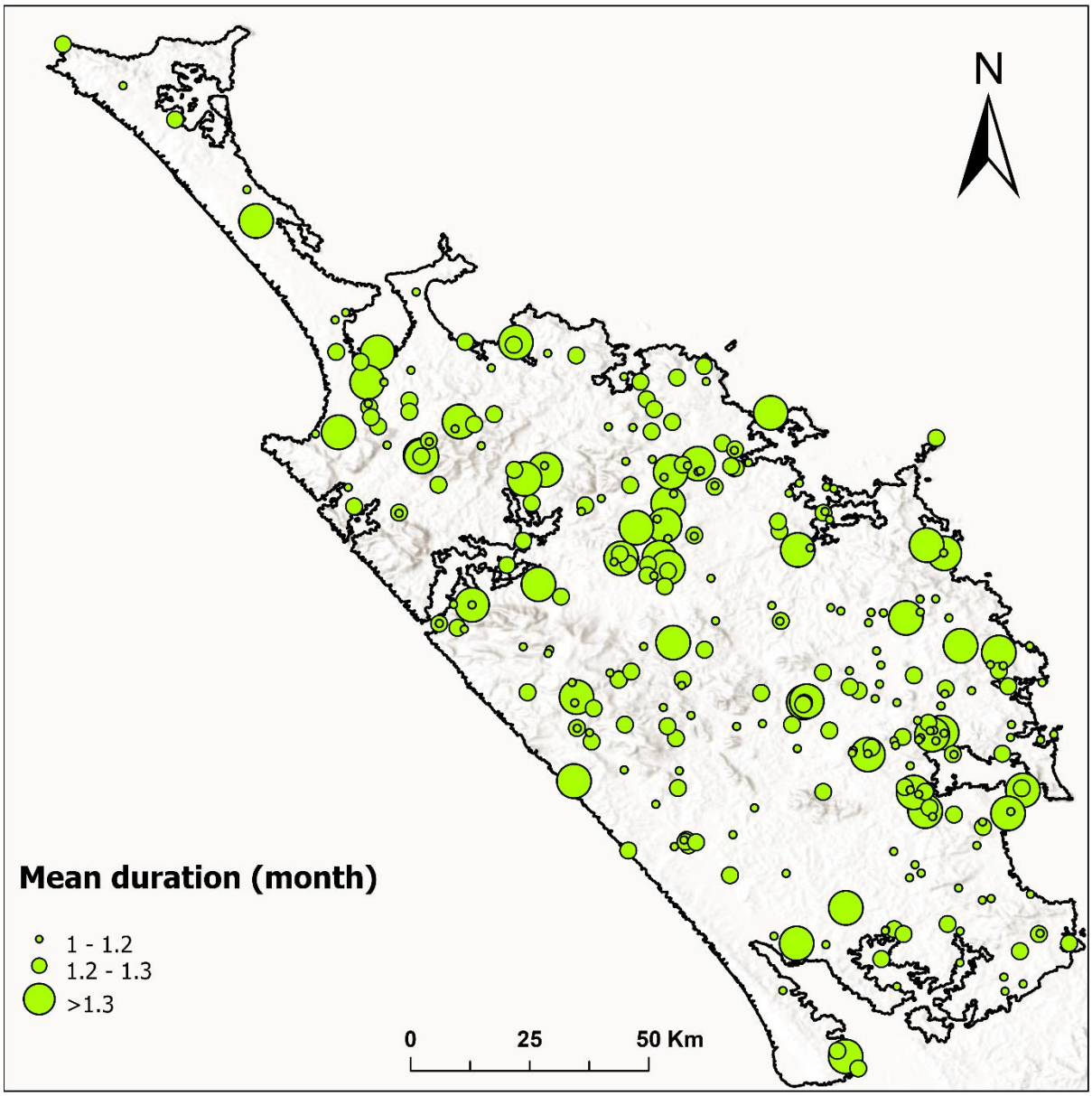

Figure 5-7: Mean drought duration D for all sites.

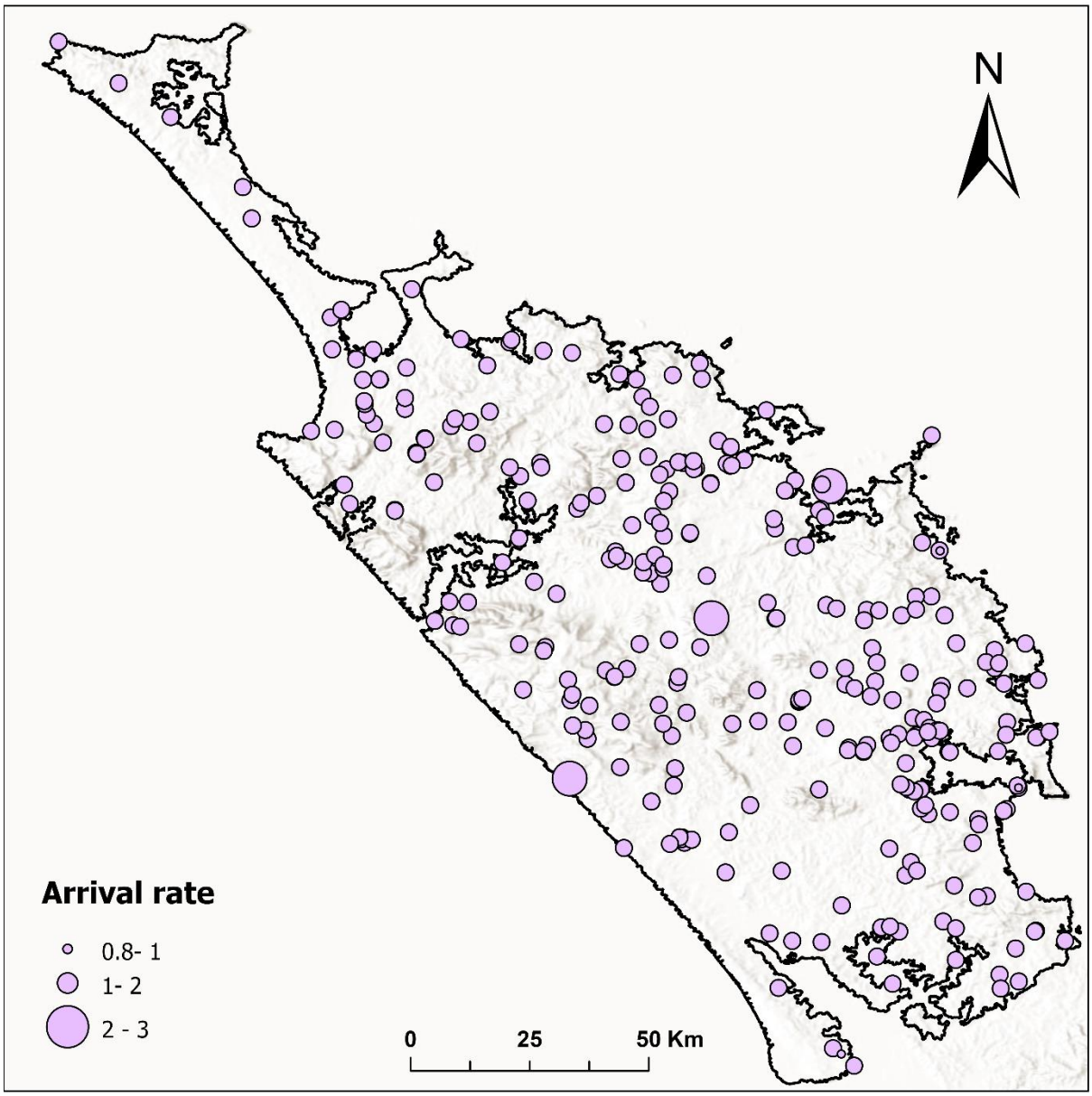

Figure 5-8: Mean arrival rate of drought for all sites.

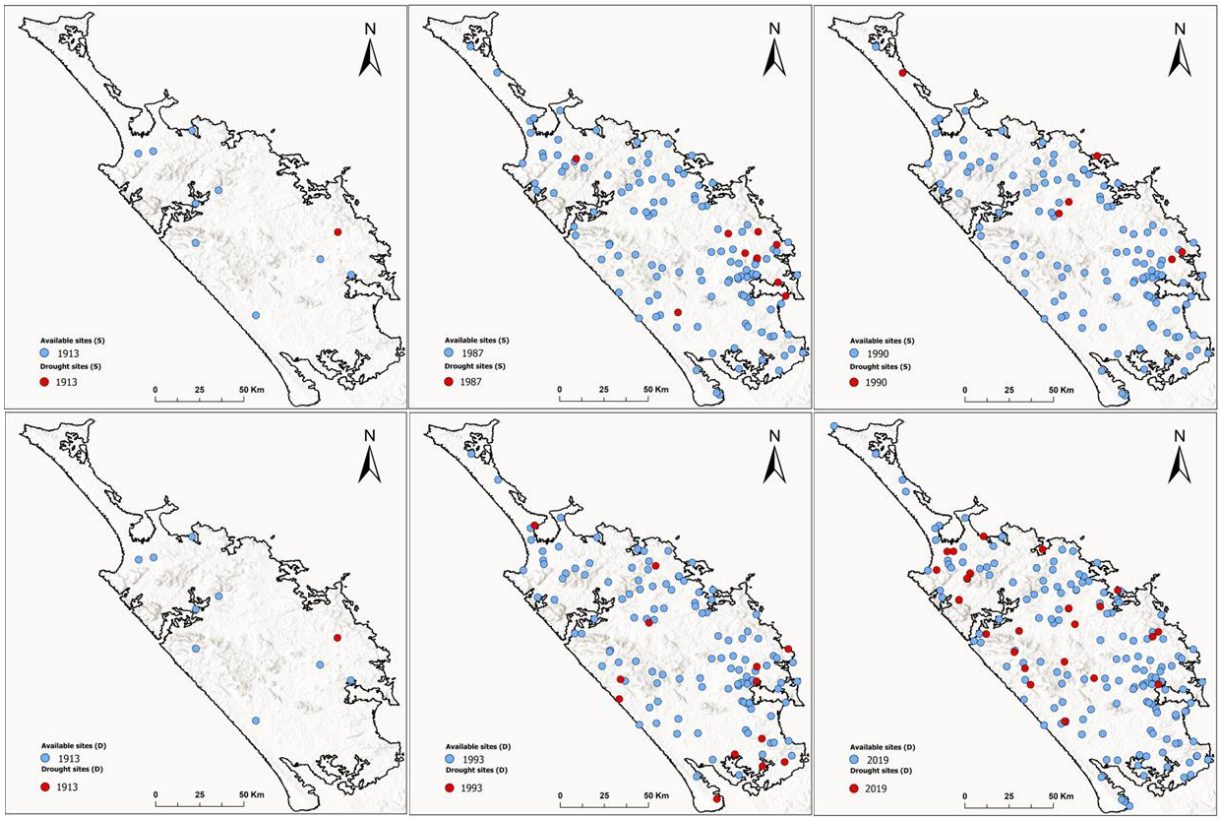

Figure 5-9: Location of sites where the three worst droughts occurred in the record based on severity. S (top) (1913, 1987, 1990) and on duration D (bottom) (1913, 1993, 2019).

Table 5-1: Representative sites for each group of sites.

Group	Gauge ID	Gauge Name
1	530202	Waipapakauri
2	530210	Awanui at Temples
3	530710	Pupuke at Giesbers
4	531501	Honeymoon Valley
5	531513	Mangonui at Mangonui
6	531715	Kaeo at Bramley (Manual)
7	532312	Takahue at Saddle Road
8	532510	Mangamuka at Mangamuka
9	532821	Maungaparerua at Tyrees Ford
10	533710	Lake Omapere at Rototiro
11	536601	Whatoro
12	537613	Kaihu at Kaiiwi Lakes (McLeod)
13	538811	Awakino at Booths
14	541001	Purerua Aws
15	542102	Russell Cws
16	543312	Oakura Bay at Te Kapua Street
17	547119	Waipao at Williams (Draffins Road)

Group	Gauge ID	Gauge Name
18	547412	Massey at Pataua
19	548101	Tangihua
20	548212	Whangarei Harbour at N.Z. Refining Co
21	549201	Waikiekie
22	640501	Waipu Cove
23	642201	Pukehau
24	643112	Tauhara at Lake Rotokawau
25	643116	Swan Lake at Bishops

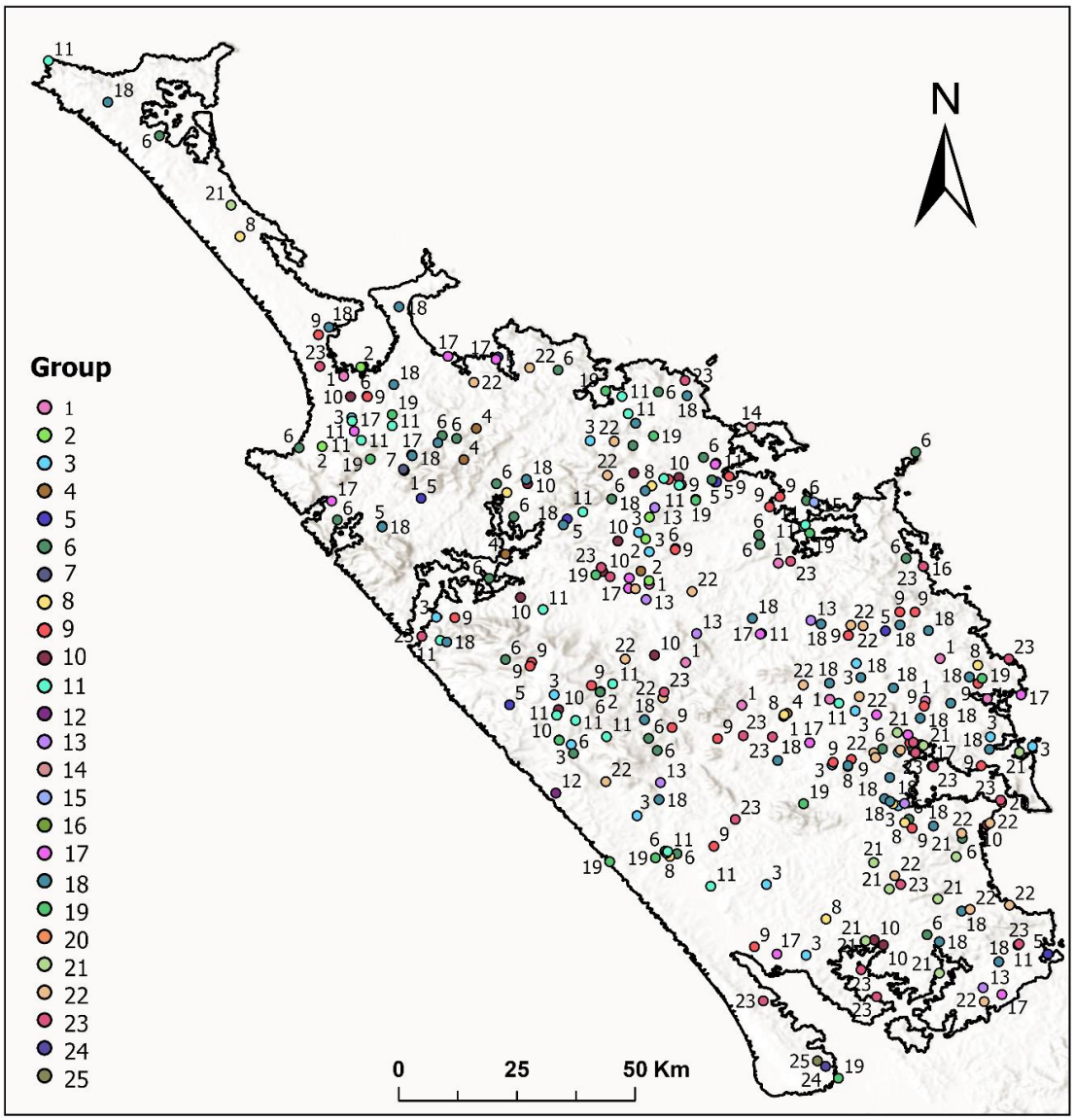

Figure 5-10: Clustering of sites by group based on mean severity, mean duration and mean arrival rate.

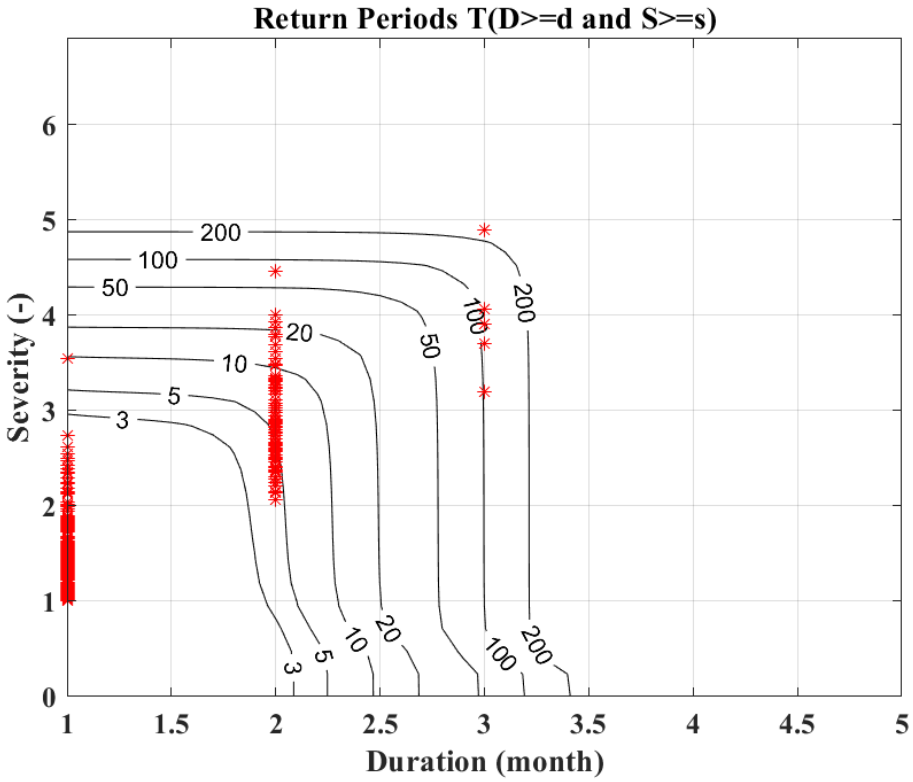

Figure 5-11: Severity duration and return period relationship for Group 1.

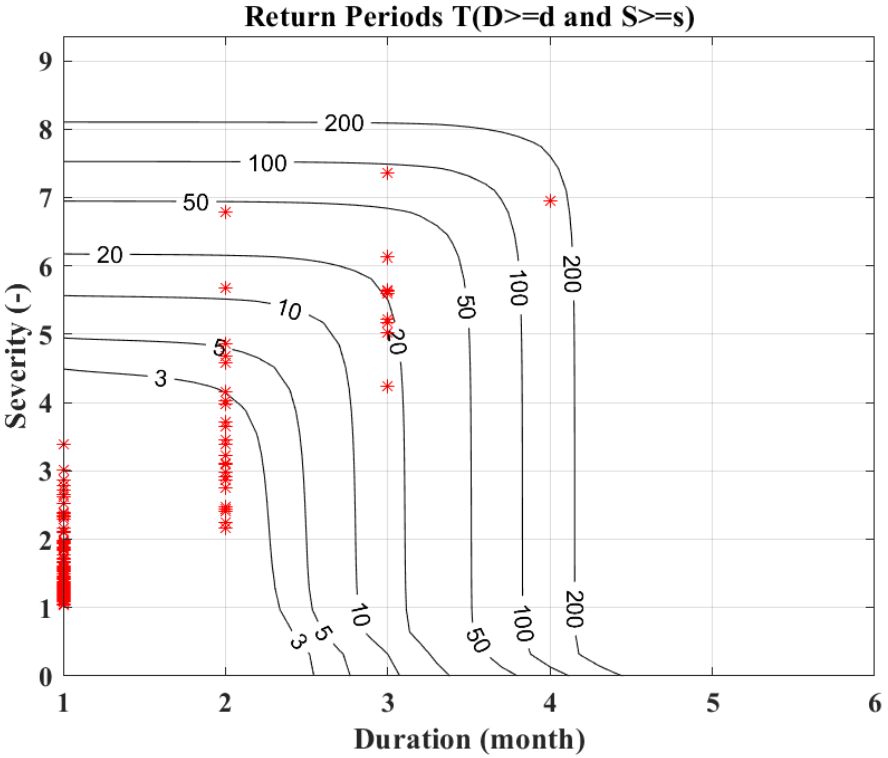

Figure 5-12: Severity duration and return period relationship for Group 2.

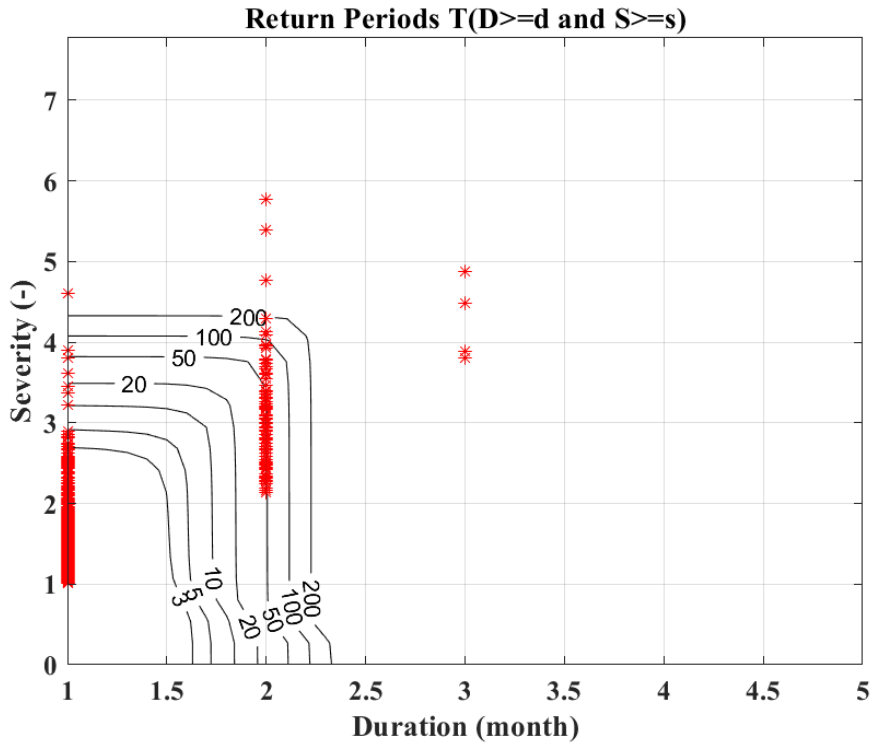

Figure 5-13: Severity duration and return period relationship for Group 3.

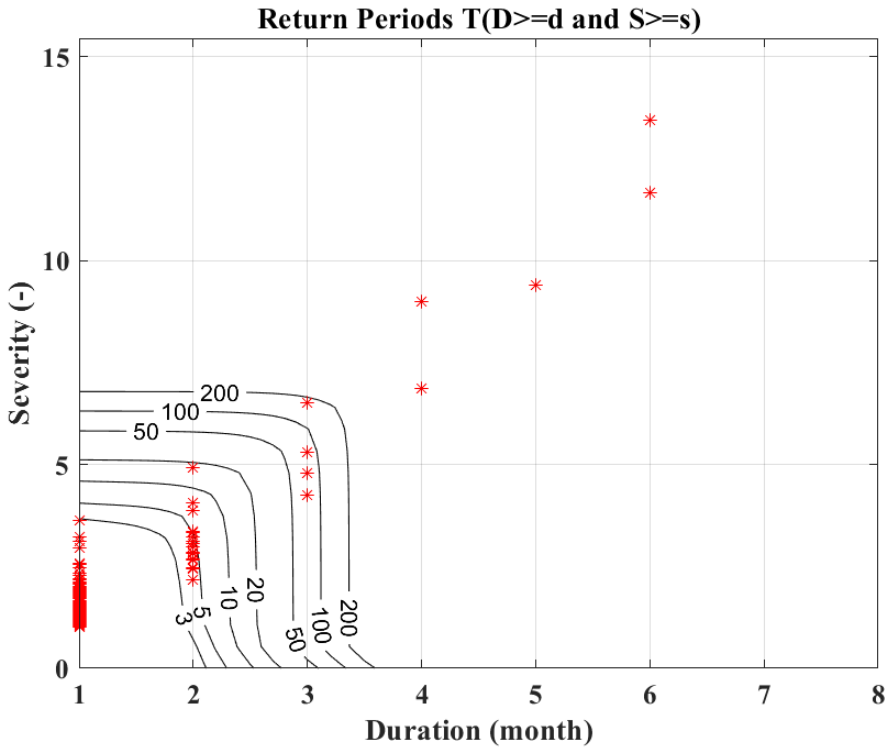

Figure 5-14: Severity duration and return period relationship for Group 4.

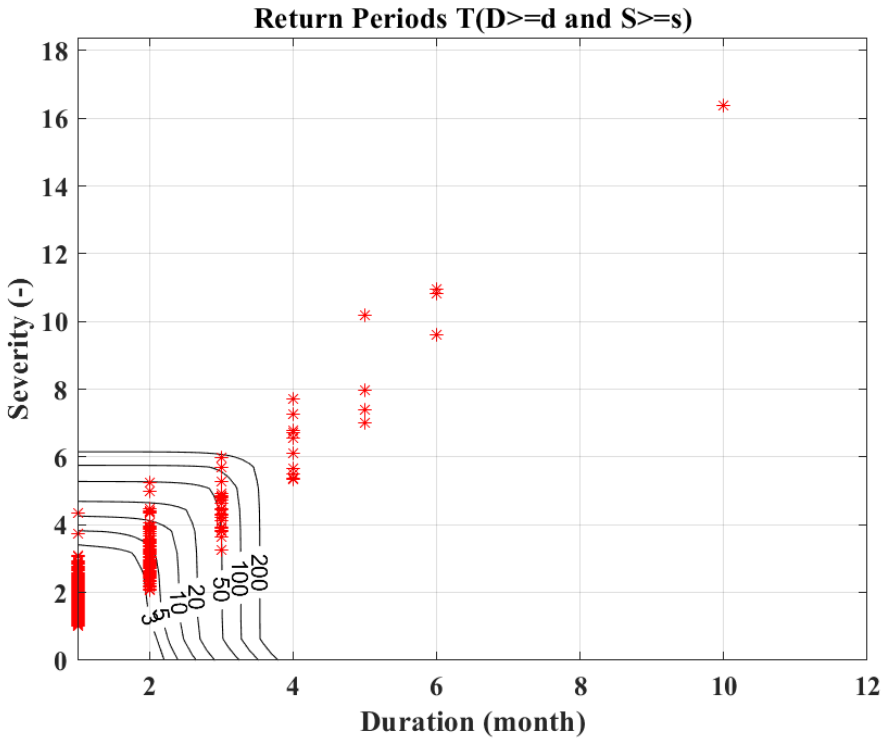

Figure 5-15: Severity duration and return period relationship for Group 5.

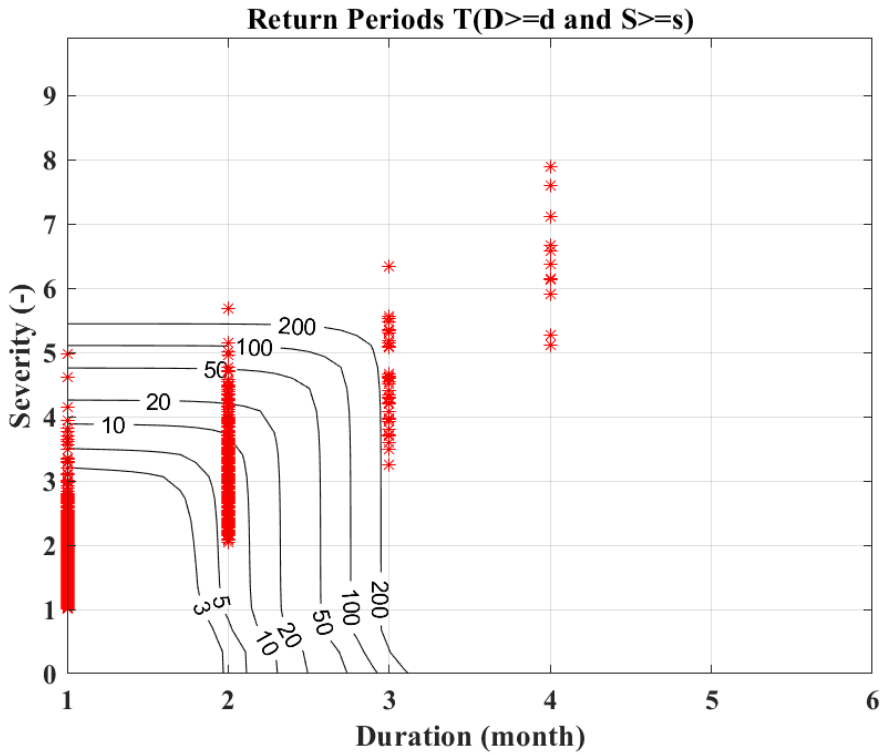

Figure 5-16: Severity duration and return period relationship for Group 6.

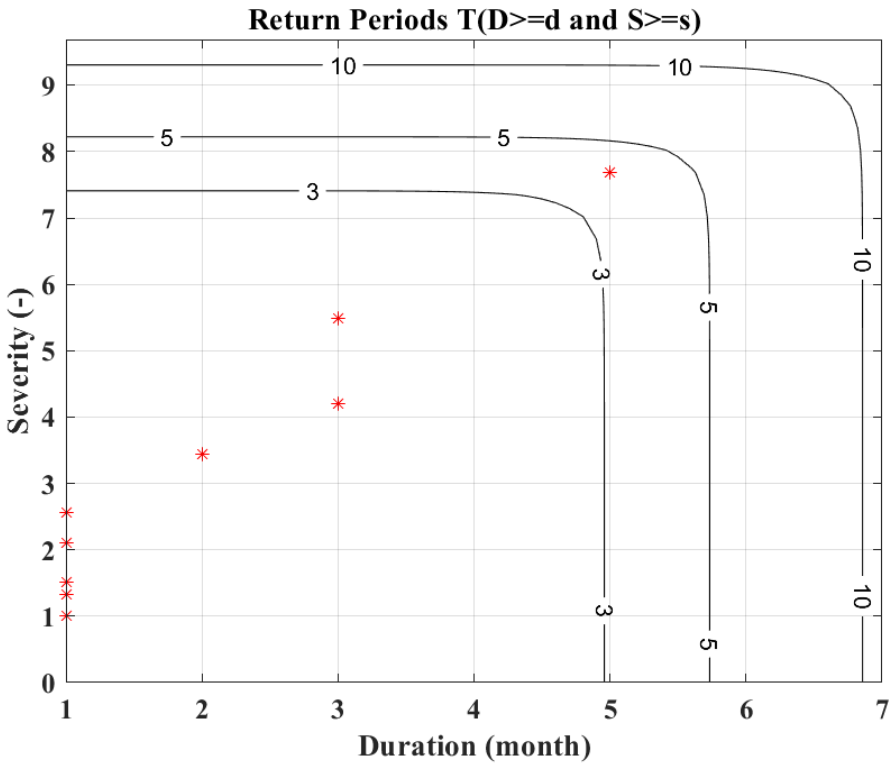

Figure 5-17: Severity duration and return period relationship for Group 7.

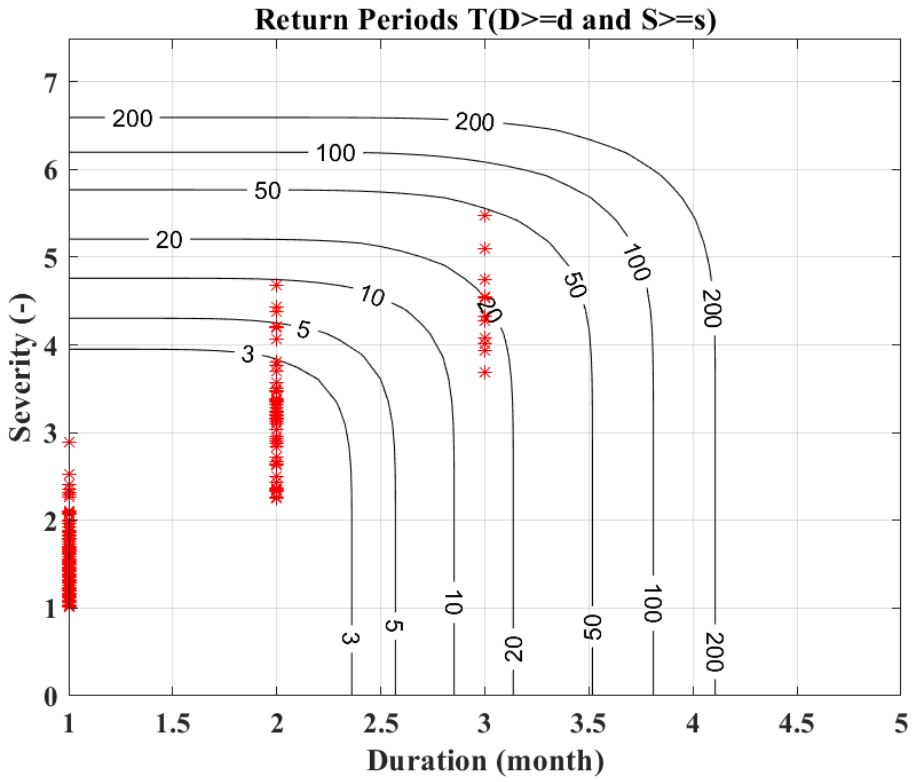

Figure 5-18: Severity duration and return period relationship for Group 8.

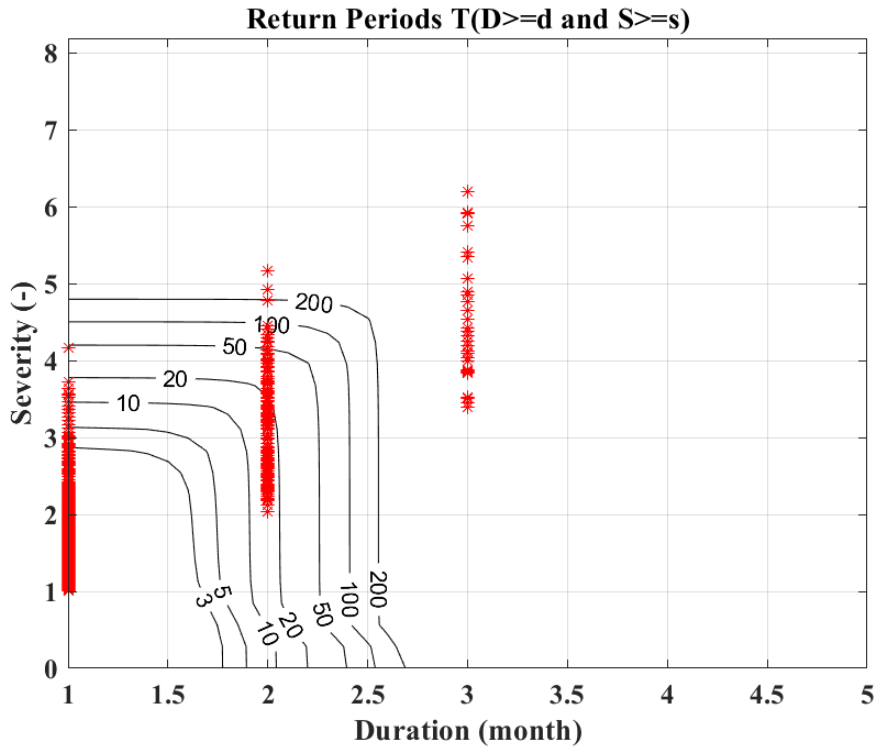

Figure 5-19: Severity duration and return period relationship for Group 9.

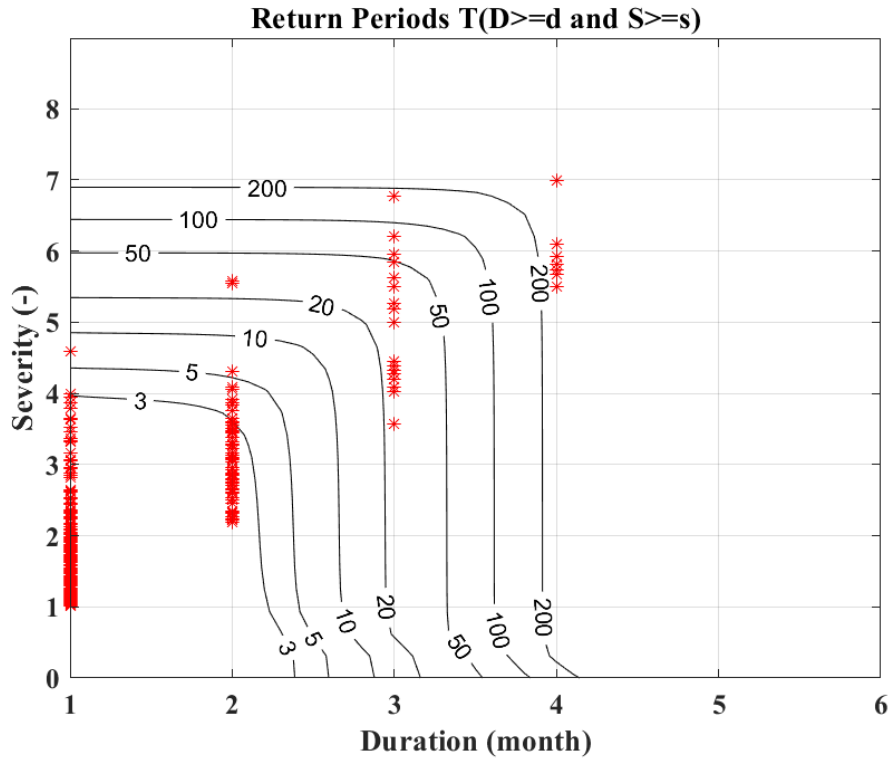

Figure 5-20: Severity duration and return period relationship for Group 10.

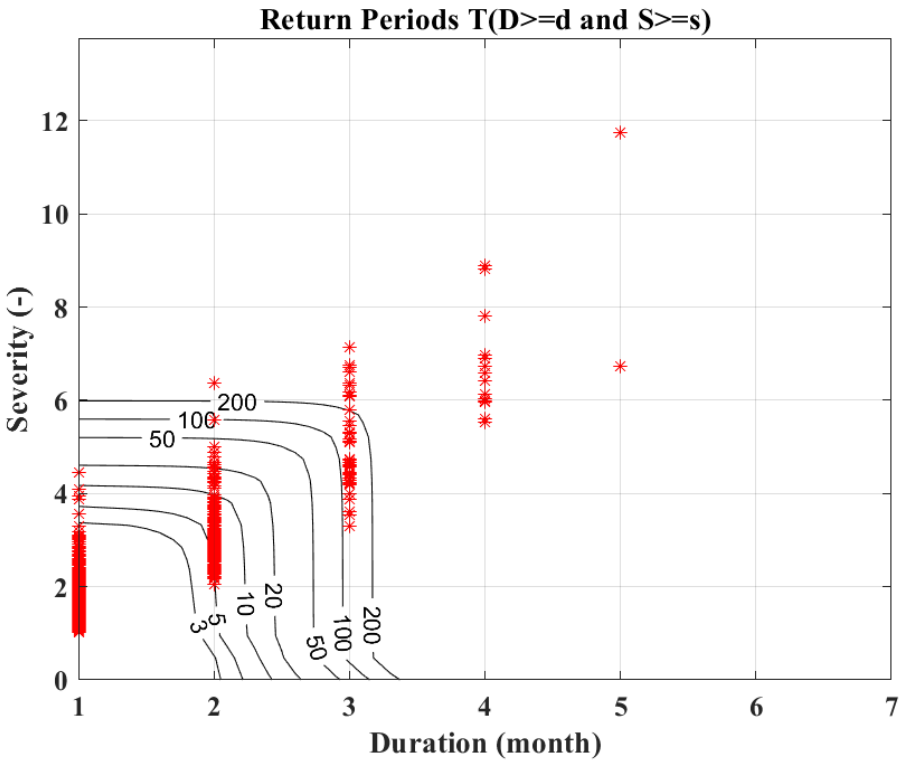

Figure 5-21: Severity duration and return period relationship for Group 11.

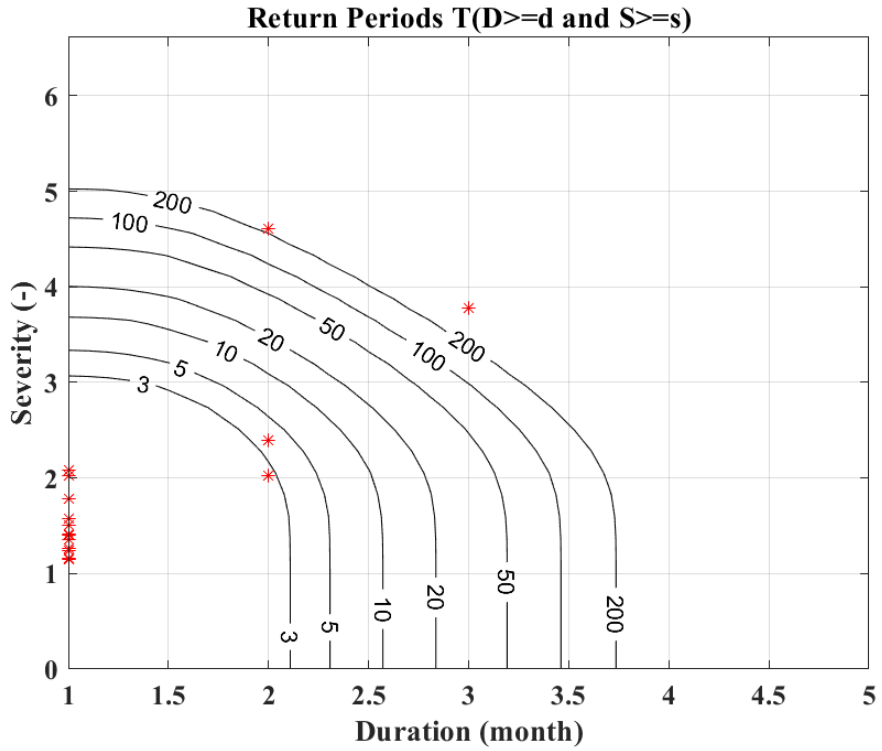

Figure 5-22: Severity duration and return period relationship for Group 12.

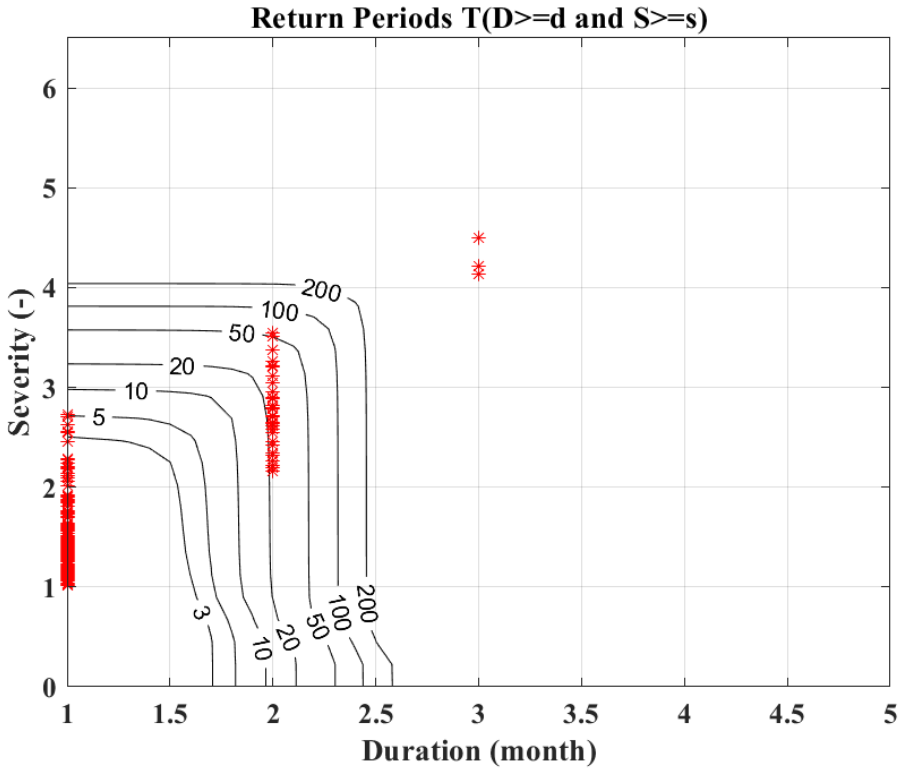

Figure 5-23: Severity duration and return period relationship for Group 13.

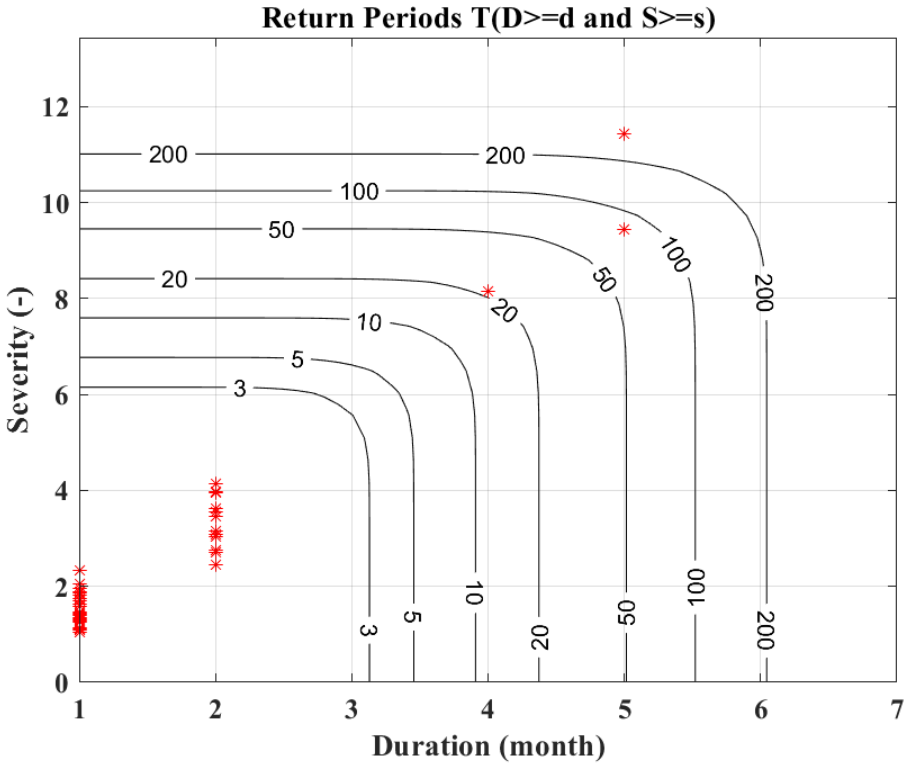

Figure 5-24: Severity duration and return period relationship for Group 14.

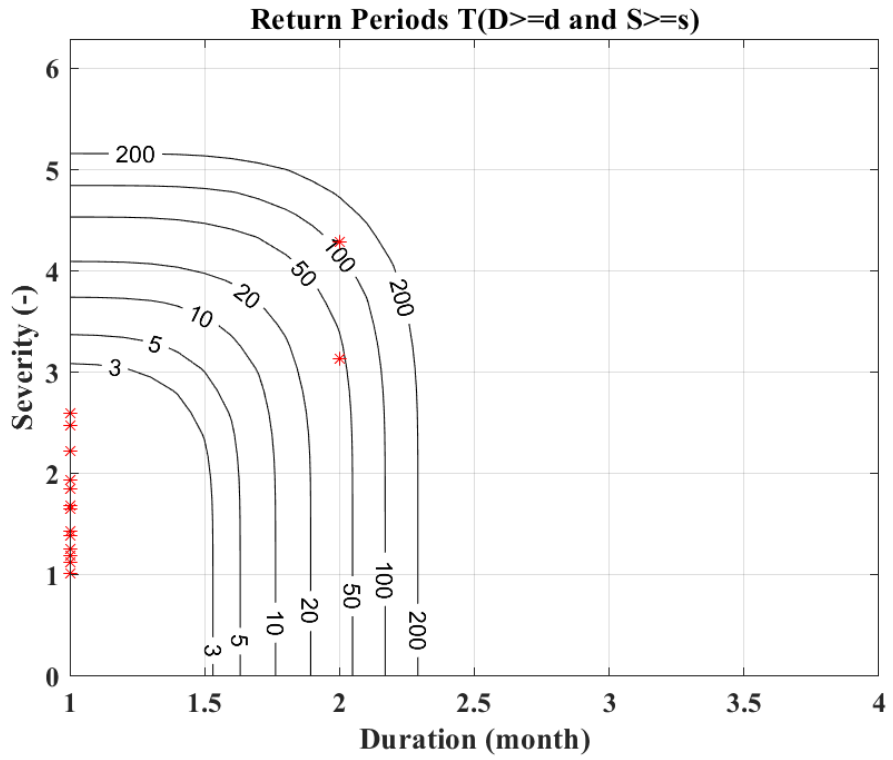

Figure 5-25: Severity duration and return period relationship for Group 15.

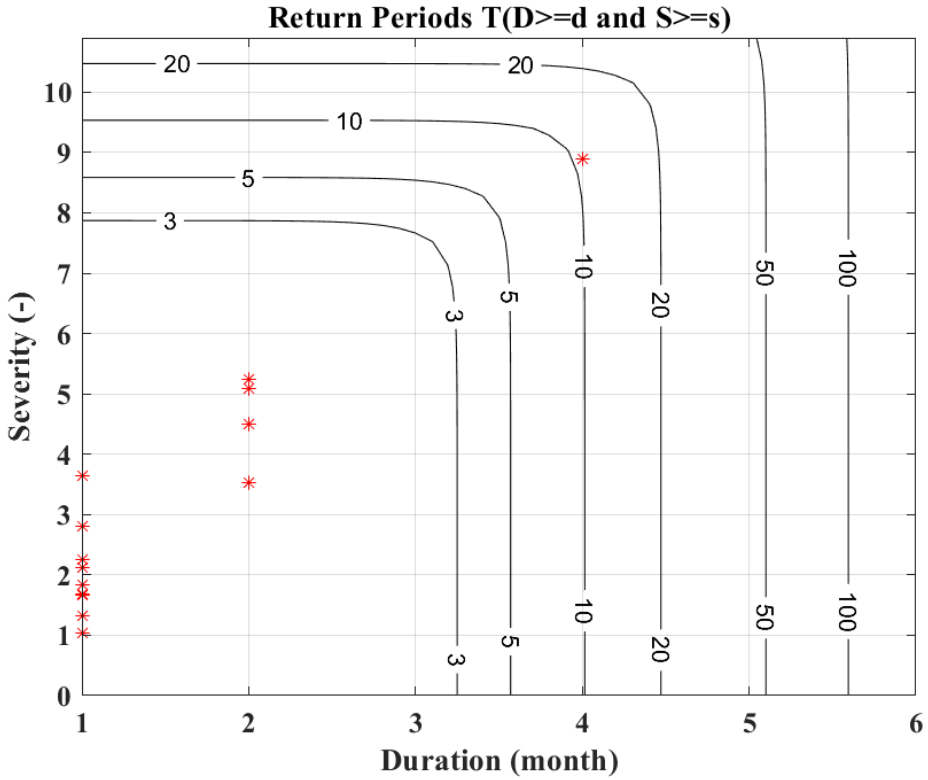

Figure 5-26: Severity duration and return period relationship for Group 16.

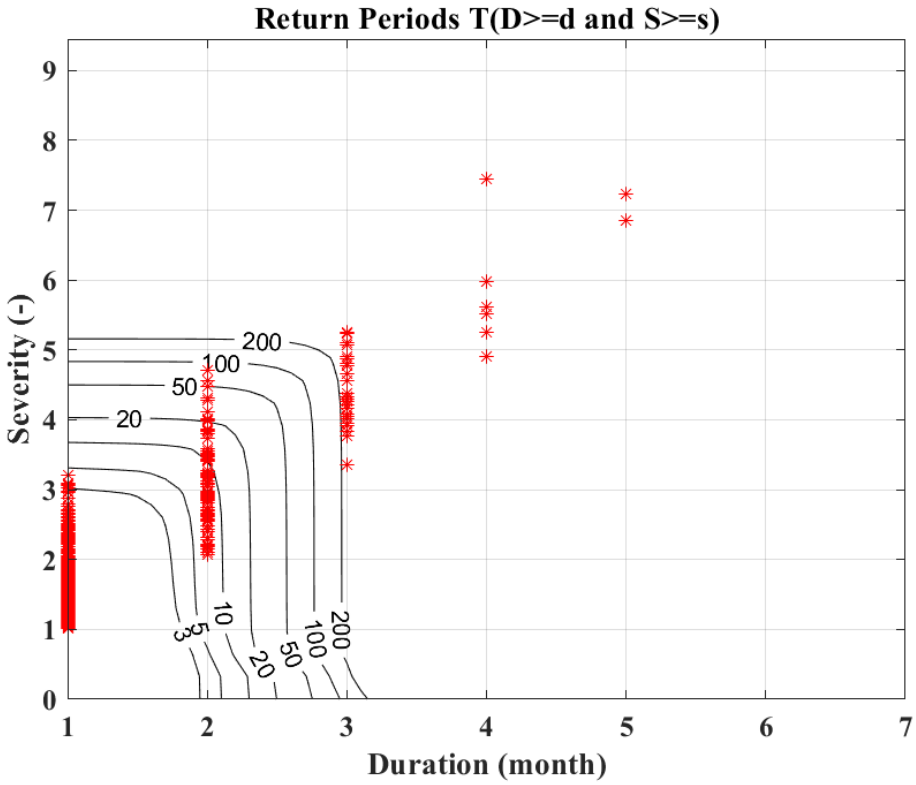

Figure 5-27: Severity duration and return period relationship for Group 17.

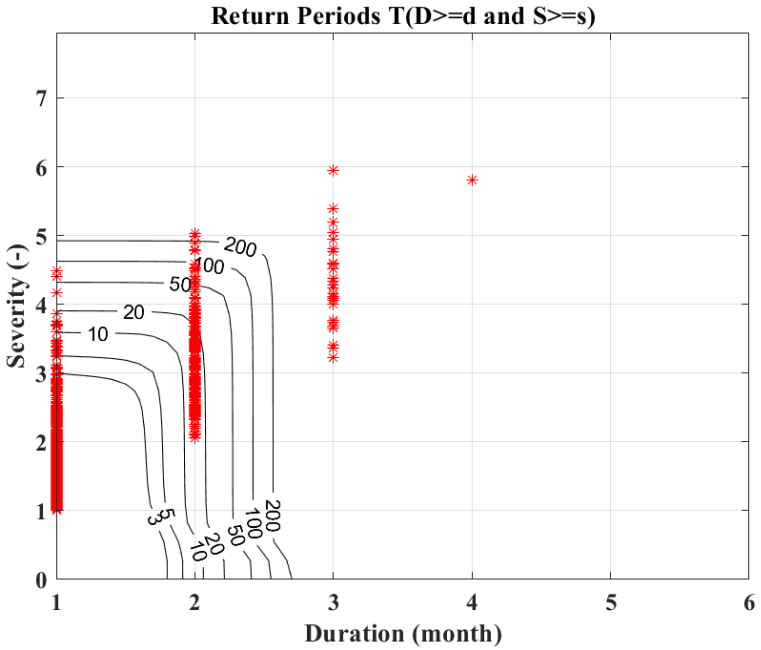

Figure 5-28: Severity duration and return period relationship for Group 18.

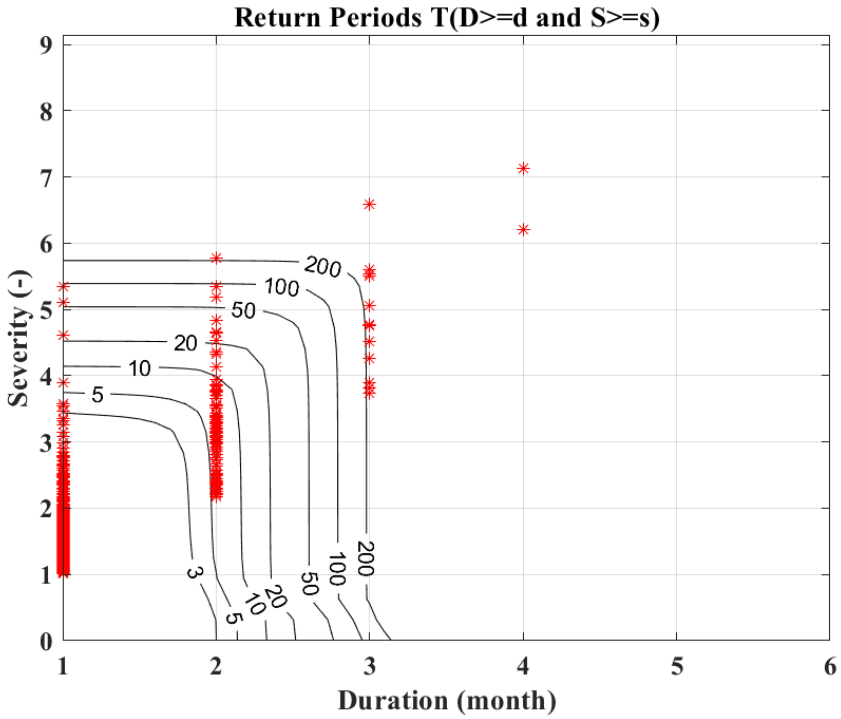

Figure 5-29: Severity duration and return period relationship for Group 19.

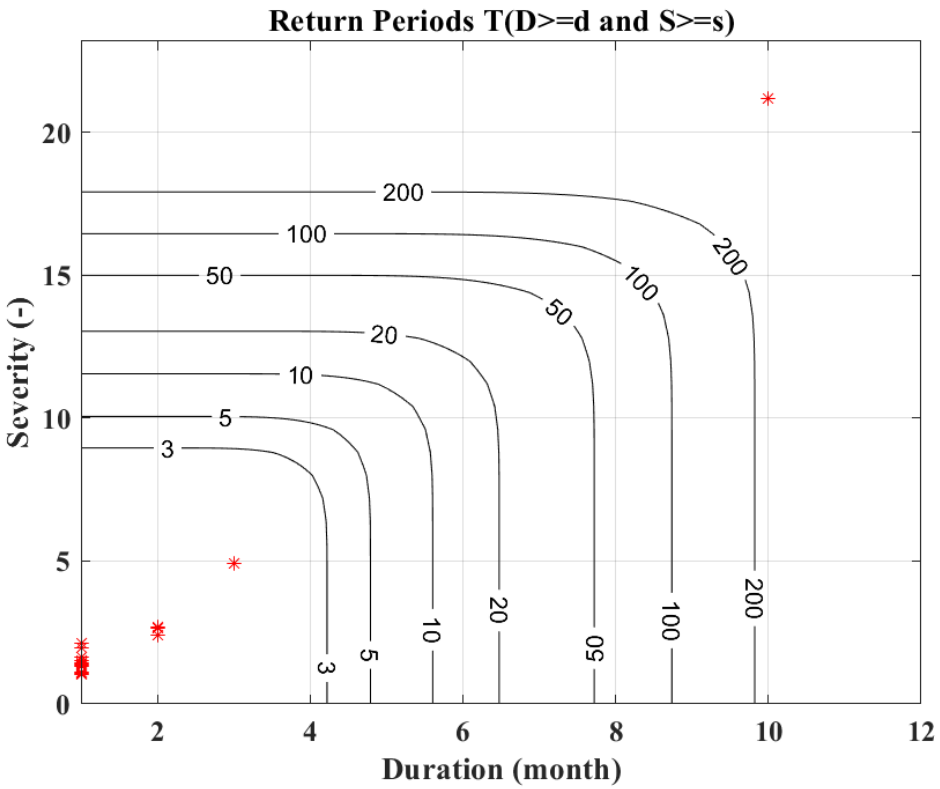

Figure 5-30: Severity duration and return period relationship for Group 20.

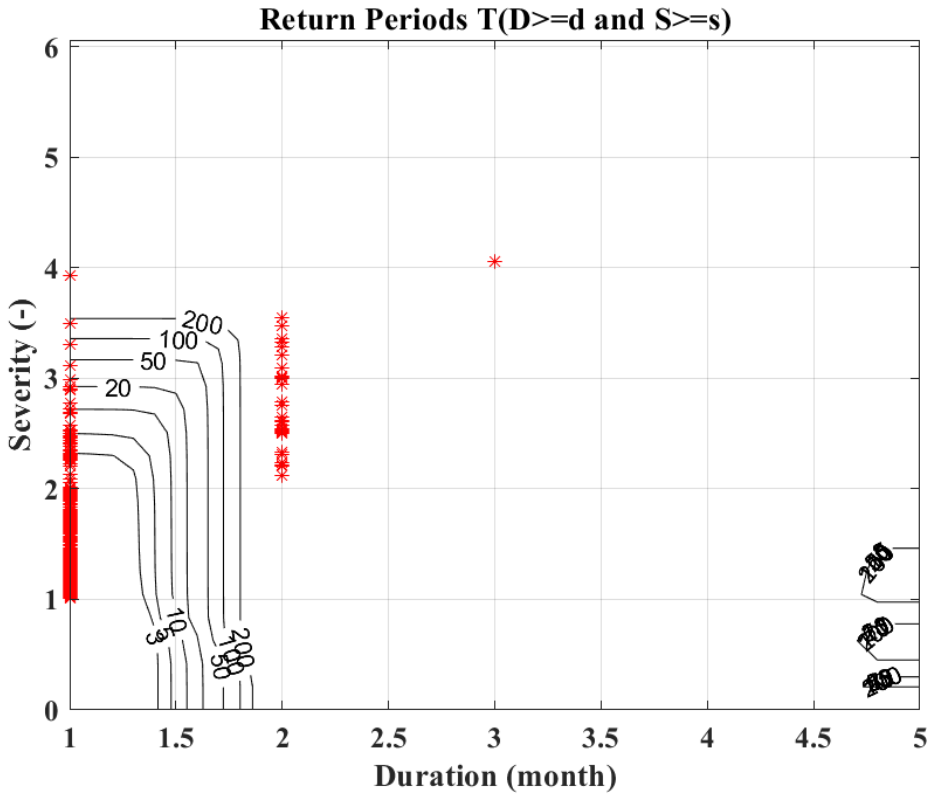

Figure 5-31: Severity duration and return period relationship for Group 21.

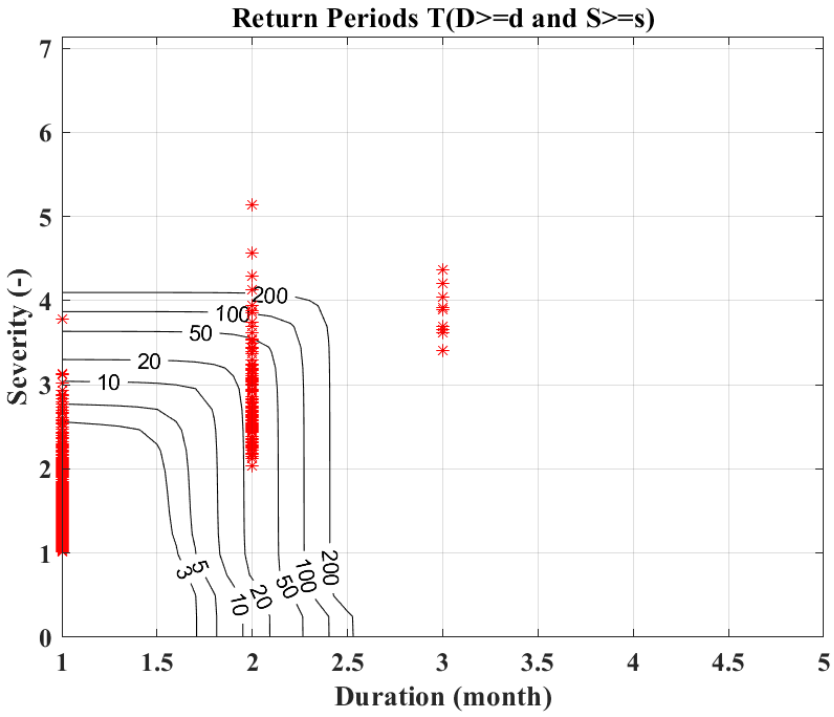

Figure 5-32: Severity duration and return period relationship for Group 22.

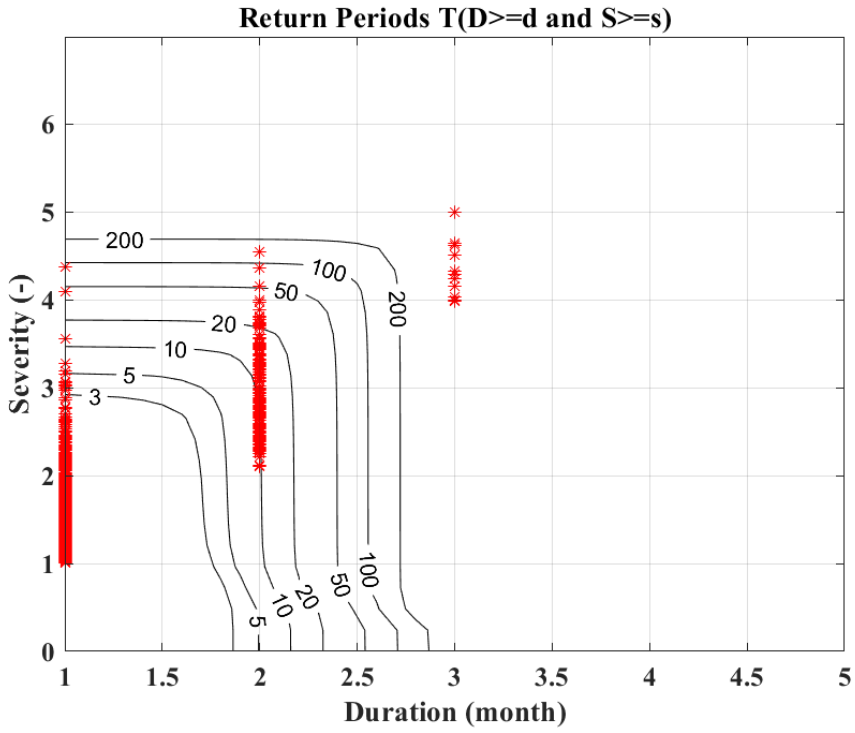

Figure 5-33: Severity duration and return period relationship for Group 23.

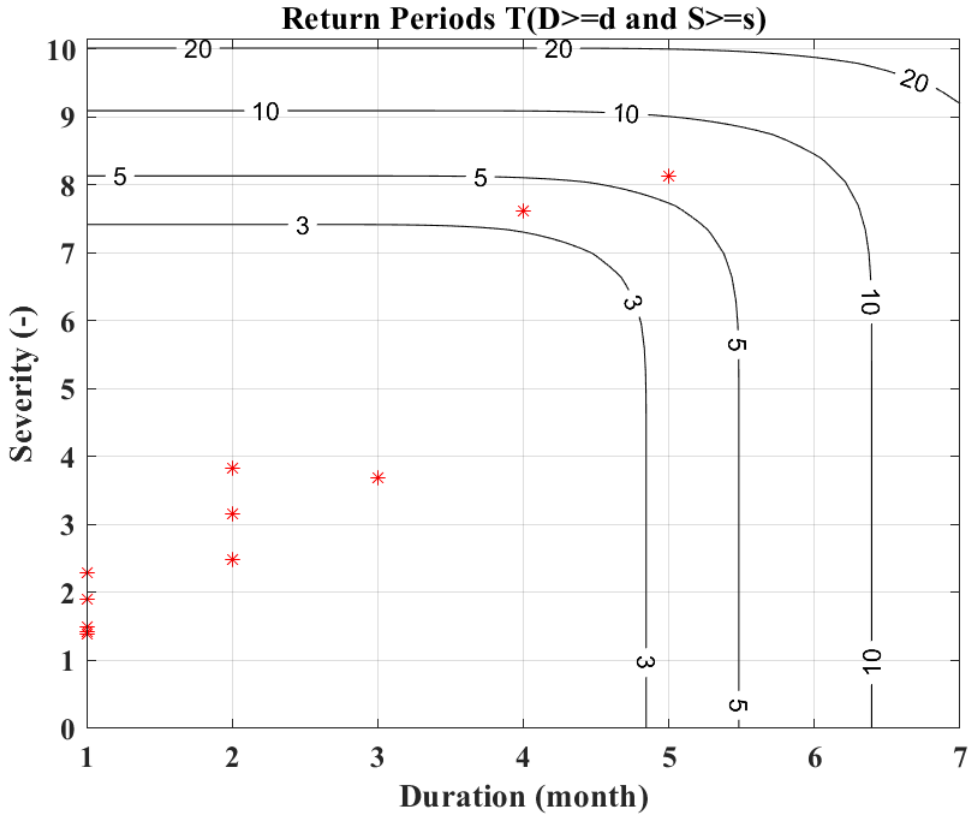

Figure 5-34: Severity duration and return period relationship for Group 24.

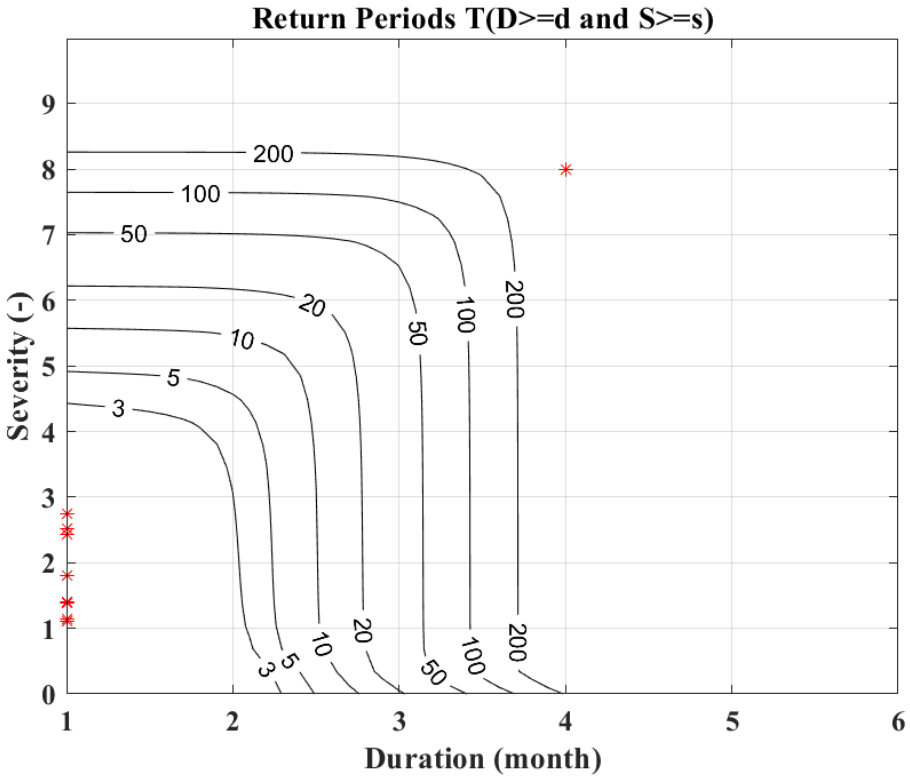

Figure 5-35: Severity duration and return period relationship for Group 25.

6 Droughts and teleconnections in Northland

Droughts in New Zealand have been a significant concern for both agricultural and environmental sectors. The recent examples of severe droughts in New Zealand (e.g., 2007, 2008 and 2010) has motivated us to investigate the atmospheric teleconnections during these periods. Understanding the drivers of drought is necessary for effective mitigation and adaptation strategies (NIWA, 2013). El Niño and La Niña, the warm and cold phases of the El Niño-Southern Oscillation (ENSO), respectively, play a key role in modulating global climate patterns, including drought occurrences (NIWA, 2022).

ENSO is the most prominent climate signal on interannual time scales, reflecting the climate variability in the tropical Pacific Ocean and the phases of El Niño and La Niña events. ENSO impacts our weather by causing alterations in air pressure, sea temperature, and wind patterns. Research has shown the strong influence of ENSO phases on drought occurrences worldwide. Understanding the complex interactions between ENSO and regional climate systems is essential for better drought prediction, preparedness, and adaptation strategies to minimize the adverse impacts of droughts.

Previous studies have shown the impact of ENSO on droughts depends on geographical locations and seasons. Seager et al (2005) found that El Niño events are associated with increased winter rainfall in the southern U.S. and decreased rainfall in the Pacific Northwest. In Australia, McBride and Nicholls (1983) analysed the relationship between ENSO and Australian rainfall, showing that El Niño events often lead to severe droughts. Saji et al. (1999) showed that the Indian Ocean Dipole (IOD) significantly affects rainfall patterns in East Africa, influencing drought and flood occurrences. Positive IOD phases are associated with increased rainfall, often leading to flooding, while negative IOD phases can link to drought. However, Meyers et al. (2007) studied the influence of the IOD on Australian climate and concluded that positive phases lead to reduced winter and spring rainfall in southern Australia bringing drought conditions in the region.

Figure 6-1 and Figure 6-2 show typical Australasian and Southwest Pacific barometric pressure patterns for El Niño and La Niña respectively.

In New Zealand, an El Niño episode during summer can result in increased westerly winds, heightened rainfall in western regions, and dry conditions in the east. In winter, it may lead to the prevalence of cooler southerly winds. During an La Niña phase, New Zealand experiences more north-easterly winds, greater precipitation in northern and eastern areas, and elevated sea levels. This phase can also bring warmer-than-average air and sea temperatures.

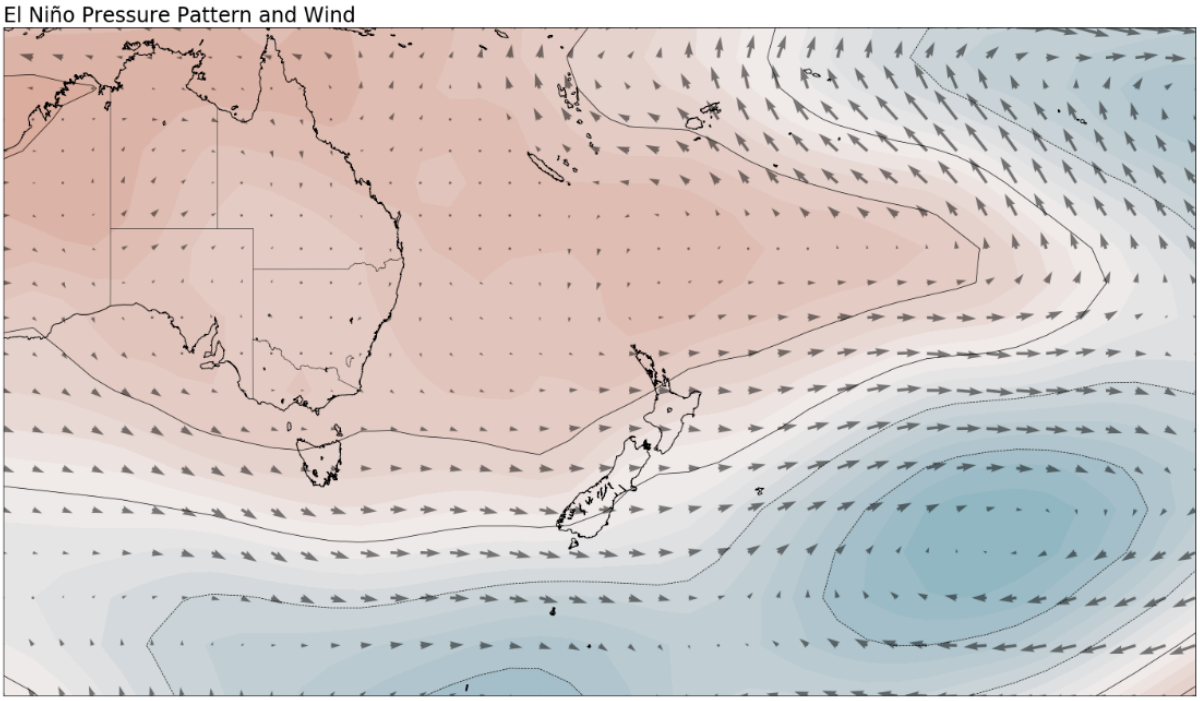

Figure 6-1: A composite, or average, of the summer pressure and wind pattern during four different El Niño events. Areas of above normal pressure are shaded in red while areas of below normal pressure are shaded in blue. [NIWA / data: NCEP].

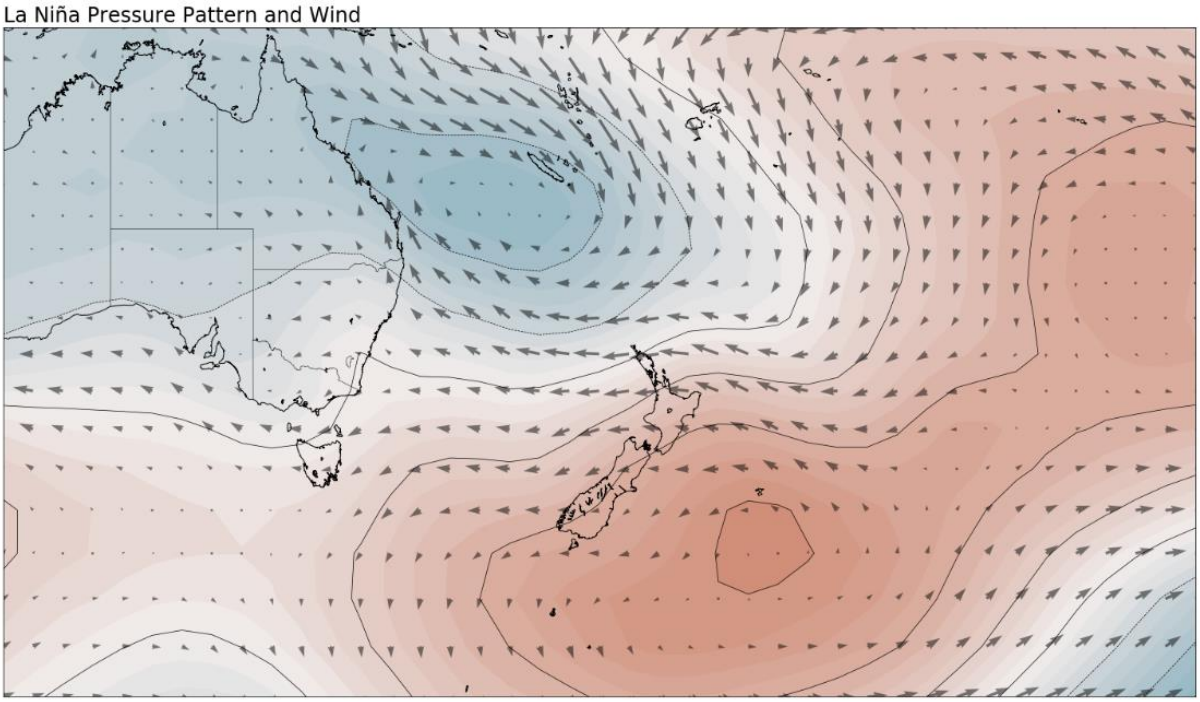

Figure 6-2: A composite, or average, of the summer pressure and wind pattern during four different La Niña events. Areas of above normal pressure are shaded in red while areas of below normal pressure are shaded in blue. [NIWA / data: NCEP].

The southern oscillation index (SOI) is another metric used to monitor ENSO events. It measures the difference in air pressure between Tahiti in the eastern Pacific and Darwin in northern Australia. A

sustained positive SOI value can indicate La Niña, while a sustained negative value can indicate El Niño (Figure 6-3).

The southern annular mode (SAM), also known as the Antarctic oscillation (AAO), is a climate variability pattern that describes the north-south movement of the westerly winds and atmospheric pressure anomalies over the Southern Hemisphere. It plays a significant role in influencing weather and climate patterns in the southern latitudes. The SAM index is typically calculated based on pressure differences between the mid-latitudes and high latitudes. A negative phase typically causes increased westerlies, unsettled weather, and storms in New Zealand. A phase can last several weeks, but changes can be rapid and unpredictable. The SAM has been increasing (becoming more positive) since 1970. However, the period 1887–2005 exhibited long-term oscillations, so we expect to observe increasing and decreasing phases. Over this period, SAM had an indeterminate trend at the 95 percent confidence level.

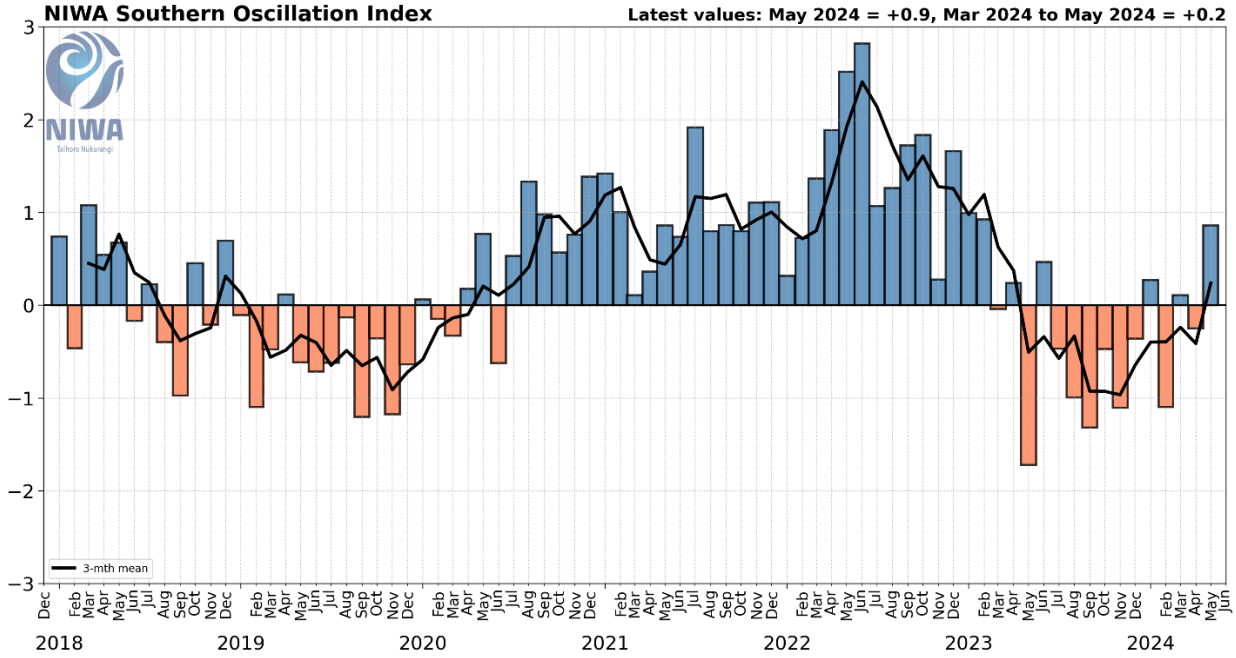

Figure 6-3: Monthly southern oscillation index (Jan 2018 – Jun 2024).

The Pacific decadal oscillation (PDO) is a long-term climate pattern characterised by variations in sea surface temperatures and atmospheric pressure over the North Pacific Ocean. The PDO has two phases: positive and negative.

A positive PDO phase is characterised by warmer sea surface temperatures in the central and eastern Pacific Ocean. In New Zealand, a positive PDO is often associated with increased westerly winds and more rainfall on the western side of the country. This can lead to wetter conditions, potentially increasing the risk of flooding. Additionally, a positive PDO may result in cooler temperatures in parts of New Zealand. Conversely, a negative PDO phase is characterised by cooler sea surface temperatures in the central and eastern Pacific. During a negative PDO phase, New Zealand tends to experience more settled weather conditions with decreased westerly winds. This can lead to drier conditions in some regions, potentially contributing to drought risks.

Sections 6.1 and 6.2 cover the relationships between climate indices and Northland drought severity and duration respectively. As mentioned in Section 3.3, drought severity and duration are not

independent as severe drought normally lasts a long time. This is shown for the Northland data in Figure 6-4.

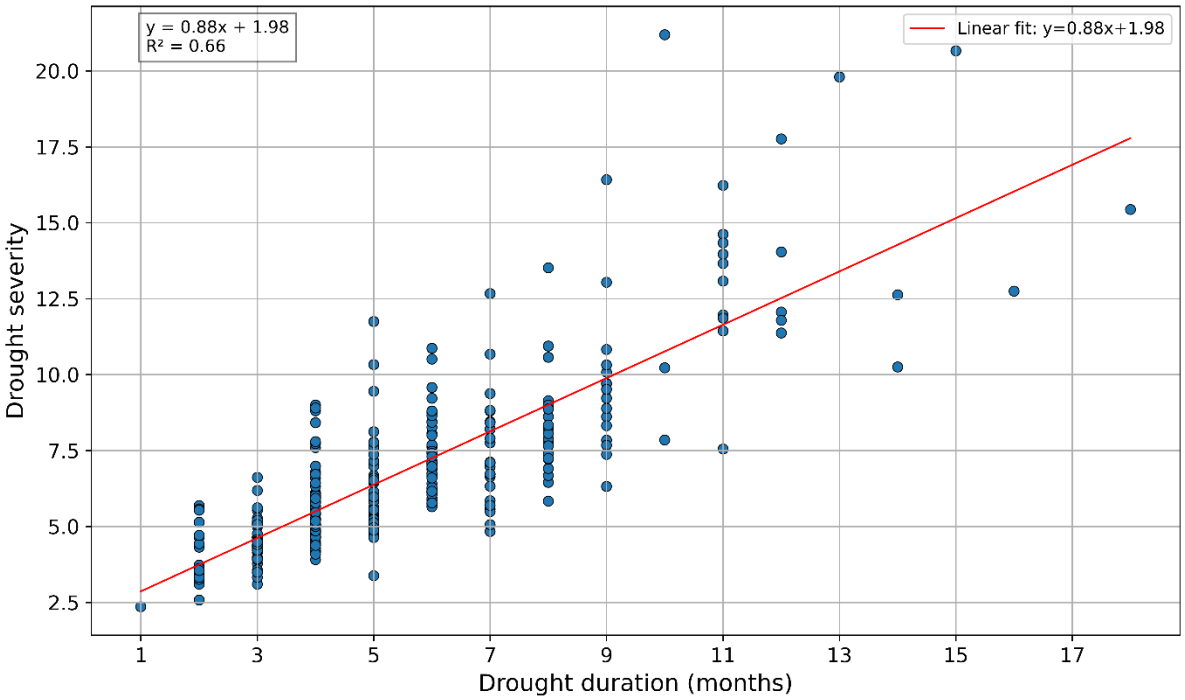

Figure 6-4: The relationship between Northland drought severity and drought duration.

6.1 The relationship between climate indices and drought severity

The observed associations between severe droughts in Northland and various climatic phenomena raise critical questions and offer valuable insights into the dynamics of drought in the region.

The strong connection between negative monthly Southern Oscillation Index (SOI) values and drought events highlights the influence of ENSO on Northland's drought patterns. Negative SOI values are typically indicative of El Niño conditions, which are known to bring drier weather to many parts of the world, including New Zealand. This suggests that when El Niño is in play, the risk of severe drought in Northland is significantly heightened (Figure 6-5).

Moreover, the increased severity of droughts during El Niño years, with 82% of highly severe droughts occurring in such periods, underscores the impact of this climate phenomenon on exacerbating drought conditions. El Niño is characterized by warmer-than-average sea surface temperatures in the central and eastern tropical Pacific Ocean, leading to altered weather patterns. These patterns can result in reduced rainfall and prolonged dry spells, contributing to the intensification of drought events.

The association between positive monthly oceanic ‘Niño 3.4’ values and 64% of severe droughts indicates that Northland's climate can also be influenced by La Niña, the contrasting phase of ENSO (Figure 6-6). La Niña typically leads to wetter conditions in some regions, and the positive Niño 3.4 values suggest a propensity for increased rainfall during such periods. This variation in the impact of different ENSO phases underscores the complexity of New Zealand's climate system.

The Pacific decadal oscillation (PDO) adds another layer of complexity to Northland's drought dynamics. While many severe droughts align with negative PDO values, the most severe drought

events coincide with positive PDO values (Figure 6-7). This suggests that the relationship between PDO and drought severity is not straightforward and may involve intricate interactions with other climatic factors.

In the broader context, these teleconnections, while significant, are only a part of the equation when it comes to understanding and predicting drought events. Northland's unique topography, local climate variability, and other regional influences also contribute to the region's drought risk. The challenge lies in deciphering how these complex factors interplay and identifying the specific conditions that lead to severe droughts in Northland.

This study underscores the importance of continued research and monitoring of Northland's climate and drought patterns. The insights gained from such investigations are crucial for enhancing early warning systems, developing robust drought preparedness strategies, and ultimately mitigating the impacts of severe drought events in the region. Additionally, these findings contribute to our broader understanding of how global and regional climate phenomena influence local weather patterns and climatic extremes.

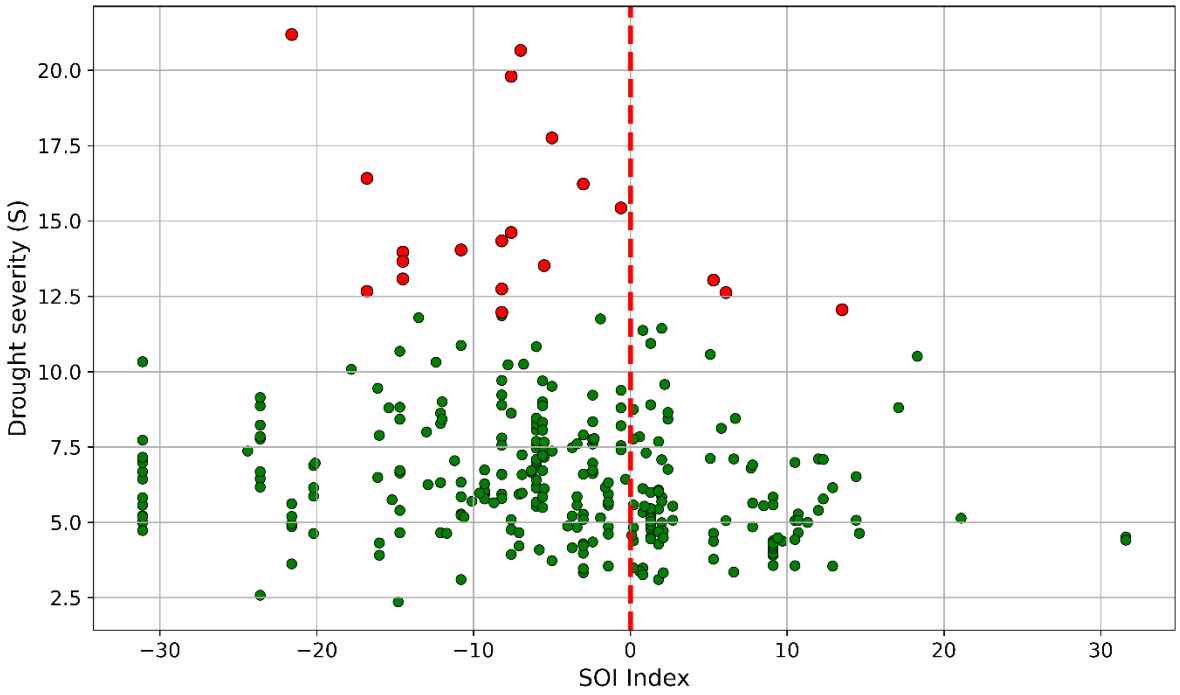

Figure 6-5: Monthly Southern Oscillation Index (SOI) during drought events in Northland region. The red markers show the top 20 most severe events.

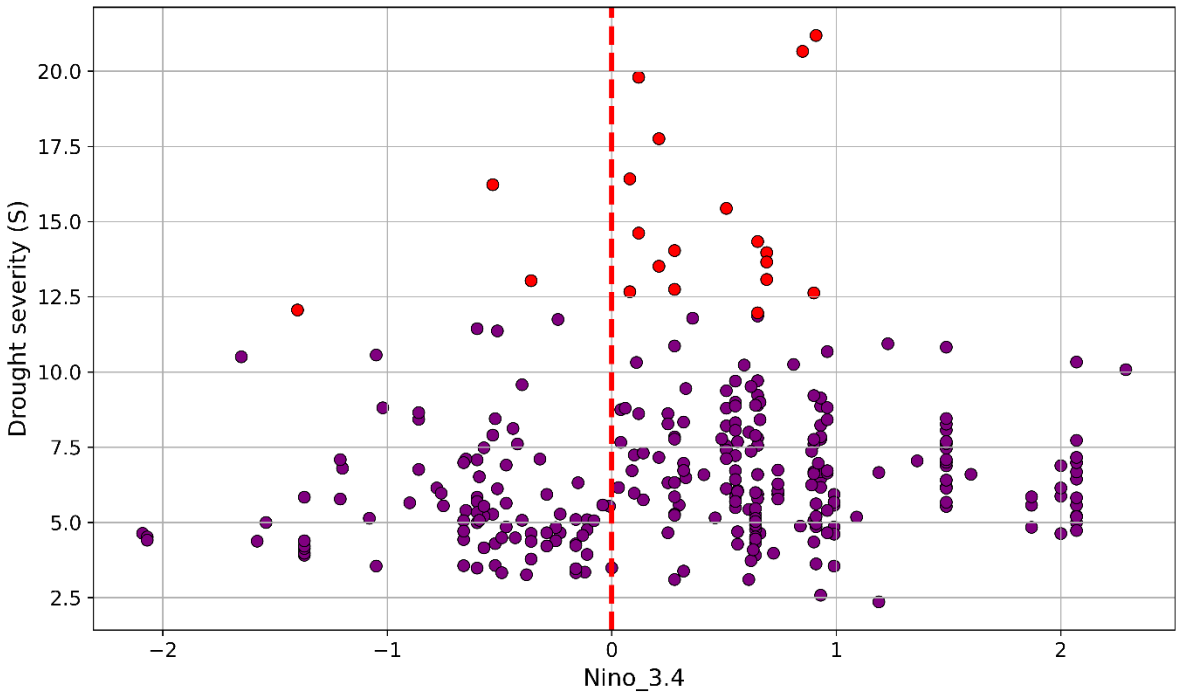

Figure 6-6: Monthly Niño 3.4 index during drought events in Northland region. The red markers show the top 20 most severe events.

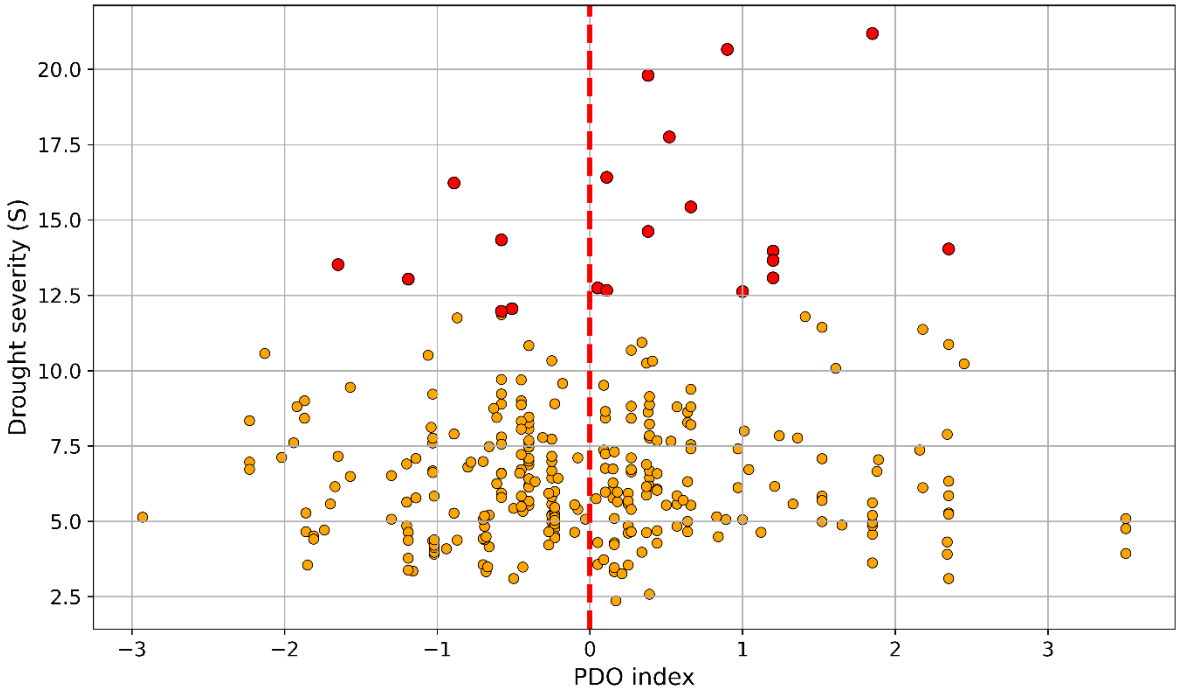

Figure 6-7: Monthly Pacific Decadal Oscillation (PDO) index during drought events in Northland region. The red markers show the top 20 most severe events.

6.2 The relationship between climate indices and drought duration

We also looked at the relationship between the climate indices and drought duration. Similar to drought severity, drought events can happen during both negative and positive phases. However, looking at the events with duration more than 12 months clearly shows that they are often associated with negative values of SOI index (Figure 6-8) and positive values of Niño_3.4 and PDO indices (Figures 6-9 and 6-10).

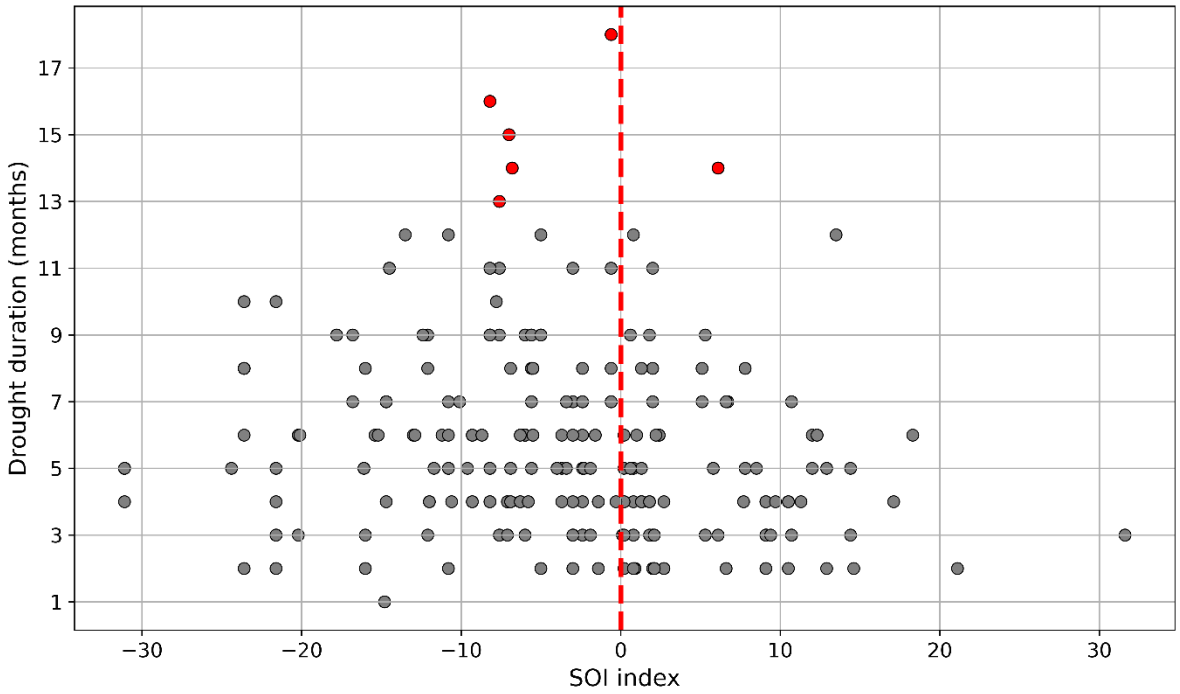

Figure 6-8: Monthly Southern Oscillation Index (SOI) versus drought duration in Northland region.

The red markers show the events with duration more than 12 months.

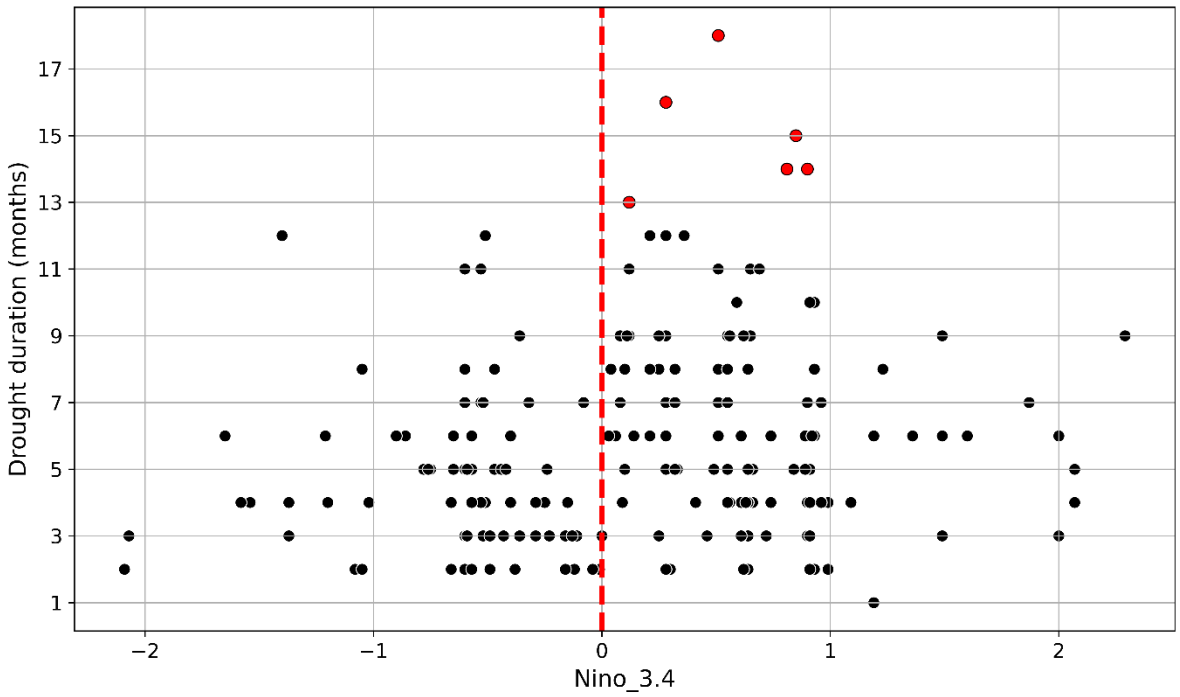

Figure 6-9: Monthly Niño 3.4 index versus drought duration in Northland region. The red markers show the events with duration more than 12 months.

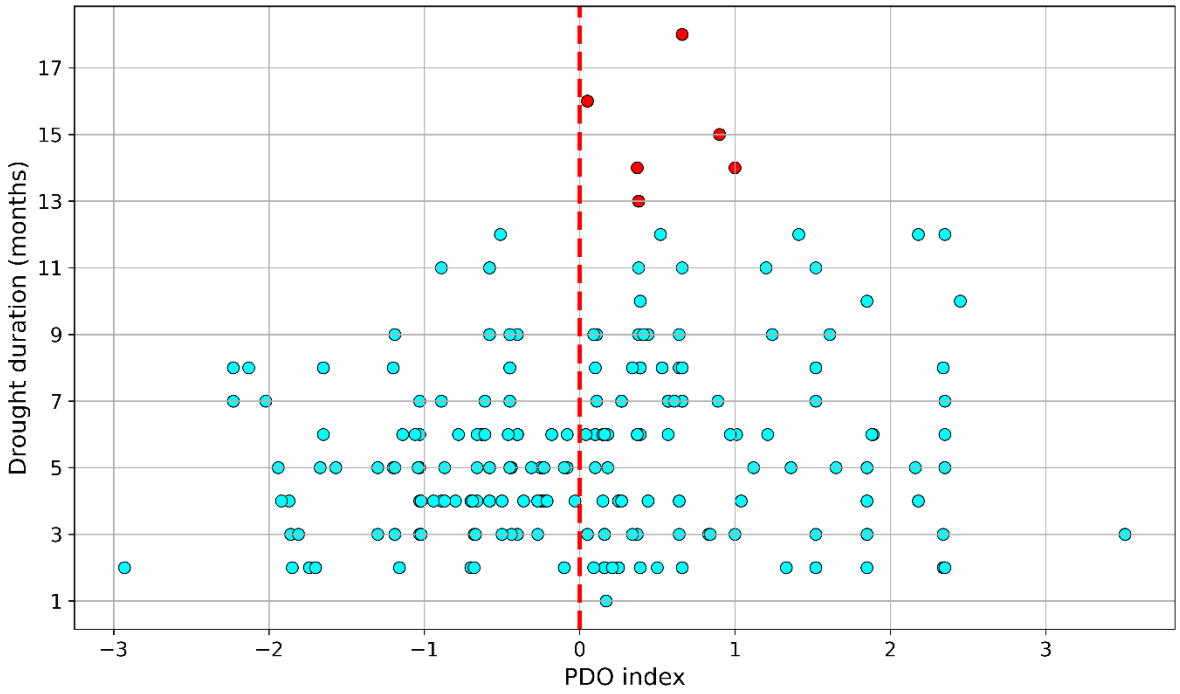

Figure 6-10: Monthly Pacific Decadal Oscillation (PDO) index versus drought duration. The red markers show the events with duration more than 12 months.

7 Recommendations for future work

Our recommendations which NRC may wish to consider include:

- Monitoring of possible or probable drought conditions and indications of trend (temporal and spatial) using the online New Zealand Drought Monitor (NIWA). The monitor employs SPI and other drought indices including potential evapotranspiration and soil moisture deficits.
- Drought management planning which incorporates climate change projections and implications given for example in NIWA (2016).
- Seeking an improved climatological understanding of drivers of long-term drought occurrence and the effects of persistence.
- Teleconnections can influence New Zealand's climate and contribute to drought events; however, they are just one component of a complex set of factors that can lead to drought conditions. We recommend a more thorough investigation should focus on local climate variabilities, topography, and other regional influences in shaping the weather patterns and drought risk during drought events.
- This study has focused on event-based droughts for each site. However, phenomena such as the Pacific Decadal Oscillation (PDO) can influence drought patterns over decadal scales. Long time series are necessary to capture these oscillations and understand their impacts. They provide the foundation for detecting trends, improving predictive models, and developing effective management strategies to mitigate the impacts of droughts.

8 Conclusions

The following conclusions may be derived from this study:

- The cause of droughts and their persistence can only be described broadly at present.
- Severity-duration-return period relationships determined at all sites can be used in design and planning for drought management.
- The worst year in the record for monthly drought was 1993 when nearly 40% of all sites were affected.
- Based on severity alone the worst drought occurred in 1987 at Whangarei Harbour at N.Z. Refining Co and had a duration of 10 months.
- Based on duration alone the maximum recorded drought duration is 18 months which occurred at Russell.
- Based on severity alone the three worst drought years were (in order of worst to third worst) 1987, 1913 and 1990.
- Based on duration alone the three worst drought years were (in order of worst to third worst) 2019, 1993 and 1913.
- No consistent temporal or spatial trends in drought occurrence are apparent.
- Severity-duration relations and severity-duration-return period relations are not spatially dependent that is, they cannot be locally grouped or zoned geographically. In other words, there are no persistent drought prone areas and where droughts of different severity, duration and return period may occur in the Northland region at any site and any time.
- Sixty-five percent (65%) of severe droughts in Northland are coincident with negative values of monthly SOI index.
- About 82% of droughts with severity more than 10 are associated with negative monthly SOI and they occur during El Niño years. Out of the top 20 most severe droughts, 17 are all associated with El Niño years and negative monthly SOI.
- Sixty-four percent (64%) of severe droughts in Northland are associated with positive monthly Niño 3.4.
- Fifty-six per cent (56%) of severe droughts are during the months with negative PDO; however, the top five most severe droughts are coincident with positive monthly PDO.
- In terms of duration all the identified drought events with duration more than 12 months are associated with positive values of PDO and Niño 3.4 indexes as well as negative values of SOI index (except for one event) showing the impact of these phases on longest drought events in Northland.

9 Acknowledgements

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10 References

Ali, G., Tetzlaff, D., Soulsby, C., McDonnell, J.J., Capell, R. (2012) A comparison of similarity indices for catchment classification using a cross-regional dataset. *Advances in Water Resources*, 40: 11-22.

Bodenhofer, U., Kothmeier, A., Hochreiter, S. (2011) APCluster: An R package for affinity propagation clustering. *Bioinformatics*, 27(17): 2463-2464.

Cai, W., Zhang, Y., Chen, Q., Yao, Y. (2015) Spatial Patterns and Temporal Variability of Drought in Beijing-Tianjin-Hebei Metropolitan Areas in China. Advances in Meteorology, 2015: 14. DOI:10.1155/2015/289471.

Chappell, P.R. (2013) The climate and weather of Northland. NIWA Science and Technology Series 59, 40 pp.

Chen, L., Singh, V.P., Guo, S., Mishra, A.K., Guo, J. (2012) Drought analysis using copulas. *Journal of Hydrologic Engineering*, 18(7): 797-808.

Cherubini, U., Luciano, E., Vecchiato, W. (2004) Copula methods in finance. John Wiley & Sons.

Clausen, B., Pearson, C. (1995) Regional frequency analysis of annual maximum streamflow drought. *Journal of Hydrology*, 173(1-4): 111-130.

Dalezios, N.R., Loukas, A., Vasiliades, L., Liakopoulos, E. (2000) Severity-duration-frequency analysis of droughts and wet periods in Greece. *Hydrological Sciences Journal,* 45(5): 751-769.

Frey, B.J., Dueck, D. (2007) Clustering by passing messages between data points. science, 315(5814): 972-976.

Ganguli, P., Ganguly, A.R. (2016) Space-time trends in US meteorological droughts. Journal of Hydrology: *Regional Studies*, 8: 235-259.

Gilbert, R.O. (1987) Statistical methods for environmental pollution monitoring. John Wiley & Sons.

Halwatura, D., Lechner, A.M., Arnold, S. (2015a) Drought severity–duration–frequency curves: a foundation for risk assessment and planning tool for ecosystem establishment in post-mining landscapes. *Hydrological Earth System Science,* 19(2): 1069-1091. DOI:10.5194/hess-19-1069-2015.

Halwatura, D., Lechner, A.M., Arnold, S. (2015b) Drought severity–duration–frequency curves: a foundation for risk assessment and planning tool for ecosystem establishment in post-mining landscapes. Hydrol. *Earth Syst. Sci*., 19(2): 1069-1091. DOI:10.5194/hess-19-1069-2015.

Haslinger, K., Blöschl, G. (2017) Space-Time Patterns of Meteorological Drought Events in the European Greater Alpine Region Over the Past 210 Years. *Water Resources Research,* 53(11): 9807-9823.

Hirsch, R.M., Slack, J.R., Smith, R.A. (1982) Techniques of trend analysis for monthly water quality data. *Water resources research,* 18(1): 107-121.

Janga Reddy, M., Ganguli, P. (2012) Application of copulas for derivation of drought severity–duration–frequency curves. *Hydrological Processes,* 26(11): 1672-1685.

Juliani, B.H.T., Okawa, C.M.P. (2017) Application of a Standardized Precipitation Index for Meteorological Drought Analysis of the Semi-Arid Climate Influence in Minas Gerais, Brazil. *Hydrology,* 4(2): 26.

Kendall, M.G. (1955) Rank correlation methods, Griffin, London.

Keyte, M. (1993) Droughts in Northland. MSc Thesis. Waikato University. Hamilton. New Zealand.

Kim, D.H., Yoo, C., Kim, T.-W. (2011) Application of spatial EOF and multivariate time series model for evaluating agricultural drought vulnerability in Korea. *Advances in water resources*, 34(3): 340-350.

Mann, H.B. (1945) Nonparametric tests against trend. Econometrica: *Journal of the Econometric Society*: 245-259.

Masud, M., Khaliq, M., Wheater, H. (2015) Analysis of meteorological droughts for the Saskatchewan River Basin using univariate and bivariate approaches. *Journal of Hydrology*, 522: 452-466.

Meyers, G., P. McIntosh, L. Pigot, and M. Pook (2007), The years of El Niño, La Niña, and interactions with the tropical Indian ocean, *J. Clim.*, 20, pp. 2872–2880.

McBride, J. L. and Nicholls, N. (1983) Seasonal relationships between Australian rainfall and the Southern Oscillation, Mon. Weather Rev., 111, pp. 1998–2004.

McKee, T.B., Doesken, N.J., Kleist, J. (1993) The relationship of drought frequency and duration to time scales, Proceedings of the 8th Conference on Applied Climatology. American Meteorological Society Boston, MA, pp. 179-183.

Miller, C.D., Durnford, D.S. (2005) Modified use of the "SDF" Semi-Analytical Stream Depletion Model in bounded alluvial aquifers. *Hydrology Days:* 146-159.

National Institute of Water & Atmospheric Research Ltd (NIWA). (2013) The 2012-13 drought: an assessment and historical perspective, report prepared for Ministry for Primary Industries. Wellington, NZ.

National Institute of Water & Atmospheric Research Ltd (NIWA). (2022) Projected changes in New Zealand drought risk, report prepared for Tonkin and Taylor, as a contribution to the Deep South National Science Challenge project "Drinking water, drought and climate change". Wellington, NZ.

National Institute of Water & Atmospheric Research Ltd (NIWA). (2016) Climate change projections and implications for Northland, report prepared for NRC. Auckland, NZ.

Nelsen, R.B. (1999) An introduction to copulas. Springer.

Nelsen, R.B. (2007) An introduction to copulas. Springer.

Pham, H.X., Donaghy, J. (2017) Northland drought assessment using Standard Precipitation Index. New Zealand Hydrological Society Current Newsletter, Newsletter No.52.

Porteous, A., Mullan, B. (2013) The 2012-13 drought: an assessment and historical perspective, Ministry of Primary Industries.

Raziei, T., Saghafian, B., Paulo, A.A., Pereira, L.S., Bordi, I. (2009) Spatial patterns and temporal variability of drought in western Iran. *Water Resources Management,* 23(3): 439.

Reddy, M.J., Singh, V.P. (2014) Multivariate modelling of droughts using copulas and meta-heuristic methods. *Stochastic environmental research and risk assessment*, 28(3): 475-489.

Saghafian, B., Shokoohi, A., Raziei, T. (2003) Drought spatial analysis and development of severity-duration-frequency curves for an arid region. *International Association of Hydrological Sciences, Publication* (278): 305-311.

Saji, N., et al (1999). A dipole mode in the tropical Indian Ocean. Nature 401, 360–363 (1999). https://doi.org/10.1038/43854.

Salinger, M., Renwick, J., Mullan, A. (2001) Interdecadal Pacific oscillation and south Pacific climate. *International Journal of Climatology,* 21(14): 1705-1721.

Seager, R., Kushnir, Y., Herweijer, C., Naik, N., and Velez, J. (2005) Modelling of Tropical Forcing of Persistent Droughts and Pluvials over Western North America: 1856–2000. *J. Climate*, 18, 4065–4088.

Shiau, J. (2003) Return period of bivariate distributed extreme hydrological events. *Stochastic environmental research and risk assessment*, 17(1): 42-57.

Shiau, J. (2006) Fitting drought duration and severity with two-dimensional copulas. *Water resources management*, 20(5): 795-815.

Shiau, J.-T., Modarres, R. (2009) Copula-based drought severity-duration-frequency analysis in Iran. *Meteorological Applications*, 16(4): 481-489.

Singh, S.K., Alejandro Chamorro, M. S. Srinivasan, Breuer, L. (2017) A copula-based analysis of severity-duration-frequency of droughts in six climatic regions of New Zealand Journal of hydrological (NZ) 56(1).

Singh, S.K.,, George, G. (2018) Drought in Western Northland: A Regional and Local Analysis, NIWA Client Report No. 2018126CH.

Singh, S.K.,, George, G. (2019) Drought in Eastern Northland: A Regional and Local Analysis, NIWA Client Report No. 2019068CH.

Sklar, A. (1959) Fonctions de répartition à n dimensions et leurs marges. Publ. Inst. Statist. Univ., 8, Paris, 229–231 pp.

Svoboda, M., Hayes, M., Wood, D. (2012) Standardized precipitation index user guide. World Meteorological Organization Geneva, Switzerland.

Todisco, F., Mannocchi, F., Vergni, L. (2013) Severity–duration–frequency curves in the mitigation of drought impact: an agricultural case study. *Natural hazards,* 65(3): 1863-1881.

Trenberth, K.E., et al. (2013) Global warming and changes in drought. Nature Climate Change, 4: 17. DOI:10.1038/nclimate2067.

WMO. (2011) Current problems of hydrological networks design and optimization; www.wmo.int/pages/prog/hwrp/chy/chy14/.../ms/Network_OptimizationV1.pdf.

Woods, R.A., McKerchar, A.I. (2010) The Northland Drought of 2009-2010: Situation Report 1, NRC110501. NIWA, Christchurch, pp. 36 p.: 21 figs, 10 tables, refs p. 33-34.

Appendix A Rainfall sites

Table A-1: Northland rainfall sites used in this study.

Gauge ID	Gauge Name	Lat	Long	Record From	To	Length (Years)	Mean Annual
424602	Cape Reinga Aws	-34.4296	172.6819	1995	2023	29	946.5
425801	Te Paki Stn, Te Hapua	-34.5080	172.7950	1931	1973	42	1417.1
425902	Paua Blk Parengarenga	-34.5720	172.8930	1970	2011	41	1181.7
437001	Cape View	-34.7040	173.0290	1967	1996	29	1153.4
437010	Waihopo at Kimberley Road	-34.7633	173.0460	2016	2023	7	1222.4
439201	Waiharara	-34.9500	173.1950	1956	2023	67	1209.5
439202	Waiharara 2	-34.9360	173.2150	1983	2011	28	1174.4
439301	Rangiputa	-34.8970	173.3480	1970	2004	34	1192.4
439501	Mangonui	-34.9970	173.5320	1901	1996	95	1376.2
530201	Kaitaia Aero	-35.0670	173.2870	1949	1985	36	1392.9
530202	Waipapakauri	-35.0290	173.2430	1955	1988	33	1250.3
530204	Aupouri Forest at Forest HQ	-35.0104	173.1975	1967	2022	56	1243.7
530205	Wiessing at Kaitaia	-35.0679	173.2558	1992	2023	31	1293.3
530206	Kaitaia Aero Ews	-35.0677	173.2878	2000	2023	23	1272.6
530210	Awanui at Temples	-35.0114	173.2751	1978	1987	9	1320.6
530301	Kaingaroa North	-35.0450	173.3380	1962	1995	34	1346.3
530511	Oruru at Bowling Club	-35.0406	173.4901	2010	2023	13	1385.9
530601	Oruaiti	-35.0170	173.6500	1952	1967	15	1752.1
530602	Oruaiti 2	-35.0130	173.5960	1968	1980	13	1467.5
530701	Kaeo Northland	-35.0570	173.7400	1987	2023	36	1646.4
530710	Pupuke at Giesbers	-35.1516	173.7106	1983	2006	23	1692.8
530801	Matauri Bay	-35.0370	173.8910	1964	1987	23	1432.4
530810	Matauri Bay at NZ China Clays	-35.0661	173.8951	1986	2020	35	1903.4
531101	Ahipara	-35.1650	173.1580	1961	1997	36	1169.9
531201	Kaitaia (Vincent)	-35.1140	173.2590	1893	2010	117	1368.2
531203	Kaitaia 3	-35.1080	173.2580	1967	1979	12	1326.3
531205	Kaitaia Observatory	-35.1335	173.2629	1985	2018	33	1358.4
531207	Kaitaia Ews	-35.1335	173.2629	1998	2024	25	1322.3
531209	Pukepoto	-35.1622	173.2018	2007	2019	13	1413.4
531210	Tarawhataroa at Larmer Road	-35.1507	173.2763	2011	2023	12	1303.3
531301	Rangitihi	-35.1020	173.3350	1913	1979	65	1469.1
531302	Rangitihi Sub Stn	-35.1230	173.3350	1961	1992	31	1474.7
531310	Takahue at Wallace	-35.1800	173.3729	1966	2006	40	1743.7
531311	Takahue at Diggers Valley	-35.1863	173.2934	1967	1987	20	1770.3
531313	Takahue at Te Rore	-35.1781	173.3720	2003	2021	17	1394.7
531411	Victoria at Kitchen	-35.1555	173.4217	1966	2017	51	1792.5

Gauge ID	Gauge Name	Lat	Long	Record From	To	Length (Years)	Mean Annual
531412	Mangamuka at Forest Veiw	-35.1875	173.4708	1981	1994	13	2147.8
531413	Te Puhi at Stanton	-35.1417	173.4298	1977	1987	10	1699.8
531415	Te Puhi at Mangakawakawa Trig	-35.1470	173.4573	2002	2023	21	1634.6
531501	Honeymoon Valley	-35.1280	173.4950	1962	1998	36	1781.2
531512	Kanekane at Coopers Beach	-34.9912	173.4406	1996	2023	27	1267
531513	Mangonui at Mangonui	-34.9924	173.5359	1996	2019	23	1507.4
531701	Kaeo	-35.1000	173.7830	1918	1952	34	1761.5
531711	Kaeo at Paitu	-35.1184	173.7971	1963	2013	50	1824.4
531713	Kaeo at Waihuka	-35.1530	173.7567	1970	1982	12	1955.3
531715	Kaeo at Bramley (Manual)	-35.1608	173.7922	1971	2006	35	1953.9
531716	Kaeo at Kaeo	-35.1424	173.8312	1991	2003	12	1998.9
531717	Kaeo at Bramleys	-35.1608	173.7922	2003	2023	20	1691.4
531718	Touwai at Weta	-35.0588	173.8402	2009	2023	14	2007.1
531719	Kaeo at Bennetts	-35.0672	173.7712	1993	2016	23	1741.1
531901	Kerikeri EWS	-35.1830	173.9260	1995	2024	28	1682.8
531910	Kerikeri at Laurenson	-35.1963	173.9483	1977	1995	18	1570.1
531911	Kerikeri at KiaKaha	-35.1944	173.9496	1987	2014	28	1715
532202	Herekino	-35.2660	173.2200	1916	1992	75	1581.3
532311	Takahue at Takahue Top	-35.2074	173.3576	1971	2023	52	1847.5
532312	Takahue at Saddle Road	-35.2056	173.3562	2018	2023	5	1703.4
532402	Broadwood	-35.2610	173.3900	1929	1988	59	1849.5
532501	Mangamuka Bridge	-35.2330	173.5330	1949	1971	22	1682.7
532503	Omahuta 2	-35.2250	173.5900	1977	2002	25	1789.8
532510	Mangamuka at Mangamuka	-35.2501	173.5525	1977	1987	10	1507.7
532601	Omahuta 1	-35.2330	173.5920	1949	1975	27	1756.2
532611	Waipapa at Waihou Valley (Grahams)	-35.2868	173.6971	1979	2023	45	1663.1
532710	Waipapa at Puketi Road (Candy)	-35.2621	173.7517	1963	2018	55	2249.4
532711	Waipapa at Puketi R/V	-35.2171	173.7435	1983	1994	11	2131.1
532801	Taus Falls	-35.2468	173.8155	1951	2003	53	2253.3
532810	Maungaparerua at Tyrees	-35.2364	173.8798	1966	1987	21	1844.5
532811	Maungaparerua at Black Poll	-35.2250	173.8600	1966	1987	20	1960.6
532812	Maungaparerua at Airstrip	-35.2213	173.8795	1967	1978	11	2585
532813	Maungaparerua at Flats	-35.2371	173.8281	1967	1977	10	2923.9
532814	Maungaparerua at Roadside	-35.2233	173.8510	1967	1985	18	2614.2
532820	Waipapa at Puketi State Forest	-35.2130	173.7937	1970	1985	15	2294.7
532821	Maungaparerua at Tyrees Ford	-35.2347	173.8843	1984	2008	24	1836.3
532822	Waitangi at Wiroa Road 2	-35.2784	173.8337	2016	2023	7	2232.8
532901	Kerikeri 1	-35.2300	173.9480	1945	1974	29	1640.2
532903	Kerikeri Aero 2	-35.2647	173.9113	1978	2008	30	1797.4

Gauge ID	Gauge Name	Lat	Long	Record From	To	Length (Years)	Mean Annual
532905	Kerikeri Aerodrome AWS	-35.2628	173.9114	2008	2023	15	1908.8
532910	Wairoa at Kerikeri (Carver)	-35.2296	173.9510	1974	1987	13	1600.3
532913	Kerikeri at Waikimihia	-35.2194	173.9750	1977	1998	21	1494.9
532915	Kerikeri at BOI Golf club	-35.2260	173.9422	2011	2023	12	1681.4
533201	Puhata	-35.3020	173.2310	1979	2010	30	1484.9
533301	Rotokakahi at Adams	-35.3152	173.3159	1986	2007	20	1708.7
533302	Rotokakahi at Kohe Road	-35.3136	173.3158	1998	2023	25	1481.8
533501	Kohukohu	-35.3670	173.5500	1905	1961	56	1442.3
533502	Umawera	-35.2960	173.5660	1967	1985	18	1366.6
533601	Rangiahua	-35.3000	173.6670	1901	1951	49	1595.3
533610	Waihou at Crawfords	-35.3115	173.6598	1976	1995	19	1340.1
533710	Lake Omapere at Rototiro	-35.3422	173.7635	1969	1985	16	1651.5
533810	Lake Omapere at Conelley	-35.3256	173.8029	1969	1979	10	1714.3
533812	Utakura at Lake Acres	-35.3624	173.8232	1965	1997	32	1771.5
533813	Waitangi at Ohaeawai (Woods)	-35.3583	173.8726	1967	2000	34	1828.6
533814	Waitangi at Highrisings	-35.2966	173.8234	1976	1987	11	1960.4
533815	Lake Omapere at Faithfull	-35.3381	173.8164	1979	1987	8	1619.6
533817	Waitangi at Ohaeawai	-35.3565	173.8728	1998	2023	25	1672.6
534402	Opononi	-35.4869	173.4188	1967	2007	40	1296.8
534403	Hokianga Harbour Omapere/Opononi	-35.5232	173.3912	2006	2023	17	1203.8
534503	Rawene 2	-35.4127	173.5191	1977	2010	32	1304.7
534610	Whawharu at Topu B Taheke	-35.4721	173.6212	2013	2023	10	1401.4
534701	Kaikohe	-35.4320	173.7840	1922	1971	49	1608.4
534711	Opahi at Norwest Corner	-35.3920	173.7322	1967	1978	11	2139.7
534716	Opahi at Auto Site	-35.4001	173.7347	1966	1985	19	1448.7
534717	Opahi at Long Valley	-35.4099	173.7489	1967	1978	11	2118.3
534722	Opahi at Cocksfoot	-35.4065	173.7216	1985	1994	9	1353.5
534724	Mangamutu at Kaikohe Hill	-35.4123	173.7853	1985	2005	20	1572.2
534725	Punakitere at Kaikohe Woolshed	-35.4329	173.7968	1989	1999	10	1401.6
534801	Kaikohe Aero	-35.4530	173.8170	1956	1978	22	1556.1
534802	Kaikohe Grasslands, D.S.I.R	-35.4240	173.8230	1973	1986	13	1590.7
534803	Kaikohe M.W.D	-35.3990	173.8070	1979	1989	11	1503
534807	Kaikohe AWS	-35.4172	173.8229	1985	2023	38	1544.3
534811	Otiria at Ngapipito	-35.4378	173.9043	2011	2023	12	1594.5
535401	Waiotemarama	-35.5310	173.4260	1977	1992	16	1595.7
535412	Waiotemarama at Tooremburg	-35.5337	173.4387	1999	2018	19	1732.8
535413	Whirinaki at King	-35.4877	173.4537	1993	2023	31	1544.3
535501	Wekaweka	-35.5670	173.5500	1908	1958	50	2612.1
535510	Waimamaku at Waiora Farm	-35.5724	173.5999	1976	2004	28	2806.9

Gauge ID	Gauge Name	Lat	Long	Record From	To	Length (Years)	Mean Annual
535512	Waimamaku at Wekaweka(Russell)	-35.5796	173.5968	1981	2023	43	2628.3
535513	Waimamaku at Wekaweka Road	-35.2080	173.3579	2016	2023	7	2598.5
535712	Awarua at Gammons Rd	-35.5665	173.7774	1965	1986	21	1669.1
535812	Awarua at Awarua Block	-35.5590	173.8330	1966	1987	21	1437.3
535813	Awarua at Tokawhero Road	-35.5727	173.8922	1965	1976	12	1684.7
535901	Kauana Downs	-35.5180	173.9130	1956	1970	14	1719.7
536501	Waipoua Visitor Centre	-35.6530	173.5580	1928	2009	81	1540.1
536601	Whatoro	-35.6830	173.6830	1914	1953	40	2483.9
536610	Kaihu at Tutamoe	-35.6730	173.6473	1962	1980	17	2393.4
536611	Mangakahia at TY Ranch	-35.6342	173.6425	1966	2001	35	2777.8
536613	Waima at Tutamoe	-35.6621	173.6507	2003	2023	20	2060.3
536702	Waimatenui 2	-35.6290	173.7300	1914	2004	91	2005.3
536710	Mangakahia at Waimatenui	-35.6281	173.7309	1965	1984	19	1768.6
536711	Mangakahia at Roudershore	-35.6135	173.7537	1965	1976	12	1842.8
536712	Mangakahia at Glenoban	-35.6163	173.7135	1962	1972	10	2304.1
536811	Opouteke at Kingsclear	-35.6815	173.8142	1967	2004	38	1833
536812	Opouteke at Brookvale	-35.6963	173.8665	1987	2023	36	1709.6
536814	Mangakahia at Nukatawhiti	-35.6397	173.8490	1962	1979	16	1598.2
536816	Mangakahia at Twin Bridges	-35.6289	173.8512	1999	2023	24	1473.7
536901	Pipiwai	-35.6540	173.9990	1948	1985	37	1536.9
537510	Kahiu at Katui	-35.4491	173.5787	1962	1983	21	1519.9
537601	Whatoro 2	-35.7290	173.6750	1993	2008	14	1766.5
537602	Trounson Cws	-35.7204	173.6515	2009	2023	15	1398.9
537611	Kaihu at Trounson Park	-35.7206	173.6519	1968	1995	28	1705.8
537613	Kaihu at Kaiiwi Lakes(McLeod)	-35.8208	173.6456	1986	1993	8	1188.4
537614	Kaihu at Whatoro (Haywoods)	-35.7457	173.6793	1995	2020	26	1717.3
537712	Opouteke at Aomarama	-35.7137	173.7419	1962	1975	13	2338.7
537801	Pakotai, Glenmont	-35.7170	173.8220	1949	1985	37	1721.3
537815	Tangowahine at Kereru	-35.7399	173.8382	1978	2007	29	1679.2
537816	Wairoa at Paradise Road	-35.8709	173.9863	2007	2023	16	1388
537901	Parakao	-35.7175	173.9527	1951	2010	59	1459.9
538611	Kaiiwi at Kaiiwi Lakes Road	-35.5229	173.3916	2015	2023	8	1039.4
538710	Kahiu at Maropiu	-35.7993	173.7405	1965	1976	12	1558.3
538801	Mamaranui	-35.8640	173.8000	1951	2010	59	1298.7
538810	Awakino at Nilssons (Nash)	-35.8335	173.8419	1962	1996	35	1334.5
538811	Awakino at Booths	-35.8011	173.8445	1971	1981	11	1379
539710	Chases Gorge at Baylys Beach (Andrews)	-35.9515	173.7482	1976	2008	32	1099.6
539801	Dargaville	-35.9350	173.8560	1905	1990	85	1246.9
539802	Dargaville Exp Farm	-35.9440	173.8350	1943	1999	57	1202

Gauge ID	Gauge Name	Lat	Long	Record From	To	Length (Years)	Mean Annual
539803	Dargaville N.Z.E.D.	-35.9360	173.8760	1965	1988	24	1183.9
539807	Dargaville 2 Ews	-35.9315	173.8532	2003	2024	20	1049.3
539811	Wairoa at Dargaville County	-35.9415	173.8620	1981	1989	9	1157.2
539813	Wairoa at Dargaville (Hokianga Road)	-35.9318	173.8580	2007	2021	15	1194.2
541001	Purerua Aws	-35.1254	174.0168	1983	2023	40	1169.1
541301	Cape Brett Lighthouse	-35.1730	174.3290	1934	1978	44	1098.5
542001	Waitangi Forest	-35.2580	174.0710	1962	1986	24	1407.7
542010	Waitangi at Wakelins Block	-35.2772	174.0517	1979	2007	28	1518.7
542101	Russell	-35.2653	174.1218	1919	2021	116	1428.3
542102	Russell Cws	-35.2684	174.1360	2016	2020	8	1415.4
543001	Kawakawa Water Treatment Plant	-35.3804	174.0914	1918	2010	91	1469
543003	Kawakawa	-35.3840	174.0680	1982	1996	14	763
543010	Waitangi at McDonald Road	-35.3306	174.0308	1986	2023	37	1480.6
543012	Waitangi at Whangae	-35.3486	174.0333	1980	2023	43	1627.8
543110	Kawakawa at Opua	-35.3143	174.1163	1993	2010	17	1426.2
543111	Veronica Channel at Opua	-35.3116	174.1196	2008	2019	14	1278.2
543113	Veronica Channel M and P	-35.3268	174.1278	2009	2020	11	1596.4
543310	Punaruka at Russell State Forest	-35.3751	174.3108	1973	1986	13	1609.5
543311	Oakura Bay at Murphy	-35.3900	174.3433	1993	2023	30	1648.2
543312	Oakura Bay at Te Kapua Street	-35.3908	174.3444	2006	2021	15	1539.3
544002	Motarau, Opahi Stn	-35.4890	174.0190	1948	1977	29	1470.9
544101	Towai	-35.4930	174.1300	1958	1982	24	1552.9
544213	Mimiha at Helena Bay Hill Gallery	-35.4767	174.3279	2012	2022	11	1915.6
544311	Kaimamaku at Peach Orchard Road	-35.4771	174.2987	1981	2014	32	2359.8
545013	Waiharakeke at Motatau (Donaldson's)	-35.5180	174.0360	1995	2017	22	1526.9
545014	Waiharakeke at Okaroro Road	-35.5186	174.0341	2010	2023	13	1432.6
545111	Waiotu at Dawson	-35.4996	174.1492	1978	2023	45	1594.5
545201	Whakapara at Puhipuhi	-35.5126	174.2718	1905	2023	118	2008.8
545210	Wairua at Forstythe Road (McHardys)	-35.5745	174.2165	1968	1982	13	1525.8
545211	Waiotu at Morgans	-35.5021	174.2062	1960	1974	14	1821.6
545212	Waiotu at Waiotu	-35.5032	174.2295	1965	1988	23	1929.4
545213	Waiotu at Hukerenui (Morgans)	-35.5215	174.2014	1974	2013	39	1611.7
545310	Whakapara at Opuawhanga	-35.5124	174.3532	1968	2005	38	1952.8
545311	Kirikiritoki at Maureens	-35.5653	174.3752	2000	2008	8	1981.2
545312	Whakapara at Dandelion	-35.5014	174.2992	1995	2023	28	2177.5
545412	Ngunguru at Taihoa	-35.5778	174.4471	1979	1987	8	1809.7
545501	Matapouri	-35.5657	174.5057	1967	2016	49	1306.5
546001	Puketurua Northland	-35.6730	174.0800	1965	1976	11	1382.1
546030	Puketurua at Pukewaenga	-35.6720	174.0792	1964	1985	22	1342.6

Gauge ID	Gauge Name	Lat	Long	Record From	To	Length (Years)	Mean Annual
546031	Puketurua at Pukeiti	-35.6753	174.0781	1965	1980	15	1441.7
546032	Puketurua at Woolshed	-35.6698	174.0848	1965	1976	11	1391.8
546103	Ruatangata	-35.6500	174.1830	1905	1963	58	1630.4
546111	Wairua at Rarewa	-35.6427	174.1659	1968	1981	13	1446.8
546202	Hikurangi	-35.6210	174.2870	1956	1999	43	1672
546203	Ruatangata No2	-35.6650	174.2140	1963	2005	42	1522.7
546210	Wairua at Matarau 2	-35.6376	174.2221	1966	1981	15	1579.4
546212	Wairua at Jordan Valley	-35.6015	174.2249	1967	2008	42	1532.6
546216	Okarika at Rowland Rd	-35.6121	174.1655	1988	2023	36	1305
546218	Wairua at Cathcart	-35.6723	174.2550	1990	2010	19	1355.6
546301	Hatea at Glenbervie Forest HQ	-35.6558	174.3452	1947	2023	76	1802.6
546310	Waitangi at Totara Block	-35.6416	174.4651	1976	1987	11	1754.6
546315	Hatea at Hansen Orchards	-35.6785	174.3379	1987	2023	37	1662.5
546316	Batt at Glenbervie	-35.6500	174.3958	1987	2019	32	1790.2
546411	Ngunguru at Sands	-35.6030	174.4554	1966	1984	18	1845.9
546412	Ferguson at Kaiatea	-35.6125	174.4475	1968	2023	50	1832.1
546416	Ngunguru at Dugmores Rock	-35.6006	174.4313	1987	2023	36	1790
546510	Wairua at Riponui	-35.6154	174.1157	1969	1999	30	1480.8
546512	Lambly at Whangaumu Bay	-35.6343	174.5292	1993	2014	21	1389.3
547001	Wairua Falls	-35.7590	174.0670	1916	1995	80	1357.1
547002	Titoki	-35.7140	174.0570	1967	2004	38	1282.4
547010	Mangakahia at Parakao (Ware)	-35.7121	174.0015	2002	2023	21	1467.9
547112	Whatitiri at Totara Grove	-35.7625	174.1724	1973	1985	12	1443.8
547119	Waipao at Williams (Draffins Road)	-35.7252	174.1277	2007	2023	16	1307.6
547201	Maungatapere	-35.7570	174.2070	1948	1990	41	1631.3
547214	Raumanga at Totara Place	-35.7430	174.2961	1978	2023	45	1499.1
547215	Otaika at Maungatapere	-35.7703	174.2002	1976	1986	11	1579.9
547219	Otaika at Cemetery Road (Mokupara)	-35.7534	174.2525	1979	2019	39	1576.7
547220	Te Hihi at Te Hihi (Jongkees)	-35.7371	174.2659	1988	2004	16	1636.4
547222	Otaika at Lynwood Farm	-35.7445	174.2495	1967	1993	26	1683.1
547223	Otaika at Redwood Orchard	-35.7685	174.2004	1983	2023	41	1578.3
547224	Otaika at Valley View Rd (McIntosh)	-35.7916	174.2801	1995	2008	13	1429
547225	Waipao at Whatatiri (Coopers)	-35.7672	174.1707	1998	2010	12	1531.4
547226	Otaika at Cemetery Road	-35.7533	174.2525	2011	2023	12	1543.2
547302	Whangarei	-35.7290	174.3390	1909	1967	58	1631.8
547303	Whangarei Aero	-35.7696	174.3603	1943	1988	45	1508.3
547304	Whangarei Hospital	-35.7390	174.3000	1970	1988	18	1519.5
547305	Whangarei, Whau Valley	-35.7060	174.2940	1970	1993	23	1618.4
547307	Whangarei Aero Aws	-35.7706	174.3629	1994	2023	30	1362.7

Gauge ID	Gauge Name	Lat	Long	Record From	To	Length (Years)	Mean Annual
547308	Whangarei Ews	-35.7444	174.3287	2015	2024	8	1408.9
547312	Glenbervie at Waitangi Rd	-35.6461	174.3472	1977	1989	12	1929.4
547315	Raumanga at Kaka St	-35.7327	174.3213	1983	1993	10	1391.6
547316	Hatea at Parahaki (Steele)	-35.7304	174.3439	1984	1995	11	1519.3
547338	Hatea at Robert Street	-35.7246	174.3245	1989	2004	15	1340.9
547339	Waiarohia at NRC Water Street	-35.7256	174.3179	2004	2023	19	1416
547340	Waiarohia at Kensington	-35.7102	174.3143	2006	2020	14	1447.6
547402	Waiparera	-35.7140	174.4710	1965	1976	11	1505.1
547411	Whangarei Harbour at Parua Bay	-35.7688	174.4536	1986	2011	24	1529.7
547412	Massey at Pataua	-35.7379	174.4693	1992	2006	14	1400.7
547503	Parua Bay, Beasley Road	-35.7430	174.5260	1974	1985	11	1268.9
547512	Taiharuru at Taiharuru	-35.7323	174.5510	1988	2004	16	1233.9
548101	Tangihua	-35.8410	174.1160	1958	1992	35	1436.3
548201	Mangapai	-35.8450	174.2960	1970	2005	35	1314.3
548210	Tauraroa at Palmer	-35.8317	174.2699	1988	2004	15	1327.2
548211	Tauraroa at Jones	-35.8369	174.2802	1972	2008	37	1503.7
548212	Whangarei Harbour at N.Z. Refining Co	-35.8379	174.4926	1986	2005	20	1197.9
548213	Ruakaka at Fosters	-35.8814	174.4646	2000	2023	24	1360
548214	Tauraroa at Ormandy Rd (Palmer)	-35.8415	174.2865	2004	2011	8	1301.5
548215	Whangarei Harbour at Marsden Point	-35.8341	174.4904	2006	2017	11	989.3
548310	Ahuroa at Whittles	-35.8707	174.3163	1964	2005	42	1433.2
548311	Ahuroa at Sloanes	-35.8836	174.3628	1969	1984	15	1397.6
548313	Tauraroa at Cotton	-35.8771	174.3084	1976	1989	13	1577.8
548314	Mangapai at McCullough Road	-35.8405	174.3080	1991	1998	8	1103
548315	Waikokopa at McDonnell Road	-35.8877	174.3224	2010	2023	13	1406.8
548402	Marsden Power Station	-35.8780	174.4700	1970	1990	20	1372.4
548410	Waiwarawara at Prescotts	-35.9070	174.4176	1980	2001	21	1410.5
548412	Waiwarawara at Wilson's Dam	-35.8973	174.4165	2007	2023	16	1341.6
548413	Whangarei Harbour at Marsden Point Oil Refinery	-35.8379	174.4926	2015	2023	8	1324.1
549010	Manganui at Monymusk	-35.9947	174.0459	1976	2008	32	1302.7
549011	Manganui at Omana (Bull)	-35.9218	173.9459	1981	1998	18	1277.3
549201	Waikiekie	-35.9530	174.2490	1956	1977	21	1566.8
549211	Taipuha at Keay	-35.9783	174.2893	1970	2007	37	1490.1
549310	Taipuha at Settlement Rd	-35.9944	174.3007	1963	1993	30	1483.5
549402	Waipu, Apple Cross	-35.9420	174.4060	1954	1977	24	1646.9
630901	Arapohue	-35.9980	173.9400	1955	2010	55	1195.8
640010	Nth Wairoa at Naumai	-36.0601	174.1588	1970	1983	13	1269
640201	Taipuha	-36.0030	174.2790	1948	1977	29	1471.4
640310	Ahuroa at Finlayson Brook	-36.0223	174.3712	1981	1996	15	1553

Gauge ID	Gauge Name	Lat	Long	Record From	To	Length (Years)	Mean Annual
640411	Waihoihoi at Glenmohr Road	-36.0422	174.4326	1969	2006	37	1468.9
640436	Waihoihoi at Brynderwyn	-36.0451	174.4162	1981	2023	42	1407.6
640501	Waipu Cove	-36.0340	174.5070	1948	2009	61	1311.8
641001	Ruawai	-36.1130	174.0230	1946	1985	39	1213.6
641010	Awaroa at Wallace Road	-36.1269	174.0658	2007	2023	16	1046.4
641102	Claren Brae (Ruawai)	-36.1290	174.1210	1968	2001	34	1224.3
641201	Paparoa 1	-36.1000	174.2500	1938	1971	32	1412.1
641203	Paparoa 2	-36.1030	174.2330	1971	1994	24	1224.5
641210	Paparoa at Higgins	-36.1016	174.2339	1991	2003	13	1430.6
641213	Paparoa at Maungaturoto	-36.0902	174.3505	2005	2023	18	1396.3
641214	Paparoa at Taylors	-36.1093	174.2676	2005	2023	18	1278.2
641215	Paparoa at Stubbs	-36.1564	174.2257	2005	2023	18	1216.9
641302	Maungaturoto, Melford	-36.1630	174.3740	1952	1997	44	1415.4
641310	Wairua at Northland Dairy CO	-36.1034	174.3741	1992	2008	16	1396.9
641410	Topuni at Saunders	-36.1906	174.4568	1977	1987	11	1434.8
641413	Topuni at Dunn Road (Cook)	-36.1415	174.4869	1980	2003	24	1418.8
641414	Hakaru at Valley Road (Kaiwaka)	-36.2660	174.6535	2003	2023	20	1559.6
641501	Mangawhai	-36.1266	174.5801	1917	1990	74	1237
641511	Mangawhai Harbour at Tara	-36.1094	174.5231	1946	2014	68	1566.8
641512	Hakaru at Tara	-36.1077	174.5253	2013	2023	10	1503.1
642010	Okoraka at NgatawhitiRoad	-35.4877	173.4537	2015	2023	8	1134.2
642011	Okoraka at Poutu Forest Farms Ltd	-36.2158	174.0397	1987	2012	26	1202.6
642201	Pukehau	-36.2080	174.2550	1955	2001	46	1180
642401	Topuni	-36.2170	174.4590	1948	1992	44	1350.2
642415	Hakaru at Topuni Creek Farms	-36.2036	174.4929	2011	2023	12	1405.1
643112	Tauhara at Lake Rotokawau	-36.3404	174.1582	1976	1990	14	859.9
643116	Swan Lake at Bishops	-36.3297	174.1426	1985	1996	11	979.6
643118	Kaipara Harbour at Pouto Point	-36.3626	174.1822	2006	2023	17	925.8

Appendix B Worst drought recorded at each site

Table B-1: Worst drought, year, month of occurrence and corresponding SPI for different durations for each site (presented in ascending gauge ID number order).

		1 Month			3 Month			6 Month			9 Month			12 Month			24 Month		
Gauge ID	Gauge Name	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI
424602	Cape Reinga Aws	2022	7	-3.38	2022	8	-3.38	2022	10	-2.85	2022	8	-2.75	2022	10	-2.58	2017	1	-2.13
425801	Te Paki Stn, Te Hapua	1931	8	-2.89	1950	3	-2.70	1933	1	-2.58	1933	4	-2.52	1933	5	-2.52	1933	6	-2.30
425902	Paua Blk Parengarenga	1982	8	-3.19	2005	4	-2.92	2010	4	-2.93	2010	7	-3.05	2010	7	-3.16	2010	12	-2.88
437001	Cape View	1990	9	-2.50	1993	9	-3.07	1993	8	-2.77	1993	11	-2.52	1993	12	-2.39	1994	5	-2.15
437010	Waihopo at Kimberley Road	2020	9	-2.53	2019	6	-1.96	2019	7	-2.22	2019	9	-2.20	2019	12	-2.08	2020	3	-2.00
439201	Waiharara	1963	10	-3.59	1963	11	-2.81	1974	5	-3.09	1974	6	-3.31	1974	8	-3.42	1975	8	-3.15
439202	Waiharara 2	1993	11	-3.46	2010	5	-2.77	2010	5	-3.21	2010	5	-3.28	2010	7	-2.92	2006	2	-2.38
439301	Rangiputa	1970	12	-3.16	1974	2	-2.33	1974	3	-2.50	1974	5	-2.47	1987	9	-2.08	1974	5	-2.27
439501	Mangonui	1993	7	-3.34	1943	3	-2.64	1914	11	-3.01	1915	1	-3.29	1914	12	-3.14	1994	12	-2.21
530201	Kaitaia Aero	1969	3	-2.49	1950	9	-2.99	1983	3	-2.20	1983	3	-2.13	1983	3	-2.17	1983	11	-2.58
530202	Waipapakauri	1969	3	-2.62	1987	8	-2.55	1974	3	-2.79	1987	9	-2.45	1987	9	-2.72	1988	1	-2.83
530204	Aupouri Forest at Forest HQ	1990	9	-3.11	2010	1	-2.95	2010	4	-3.80	1983	1	-2.74	1974	8	-2.33	1975	8	-2.77
530205	Wiessing at Kaitaia	2010	10	-2.67	2005	8	-3.00	2005	8	-3.17	2005	11	-2.83	2020	3	-2.61	2020	12	-2.73
530206	Kaitaia Aero Ews	2019	5	-2.57	2019	7	-3.13	2019	7	-3.10	2019	9	-2.47	2020	3	-2.56	2020	3	-2.68
530210	Awanui at Temples	1987	7	-2.74	1987	7	-2.45	1987	7	-2.02	1983	3	-1.89	1987	8	-1.71	1987	12	-1.62
530301	Kaingaroa North	1974	6	-4.49	1988	4	-3.33	1983	3	-2.37	1983	3	-2.45	1983	7	-2.40	1984	4	-1.80
530511	Oruru at Bowling Club	2011	8	-3.10	2019	7	-2.19	2019	8	-2.31	2019	9	-2.35	2020	2	-2.50	2020	12	-2.34
530601	Oruaiti	1963	10	-2.34	1962	9	-2.63	1958	8	-2.19	1963	3	-1.95	1963	12	-1.90	1964	6	-1.87
530602	Oruaiti 2	1972	9	-2.61	1979	6	-2.48	1974	3	-1.87	1978	4	-1.77	1973	5	-1.69	1974	3	-1.89

		1 Month			3 Month			6 Month			9 Month			12 Month			24 Month		
Gauge ID	Gauge Name	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI
530701	Kaeo Northland	2023	7	-3.26	1993	7	-2.39	2010	3	-2.57	2019	9	-2.40	2020	2	-2.62	2020	6	-2.28
530710	Pupuke at Giesbers	1999	4	-3.15	1991	12	-2.19	1991	5	-1.86	2005	4	-2.34	1994	5	-1.93	1994	12	-2.25
530801	Matauri Bay	1987	8	-3.05	1987	8	-2.85	1987	10	-2.55	1987	9	-2.59	1987	9	-2.59	1987	11	-2.62
530810	Matauri Bay at NZ China Clays	1993	8	-2.90	2010	1	-2.61	2010	3	-2.48	1991	6	-2.18	2020	2	-2.22	1995	1	-2.55
531101	Ahipara	1993	7	-3.69	1963	11	-3.61	1964	1	-2.61	1964	4	-2.30	1994	6	-2.35	1994	9	-2.18
531201	Kaitaia (Vincent)	1932	11	-3.04	1914	12	-4.50	1914	12	-4.26	1915	2	-3.28	1931	11	-2.97	1932	11	-2.96
531203	Kaitaia 3	1972	9	-2.66	1977	10	-1.94	1972	11	-2.10	1974	6	-1.90	1974	6	-1.90	1974	4	-2.01
531205	Kaitaia Observatory	1993	7	-3.06	2010	1	-2.98	2010	4	-3.16	2010	4	-2.86	2010	7	-2.86	1994	12	-2.50
531207	Kaitaia Ews	2007	10	-3.95	2010	1	-2.80	2010	4	-2.90	2010	4	-2.35	2020	3	-2.47	2020	12	-2.68
531209	Pukepoto	2013	10	-2.62	2010	1	-2.63	2019	7	-2.69	2019	9	-2.85	2019	12	-2.69	2014	3	-2.08
531210	Tarawhataroa at Larmer Road	2023	7	-2.96	2018	9	-2.28	2019	8	-2.32	2019	10	-2.01	2020	2	-1.91	2020	12	-2.13
531301	Rangitihi	1963	10	-2.88	1927	12	-3.13	1967	10	-2.89	1931	6	-2.45	1933	6	-2.42	1932	11	-2.58
531302	Rangitihi Sub Stn	1988	4	-3.17	1983	9	-3.96	1983	10	-3.11	1983	9	-3.28	1983	9	-3.45	1983	11	-3.14
531310	Takahue at Wallace	1993	7	-3.08	1967	7	-2.49	1967	10	-2.50	1983	7	-2.93	1983	7	-3.29	1984	10	-2.88
531311	Takahue at Diggers Valley	1987	7	-3.55	1974	12	-2.41	1975	5	-2.12	1975	5	-2.15	1975	9	-2.07	1975	8	-2.17
531313	Takahue at Te Rore	2006	9	-2.70	2019	7	-2.82	2019	7	-2.62	2020	1	-2.48	2020	3	-2.66	2021	1	-2.66
531411	Victoria at Kitchen	1988	1	-3.33	2010	1	-2.43	2010	4	-3.26	1983	7	-2.57	1983	7	-2.79	1974	4	-2.66
531412	Mangamuka at Forest Veiw	1984	10	-2.77	1984	11	-2.87	1984	12	-2.72	1984	12	-2.69	1985	3	-2.07	1985	2	-1.80
531413	Te Puhi at Stanton	1987	7	-2.95	1987	7	-2.51	1987	7	-2.09	1983	3	-2.04	1983	7	-2.07	1984	4	-1.88
531415	Te Puhi at Mangakawakawa Trig	2007	5	-2.67	2010	1	-2.23	2004	8	-2.67	2004	11	-2.65	2005	3	-2.27	2006	2	-2.37
531501	Honeymoon Valley	1980	9	-3.30	1972	9	-3.81	1972	11	-4.64	1972	12	-3.88	1973	3	-3.85	1974	3	-3.55

		1 Month			3 Month			6 Month			9 Month			12 Month			24 Month		
Gauge ID	Gauge Name	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI
531512	Kanekane at Coopers Beach	2019	10	-2.63	2019	12	-2.36	2020	3	-2.84	2020	5	-2.46	2020	1	-2.65	2021	1	-3.15
531513	Mangonui at Mangonui	2007	5	-2.86	2010	1	-2.91	2010	4	-2.88	2005	9	-3.07	2006	1	-2.93	2007	1	-2.81
531701	Kaeo	1951	9	-4.08	1950	3	-2.85	1952	8	-3.25	1950	3	-3.12	1919	12	-3.19	1942	3	-2.31
531711	Kaeo at Paitu	1982	8	-2.90	2010	1	-2.88	2010	4	-3.17	2010	4	-2.94	2010	7	-2.33	1994	12	-2.18
531713	Kaeo at Waihuka	1975	7	-2.40	1981	6	-2.53	1972	11	-1.69	1975	8	-1.78	1975	7	-2.01	1975	8	-1.81
531715	Kaeo at Bramley (Manual)	1984	10	-3.54	2004	5	-3.26	1991	5	-2.24	1991	5	-2.19	1991	11	-2.21	1994	12	-2.47
531716	Kaeo at Kaeo	1993	7	-2.93	1993	7	-2.22	1993	7	-1.81	1994	2	-1.86	1994	12	-1.90	1994	12	-2.14
531717	Kaeo at Bramleys	2023	7	-3.49	2020	2	-2.65	2010	3	-2.27	2019	8	-2.28	2019	6	-2.34	2020	3	-2.40
531718	Touwai at Weta	2023	7	-3.30	2019	6	-2.12	2019	8	-2.27	2019	9	-2.22	2020	2	-2.30	2020	7	-2.17
531719	Kaeo at Bennetts	2013	10	-3.30	1996	6	-3.35	2010	3	-2.82	2010	4	-2.47	2015	12	-2.35	1995	1	-2.17
531901	Kerikeri EWS	2007	5	-3.06	2010	1	-2.42	2015	7	-2.23	2015	9	-2.25	2019	6	-2.36	2020	3	-2.22
531910	Kerikeri at Laurenson	1993	7	-3.21	1983	1	-2.28	1983	1	-1.89	1978	4	-2.15	1983	7	-1.67	1995	5	-2.05
531911	Kerikeri at KiaKaha	2009	10	-3.55	2009	12	-3.53	2010	2	-3.30	2010	4	-2.85	1994	6	-2.04	1994	12	-2.29
532202	Herekino	1988	4	-2.98	1922	9	-3.05	1946	3	-2.73	1958	11	-2.35	1983	3	-2.24	1983	11	-2.25
532311	Takahue at Takahue Top	1972	7	-4.97	1972	9	-3.22	2019	6	-2.92	1973	3	-2.74	1973	4	-2.90	1974	4	-2.94
532312	Takahue at Saddle Road	2023	7	-2.56	2020	2	-2.40	2019	7	-2.09	2019	12	-2.20	2020	3	-2.19	2020	2	-1.82
532402	Broadwood	1942	6	-3.08	1967	11	-3.50	1967	11	-3.51	1968	1	-3.64	1968	2	-3.37	1975	7	-2.69
532501	Mangamuka Bridge	1971	5	-3.28	1963	12	-2.79	1958	8	-2.20	1964	6	-2.20	1960	4	-2.18	1964	6	-1.80
532503	Omahuta 2	1993	7	-3.12	1994	4	-2.33	1983	1	-2.62	1983	3	-2.35	1994	5	-2.18	1994	12	-1.84
532510	Mangamuka at Mangamuka	1977	2	-2.20	1977	4	-2.62	1987	7	-2.16	1983	2	-2.00	1983	5	-2.09	1984	4	-1.91

		1 Month			3 Month			6 Month			9 Month			12 Month			24 Month		
Gauge ID	Gauge Name	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI
532601	Omahuta 1	1972	9	-3.79	1963	12	-3.73	1964	1	-3.04	1964	1	-2.99	1964	1	-2.89	1974	3	-2.24
532611	Waipapa at Waihou Valley (Grahams)	2012	7	-4.47	2007	6	-3.24	2010	4	-3.11	2010	4	-2.67	2013	3	-2.74	1983	11	-2.39
532710	Waipapa at Puketi Road (Candy)	1969	3	-2.74	1963	12	-2.89	2010	4	-2.97	1978	3	-2.64	1983	3	-2.40	1992	4	-2.67
532711	Waipapa at Puketi R/V	1984	10	-2.61	1984	11	-2.23	1991	5	-1.90	1991	5	-1.72	1991	11	-1.45	1992	5	-1.68
532801	Taus Falls	1963	8	-4.41	1963	10	-3.21	1964	1	-2.95	1993	7	-2.52	1983	3	-2.25	1994	12	-2.52
532810	Maungaparerua at Tyrees	1987	7	-3.57	1987	7	-3.05	1987	7	-2.43	1987	7	-2.44	1987	9	-2.13	1987	7	-1.99
532811	Maungaparerua at Black Poll	1982	8	-3.02	1983	1	-2.81	1967	6	-2.26	1970	3	-2.08	1970	6	-2.43	1971	2	-2.31
532812	Maungaparerua at Airstrip	1976	6	-2.94	1970	4	-2.17	1967	11	-1.92	1967	11	-2.03	1973	4	-1.97	1978	8	-1.95
532813	Maungaparerua at Flats	1976	6	-2.89	1972	7	-2.28	1967	11	-2.28	1967	11	-2.21	1973	4	-2.21	1973	12	-2.15
532814	Maungaparerua at Roadside	1982	9	-3.15	1984	12	-2.46	1983	1	-2.34	1983	1	-2.33	1983	8	-2.42	1983	9	-2.84
532820	Waipapa at Puketi State Forest	1985	8	-3.53	1973	5	-2.85	1983	3	-2.65	1983	7	-2.49	1973	5	-2.39	1974	1	-1.73
532821	Maungaparerua at Tyrees Ford	2008	8	-3.55	2006	9	-2.08	1994	6	-2.16	2005	4	-2.01	1994	12	-2.21	1994	12	-2.10
532822	Waitangi at Wiroa Road 2	2020	9	-2.73	2015	7	-1.82	2015	7	-2.07	2015	10	-2.14	2015	12	-2.12	2020	3	-1.61
532901	Kerikeri 1	1950	2	-2.60	1949	9	-3.37	1946	4	-2.66	1950	3	-2.95	1950	3	-2.24	1950	3	-1.92
532903	Kerikeri Aero 2	1984	10	-3.25	1983	1	-2.74	1984	10	-2.62	1984	10	-2.80	1984	12	-2.61	1984	10	-2.68
532905	Kerikeri Aerodrome AWS	2008	6	-2.67	2010	1	-2.33	2019	8	-2.25	2019	8	-2.31	2019	6	-2.14	2020	6	-2.26

		1 Month			3 Month			6 Month			9 Month			12 Month			24 Month		
Gauge ID	Gauge Name	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI
532910	Wairoa at Kerikeri (Carver)	1987	7	-2.97	1987	7	-2.68	1987	7	-2.14	1987	6	-2.32	1987	8	-2.51	1987	9	-2.28
532913	Kerikeri at Waikimihia	1978	8	-3.12	1983	1	-2.39	1979	1	-1.77	1992	5	-1.85	1994	12	-1.90	1994	12	-1.89
532915	Kerikeri at BOI Golf club	2020	9	-3.12	2019	5	-1.83	2019	7	-2.00	2019	3	-2.05	2019	6	-2.24	2020	3	-1.87
533201	Puhata	1993	7	-3.62	2010	1	-3.05	1994	6	-2.40	1994	3	-2.46	1994	6	-2.65	1984	4	-2.32
533301	Rotokakahi at Adams	1988	1	-3.39	1987	10	-3.11	1987	10	-2.93	1987	10	-2.82	1987	10	-3.21	1988	9	-2.18
533302	Rotokakahi at Kohe Road	2023	7	-4.34	2011	10	-2.49	2006	10	-2.85	2007	1	-2.62	2020	3	-2.17	2020	12	-2.36
533501	Kohukohu	1914	9	-4.13	1914	11	-4.20	1914	11	-5.05	1915	2	-4.97	1915	5	-4.25	1915	2	-3.39
533502	Umawera	1982	8	-2.40	1984	11	-2.97	1974	3	-2.04	1984	12	-1.94	1983	5	-1.85	1984	2	-1.70
533601	Rangiahua	1906	10	-2.84	1914	11	-3.66	1915	1	-3.39	1915	1	-3.47	1915	2	-3.14	1915	1	-2.61
533610	Waihou at Crawfords	1993	7	-2.99	1983	9	-2.49	1983	8	-2.19	1983	8	-2.21	1983	7	-2.39	1984	7	-2.09
533710	Lake Omapere at Rototiro	1978	3	-2.64	1970	3	-2.85	1970	3	-2.33	1984	6	-2.11	1984	6	-2.54	1984	10	-2.23
533810	Lake Omapere at Conelley	1972	9	-2.36	1976	7	-2.03	1978	4	-1.87	1978	4	-1.91	1978	3	-1.66	1978	4	-2.06
533812	Utakura at Lake Acres	1993	7	-3.37	1983	1	-2.48	1983	1	-2.32	1978	3	-2.22	1987	8	-2.23	1994	12	-1.90
533813	Waitangi at Ohaeawai (Woods)	2000	8	-4.17	1983	1	-2.47	1991	5	-2.43	1978	4	-2.34	1994	6	-2.24	1994	12	-2.20
533814	Waitangi at Highrisings	1987	7	-3.19	1987	7	-2.70	1987	7	-2.37	1987	7	-2.21	1987	8	-2.10	1983	8	-1.57
533815	Lake Omapere at Faithfull	1982	12	-2.70	1987	8	-2.65	1987	7	-2.16	1987	10	-1.95	1987	8	-1.75	1988	1	-1.59
533817	Waitangi at Ohaeawai	1998	6	-3.00	2010	1	-2.64	2010	3	-2.76	2019	8	-2.60	2020	3	-2.59	2020	4	-2.80
534402	Opononi	1993	7	-4.38	1993	9	-2.42	1998	4	-2.51	1998	6	-2.75	1994	6	-2.77	1998	5	-2.67

		1 Month			3 Month			6 Month			9 Month			12 Month			24 Month		
Gauge ID	Gauge Name	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI
534403	Hokianga Harbour Omapere/Opononi	2006	9	-3.28	2013	3	-1.97	2020	2	-2.09	2020	5	-1.92	2020	4	-1.84	2020	12	-2.01
534503	Rawene 2	1993	7	-3.64	1982	8	-3.05	1982	11	-3.13	1983	1	-3.25	1983	3	-3.38	1983	8	-3.36
534610	Whawharu at Topu B Taheke	2023	7	-2.83	2019	6	-2.17	2019	7	-2.12	2020	1	-1.83	2020	3	-1.88	2020	12	-2.02
534701	Kaikohe	1930	5	-3.06	1922	8	-2.90	1964	1	-2.18	1964	6	-2.18	1931	11	-2.16	1933	1	-2.11
534711	Opahi at Norwest Corner	1969	9	-2.35	1969	9	-2.05	1967	11	-2.16	1978	4	-1.91	1978	4	-2.30	1978	4	-2.04
534716	Opahi at Auto Site	1985	7	-3.07	1966	10	-2.82	1966	12	-2.36	1966	11	-2.07	1967	7	-2.67	1968	2	-2.33
534717	Opahi at Long Valley	1976	6	-2.16	1970	4	-1.88	1967	11	-2.49	1968	1	-2.18	1978	4	-2.20	1975	9	-2.09
534722	Opahi at Cocksfoot	1993	7	-2.76	1993	3	-2.08	1991	2	-1.78	1991	5	-1.81	1987	5	-1.37	1992	5	-1.61
534724	Mangamutu at Kaikohe Hill	2005	4	-2.81	2005	7	-2.96	2005	7	-3.22	2005	9	-2.79	2005	7	-3.10	2005	7	-2.37
534725	Punakitere at Kaikohe Woolshed	1993	7	-2.38	1993	8	-2.02	1991	2	-2.12	1991	5	-2.29	1991	7	-1.96	1992	6	-2.07
534801	Kaikohe Aero	1969	3	-2.27	1976	4	-2.75	1976	7	-2.98	1964	6	-2.44	1973	5	-2.02	1978	1	-2.29
534802	Kaikohe Grasslands, D.S.I.R	1975	7	-2.55	1984	6	-2.30	1984	10	-1.94	1983	1	-1.97	1983	5	-2.23	1984	10	-2.17
534803	Kaikohe M.W.D	1989	12	-2.27	1987	7	-2.27	1987	7	-2.19	1987	7	-2.16	1987	8	-2.17	1987	11	-1.93
534807	Kaikohe AWS	1991	4	-3.26	1991	5	-3.52	1991	5	-3.59	1991	5	-3.15	1991	5	-2.45	1992	3	-2.52
534811	Otiria at Ngapipito	2023	7	-2.77	2020	4	-1.90	2019	8	-1.99	2019	8	-2.20	2019	11	-2.05	2020	4	-1.96
535401	Waiotemarama	1992	12	-3.17	1982	8	-2.59	1982	12	-2.72	1983	1	-2.80	1983	5	-2.64	1983	11	-2.51
535412	Waiotemarama at Tooremburg	2015	12	-2.64	2013	3	-2.24	2000	10	-2.27	2000	10	-2.19	2000	11	-2.41	2006	2	-2.19
535413	Whirinaki at King	1993	7	-3.52	2000	10	-2.86	2020	5	-2.91	2020	5	-2.75	2020	9	-2.76	2020	12	-2.96
535501	Wekaweka	1942	6	-3.94	1954	11	-3.00	1950	12	-2.79	1933	1	-2.70	1950	12	-2.60	1951	11	-2.30

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535510	Waimamaku at Waiora Farm	2004	10	-3.74	1992	5	-3.24	1992	5	-3.10	1982	8	-2.82	1982	11	-2.89	1983	9	-2.79
535512	Waimamaku at Wekaweka(Russell)	1993	7	-3.72	1982	7	-3.09	1982	8	-2.76	1983	1	-2.96	1982	11	-3.00	1983	8	-3.28
535513	Waimamaku at Wekaweka Road	2023	7	-2.74	2015	7	-2.38	2015	9	-2.24	2015	12	-2.50	2015	11	-2.19	2015	12	-1.94
535712	Awarua at Gammons Rd	1985	7	-3.78	1985	9	-2.33	1978	3	-2.35	1983	1	-2.40	1983	4	-2.10	1983	8	-2.07
535812	Awarua at Awarua Block	1972	7	-4.00	1975	2	-3.69	1975	4	-3.14	1975	7	-2.91	1975	8	-2.95	1975	8	-2.27
535813	Awarua at Tokawhero Road	1975	6	-3.06	1973	12	-2.51	1974	12	-2.01	1975	6	-1.92	1975	6	-2.09	1975	8	-1.91
535901	Kauana Downs	1965	9	-2.29	1957	7	-2.22	1964	1	-1.98	1964	4	-2.05	1968	3	-1.81	1968	2	-2.27
536501	Waipoua Visitor Centre	1942	6	-3.07	2000	10	-6.23	2001	1	-5.55	2001	4	-4.52	2006	10	-3.44	2006	8	-3.42
536601	Whatoro	1916	4	-4.44	1949	11	-3.37	1950	2	-3.13	1950	3	-2.38	1950	3	-2.55	1950	11	-2.17
536610	Kaihu at Tutamoe	1963	8	-3.42	1963	10	-3.18	1964	1	-2.64	1964	4	-2.78	1964	4	-2.48	1964	5	-2.34
536611	Mangakahia at TY Ranch	1993	7	-3.62	1982	8	-2.45	1982	11	-2.47	1983	1	-2.70	1983	4	-2.59	1983	11	-2.45
536613	Waima at Tutamoe	2023	7	-3.87	2019	7	-2.19	2019	7	-1.97	2004	11	-2.23	2020	1	-2.32	2020	12	-2.37
536702	Waimatenui 2	1993	7	-3.82	1926	5	-3.21	1915	2	-3.15	1915	2	-3.00	1915	5	-2.69	1915	12	-2.47
536710	Mangakahia at Waimatenui	1970	5	-3.62	1982	9	-2.90	1982	12	-2.58	1970	5	-2.39	1983	4	-2.16	1970	10	-2.16
536711	Mangakahia at Roudershore	1969	3	-2.50	1975	2	-2.60	1975	3	-2.36	1975	4	-2.19	1975	4	-2.15	1975	1	-1.88
536712	Mangakahia at Glenoban	1972	9	-2.89	1967	7	-2.43	1967	10	-2.05	1964	4	-2.32	1968	3	-1.84	1964	5	-1.99

		1 Month			3 Month			6 Month			9 Month			12 Month			24 Month		
Gauge ID	Gauge Name	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI
536811	Opouteke at Kingsclear	1996	10	-3.86	1967	7	-3.56	1983	4	-3.04	1983	4	-3.17	1983	4	-3.51	1983	12	-2.95
536812	Opouteke at Brookvale	2023	7	-3.57	2004	5	-2.79	2004	8	-2.93	2004	11	-2.86	2019	7	-2.52	2020	6	-2.77
536814	Mangakahia at Nukatawhiti	1969	3	-2.43	1963	12	-2.65	1964	1	-2.21	1964	6	-2.60	1964	4	-2.46	1964	6	-2.27
536816	Mangakahia at Twin Bridges	2023	7	-3.55	2010	1	-2.54	1999	10	-2.51	2004	11	-2.40	2020	1	-2.29	2020	6	-2.52
536901	Pipiwai	1985	6	-3.55	1983	1	-2.63	1963	11	-2.77	1964	1	-2.93	1964	4	-2.83	1984	10	-2.44
537510	Kahiu at Katui	1977	4	-3.63	1972	3	-2.82	1982	11	-2.52	1983	1	-2.59	1983	4	-2.14	1964	6	-1.80
537601	Whatoro 2	1994	12	-2.68	2000	10	-2.18	2004	8	-2.50	2004	11	-2.71	2005	2	-2.26	2006	2	-2.21
537602	Trounson Cws	2013	9	-3.36	2010	12	-3.31	2011	3	-2.67	2013	11	-2.09	2014	1	-1.72	2014	3	-2.19
537611	Kaihu at Trounson Park	1991	10	-3.55	1993	9	-3.37	1993	12	-3.45	1994	3	-2.62	1994	6	-2.59	1995	5	-2.54
537613	Kaihu at Kaiiwi Lakes (McLeod)	1993	8	-2.80	1993	9	-2.27	1990	5	-2.01	1993	9	-1.65	1991	1	-1.56	1991	1	-1.36
537614	Kaihu at Whatoro (Haywoods)	2020	2	-2.81	2017	12	-2.60	2020	5	-2.72	2020	5	-3.03	2020	9	-2.59	2020	6	-2.87
537712	Opouteke at Aomarama	1964	3	-2.69	1964	4	-2.46	1964	3	-2.24	1964	5	-2.48	1964	4	-2.06	1964	4	-2.26
537801	Pakotai, Glenmont	1980	8	-4.62	1983	1	-3.41	1983	4	-3.12	1983	1	-2.61	1983	4	-3.03	1964	6	-2.21
537815	Tangowahine at Kereru	1993	7	-3.56	1983	2	-2.43	1982	9	-2.81	1983	2	-2.95	1983	3	-3.04	1984	5	-3.06
537816	Wairoa at Paradise Road	2012	6	-2.77	2012	6	-2.48	2010	1	-2.15	2015	12	-2.10	2013	3	-2.24	2014	3	-2.05
537901	Parakao	1994	12	-3.41	2010	1	-3.14	1993	12	-2.46	1983	1	-2.76	1987	8	-2.79	1988	1	-2.49
538611	Kaiiwi at Kaiiwi Lakes Road	2023	7	-2.71	2022	10	-2.10	2023	12	-1.94	2022	10	-1.91	2022	10	-1.76	2022	10	-1.82

		1 Month			3 Month			6 Month			9 Month			12 Month			24 Month		
Gauge ID	Gauge Name	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI
538710	Kahiu at Maropiu	1976	3	-2.59	1965	11	-1.72	1974	3	-1.81	1970	3	-1.86	1974	12	-1.70	1974	12	-2.00
538801	Mamaranui	1993	7	-3.80	2010	1	-2.82	1973	6	-2.28	1994	3	-2.49	1994	6	-2.71	1974	12	-2.46
538810	Awakino at Nilssons (Nash)	1996	7	-3.38	1967	8	-2.55	1964	6	-2.26	1964	6	-2.62	1964	5	-2.76	1964	7	-2.25
538811	Awakino at Booths	1981	9	-2.24	1971	6	-2.09	1974	3	-1.95	1981	9	-1.75	1973	10	-1.47	1974	10	-1.76
539710	Chases Gorge at Baylys Beach (Andrews)	2008	5	-3.32	2000	10	-4.11	2000	12	-2.96	2001	4	-2.66	2000	11	-2.55	2006	12	-2.14
539801	Dargaville	1907	10	-3.18	1928	1	-3.40	1946	3	-2.84	1933	1	-2.63	1933	1	-2.42	1933	1	-2.92
539802	Dargaville Exp Farm	1999	9	-5.35	1950	4	-4.36	1950	6	-3.33	1950	9	-3.49	1950	12	-3.22	1951	4	-2.97
539803	Dargaville N.Z.E.D.	1988	8	-3.76	1972	9	-2.84	1972	11	-2.36	1973	2	-2.50	1973	5	-2.65	1974	3	-2.68
539807	Dargaville 2 Ews	2003	10	-3.33	2013	3	-2.26	2004	11	-1.99	2012	12	-2.08	2013	3	-2.28	2014	3	-2.39
539811	Wairoa at Dargaville County	1989	8	-2.74	1982	12	-2.46	1983	3	-1.85	1989	10	-1.91	1983	4	-1.64	1990	3	-1.40
539813	Wairoa at Dargaville (Hokianga Road)	2008	8	-3.06	2008	10	-2.68	2009	1	-2.11	2012	12	-2.47	2013	3	-2.46	2014	3	-2.20
541001	Pureua Aws	1991	7	-4.17	1991	7	-4.63	1991	7	-3.71	1991	8	-3.62	1991	8	-3.58	1988	2	-3.78
541301	Cape Brett Lighthouse	1945	11	-2.90	1946	1	-2.94	1946	3	-2.90	1955	6	-2.40	1946	3	-2.69	1946	4	-2.57
542001	Waitangi Forest	1965	9	-2.82	1986	8	-3.14	1986	8	-3.07	1986	11	-2.47	1973	5	-2.32	1978	1	-1.65
542010	Waitangi at Wakelins Block	1995	2	-3.22	1983	1	-2.52	1994	6	-2.32	2005	4	-2.18	2007	1	-2.09	1994	12	-2.26
542101	Russell	1992	8	-4.15	1991	6	-3.45	1930	10	-2.65	1931	1	-2.50	1931	4	-2.54	2020	6	-2.70
542102	Russell Cws	2013	10	-2.60	2011	10	-2.38	2011	11	-1.99	2015	9	-1.88	2015	12	-2.12	2020	4	-1.90
543001	Kawakawa Water Treatment Plant	2009	7	-4.37	2003	8	-4.15	2006	11	-3.16	2007	2	-3.04	1987	9	-2.42	1994	12	-2.78
543003	Kawakawa	1987	10	-2.66	1988	4	-2.36	1987	10	-2.04	1987	10	-2.03	1987	10	-2.30	1987	10	-2.58

		1 Month			3 Month			6 Month			9 Month			12 Month			24 Month		
Gauge ID	Gauge Name	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI
543010	Waitangi at McDonald Road	1986	6	-2.93	1987	6	-3.39	1987	9	-2.81	1987	10	-2.81	1987	10	-2.53	1988	4	-2.34
543012	Waitangi at Whangae	1993	7	-2.88	1983	1	-2.95	1983	1	-2.75	1993	8	-2.48	2020	4	-2.51	1994	12	-2.53
543110	Kawakawa at Opua	2006	8	-2.91	2006	8	-3.11	2006	11	-2.72	1994	6	-2.33	1994	8	-2.20	1995	8	-1.94
543111	Veronica Channel at Opua	2011	8	-2.67	2010	1	-2.30	2010	4	-2.32	2010	4	-2.30	2015	12	-2.49	2016	12	-2.38
543113	Veronica Channel M and P	2009	9	-3.14	2011	8	-2.21	2011	11	-2.25	2010	4	-2.27	2015	12	-2.13	2013	4	-2.29
543310	Punaruka at Russell State Forest	1976	2	-2.18	1986	5	-2.20	1986	8	-1.89	1983	8	-1.74	1983	8	-2.07	1983	8	-1.75
543311	Oakura Bay at Murphy	2005	4	-3.27	2020	2	-2.68	1994	8	-2.34	1994	8	-2.51	2020	2	-2.50	2020	4	-2.88
543312	Oakura Bay at Te Kapua Street	2007	5	-3.64	2007	6	-3.18	2020	6	-3.01	2021	8	-2.70	2021	8	-2.85	2021	8	-2.41
544002	Motarau, Opahi Stn	1974	12	-3.69	1950	3	-3.15	1974	12	-2.83	1950	3	-2.72	1950	3	-2.30	1975	1	-2.28
544101	Towai	1980	3	-2.63	1981	11	-3.27	1981	11	-2.47	1982	1	-2.74	1981	11	-2.89	1982	4	-3.07
544213	Mimiha at Helena Bay Hill Gallery	2020	9	-2.74	2020	2	-2.19	2020	2	-1.92	2019	3	-1.87	2020	2	-2.04	2020	6	-2.12
544311	Kaimamaku at Peach Orchard Road	1982	8	-2.91	1987	7	-2.71	1983	1	-2.60	1987	6	-2.20	1987	8	-2.43	1994	12	-2.23
545013	Waiharakeke at Motatau (Donaldson's)	2007	5	-3.10	2009	12	-2.68	2005	6	-2.36	2004	11	-2.44	2005	6	-2.42	2006	2	-2.68
545014	Waiharakeke at Okaroro Road	2023	7	-3.09	2011	10	-2.38	2019	8	-1.91	2019	9	-2.04	2020	4	-2.09	2020	12	-1.84
545111	Waiotu at Dawson	2020	2	-2.81	2013	3	-2.47	2010	1	-2.22	2010	4	-2.25	1994	12	-2.24	1994	12	-2.37
545201	Whakapara at Puhipuhi	1919	4	-3.27	1914	10	-2.93	1914	10	-3.65	1915	2	-3.82	1914	12	-3.81	1915	1	-4.09

		1 Month			3 Month			6 Month			9 Month			12 Month			24 Month		
Gauge ID	Gauge Name	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI
545210	Wairua at Forstythe Road (McHardys)	1975	6	-3.21	1975	7	-3.04	1975	8	-2.53	1975	7	-2.64	1975	7	-2.33	1974	3	-2.08
545211	Waiotu at Morgans	1965	9	-2.09	1974	1	-1.99	1974	1	-1.81	1973	5	-2.04	1973	5	-2.50	1974	3	-2.44
545212	Waiotu at Waiotu	1982	8	-2.55	1983	1	-2.46	1987	6	-2.44	1987	6	-2.56	1987	9	-2.42	1987	9	-2.22
545213	Waiotu at Hukerenui (Morgans)	1982	8	-2.81	2013	3	-2.49	2006	12	-2.51	1987	9	-2.32	1983	7	-2.49	1983	8	-2.21
545310	Whakapara at Opuawhanga	1974	10	-3.11	1983	1	-2.66	1987	7	-2.25	1987	7	-2.56	1987	9	-2.43	1994	12	-2.43
545311	Kirikiritoki at Maureens	2005	4	-2.34	2004	9	-2.04	2005	6	-2.28	2005	4	-2.29	2005	6	-2.05	2006	2	-1.79
545312	Whakapara at Dandelion	2020	2	-3.03	2020	2	-2.50	2019	7	-2.45	2019	8	-2.57	2019	7	-2.44	2020	3	-2.47
545412	Ngunguru at Taihoa	1987	7	-2.64	1987	7	-2.61	1987	7	-2.35	1987	9	-2.20	1987	12	-2.15	1988	2	-1.86
545501	Matapouri	2011	8	-2.63	2010	1	-2.62	1991	7	-2.25	1991	8	-2.33	2015	12	-2.36	2014	5	-2.16
546001	Puketurua Northland	1969	3	-2.39	1967	7	-2.27	1974	1	-2.21	1973	5	-1.78	1973	5	-2.05	1974	3	-1.90
546030	Puketurua at Pukewaenga	1969	3	-2.36	1973	8	-2.83	1973	11	-2.95	1974	1	-2.99	1974	1	-3.08	1984	7	-2.33
546031	Puketurua at Pukeiti	1978	11	-2.43	1967	7	-2.18	1970	6	-2.13	1970	9	-2.22	1973	5	-2.12	1974	3	-1.91
546032	Puketurua at Woolshed	1974	5	-2.96	1972	9	-3.08	1972	11	-2.90	1972	9	-2.61	1973	3	-2.61	1974	1	-2.24
546103	Ruatangata	1919	4	-2.80	1905	4	-3.05	1914	11	-3.33	1915	2	-3.38	1914	12	-3.06	1915	7	-3.07
546111	Wairua at Rarewa	1972	9	-2.48	1981	9	-2.26	1970	6	-2.06	1969	11	-1.99	1970	6	-2.12	1974	3	-1.63
546202	Hikurangi	1989	5	-3.15	1957	8	-3.14	1957	9	-2.48	1987	6	-2.68	1987	9	-2.62	1988	2	-2.55
546203	Ruatangata No2	1988	11	-3.90	2005	6	-2.69	2005	6	-2.65	1994	3	-2.17	2005	6	-2.33	1994	12	-2.58
546210	Wairua at Matarau 2	1967	6	-2.80	1974	1	-2.15	1973	5	-2.03	1973	2	-1.81	1973	5	-2.22	1974	3	-2.19
546212	Wairua at Jordan Valley	1994	12	-3.47	2004	9	-3.18	2004	9	-2.44	2004	11	-2.52	2005	6	-2.37	2006	2	-2.43

		1 Month			3 Month			6 Month			9 Month			12 Month			24 Month		
Gauge ID	Gauge Name	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI
546216	Okarika at Rowland Rd	2023	8	-3.21	2015	12	-2.45	1990	9	-2.71	1990	10	-2.76	2020	2	-2.50	1991	11	-2.87
546218	Wairua at Cathcart	2007	5	-2.64	1995	9	-3.31	1995	11	-3.03	1994	9	-2.38	1994	9	-2.17	1994	12	-1.91
546301	Hatea at Glenbervie Forest HQ	2005	4	-3.20	1994	8	-3.27	1994	8	-3.39	1994	9	-3.31	1994	12	-3.43	1994	12	-3.15
546310	Waitangi at Totara Block	1976	5	-2.33	1978	3	-2.46	1986	8	-2.17	1986	11	-2.18	1983	9	-1.98	1983	8	-1.75
546315	Hatea at Hansen Orchards	2005	4	-3.19	2007	5	-2.82	2010	1	-2.43	2010	4	-2.30	2007	6	-2.11	1992	4	-2.02
546316	Batt at Glenbervie	2005	4	-2.98	1987	7	-2.42	1987	8	-2.61	1987	9	-2.56	1991	11	-2.39	1992	5	-2.73
546411	Ngunguru at Sands	1973	2	-2.67	1983	1	-2.49	1973	6	-2.62	1983	9	-2.58	1983	9	-2.55	1984	10	-2.01
546412	Ferguson at Kaiatea	1993	7	-2.99	1987	7	-2.67	1987	7	-2.59	2010	4	-2.57	1987	9	-2.35	2020	4	-2.58
546416	Ngunguru at Dugmores Rock	2023	7	-3.70	1991	6	-2.54	2019	7	-2.21	2019	9	-2.35	2020	2	-2.26	2020	6	-2.23
546510	Wairua at Riponui	1993	7	-2.94	1989	4	-2.28	1992	4	-2.09	1991	12	-2.28	1992	4	-2.47	1992	4	-2.50
546512	Lambly at Whangaumu Bay	2007	5	-2.96	2007	6	-2.69	1994	7	-2.34	2010	3	-2.40	1994	9	-2.41	1994	12	-2.05
547001	Wairua Falls	1993	7	-3.75	1919	4	-2.88	1919	4	-3.14	1919	7	-2.96	1919	11	-3.11	1988	1	-2.99
547002	Titoki	2004	7	-3.15	2000	10	-2.42	1983	1	-2.28	1987	6	-2.59	1987	9	-2.62	1984	7	-2.81
547010	Mangakahia at Parakao (Ware)	2020	9	-2.41	2013	3	-1.98	2019	7	-2.09	2019	10	-2.26	2020	1	-2.29	2020	4	-2.22
547112	Whatitiri at Totara Grove	1975	5	-2.54	1983	9	-2.28	1977	6	-2.27	1983	1	-2.15	1984	10	-1.94	1984	2	-2.09
547119	Waipao at Williams (Draffins Road)	2023	7	-3.21	2019	5	-2.15	2019	8	-2.49	2019	9	-2.36	2019	11	-1.90	2020	4	-1.81
547201	Maungatapere	1988	4	-3.64	1950	3	-2.87	1983	4	-2.33	1983	1	-2.56	1983	4	-2.64	1984	4	-2.80
547214	Raumanga at Totara Place	2005	4	-3.55	2000	10	-2.30	2019	8	-2.24	2019	9	-2.35	2020	4	-2.28	1994	12	-2.26

		1 Month			3 Month			6 Month			9 Month			12 Month			24 Month		
Gauge ID	Gauge Name	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI
547215	Otaika at Maungatapere	1986	12	-2.82	1986	12	-2.38	1986	8	-2.35	1986	12	-2.18	1983	5	-2.07	1984	4	-1.81
547219	Otaika at Cemetery Road (Mokupara)	2005	4	-2.72	2013	3	-2.48	2010	4	-2.98	2010	4	-2.82	1987	8	-2.60	1992	4	-2.66
547220	Te Hihi at Te Hihi (Jongkees)	1990	12	-2.89	1994	4	-2.59	1994	4	-2.12	1994	3	-2.22	1994	9	-2.17	1994	12	-2.05
547222	Otaika at Lynwood Farm	1982	8	-2.42	1989	4	-2.15	1973	5	-2.18	1973	5	-2.25	1973	5	-2.33	1992	4	-2.04
547223	Otaika at Redwood Orchard	2005	4	-3.12	2007	6	-2.36	2010	4	-2.45	2010	4	-2.48	1987	9	-2.12	1992	3	-2.40
547224	Otaika at Valley View Rd (McIntosh)	2007	5	-2.92	2005	4	-2.71	2004	9	-2.68	2004	11	-2.60	2005	3	-2.30	2006	2	-2.01
547225	Waipao at Whatatiri (Coopers)	2007	5	-2.62	2010	1	-2.25	2010	1	-2.49	2010	4	-2.45	2010	7	-2.38	2010	7	-2.07
547226	Otaika at Cemetery Road	2023	7	-2.84	2012	6	-2.19	2019	8	-2.13	2019	9	-2.13	2020	4	-1.97	2020	6	-1.67
547302	Whangarei	1930	12	-2.58	1967	7	-2.99	1913	4	-3.26	1915	2	-3.28	1915	5	-2.96	1914	12	-3.07
547303	Whangarei Aero	1951	9	-2.67	1950	3	-2.97	1946	4	-3.08	1987	6	-2.61	1987	9	-2.71	1988	1	-2.45
547304	Whangarei Hospital	1988	10	-2.87	1973	3	-2.03	1987	6	-2.31	1987	6	-2.70	1987	9	-2.44	1988	2	-2.29
547305	Whangarei, Whau Valley	1977	10	-3.31	1976	7	-2.84	1979	1	-2.21	1987	6	-2.20	1987	9	-2.13	1992	4	-2.42
547307	Whangarei Aero Aws	2004	4	-2.62	2004	6	-2.54	2004	9	-3.16	2004	11	-2.56	2005	3	-2.33	2005	10	-2.14
547308	Whangarei Ews	2020	9	-2.30	2019	6	-2.27	2019	8	-2.60	2019	10	-2.51	2019	12	-2.16	2020	12	-1.63
547312	Glenbervie at Waitangi Rd	1977	9	-2.23	1987	7	-1.98	1987	6	-2.60	1987	6	-2.38	1987	9	-2.14	1988	1	-2.11
547315	Raumanga at Kaka St	1990	12	-2.49	1983	9	-2.13	1992	4	-1.43	1992	4	-1.74	1992	4	-1.62	1992	4	-1.99
547316	Hatea at Parahaki (Steele)	1995	6	-2.92	1991	12	-1.90	1992	2	-1.54	1992	4	-1.87	1992	4	-1.77	1992	5	-1.75

		1 Month			3 Month			6 Month			9 Month			12 Month			24 Month		
Gauge ID	Gauge Name	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI
547338	Hatea at Robert Street	2003	10	-3.12	2003	12	-2.33	1999	10	-2.43	1994	10	-1.90	1994	12	-2.04	1994	12	-2.34
547339	Waiarohia at NRC Water Street	2005	4	-3.22	2004	10	-2.20	2004	10	-2.29	2019	9	-2.16	2020	2	-2.03	2020	6	-1.77
547340	Waiarohia at Kensington	2020	7	-2.77	2019	5	-2.56	2019	8	-2.38	2019	9	-2.24	2020	2	-2.34	2020	11	-2.25
547402	Waiparera	1966	8	-2.73	1974	4	-2.25	1974	4	-2.19	1973	2	-1.96	1973	5	-2.15	1974	5	-2.15
547411	Whangarei Harbour at Parua Bay	1993	7	-2.70	1994	4	-2.57	1994	6	-2.44	1994	6	-2.31	1994	12	-2.40	1994	12	-2.51
547412	Massey at Pataua	2000	10	-2.58	2005	10	-2.04	1993	7	-2.46	1993	7	-2.37	1993	7	-2.17	1994	11	-2.47
547503	Parua Bay, Beasley Road	1982	8	-2.53	1983	9	-2.46	1983	9	-1.83	1983	9	-2.04	1983	9	-2.31	1984	6	-1.84
547512	Taiharuru at Taiharuru	1993	7	-2.48	1994	3	-2.11	1994	3	-2.75	1994	6	-2.55	1994	8	-2.53	1994	12	-2.45
548101	Tangihua	1992	7	-4.61	1989	4	-3.06	1987	10	-2.78	1987	9	-2.84	1987	9	-2.95	1988	10	-2.97
548201	Mangapai	1995	8	-2.53	1983	9	-2.43	2004	11	-2.70	2004	11	-2.51	1991	8	-2.64	1992	5	-2.99
548210	Tauraroa at Palmer	1993	7	-2.98	1989	4	-1.99	1993	11	-2.26	1994	3	-2.42	1991	8	-2.24	1992	5	-2.41
548211	Tauraroa at Jones	2008	9	-4.17	2007	6	-3.03	1999	10	-2.23	1983	1	-2.57	1994	6	-2.29	1994	12	-2.70
548212	Whangarei Harbour at N.Z. Refining Co	1987	8	-2.93	1987	9	-3.29	1987	10	-3.62	1988	1	-3.55	1988	1	-3.18	1988	2	-2.67
548213	Ruakaka at Fosters	2020	2	-2.73	2012	7	-3.00	2012	10	-2.77	2010	4	-2.36	2013	3	-2.30	2020	12	-2.12
548214	Tauraroa at Ormandy Rd (Palmer)	2011	9	-2.81	2011	10	-2.34	2010	4	-1.90	2004	11	-2.20	2005	9	-1.93	2013	7	-2.06
548215	Whangarei Harbour at Marsden Point	2012	6	-2.39	2014	5	-2.18	2010	4	-2.15	2010	4	-1.97	2013	3	-1.88	2014	5	-1.64
548310	Ahuroa at Whittles	1987	12	-3.78	1983	9	-2.79	1986	6	-2.30	1988	1	-2.23	2005	7	-2.26	1988	2	-2.53
548311	Ahuroa at Sloanes	1984	4	-2.92	1980	6	-2.94	1973	6	-2.38	1974	4	-2.18	1973	12	-2.40	1974	6	-2.59
548313	Tauraroa at Cotton	1982	12	-2.33	1983	9	-2.64	1976	7	-2.55	1983	1	-2.17	1983	5	-2.22	1984	7	-1.96

		1 Month			3 Month			6 Month			9 Month			12 Month			24 Month		
Gauge ID	Gauge Name	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI
548314	Mangapai at McCullough Road	1993	7	-2.46	1998	6	-2.63	1998	6	-1.89	1998	10	-2.21	1998	10	-2.36	1999	8	-2.33
548315	Waikokopa at McDonnell Road	2023	7	-2.87	2012	6	-2.42	2019	8	-2.11	2019	9	-2.08	2015	12	-1.88	2020	12	-1.53
548402	Marsden Power Station	1989	3	-2.41	1987	7	-2.19	1990	6	-2.42	1987	7	-2.01	1987	9	-2.09	1988	2	-2.39
548410	Waiwarawara at Prescotts	1984	5	-3.53	2001	8	-3.16	1994	3	-2.36	1994	3	-2.82	1994	3	-2.77	1994	12	-2.76
548412	Waiwarawara at Wilson's Dam	2020	2	-2.74	2011	9	-2.96	2011	9	-2.23	2010	4	-2.09	2013	3	-1.82	2014	3	-1.82
548413	Whangarei Harbour at Marsden Point Oil Refinery	2020	4	-2.09	2023	9	-2.19	2019	9	-1.95	2019	8	-1.84	2019	11	-1.83	2020	10	-1.64
549010	Manganui at Monymusk	2007	8	-4.61	1982	8	-2.48	2000	10	-2.46	1982	12	-2.54	1994	6	-2.48	1983	9	-2.64
549011	Manganui at Omana (Bull)	1988	9	-3.41	1987	7	-3.00	1987	10	-2.76	1987	9	-2.77	1987	8	-2.82	1988	2	-2.22
549201	Waikiekie	1958	6	-2.57	1967	7	-2.24	1974	3	-2.09	1957	12	-2.29	1973	5	-1.93	1974	3	-2.59
549211	Taipuha at Keay	2007	1	-3.14	2005	1	-2.34	2005	4	-2.51	2005	4	-2.51	2005	9	-2.37	2006	2	-2.23
549310	Taipuha at Settlement Rd	1975	7	-2.60	1987	8	-2.67	1987	9	-2.32	1987	8	-2.32	1987	9	-2.36	1992	6	-2.15
549402	Waipu, Apple Cross	1965	9	-2.90	1963	10	-2.77	1976	7	-2.36	1973	2	-2.02	1970	2	-2.26	1974	3	-2.57
630901	Arapohue	1993	7	-3.56	2010	1	-5.12	1982	8	-3.21	1982	8	-3.56	1982	8	-3.49	1983	4	-3.26
640010	Nth Wairoa at Naumai	1980	10	-1.97	1983	9	-2.85	1976	7	-2.13	1983	9	-2.44	1983	10	-2.42	1983	9	-2.45
640201	Taipuha	1977	5	-3.93	1972	11	-2.79	1972	11	-2.72	1973	3	-2.92	1973	6	-2.78	1973	10	-2.41
640310	Ahuroa at Finlayson Brook	1996	6	-3.50	1983	9	-1.82	1993	12	-2.03	1994	3	-2.05	1993	10	-1.98	1994	12	-1.84

		1 Month			3 Month			6 Month			9 Month			12 Month			24 Month		
Gauge ID	Gauge Name	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI
640411	Waihoihoi at Glenmohr Road	1975	3	-3.12	1978	1	-2.31	1986	8	-2.07	1983	1	-2.22	1994	6	-2.24	1994	12	-2.13
640436	Waihoihoi at Brynderwyn	2023	7	-3.71	2000	10	-2.48	1999	10	-2.46	2005	4	-2.30	2020	4	-1.95	1994	12	-1.80
640501	Waipu Cove	1951	9	-3.02	1982	8	-2.74	1982	11	-2.75	1983	2	-2.94	1983	4	-2.91	1983	3	-3.03
641001	Ruawai	1951	9	-3.41	1967	7	-2.66	1954	2	-2.35	1983	7	-2.67	1983	4	-2.58	1983	9	-2.72
641010	Awaroa at Wallace Road	2011	8	-2.59	2010	1	-2.14	2010	4	-1.94	2012	12	-2.00	2013	3	-1.92	2014	5	-1.99
641102	Claren Brae (Ruawai)	1994	12	-2.59	2001	8	-2.66	1987	9	-2.40	1994	3	-2.32	1994	6	-2.71	1983	9	-2.74
641201	Paparoa 1	1963	8	-4.59	1946	1	-2.84	1946	3	-3.05	1946	2	-2.98	1946	5	-2.63	1943	3	-2.44
641203	Paparoa 2	1978	3	-2.68	1991	6	-2.52	1991	9	-2.53	1991	12	-2.73	1994	7	-2.61	1992	6	-2.55
641210	Paparoa at Higgins	1993	7	-2.44	2000	11	-2.05	1999	10	-2.18	1993	11	-2.35	1993	12	-2.35	1994	12	-2.52
641213	Paparoa at Maungaturoto	2005	4	-2.79	2011	10	-2.40	2019	8	-2.01	2015	12	-2.16	2015	12	-1.99	2014	3	-2.09
641214	Paparoa at Taylors	2006	9	-3.64	2005	9	-2.95	2005	9	-1.89	2012	12	-1.72	2013	3	-1.92	2014	3	-1.62
641215	Paparoa at Stubbs	2007	5	-2.31	2011	10	-2.40	2021	8	-2.22	2021	8	-2.05	2020	1	-2.15	2020	4	-1.81
641302	Maungaturoto, Melford	1993	7	-3.11	1993	9	-2.47	1986	8	-2.58	1986	11	-2.74	1987	2	-2.65	1988	1	-2.65
641310	Wairua at Northland Dairy CO	2008	6	-3.29	2000	2	-2.48	1994	3	-2.25	1994	3	-2.49	1994	6	-2.64	1994	12	-2.57
641410	Topuni at Saunders	1983	7	-2.20	1983	9	-2.18	1987	9	-1.69	1983	2	-1.77	1983	9	-1.79	1983	9	-1.72
641413	Topuni at Dunn Road (Cook)	1993	6	-2.96	2003	11	-3.11	1993	8	-3.08	1993	10	-3.03	1993	12	-2.82	1994	12	-2.46
641414	Hakaru at Valley Road (Kaiwaka)	2019	5	-2.85	2004	9	-2.56	2004	9	-2.46	2004	11	-2.50	2015	12	-1.78	2020	12	-1.82
641501	Mangawhai	1971	7	-3.75	1921	8	-3.60	1924	4	-5.45	1924	5	-4.00	1924	3	-3.29	1924	5	-3.01

		1 Month			3 Month			6 Month			9 Month			12 Month			24 Month		
Gauge ID	Gauge Name	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI	Year	Month	SPI
641511	Mangawhai Harbour at Tara	1951	9	-3.88	2013	12	-5.47	2014	2	-3.96	2014	2	-3.09	2014	2	-2.99	2014	3	-3.40
641512	Hakaru at Tara	2013	10	-2.53	2015	8	-1.96	2015	10	-1.75	2015	12	-1.98	2015	12	-1.54	2021	1	-1.41
642010	Okoraka at NgatawhitiRoad	2020	2	-2.25	2020	4	-2.28	2020	5	-2.09	2020	5	-1.74	2020	10	-1.78	2020	12	-2.00
642011	Okoraka at Poutu Forest Farms Ltd	1993	7	-2.88	2005	4	-2.49	2004	11	-2.41	2005	5	-2.74	2005	5	-2.80	2006	2	-2.82
642201	Pukehau	1965	9	-3.07	1967	7	-2.68	1974	3	-2.37	1983	7	-2.70	1994	6	-2.75	1983	9	-2.90
642401	Topuni	1950	7	-3.14	1950	9	-2.85	1989	7	-2.47	1983	2	-2.15	1983	9	-2.22	1979	1	-2.35
642415	Hakaru at Topuni Creek Farms	2011	9	-2.56	2012	6	-2.36	2020	4	-1.56	2015	12	-1.65	2015	12	-1.60	2020	4	-1.22
643112	Tauhara at Lake Rotokawau	1986	3	-2.74	1980	4	-2.99	1980	5	-3.32	1980	7	-3.24	1980	7	-3.03	1980	12	-2.70
643116	Swan Lake at Bishops	1993	7	-2.88	1993	9	-2.60	1993	12	-2.92	1994	3	-2.69	1994	6	-2.83	1994	8	-2.19
643118	Kaipara Harbour at Pouto Point	2012	4	-2.61	2007	6	-2.48	2021	8	-2.12	2021	8	-2.05	2020	10	-2.02	2020	12	-2.20

Appendix C Sites based on severity S of worst drought

Table C-1: Ranking of sites based on severity S of worst drought.

auge ID	Gauge Name	Lat	Long	D (months)	S	Year	Start month	Rank
548212	Whangarei Harbour at N.Z. Refining Co	-35.8379	174.4926	10	21.19	1987	5	1
545201	Whakapara at Puhipuhi	-35.5126	174.2718	15	20.66	1913	12	2
541001	Purerua Aws	-35.1254	174.0168	13	19.8	1990	9	3
643112	Tauhara at Lake Rotokawau	-36.3404	174.1582	12	17.76	1979	8	4
533501	Kohukohu	-35.367	173.55	9	16.42	1914	6	5
532402	Broadwood	-35.261	173.39	11	16.23	1967	4	6
542101	Russell	-35.2653	174.1218	18	15.44	2019	1	7
534807	Kaikohe AWS	-35.4172	173.8229	11	14.62	1990	9	8
534503	Rawene 2	-35.4127	173.5191	11	14.34	1982	5	9
643116	Swan Lake at Bishops	-36.3297	174.1426	12	14.04	1993	7	10
546103	Ruatangata	-35.65	174.183	11	13.97	1914	4	11
533601	Rangiahua	-35.3	173.667	11	13.66	1914	4	12
531501	Honeymoon Valley	-35.128	173.495	8	13.52	1972	4	13
547302	Whangarei	-35.729	174.339	11	13.08	1914	4	14
536501	Waipoua Visitor Centre	-35.653	173.558	9	13.04	2000	8	15
641413	Topuni at Dunn Road (Cook)	-36.1415	174.4869	16	12.75	1993	1	16
531201	Kaitaia (Vincent)	-35.114	173.259	7	12.67	1914	6	17
548101	Tangihua	-35.841	174.116	14	12.63	1986	10	18
439201	Waiharara	-34.95	173.195	12	12.06	1973	9	19
531302	Rangitihi Sub Stn	-35.123	173.335	11	11.97	1982	5	20
537510	Kahiu at Katui	-35.4491	173.5787	11	11.86	1982	5	21
546301	Hatea at Glenbervie Forest HQ	-35.6558	174.3452	12	11.79	1993	10	22
641511	Mangawhai Harbour at Tara	-36.1094	174.5231	5	11.75	2013	10	23
532903	Kerikeri Aero 2	-35.2647	173.9113	11	11.44	1984	4	24
530202	Waipapakauri	-35.029	173.243	12	11.37	1986	3	25
547001	Wairua Falls	-35.759	174.067	8	10.94	1918	11	26
537611	Kaihu at Trounson Park	-35.7206	173.6519	6	10.87	1993	7	27
425902	Paua Blk Parengarenga	-34.572	172.893	9	10.83	2009	11	28
531911	Kerikeri at KiaKaha	-35.1944	173.9496	7	10.68	2009	10	29
539802	Dargaville Exp Farm	-35.944	173.835	8	10.57	1950	1	30
537602	Trounson Cws	-35.7204	173.6515	6	10.51	2010	10	31
532820	Waipapa at Puketi State Forest	-35.213	173.7937	5	10.33	1982	11	32
530205	Wiessing at Kaitaia	-35.0679	173.2558	9	10.32	2019	9	33
530701	Kaeo Northland	-35.057	173.74	14	10.25	2019	3	34
535513	Waimamaku at Wekaweka Road	-35.208	173.3579	10	10.23	2015	1	35
534402	Opononi	-35.4869	173.4188	9	10.08	1997	10	36

auge ID	Gauge Name	Lat	Long	D (months)	S	Year	Start month	Rank
547201	Maungatapere	-35.757	174.207	9	9.71	1982	5	37
537614	Kaihu at Whatoro (Haywoods)	-35.7457	173.6793	9	9.7	2019	10	38
531412	Mangamuka at Forest Veiw	-35.1875	173.4708	6	9.58	1984	7	39
531711	Kaeo at Paitu	-35.1184	173.7971	9	9.52	2009	8	40
532311	Takahue at Takahue Top	-35.2074	173.3576	5	9.45	1972	5	41
531209	Pukepoto	-35.1622	173.2018	7	9.38	2019	1	42
532503	Omahuta 2	-35.225	173.59	9	9.23	1982	5	43
532801	Taus Falls	-35.2468	173.8155	6	9.22	1963	8	44
530210	Awanui at Temples	-35.0114	173.2751	8	9.14	1982	8	45
531512	Kanekane at Coopers Beach	-34.9912	173.4406	8	9	2019	10	46
546032	Puketurua at Woolshed	-35.6698	174.0848	4	9	1972	6	47
543312	Oakura Bay at Te Kapua Street	-35.3908	174.3444	4	8.9	2020	1	48
536702	Waimatenui 2	-35.629	173.73	9	8.89	1982	5	49
543003	Kawakawa	-35.384	174.068	8	8.87	1982	8	50
532312	Takahue at Saddle Road	-35.2056	173.3562	8	8.87	2019	10	51
532611	Waipapa at Waihou Valley (Grahams)	-35.2868	173.6971	7	8.82	2009	10	52
424602	Cape Reinga Aws	-34.4296	172.6819	4	8.81	2022	5	53
530206	Kaitaia Aero Ews	-35.0677	173.2878	7	8.8	2019	1	54
547307	Whangarei Aero Aws	-35.7706	174.3629	6	8.8	2004	4	55
531701	Kaeo	-35.1	173.783	6	8.75	1952	3	56
541301	Cape Brett Lighthouse	-35.173	174.329	6	8.65	1945	10	57
437001	Cape View	-34.704	173.029	9	8.62	1990	9	58
548313	Tauraroa at Cotton	-35.8771	174.3084	8	8.62	1977	8	59
531513	Mangonui at Mangonui	-34.9924	173.5359	6	8.46	2009	11	60
641501	Mangawhai	-36.1266	174.5801	7	8.45	1921	2	61
532202	Herekino	-35.266	173.22	6	8.43	1945	10	62
539803	Dargaville N.Z.E.D.	-35.936	173.876	4	8.42	1972	6	63
532905	Kerikeri Aerodrome AWS	-35.2628	173.9114	7	8.42	2009	10	64
533813	Waitangi at Ohaeawai (Woods)	-35.3583	173.8726	8	8.34	1990	12	65
533302	Rotokakahi at Kohe Road	-35.3136	173.3158	9	8.32	2019	10	66
533814	Waitangi at Highrisings	-35.2966	173.8234	8	8.28	1977	8	67
530204	Aupouri Forest at Forest HQ	-35.0104	173.1975	6	8.27	2009	11	68
530301	Kaingaroa North	-35.045	173.338	8	8.23	1982	8	69
531313	Takahue at Te Rore	-35.1781	173.372	7	8.21	2019	1	70
536601	Whatoro	-35.683	173.683	5	8.12	1922	6	71
531205	Kaitaia Observatory	-35.1335	173.2629	6	8.07	2009	11	72
534610	Whawharu at Topu B Taheke	-35.4721	173.6212	8	8.06	2019	10	73
535501	Wekaweka	-35.567	173.55	6	8	1942	1	74
531310	Takahue at Wallace	-35.18	173.3729	7	7.9	1967	4	75

auge ID	Gauge Name	Lat	Long	D (months)	S	Year	Start month	Rank
545501	Matapouri	-35.5657	174.5057	8	7.89	1993	6	76
549211	Taipuha at Keay	-35.9783	174.2893	10	7.85	1982	8	77
439202	Waiharara 2	-34.936	173.215	9	7.84	1993	11	78
630901	Arapohue	-35.998	173.94	4	7.8	1982	5	79
543001	Kawakawa Water Treatment Plant	-35.3804	174.0914	5	7.78	2009	6	80
439501	Mangonui	-34.997	173.532	8	7.77	1982	8	81
534724	Mangamutu at Kaikohe Hill	-35.4123	173.7853	5	7.77	2005	3	82
532710	Waipapa at Puketi Road (Candy)	-35.2621	173.7517	7	7.76	1963	8	83
530801	Matauri Bay	-35.037	173.891	4	7.73	1982	11	84
547223	Otaika at Redwood Orchard	-35.7685	174.2004	6	7.69	2009	11	85
642011	Okoraka at Poutu Forest Farms Ltd	-36.2158	174.0397	9	7.68	2005	1	86
547412	Massey at Pataua	-35.7379	174.4693	8	7.66	1992	12	87
547219	Otaika at Cemetery Road (Mokupara)	-35.7534	174.2525	6	7.62	2009	11	88
539801	Dargaville	-35.935	173.856	5	7.61	1945	11	89
531101	Ahipara	-35.165	173.158	4	7.6	1963	8	90
536710	Mangakahia at Waimatenui	-35.6281	173.7309	5	7.56	1982	5	91
642010	Okoraka at NgatawhitiRoad	-35.4877	173.4537	11	7.55	2019	1	92
543111	Veronica Channel at Opua	-35.3116	174.1196	6	7.48	2009	11	93
539710	Chases Gorge at Baylys Beach (Andrews)	-35.9515	173.7482	6	7.48	2000	7	94
531207	Kaitaia Ews	-35.1335	173.2629	6	7.47	2009	11	95
531411	Victoria at Kitchen	-35.1555	173.4217	6	7.47	2009	11	96
535413	Whirinaki at King	-35.4877	173.4537	6	7.41	2019	12	97
545312	Whakapara at Dandelion	-35.5014	174.2992	8	7.41	2019	1	98
547214	Raumanga at Totara Place	-35.743	174.2961	9	7.37	2009	8	99
549011	Manganui at Omana (Bull)	-35.9218	173.9459	5	7.37	1987	4	100
534716	Opahi at Auto Site	-35.4001	173.7347	6	7.31	1966	6	101
549310	Taipuha at Settlement Rd	-35.9944	174.3007	8	7.24	1969	7	102
535512	Waimamaku at Wekaweka(Russell)	-35.5796	173.5968	8	7.22	2019	10	103
532601	Omahuta 1	-35.233	173.592	6	7.16	1972	4	104
532810	Maungaparerua at Tyrees	-35.2364	173.8798	5	7.16	1982	11	105
533815	Lake Omapere at Faithfull	-35.3381	173.8164	5	7.16	1982	11	106
530810	Matauri Bay at NZ China Clays	-35.0661	173.8951	7	7.12	1991	1	107
544002	Motarau, Opahi Stn	-35.489	174.019	6	7.11	1974	7	108
536711	Mangakahia at Roudershore	-35.6135	173.7537	7	7.11	1974	8	109
548214	Tauraroa at Ormandy Rd (Palmer)	-35.8415	174.2865	6	7.09	2009	11	110
548311	Ahuroa at Sloanes	-35.8836	174.3628	6	7.09	1973	8	111
533610	Waihou at Crawfords	-35.3115	173.6598	7	7.08	1984	4	112
425801	Te Paki Stn, Te Hapua	-34.508	172.795	6	7.05	1941	4	113
531719	Kaeo at Bennetts	-35.0672	173.7712	6	7	2009	11	114

auge ID	Gauge Name	Lat	Long	D (months)	S	Year	Start month	Rank
548213	Ruakaka at Fosters	-35.8814	174.4646	4	6.99	2020	9	115
532910	Wairoa at Kerikeri (Carver)	-35.2296	173.951	5	6.99	1982	11	116
546316	Batt at Glenbervie	-35.65	174.3958	7	6.97	1990	12	117
532814	Maungaparerua at Roadside	-35.2233	173.851	6	6.97	1982	6	118
641001	Ruawai	-36.113	174.023	8	6.91	1967	3	119
542001	Waitangi Forest	-35.258	174.071	6	6.89	1982	10	120
531415	Te Puhi at Mangakawakawa Trig	-35.147	173.4573	6	6.88	2009	11	121
532901	Kerikeri 1	-35.23	173.948	4	6.8	1949	12	122
534701	Kaikohe	-35.432	173.784	6	6.76	1945	10	123
547308	Whangarei Ews	-35.7444	174.3287	6	6.74	2019	11	124
546412	Ferguson at Kaiatea	-35.6125	174.4475	7	6.73	1990	12	125
536816	Mangakahia at Twin Bridges	-35.6289	173.8512	7	6.72	2019	10	126
543010	Waitangi at McDonald Road	-35.3306	174.0308	7	6.72	2009	10	127
543110	Kawakawa at Opua	-35.3143	174.1163	4	6.72	2006	6	128
530601	Oruaiti	-35.017	173.65	5	6.68	1963	8	129
546212	Wairua at Jordan Valley	-35.6015	174.2249	8	6.68	1982	8	130
532811	Maungaparerua at Black Poll	-35.225	173.86	5	6.68	1982	11	131
546202	Hikurangi	-35.621	174.287	6	6.66	1987	1	132
531717	Kaeo at Bramleys	-35.1608	173.7922	7	6.64	2009	10	133
536610	Kaihu at Tutamoe	-35.673	173.6473	3	6.62	1963	8	134
535401	Waiotemarama	-35.531	173.426	5	6.6	1982	5	135
546411	Ngunguru at Sands	-35.603	174.4554	6	6.6	1973	1	136
535510	Waimamaku at Waiora Farm	-35.5724	173.5999	4	6.59	2004	7	137
536611	Mangakahia at TY Ranch	-35.6342	173.6425	5	6.59	1982	5	138
545210	Wairua at Forstythe Road (McHardys)	-35.5745	174.2165	5	6.52	1975	4	139
531203	Kaitaia 3	-35.108	173.258	5	6.49	1972	5	140
538801	Mamaranui	-35.864	173.8	8	6.45	1982	8	141
536811	Opouteke at Kingsclear	-35.6815	173.8142	5	6.44	1982	11	142
537712	Opouteke at Aomarama	-35.7137	173.7419	4	6.43	1964	2	143
548215	Whangarei Harbour at Marsden Point	-35.8341	174.4904	6	6.41	2009	11	144
641302	Maungaturoto, Melford	-36.163	174.374	7	6.33	1993	7	145
530602	Oruaiti 2	-35.013	173.596	9	6.32	1977	8	146
546315	Hatea at Hansen Orchards	-35.6785	174.3379	4	6.32	2007	3	147
543012	Waitangi at Whangae	-35.3486	174.0333	6	6.28	2019	11	148
537801	Pakotai, Glenmont	-35.717	173.822	6	6.25	1977	10	149
537901	Parakao	-35.7175	173.9527	3	6.19	2009	11	150
538810	Awakino at Nilssons (Nash)	-35.8335	173.8419	6	6.17	1982	8	151
546218	Wairua at Cathcart	-35.6723	174.255	6	6.16	1994	1	152
439301	Rangiputa	-34.897	173.348	5	6.15	1970	9	153

auge ID	Gauge Name	Lat	Long	D (months)	S	Year	Start month	Rank
542010	Waitangi at Wakelins Block	-35.2772	174.0517	6	6.15	1982	10	154
531901	Kerikeri EWS	-35.183	173.926	6	6.14	2009	11	155
539807	Dargaville 2 Ews	-35.9315	173.8532	6	6.12	2019	12	156
543310	Punaruka at Russell State Forest	-35.3751	174.3108	4	6.12	1986	3	157
546416	Ngunguru at Dugmores Rock	-35.6006	174.4313	4	6.07	2005	1	158
534811	Otiria at Ngapipito	-35.4378	173.9043	6	6.05	2019	11	159
547224	Otaika at Valley View Rd (McIntosh)	-35.7916	174.2801	4	6.03	2005	1	160
641512	Hakaru at Tara	-36.1077	174.5253	4	5.99	2020	1	161
548310	Ahuroa at Whittles	-35.8707	174.3163	5	5.97	1969	7	162
535712	Awarua at Gammons Rd	-35.5665	173.7774	5	5.97	1985	6	163
640501	Waipu Cove	-36.034	174.507	4	5.94	1982	5	164
530201	Kaitaia Aero	-35.067	173.287	4	5.93	1958	3	165
533817	Waitangi at Ohaeawai	-35.3565	173.8728	6	5.93	2019	11	166
537816	Wairoa at Paradise Road	-35.8709	173.9863	4	5.93	2012	4	167
531910	Kerikeri at Laurenson	-35.1963	173.9483	6	5.87	1982	10	168
547304	Whangarei Hospital	-35.739	174.3	7	5.85	1972	11	169
641210	Paparoa at Higgins	-36.1016	174.2339	5	5.85	1993	7	170
536613	Waima at Tutamoe	-35.6621	173.6507	5	5.84	2019	10	171
536812	Opouteke at Brookvale	-35.6963	173.8665	4	5.84	1989	2	172
530710	Pupuke at Giesbers	-35.1516	173.7106	8	5.84	1984	4	173
533812	Utakura at Lake Acres	-35.3624	173.8232	5	5.82	1982	11	174
642201	Pukehau	-36.208	174.255	4	5.79	1982	5	175
544213	Mimiha at Helena Bay Hill Gallery	-35.4767	174.3279	4	5.78	2019	11	176
533710	Lake Omapere at Rototiro	-35.3422	173.7635	6	5.78	1973	8	177
547339	Waiarohia at NRC Water Street	-35.7256	174.3179	6	5.75	2004	6	178
546030	Puketurua at Pukewaenga	-35.672	174.0792	7	5.7	1970	1	179
548410	Waiwarawara at Prescotts	-35.907	174.4176	2	5.69	1984	4	180
531301	Rangitihi	-35.102	173.335	4	5.67	1958	3	181
535901	Kauana Downs	-35.518	173.913	4	5.67	1958	3	182
534403	Hokianga Harbour Omapere/Opononi	-35.5232	173.3912	6	5.67	2009	11	183
531715	Kaeo at Bramley (Manual)	-35.1608	173.7922	6	5.65	1984	6	184
533502	Umawera	-35.296	173.566	5	5.64	1967	3	185
545412	Ngunguru at Taihoa	-35.5778	174.4471	3	5.62	1987	5	186
641201	Paparoa 1	-36.1	174.25	2	5.58	1958	6	187
539813	Wairoa at Dargaville (Hokianga Road)	-35.9318	173.858	2	5.58	2008	8	188
532501	Mangamuka Bridge	-35.233	173.533	4	5.57	1958	3	189
547303	Whangarei Aero	-35.7696	174.3603	7	5.57	1972	11	190
532913	Kerikeri at Waikimihia	-35.2194	173.975	5	5.57	1982	11	191
531311	Takahue at Diggers Valley	-35.1863	173.2934	5	5.55	1974	10	192

auge ID	Gauge Name	Lat	Long	D (months)	S	Year	Start month	Rank
641214	Paparoa at Taylors	-36.1093	174.2676	2	5.54	2005	7	193
549010	Manganui at Monymusk	-35.9947	174.0459	2	5.54	2007	8	194
533201	Puhata	-35.302	173.231	3	5.53	2009	11	195
547010	Mangakahia at Parakao (Ware)	-35.7121	174.0015	7	5.49	2019	10	196
641213	Paparoa at Maungaturoto	-36.0902	174.3505	4	5.46	2020	1	197
640201	Taipuha	-36.003	174.279	4	5.43	1969	3	198
545013	Waiharakeke at Motatau (Donaldson's)	-35.518	174.036	4	5.4	2009	10	199
545212	Waiotu at Waiotu	-35.5032	174.2295	5	5.4	1974	7	200
547503	Parua Bay, Beasley Road	-35.743	174.526	5	5.33	1978	9	201
542102	Russell Cws	-35.2684	174.136	3	5.28	2011	7	202
537613	Kaihu at Kaiiwi Lakes(McLeod)	-35.8208	173.6456	5	5.28	1993	7	203
536712	Mangakahia at Glenoban	-35.6163	173.7135	4	5.27	1967	4	204
640436	Waihoihoi at Brynderwyn	-36.0451	174.4162	4	5.25	2020	1	205
640310	Ahuroa at Finlayson Brook	-36.0223	174.3712	5	5.24	1993	7	206
547119	Waipao at Williams (Draffins Road)	-35.7252	174.1277	4	5.23	2020	1	207
536901	Pipiwai	-35.654	173.999	5	5.22	1982	11	208
535412	Waiotemarama at Tooremburg	-35.5337	173.4387	5	5.21	2000	7	209
531413	Te Puhi at Stanton	-35.1417	173.4298	3	5.2	1987	5	210
544311	Kaimamaku at Peach Orchard Road	-35.4771	174.2987	5	5.19	1982	11	211
546310	Waitangi at Totara Block	-35.6416	174.4651	4	5.18	1977	12	212
547338	Hatea at Robert Street	-35.7246	174.3245	3	5.15	2003	10	213
642401	Topuni	-36.217	174.459	2	5.14	1950	7	214
545111	Waiotu at Dawson	-35.4996	174.1492	5	5.13	2020	1	215
548211	Tauraroa at Jones	-35.8369	174.2802	3	5.1	2007	4	216
547315	Raumanga at Kaka St	-35.7327	174.3213	3	5.09	1983	7	217
548412	Waiwarawara at Wilson's Dam	-35.8973	174.4165	4	5.09	2020	1	218
532711	Waipapa at Puketi R/V	-35.2171	173.7435	4	5.07	1984	8	219
535813	Awarua at Tokawhero Road	-35.5727	173.8922	3	5.07	1975	4	220
531210	Tarawhataroa at Larmer Road	-35.1507	173.2763	4	5.06	2020	9	221
534722	Opahi at Cocksfoot	-35.4065	173.7216	7	5.06	1986	6	222
547215	Otaika at Maungatapere	-35.7703	174.2002	3	5.06	1986	10	223
641414	Hakaru at Valley Road (Kaiwaka)	-36.266	174.6535	4	5.03	2020	1	224
641102	Claren Brae (Ruawai)	-36.129	174.121	5	5	1982	11	225
547220	Te Hihi at Te Hihi (Jongkees)	-35.7371	174.2659	4	5	1988	7	226
535812	Awarua at Awarua Block	-35.559	173.833	3	4.99	1984	4	227
545213	Waiotu at Hukerenui (Morgans)	-35.5215	174.2014	5	4.96	1987	5	228
547411	Whangarei Harbour at Parua Bay	-35.7688	174.4536	5	4.96	1987	5	229
548315	Waikokopa at McDonnell Road	-35.8877	174.3224	4	4.91	2020	1	230
532510	Mangamuka at Mangamuka	-35.2501	173.5525	5	4.88	1977	1	231

auge ID	Gauge Name	Lat	Long	D (months)	S	Year	Start month	Rank
545310	Whakapara at Opuawhanga	-35.5124	174.3532	4	4.86	1987	5	232
534801	Kaikohe Aero	-35.453	173.817	4	4.85	1958	3	233
536814	Mangakahia at Nukatawhiti	-35.6397	173.849	5	4.85	1967	3	234
546210	Wairua at Matarau 2	-35.6376	174.2221	7	4.84	1972	11	235
530511	Oruru at Bowling Club	-35.0406	173.4901	4	4.83	2011	6	236
547226	Otaika at Cemetery Road	-35.7533	174.2525	4	4.77	2020	1	237
547112	Whatitiri at Totara Grove	-35.7625	174.1724	3	4.76	1983	7	238
640411	Waihoihoi at Glenmohr Road	-36.0422	174.4326	5	4.73	1982	11	239
545014	Waiharakeke at Okaroro Road	-35.5186	174.0341	2	4.71	2011	8	240
543311	Oakura Bay at Murphy	-35.39	174.3433	4	4.69	2005	1	241
547305	Whangarei, Whau Valley	-35.706	174.294	3	4.66	1977	8	242
531718	Touwai at Weta	-35.0588	173.8402	3	4.66	2011	7	243
546216	Okarika at Rowland Rd	-35.6121	174.1655	4	4.66	2009	10	244
641010	Awaroa at Wallace Road	-36.1269	174.0658	4	4.66	2012	4	245
546203	Ruatangata No2	-35.665	174.214	2	4.64	1988	10	246
547002	Titoki	-35.714	174.057	3	4.64	2000	8	247
547402	Waiparera	-35.714	174.471	5	4.64	1969	10	248
539811	Wairoa at Dargaville County	-35.9415	173.862	3	4.63	1982	10	249
549201	Waikiekie	-35.953	174.249	4	4.61	1958	3	250
537815	Tangowahine at Kereru	-35.7399	173.8382	3	4.57	1983	8	251
548413	Whangarei Harbour at Marsden Point Oil Refinery	-35.8379	174.4926	4	4.52	2020	1	252
532812	Maungaparerua at Airstrip	-35.2213	173.8795	3	4.52	1973	11	253
531713	Kaeo at Waihuka	-35.153	173.7567	3	4.49	1976	5	254
538811	Awakino at Booths	-35.8011	173.8445	3	4.49	1981	7	255
532822	Waitangi at Wiroa Road 2	-35.2784	173.8337	4	4.45	2020	1	256
437010	Waihopo at Kimberley Road	-34.7633	173.046	2	4.43	2020	9	257
532813	Maungaparerua at Flats	-35.2371	173.8281	3	4.41	1973	11	258
546512	Lambly at Whangaumu Bay	-35.6343	174.5292	4	4.39	2011	6	259
548210	Tauraroa at Palmer	-35.8317	174.2699	3	4.39	1989	2	260
534717	Opahi at Long Valley	-35.4099	173.7489	4	4.38	1973	10	261
548201	Mangapai	-35.845	174.296	3	4.37	2000	8	262
549402	Waipu, Apple Cross	-35.942	174.406	3	4.35	1963	8	263
531716	Kaeo at Kaeo	-35.1424	173.8312	2	4.32	1993	6	264
643118	Kaipara Harbour at Pouto Point	-36.3626	174.1822	3	4.3	2017	10	265
547340	Waiarohia at Kensington	-35.7102	174.3143	3	4.29	2007	4	266
545311	Kirikiritoki at Maureens	-35.5653	174.3752	4	4.28	2005	1	267
641215	Paparoa at Stubbs	-36.1564	174.2257	3	4.23	2007	4	268
642415	Hakaru at Topuni Creek Farms	-36.2036	174.4929	3	4.22	2012	4	269

auge ID	Gauge Name	Lat	Long	D (months)	S	Year	Start month	Rank
547222	Otaika at Lynwood Farm	-35.7445	174.2495	4	4.21	1989	2	270
533301	Rotokakahi at Adams	-35.3152	173.3159	4	4.16	2000	7	271
546510	Wairua at Riponui	-35.6154	174.1157	3	4.14	1989	2	272
532821	Maungaparerua at Tyrees Ford	-35.2347	173.8843	4	4.09	2006	9	273
548402	Marsden Power Station	-35.878	174.47	3	3.98	1989	2	274
641203	Paparoa 2	-36.103	174.233	3	3.98	1978	1	275
641410	Topuni at Saunders	-36.1906	174.4568	3	3.94	1983	7	276
534803	Kaikohe M.W.D	-35.399	173.807	4	3.91	1989	2	277
534725	Punakitere at Kaikohe Woolshed	-35.4329	173.7968	3	3.91	1993	6	278
537601	Whatoro 2	-35.729	173.675	3	3.78	2000	8	279
543113	Veronica Channel M and P	-35.3268	174.1278	2	3.73	2009	8	280
547312	Glenbervie at Waitangi Rd	-35.6461	174.3472	2	3.62	1987	5	281
538611	Kaiiwi at Kaiiwi Lakes Road	-35.5229	173.3916	3	3.57	2017	10	282
532915	Kerikeri at BOI Golf club	-35.226	173.9422	2	3.56	2020	9	283
544101	Towai	-35.493	174.13	2	3.55	1958	3	284
538710	Kahiu at Maropiu	-35.7993	173.7405	2	3.55	1976	2	285
534711	Opahi at Norwest Corner	-35.392	173.7322	3	3.49	1976	6	286
546031	Puketurua at Pukeiti	-35.6753	174.0781	3	3.48	1978	9	287
641310	Wairua at Northland Dairy CO	-36.1034	174.3741	2	3.46	2007	4	288
547512	Taiharuru at Taiharuru	-35.7323	174.551	5	3.38	1991	2	289
546001	Puketurua Northland	-35.673	174.08	2	3.35	1967	6	290
547225	Waipao at Whatatiri (Coopers)	-35.7672	174.1707	3	3.33	2007	4	291
546111	Wairua at Rarewa	-35.6427	174.1659	2	3.33	1976	5	292
548314	Mangapai at McCullough Road	-35.8405	174.308	2	3.26	1995	8	293
547316	Hatea at Parahaki (Steele)	-35.7304	174.3439	2	3.1	1993	7	294
545211	Waiotu at Morgans	-35.5021	174.2062	3	3.1	1969	3	295
534802	Kaikohe Grasslands, D.S.I.R	-35.424	173.823	2	2.58	1982	8	296
533810	Lake Omapere at Conelley	-35.3256	173.8029	1	2.36	1972	9	297

Appendix D Ranking of sites based on duration D of worst drought

Table D-1: Ranking of sites based on duration D of worst drought.

Gauge ID	Gauge Name	Lat	Long	D (months)	S	Year	Start month	Rank
542101	Russell	-35.2653	174.1218	18	15.44	2019	1	1
641413	Topuni at Dunn Road (Cook)	-36.1415	174.4869	16	12.75	1993	1	2
545201	Whakapara at Puhipuhi	-35.5126	174.2718	15	20.66	1913	12	3
530701	Kaeo Northland	-35.057	173.74	14	10.25	2019	3	4
548101	Tangihua	-35.841	174.116	14	12.63	1986	10	5
541001	Purerua Aws	-35.1254	174.0168	13	19.8	1990	9	6
439201	Waiharara	-34.95	173.195	12	12.06	1973	9	7
530202	Waipapakauri	-35.029	173.243	12	11.37	1986	3	8
546301	Hatea at Glenbervie Forest HQ	-35.6558	174.3452	12	11.79	1993	10	9
643112	Tauhara at Lake Rotokawau	-36.3404	174.1582	12	17.76	1979	8	10
643116	Swan Lake at Bishops	-36.3297	174.1426	12	14.04	1993	7	11
531302	Rangitihi Sub Stn	-35.123	173.335	11	11.97	1982	5	12
532402	Broadwood	-35.261	173.39	11	16.23	1967	4	13
532903	Kerikeri Aero 2	-35.2647	173.9113	11	11.44	1984	4	14
533601	Rangiahua	-35.3	173.667	11	13.66	1914	4	15
534503	Rawene 2	-35.4127	173.5191	11	14.34	1982	5	16
546103	Ruatangata	-35.65	174.183	11	13.97	1914	4	17
547302	Whangarei	-35.729	174.339	11	13.08	1914	4	18
534807	Kaikohe AWS	-35.4172	173.8229	11	14.62	1990	9	19
642010	Okoraka at Ngatawhiti Road	-35.4877	173.4537	11	7.55	2019	1	20
537510	Kahiu at Katui	-35.4491	173.5787	11	11.86	1982	5	21
536501	Waipoua Visitor Centre	-35.653	173.558	10	10.42	2007	8	22
536702	Waimatenui 2	-35.629	173.73	10	6.35	1932	4	23
548212	Whangarei Harbour at N.Z. Refining Co	-35.8379	174.4926	10	21.19	1987	5	24
549211	Taipuha at Keay	-35.9783	174.2893	10	7.85	1982	8	25
535513	Waimamaku at Wekaweka Road	-35.208	173.3579	10	10.23	2015	1	26
425801	Te Paki Stn, Te Hapua	-34.508	172.795	9	5.48	1972	4	27
425902	Paua Blk Parengarenga	-34.572	172.893	9	10.83	2009	11	28
437001	Cape View	-34.704	173.029	9	8.62	1990	9	29
439202	Waiharara 2	-34.936	173.215	9	7.84	1993	11	30
439501	Mangonui	-34.997	173.532	9	7.23	1992	12	31
530602	Oruaiti 2	-35.013	173.596	9	6.32	1977	8	32
531201	Kaitaia (Vincent)	-35.114	173.259	9	9.77	1932	5	33
532503	Omahuta 2	-35.225	173.59	9	9.23	1982	5	34
533501	Kohukohu	-35.367	173.55	9	16.42	1914	6	35
534402	Opononi	-35.4869	173.4188	9	10.08	1997	10	36

Gauge ID	Gauge Name	Lat	Long	D (months)	S	Year	Start month	Rank
547201	Maungatapere	-35.757	174.207	9	9.71	1982	5	37
533302	Rotokakahi at Kohe Road	-35.3136	173.3158	9	8.32	2019	10	38
530205	Wiessing at Kaitaia	-35.0679	173.2558	9	10.32	2019	9	39
531711	Kaeo at Paitu	-35.1184	173.7971	9	9.52	2009	8	40
537614	Kaihu at Whatoro (Haywoods)	-35.7457	173.6793	9	9.7	2019	10	41
547214	Raumanga at Totara Place	-35.743	174.2961	9	7.37	2009	8	42
642011	Okoraka at Poutu Forest Farms Ltd	-36.2158	174.0397	9	7.68	2005	1	43
530301	Kaingaroa North	-35.045	173.338	8	8.23	1982	8	44
531501	Honeymoon Valley	-35.128	173.495	8	13.52	1972	4	45
532601	Omahuta 1	-35.233	173.592	8	6.81	1962	11	46
536601	Whatoro	-35.683	173.683	8	5.66	1950	5	47
538801	Mamaranui	-35.864	173.8	8	6.45	1982	8	48
539802	Dargaville Exp Farm	-35.944	173.835	8	10.57	1950	1	49
543003	Kawakawa	-35.384	174.068	8	8.87	1982	8	50
545501	Matapouri	-35.5657	174.5057	8	7.89	1993	6	51
547001	Wairua Falls	-35.759	174.067	8	10.94	1918	11	52
641001	Ruawai	-36.113	174.023	8	6.91	1967	3	53
534610	Whawharu at Topu B Taheke	-35.4721	173.6212	8	8.06	2019	10	54
530710	Pupuke at Giesbers	-35.1516	173.7106	8	5.84	1984	4	55
531512	Kanekane at Coopers Beach	-34.9912	173.4406	8	9	2019	10	56
532311	Takahue at Takahue Top	-35.2074	173.3576	8	8.9	2019	10	57
532710	Waipapa at Puketi Road (Candy)	-35.2621	173.7517	8	6.92	1990	12	58
533813	Waitangi at Ohaeawai (Woods)	-35.3583	173.8726	8	8.34	1990	12	59
535512	Waimamaku at Wekaweka (Russell)	-35.5796	173.5968	8	7.22	2019	10	60
545312	Whakapara at Dandelion	-35.5014	174.2992	8	7.41	2019	1	61
546212	Wairua at Jordan Valley	-35.6015	174.2249	8	6.68	1982	8	62
547224	Otaika at Valley View Rd (McIntosh)	-35.7916	174.2801	8	5.43	1997	10	63
547412	Massey at Pataua	-35.7379	174.4693	8	7.66	1992	12	64
548313	Tauraroa at Cotton	-35.8771	174.3084	8	8.62	1977	8	65
549310	Taipuha at Settlement Rd	-35.9944	174.3007	8	7.24	1969	7	66
530210	Awanui at Temples	-35.0114	173.2751	8	9.14	1982	8	67
532910	Wairoa at Kerikeri (Carver)	-35.2296	173.951	8	5.82	1977	8	68
533814	Waitangi at Highrisings	-35.2966	173.8234	8	8.28	1977	8	69
532312	Takahue at Saddle Road	-35.2056	173.3562	8	8.87	2019	10	70
530601	Oruaiti	-35.017	173.65	7	5.3	1962	12	71
531209	Pukepoto	-35.1622	173.2018	7	9.38	2019	1	72
532202	Herekino	-35.266	173.22	7	6.24	1984	4	73
547303	Whangarei Aero	-35.7696	174.3603	7	5.57	1972	11	74
547304	Whangarei Hospital	-35.739	174.3	7	5.85	1972	11	75

Gauge ID	Gauge Name	Lat	Long	D (months)	S	Year	Start month	Rank
641302	Maungaturoto, Melford	-36.163	174.374	7	6.33	1993	7	76
641501	Mangawhai	-36.1266	174.5801	7	8.45	1921	2	77
530206	Kaitaia Aero Ews	-35.0677	173.2878	7	8.8	2019	1	78
531207	Kaitaia Ews	-35.1335	173.2629	7	7.46	2019	1	79
532905	Kerikeri Aerodrome AWS	-35.2628	173.9114	7	8.42	2009	10	80
531313	Takahue at Te Rore	-35.1781	173.372	7	8.21	2019	1	81
531717	Kaeo at Bramleys	-35.1608	173.7922	7	6.64	2009	10	82
536816	Mangakahia at Twin Bridges	-35.6289	173.8512	7	6.72	2019	10	83
543010	Waitangi at McDonald Road	-35.3306	174.0308	7	6.72	2009	10	84
530810	Matauri Bay at NZ China Clays	-35.0661	173.8951	7	7.12	1991	1	85
531310	Takahue at Wallace	-35.18	173.3729	7	7.9	1967	4	86
531513	Mangonui at Mangonui	-34.9924	173.5359	7	6.34	2006	6	87
531911	Kerikeri at KiaKaha	-35.1944	173.9496	7	10.68	2009	10	88
532611	Waipapa at Waihou Valley (Grahams)	-35.2868	173.6971	7	8.82	2009	10	89
533610	Waihou at Crawfords	-35.3115	173.6598	7	7.08	1984	4	90
535413	Whirinaki at King	-35.4877	173.4537	7	5.62	2019	1	91
546316	Batt at Glenbervie	-35.65	174.3958	7	6.97	1990	12	92
546412	Ferguson at Kaiatea	-35.6125	174.4475	7	6.73	1990	12	93
547010	Mangakahia at Parakao (Ware)	-35.7121	174.0015	7	5.49	2019	10	94
534722	Opahi at Cocksfoot	-35.4065	173.7216	7	5.06	1986	6	95
546030	Puketurua at Pukewaenga	-35.672	174.0792	7	5.7	1970	1	96
536711	Mangakahia at Roudershore	-35.6135	173.7537	7	7.11	1974	8	97
546210	Wairua at Matarau 2	-35.6376	174.2221	7	4.84	1972	11	98
531205	Kaitaia Observatory	-35.1335	173.2629	6	8.07	2009	11	99
531301	Rangitihi	-35.102	173.335	6	5.42	1942	1	100
531701	Kaeo	-35.1	173.783	6	8.75	1952	3	101
532801	Taus Falls	-35.2468	173.8155	6	9.22	1963	8	102
534701	Kaikohe	-35.432	173.784	6	6.76	1945	10	103
535501	Wekaweka	-35.567	173.55	6	8	1942	1	104
537801	Pakotai, Glenmont	-35.717	173.822	6	6.25	1977	10	105
541301	Cape Brett Lighthouse	-35.173	174.329	6	8.65	1945	10	106
542001	Waitangi Forest	-35.258	174.071	6	6.89	1982	10	107
544002	Motarau, Opahi Stn	-35.489	174.019	6	7.11	1974	7	108
546202	Hikurangi	-35.621	174.287	6	6.66	1987	1	109
547503	Parua Bay, Beasley Road	-35.743	174.526	6	4.02	1977	12	110
641102	Claren Brae (Ruawai)	-36.129	174.121	6	3.77	1974	7	111
531901	Kerikeri EWS	-35.183	173.926	6	6.14	2009	11	112
537602	Trounson Cws	-35.7204	173.6515	6	10.51	2010	10	113
539807	Dargaville 2 Ews	-35.9315	173.8532	6	6.12	2019	12	114

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547307	Whangarei Aero Aws	-35.7706	174.3629	6	8.8	2004	4	115
547308	Whangarei Ews	-35.7444	174.3287	6	6.74	2019	11	116
531415	Te Puhi at Mangakawakawa Trig	-35.147	173.4573	6	6.88	2009	11	117
533817	Waitangi at Ohaeawai	-35.3565	173.8728	6	5.93	2019	11	118
534403	Hokianga Harbour Omapere/Opononi	-35.5232	173.3912	6	5.67	2009	11	119
534811	Otiria at Ngapipito	-35.4378	173.9043	6	6.05	2019	11	120
543111	Veronica Channel at Opua	-35.3116	174.1196	6	7.48	2009	11	121
546416	Ngunguru at Dugmores Rock	-35.6006	174.4313	6	5.28	2004	6	122
547339	Waiarohia at NRC Water Street	-35.7256	174.3179	6	5.75	2004	6	123
548215	Whangarei Harbour at Marsden Point	-35.8341	174.4904	6	6.41	2009	11	124
641511	Mangawhai Harbour at Tara	-36.1094	174.5231	6	6.49	1999	5	125
530204	Aupouri Forest at Forest HQ	-35.0104	173.1975	6	8.27	2009	11	126
531411	Victoria at Kitchen	-35.1555	173.4217	6	7.47	2009	11	127
531715	Kaeo at Bramley (Manual)	-35.1608	173.7922	6	5.65	1984	6	128
531719	Kaeo at Bennetts	-35.0672	173.7712	6	7	2009	11	129
531910	Kerikeri at Laurenson	-35.1963	173.9483	6	5.87	1982	10	130
534724	Mangamutu at Kaikohe Hill	-35.4123	173.7853	6	4.97	2004	6	131
536811	Opouteke at Kingsclear	-35.6815	173.8142	6	5.79	1999	5	132
537611	Kaihu at Trounson Park	-35.7206	173.6519	6	10.87	1993	7	133
538810	Awakino at Nilssons (Nash)	-35.8335	173.8419	6	6.17	1982	8	134
539710	Chases Gorge at Baylys Beach (Andrews)	-35.9515	173.7482	6	7.48	2000	7	135
542010	Waitangi at Wakelins Block	-35.2772	174.0517	6	6.15	1982	10	136
543012	Waitangi at Whangae	-35.3486	174.0333	6	6.28	2019	11	137
543110	Kawakawa at Opua	-35.3143	174.1163	6	6.04	1997	10	138
546218	Wairua at Cathcart	-35.6723	174.255	6	6.16	1994	1	139
546315	Hatea at Hansen Orchards	-35.6785	174.3379	6	6.09	2019	11	140
547219	Otaika at Cemetery Road (Mokupara)	-35.7534	174.2525	6	7.62	2009	11	141
547223	Otaika at Redwood Orchard	-35.7685	174.2004	6	7.69	2009	11	142
548211	Tauraroa at Jones	-35.8369	174.2802	6	4.27	1972	12	143
548214	Tauraroa at Ormandy Rd (Palmer)	-35.8415	174.2865	6	7.09	2009	11	144
548311	Ahuroa at Sloanes	-35.8836	174.3628	6	7.09	1973	8	145
531412	Mangamuka at Forest Veiw	-35.1875	173.4708	6	9.58	1984	7	146
532811	Maungaparerua at Black Poll	-35.225	173.86	6	4.67	1977	10	147
534716	Opahi at Auto Site	-35.4001	173.7347	6	7.31	1966	6	148
531713	Kaeo at Waihuka	-35.153	173.7567	6	3.24	1977	10	149
532814	Maungaparerua at Roadside	-35.2233	173.851	6	6.97	1982	6	150
533710	Lake Omapere at Rototiro	-35.3422	173.7635	6	5.78	1973	8	151
546411	Ngunguru at Sands	-35.603	174.4554	6	6.6	1973	1	152
439301	Rangiputa	-34.897	173.348	5	6.15	1970	9	153

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530201	Kaitaia Aero	-35.067	173.287	5	4.82	1972	5	154
531203	Kaitaia 3	-35.108	173.258	5	6.49	1972	5	155
532901	Kerikeri 1	-35.23	173.948	5	6.42	1952	3	156
533502	Umawera	-35.296	173.566	5	5.64	1967	3	157
534801	Kaikohe Aero	-35.453	173.817	5	4.18	1967	3	158
535401	Waiotemarama	-35.531	173.426	5	6.6	1982	5	159
536901	Pipiwai	-35.654	173.999	5	5.22	1982	11	160
537901	Parakao	-35.7175	173.9527	5	5.74	1952	3	161
539801	Dargaville	-35.935	173.856	5	7.61	1945	11	162
539803	Dargaville N.Z.E.D.	-35.936	173.876	5	4.56	1987	4	163
543001	Kawakawa Water Treatment Plant	-35.3804	174.0914	5	7.78	2009	6	164
547402	Waiparera	-35.714	174.471	5	4.64	1969	10	165
641201	Paparoa 1	-36.1	174.25	5	4.63	1940	8	166
642201	Pukehau	-36.208	174.255	5	5.71	1982	11	167
424602	Cape Reinga Aws	-34.4296	172.6819	5	6.31	1998	1	168
536613	Waima at Tutamoe	-35.6621	173.6507	5	5.84	2019	10	169
536812	Opouteke at Brookvale	-35.6963	173.8665	5	5.34	1994	2	170
543312	Oakura Bay at Te Kapua Street	-35.3908	174.3444	5	6.81	2020	9	171
546216	Okarika at Rowland Rd	-35.6121	174.1655	5	3.69	2014	1	172
641213	Paparoa at Maungaturoto	-36.0902	174.3505	5	4.06	2011	7	173
531716	Kaeo at Kaeo	-35.1424	173.8312	5	3.81	1992	11	174
532913	Kerikeri at Waikimihia	-35.2194	173.975	5	5.57	1982	11	175
533812	Utakura at Lake Acres	-35.3624	173.8232	5	5.82	1982	11	176
535412	Waiotemarama at Tooremburg	-35.5337	173.4387	5	5.21	2000	7	177
535510	Waimamaku at Waiora Farm	-35.5724	173.5999	5	4.53	1982	11	178
536611	Mangakahia at TY Ranch	-35.6342	173.6425	5	6.59	1982	5	179
537613	Kaihu at Kaiiwi Lakes (McLeod)	-35.8208	173.6456	5	5.28	1993	7	180
544311	Kaimamaku at Peach Orchard Road	-35.4771	174.2987	5	5.19	1982	11	181
545111	Waiotu at Dawson	-35.4996	174.1492	5	5.13	2020	1	182
545212	Waiotu at Waiotu	-35.5032	174.2295	5	5.4	1974	7	183
545213	Waiotu at Hukerenui (Morgans)	-35.5215	174.2014	5	4.96	1987	5	184
547411	Whangarei Harbour at Parua Bay	-35.7688	174.4536	5	4.96	1987	5	185
547512	Taiharuru at Taiharuru	-35.7323	174.551	5	3.38	1991	2	186
548213	Ruakaka at Fosters	-35.8814	174.4646	5	5.94	2020	1	187
548310	Ahuroa at Whittles	-35.8707	174.3163	5	5.97	1969	7	188
548410	Waiwarawara at Prescotts	-35.907	174.4176	5	4.89	1994	8	189
549011	Manganui at Omana (Bull)	-35.9218	173.9459	5	7.37	1987	4	190
640310	Ahuroa at Finlayson Brook	-36.0223	174.3712	5	5.24	1993	7	191
640411	Waihoihoi at Glenmohr Road	-36.0422	174.4326	5	4.73	1982	11	192

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641210	Paparoa at Higgins	-36.1016	174.2339	5	5.85	1993	7	193
536710	Mangakahia at Waimatenui	-35.6281	173.7309	5	7.56	1982	5	194
531311	Takahue at Diggers Valley	-35.1863	173.2934	5	5.55	1974	10	195
532510	Mangamuka at Mangamuka	-35.2501	173.5525	5	4.88	1977	1	196
532810	Maungaparerua at Tyrees	-35.2364	173.8798	5	7.16	1982	11	197
532820	Waipapa at Puketi State Forest	-35.213	173.7937	5	10.33	1982	11	198
533815	Lake Omapere at Faithfull	-35.3381	173.8164	5	7.16	1982	11	199
535712	Awarua at Gammons Rd	-35.5665	173.7774	5	5.97	1985	6	200
536814	Mangakahia at Nukatawhiti	-35.6397	173.849	5	4.85	1967	3	201
545210	Wairua at Forstythe Road (McHardys)	-35.5745	174.2165	5	6.52	1975	4	202
530801	Matauri Bay	-35.037	173.891	4	7.73	1982	11	203
531101	Ahipara	-35.165	173.158	4	7.6	1963	8	204
532501	Mangamuka Bridge	-35.233	173.533	4	5.57	1958	3	205
533201	Puhata	-35.302	173.231	4	5.27	1982	5	206
533301	Rotokakahi at Adams	-35.3152	173.3159	4	4.16	2000	7	207
534803	Kaikohe M.W.D	-35.399	173.807	4	3.91	1989	2	208
535901	Kauana Downs	-35.518	173.913	4	5.67	1958	3	209
547002	Titoki	-35.714	174.057	4	4.01	1990	11	210
549201	Waikiekie	-35.953	174.249	4	4.61	1958	3	211
549402	Waipu, Apple Cross	-35.942	174.406	4	4.1	1965	9	212
630901	Arapohue	-35.998	173.94	4	7.8	1982	5	213
640201	Taipuha	-36.003	174.279	4	5.43	1969	3	214
640501	Waipu Cove	-36.034	174.507	4	5.94	1982	5	215
642401	Topuni	-36.217	174.459	4	2.73	1988	9	216
530511	Oruru at Bowling Club	-35.0406	173.4901	4	4.83	2011	6	217
531210	Tarawhataroa at Larmer Road	-35.1507	173.2763	4	5.06	2020	9	218
531718	Touwai at Weta	-35.0588	173.8402	4	4.39	2019	11	219
547119	Waipao at Williams (Draffins Road)	-35.7252	174.1277	4	5.23	2020	1	220
547226	Otaika at Cemetery Road	-35.7533	174.2525	4	4.77	2020	1	221
548315	Waikokopa at McDonnell Road	-35.8877	174.3224	4	4.91	2020	1	222
548412	Waiwarawara at Wilson's Dam	-35.8973	174.4165	4	5.09	2020	1	223
548413	Whangarei Harbour at Marsden Point Oil Refinery	-35.8379	174.4926	4	4.52	2020	1	224
640436	Waihoihoi at Brynderwyn	-36.0451	174.4162	4	5.25	2020	1	225
641010	Awaroa at Wallace Road	-36.1269	174.0658	4	4.66	2012	4	226
641512	Hakaru at Tara	-36.1077	174.5253	4	5.99	2020	1	227
642415	Hakaru at Topuni Creek Farms	-36.2036	174.4929	4	3.3	2018	7	228
537816	Wairoa at Paradise Road	-35.8709	173.9863	4	5.93	2012	4	229
539811	Wairoa at Dargaville County	-35.9415	173.862	4	2.97	1987	5	230

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539813	Wairoa at Dargaville (Hokianga Road)	-35.9318	173.858	4	5.13	2012	4	231
543311	Oakura Bay at Murphy	-35.39	174.3433	4	4.69	2005	1	232
544213	Mimiha at Helena Bay Hill Gallery	-35.4767	174.3279	4	5.78	2019	11	233
545013	Waiharakeke at Motatau (Donaldson's)	-35.518	174.036	4	5.4	2009	10	234
545310	Whakapara at Opuawhanga	-35.5124	174.3532	4	4.86	1987	5	235
545311	Kirikiritoki at Maureens	-35.5653	174.3752	4	4.28	2005	1	236
546512	Lambly at Whangaumu Bay	-35.6343	174.5292	4	4.39	2011	6	237
547220	Te Hihi at Te Hihi (Jongkees)	-35.7371	174.2659	4	5	1988	7	238
547222	Otaika at Lynwood Farm	-35.7445	174.2495	4	4.21	1989	2	239
549010	Manganui at Monymusk	-35.9947	174.0459	4	3.35	1994	11	240
641215	Paparoa at Stubbs	-36.1564	174.2257	4	3.68	2011	8	241
641414	Hakaru at Valley Road (Kaiwaka)	-36.266	174.6535	4	5.03	2020	1	242
532711	Waipapa at Puketi R/V	-35.2171	173.7435	4	5.07	1984	8	243
532821	Maungaparerua at Tyrees Ford	-35.2347	173.8843	4	4.09	2006	9	244
546032	Puketurua at Woolshed	-35.6698	174.0848	4	9	1972	6	245
534717	Opahi at Long Valley	-35.4099	173.7489	4	4.38	1973	10	246
535812	Awarua at Awarua Block	-35.559	173.833	4	4.58	1984	8	247
536610	Kaihu at Tutamoe	-35.673	173.6473	4	5.33	1967	4	248
536712	Mangakahia at Glenoban	-35.6163	173.7135	4	5.27	1967	4	249
537712	Opouteke at Aomarama	-35.7137	173.7419	4	6.43	1964	2	250
543310	Punaruka at Russell State Forest	-35.3751	174.3108	4	6.12	1986	3	251
546310	Waitangi at Totara Block	-35.6416	174.4651	4	5.18	1977	12	252
532822	Waitangi at Wiroa Road 2	-35.2784	173.8337	4	4.45	2020	1	253
537601	Whatoro 2	-35.729	173.675	3	3.78	2000	8	254
546001	Puketurua Northland	-35.673	174.08	3	3.17	1965	9	255
546203	Ruatangata No2	-35.665	174.214	3	4.32	1993	6	256
547305	Whangarei, Whau Valley	-35.706	174.294	3	4.66	1977	8	257
548201	Mangapai	-35.845	174.296	3	4.37	2000	8	258
548402	Marsden Power Station	-35.878	174.47	3	3.98	1989	2	259
641203	Paparoa 2	-36.103	174.233	3	3.98	1978	1	260
542102	Russell Cws	-35.2684	174.136	3	5.28	2011	7	261
532915	Kerikeri at BOI Golf club	-35.226	173.9422	3	3.2	2012	4	262
534725	Punakitere at Kaikohe Woolshed	-35.4329	173.7968	3	3.91	1993	6	263
538611	Kaiiwi at Kaiiwi Lakes Road	-35.5229	173.3916	3	3.57	2017	10	264
545014	Waiharakeke at Okaroro Road	-35.5186	174.0341	3	3.86	2012	4	265
547315	Raumanga at Kaka St	-35.7327	174.3213	3	5.09	1983	7	266
547338	Hatea at Robert Street	-35.7246	174.3245	3	5.15	2003	10	267
547340	Waiarohia at Kensington	-35.7102	174.3143	3	4.29	2007	4	268
641214	Paparoa at Taylors	-36.1093	174.2676	3	4.61	2012	4	269

Gauge ID	Gauge Name	Lat	Long	D (months)	S	Year	Start month	Rank
643118	Kaipara Harbour at Pouto Point	-36.3626	174.1822	3	4.3	2017	10	270
537815	Tangowahine at Kereru	-35.7399	173.8382	3	4.57	1983	8	271
546510	Wairua at Riponui	-35.6154	174.1157	3	4.14	1989	2	272
547225	Waipao at Whatatiri (Coopers)	-35.7672	174.1707	3	3.33	2007	4	273
548210	Tauraroa at Palmer	-35.8317	174.2699	3	4.39	1989	2	274
641310	Wairua at Northland Dairy CO	-36.1034	174.3741	3	3.22	2007	10	275
546031	Puketurua at Pukeiti	-35.6753	174.0781	3	3.48	1978	9	276
531413	Te Puhi at Stanton	-35.1417	173.4298	3	5.2	1987	5	277
532812	Maungaparerua at Airstrip	-35.2213	173.8795	3	4.52	1973	11	278
532813	Maungaparerua at Flats	-35.2371	173.8281	3	4.41	1973	11	279
534711	Opahi at Norwest Corner	-35.392	173.7322	3	3.49	1976	6	280
535813	Awarua at Tokawhero Road	-35.5727	173.8922	3	5.07	1975	4	281
538811	Awakino at Booths	-35.8011	173.8445	3	4.49	1981	7	282
545211	Waiotu at Morgans	-35.5021	174.2062	3	3.1	1969	3	283
545412	Ngunguru at Taihoa	-35.5778	174.4471	3	5.62	1987	5	284
547112	Whatitiri at Totara Grove	-35.7625	174.1724	3	4.76	1983	7	285
547215	Otaika at Maungatapere	-35.7703	174.2002	3	5.06	1986	10	286
641410	Topuni at Saunders	-36.1906	174.4568	3	3.94	1983	7	287
437010	Waihopo at Kimberley Road	-34.7633	173.046	3	4.19	2020	1	288
534802	Kaikohe Grasslands, D.S.I.R	-35.424	173.823	2	2.58	1982	8	289
544101	Towai	-35.493	174.13	2	3.55	1958	3	290
543113	Veronica Channel M and P	-35.3268	174.1278	2	3.73	2009	8	291
547316	Hatea at Parahaki (Steele)	-35.7304	174.3439	2	3.1	1993	7	292
548314	Mangapai at McCullough Road	-35.8405	174.308	2	3.26	1995	8	293
538710	Kahiu at Maropiu	-35.7993	173.7405	2	3.55	1976	2	294
546111	Wairua at Rarewa	-35.6427	174.1659	2	3.33	1976	5	295
547312	Glenbervie at Waitangi Rd	-35.6461	174.3472	2	3.62	1987	5	296
533810	Lake Omapere at Conelley	-35.3256	173.8029	1	2.36	1972	9	297

Appendix E Mann–Kendall test statistics for all site

Table E-1: Mann–Kendall test statistics for all sites. The Z test statistics are to reject null hypothesis H0 of no trend (for 95% critical value Z= + 1.645), the exact level of significance is the p-value and it will be less than the chosen level of significance if there is a trend (HA, the alternative hypothesis, of a trend, shown as true (T) or false (F)). (Rows presented in ascending Gauge ID order).

Gauge ID	Gauge Name	TREND	HA	p-value	Z
424602	Cape Reinga Aws	no trend	F	0.4366	-0.7779
425801	Te Paki Stn, Te Hapua	no trend	F	0.9727	-0.0342
425902	Paua Blk Parengarenga	decreasing	T	0.0274	-2.2059
437001	Cape View	no trend	F	0.1077	-1.6088
437010	Waihopo at Kimberley Road	no trend	F	0.6914	0.397
439201	Waiharara	no trend	F	0.0805	1.748
439202	Waiharara 2	no trend	F	0.0977	-1.656
439301	Rangiputa	no trend	F	0.1248	1.535
439501	Mangonui	no trend	F	0.8455	-0.1948
530201	Kaitaia Aero	no trend	F	0.5386	-0.615
530202	Waipapakauri	decreasing	T	0.0029	-2.9786
530204	Aupouri Forest at Forest HQ	increasing	T	0.0147	2.4393
530205	Wiessing at Kaitaia	no trend	F	0.2871	-1.0644
530206	Kaitaia Aero Ews	no trend	F	0.9419	0.0729
530210	Awanui at Temples	no trend	F	0.2097	-1.2544
530301	Kaingaroa North	no trend	F	0.1755	-1.3546
530511	Oruru at Bowling Club	no trend	F	0.7317	0.3429
530601	Oruaiti	no trend	F	0.119	-1.5592
530602	Oruaiti 2	no trend	F	0.3274	-0.9793
530701	Kaeo Northland	no trend	F	0.8824	0.1479
530710	Pupuke at Giesbers	no trend	F	0.1672	1.3812
530801	Matauri Bay	no trend	F	0.3234	-0.9875
530810	Matauri Bay at NZ China Clays	no trend	F	0.8363	0.2067
531101	Ahipara	no trend	F	0.215	-1.2399
531201	Kaitaia (Vincent)	no trend	F	0.4287	0.7914
531203	Kaitaia 3	no trend	F	0.5562	-0.5885
531205	Kaitaia Observatory	no trend	F	0.623	0.4916
531207	Kaitaia Ews	no trend	F	0.7098	-0.3721
531209	Pukepoto	no trend	F	0.4062	-0.8306
531210	Tarawhataroa at Larmer Road	no trend	F	0.6468	0.4582
531301	Rangitihi	no trend	F	0.2719	1.0987
531302	Rangitihi Sub Stn	decreasing	T	0.0181	-2.3636
531310	Takahue at Wallace	no trend	F	0.6016	0.5221
531311	Takahue at Diggers Valley	no trend	F	0.492	0.6872

Gauge ID	Gauge Name	TREND	HA	p-value	Z
531313	Takahue at Te Rore	no trend	F	0.6698	-0.4265
531411	Victoria at Kitchen	increasing	T	0.0004	3.5194
531412	Mangamuka at Forest Veiw	no trend	F	0.607	0.5144
531413	Te Puhi at Stanton	no trend	F	0.6131	-0.5056
531415	Te Puhi at Mangakawakawa Trig	no trend	F	0.7643	0.2999
531501	Honeymoon Valley	no trend	F	0.8648	-0.1703
531512	Kanekane at Coopers Beach	no trend	F	0.8898	-0.1385
531513	Mangonui at Mangonui	no trend	F	0.516	-0.6496
531701	Kaeo	no trend	F	0.7821	0.2766
531711	Kaeo at Paitu	no trend	F	0.5502	-0.5975
531713	Kaeo at Waihuka	no trend	F	0.7005	-0.3847
531715	Kaeo at Bramley (Manual)	no trend	F	0.6279	-0.4847
531716	Kaeo at Kaeo	no trend	F	0.2207	1.2245
531717	Kaeo at Bramleys	no trend	F	0.4733	0.7171
531718	Touwai at Weta	no trend	F	0.3051	1.0256
531719	Kaeo at Bennetts	no trend	F	0.9093	-0.1139
531901	Kerikeri EWS	no trend	F	0.7134	-0.3673
531910	Kerikeri at Laurenson	no trend	F	0.7978	0.2562
531911	Kerikeri at KiaKaha	no trend	F	0.4274	0.7937
532202	Herekino	no trend	F	0.1231	-1.542
532311	Takahue at Takahue Top	no trend	F	0.5617	0.5803
532312	Takahue at Saddle Road	no trend	F	0.5328	0.6238
532402	Broadwood	decreasing	T	0.0086	-2.6286
532501	Mangamuka Bridge	no trend	F	0.8173	-0.231
532503	Omahuta 2	increasing	T	0.0413	2.0404
532510	Mangamuka at Mangamuka	no trend	F	0.844	0.1967
532601	Omahuta 1	no trend	F	0.2077	-1.26
532611	Waipapa at Waihou Valley (Grahams)	no trend	F	0.9918	0.0103
532710	Waipapa at Puketi Road (Candy)	no trend	F	0.7391	0.333
532711	Waipapa at Puketi R/V	no trend	F	0.6372	-0.4716
532801	Taus Falls	no trend	F	0.0656	-1.8413
532810	Maungaparerua at Tyrees	decreasing	T	0.0035	-2.916
532811	Maungaparerua at Black Poll	no trend	F	0.5431	0.6082
532812	Maungaparerua at Airstrip	no trend	F	0.7953	-0.2594
532813	Maungaparerua at Flats	no trend	F	0.5251	0.6356
532814	Maungaparerua at Roadside	no trend	F	0.234	-1.1902
532820	Waipapa at Puketi State Forest	no trend	F	0.6317	-0.4793
532821	Maungaparerua at Tyrees Ford	no trend	F	0.5313	-0.626
532822	Waitangi at Wiroa Road 2	increasing	T	0.0457	1.9985
532901	Kerikeri 1	no trend	F	0.3805	0.8771

Gauge ID	Gauge Name	TREND	HA	p-value	Z
532903	Kerikeri Aero 2	no trend	F	0.1226	1.544
532905	Kerikeri Aerodrome AWS	no trend	F	0.2774	1.0863
532910	Wairoa at Kerikeri (Carver)	no trend	F	0.5795	-0.5542
532913	Kerikeri at Waikimihia	decreasing	T	0.0221	-2.289
532915	Kerikeri at BOI Golf club	no trend	F	0.0814	1.7425
533201	Puhata	no trend	F	0.8104	-0.2399
533301	Rotokakahi at Adams	no trend	F	0.4362	-0.7787
533302	Rotokakahi at Kohe Road	no trend	F	0.7086	0.3737
533501	Kohukohu	no trend	F	0.0772	1.7674
533502	Umawera	no trend	F	0.0895	-1.6979
533601	Rangiahua	no trend	F	0.9152	0.1065
533610	Waihou at Crawfords	no trend	F	0.5251	-0.6355
533710	Lake Omapere at Rototiro	no trend	F	0.9403	0.0749
533810	Lake Omapere at Conelley	no trend	F	0.0773	-1.7666
533812	Utakura at Lake Acres	no trend	F	0.9688	-0.0391
533813	Waitangi at Ohaeawai (Woods)	no trend	F	0.6499	-0.4538
533814	Waitangi at Highrisings	no trend	F	0.6596	-0.4405
533815	Lake Omapere at Faithfull	no trend	F	0.962	-0.0476
533817	Waitangi at Ohaeawai	no trend	F	0.5445	-0.6061
534402	Opononi	decreasing	T	0.0052	-2.7935
534403	Hokianga Harbour Omapere/Opononi	no trend	F	0.9324	-0.0848
534503	Rawene 2	increasing	T	0.0122	2.5076
534610	Whawharu at Topu B Taheke	no trend	F	0.7739	-0.2872
534701	Kaikohe	no trend	F	0.3635	0.9087
534711	Opahi at Norwest Corner	no trend	F	0.7244	-0.3525
534716	Opahi at Auto Site	no trend	F	0.2567	1.1342
534717	Opahi at Long Valley	no trend	F	0.9421	-0.0726
534722	Opahi at Cocksfoot	no trend	F	0.7698	-0.2926
534724	Mangamutu at Kaikohe Hill	no trend	F	0.3589	-0.9175
534725	Punakitere at Kaikohe Woolshed	no trend	F	0.3889	0.8617
534801	Kaikohe Aero	no trend	F	0.3703	-0.8959
534802	Kaikohe Grasslands, D.S.I.R	no trend	F	0.5165	0.6488
534803	Kaikohe M.W.D	decreasing	T	0.0013	-3.2205
534807	Kaikohe AWS	increasing	T	0.013	2.4825
534811	Otiria at Ngapipito	no trend	F	0.3222	0.99
535401	Waiotemarama	no trend	F	0.817	-0.2314
535412	Waiotemarama at Tooremburg	no trend	F	0.2786	1.0835
535413	Whirinaki at King	no trend	F	0.7063	-0.3768
535501	Wekaweka	decreasing	T	0.0187	-2.3512
535510	Waimamaku at Waiora Farm	no trend	F	0.2547	-1.139

Gauge ID	Gauge Name	TREND	HA	p-value	Z
535512	Waimamaku at Wekaweka(Russell)	no trend	F	0.2872	1.0642
535513	Waimamaku at Wekaweka Road	increasing	T	0.0044	2.8492
535712	Awarua at Gammons Rd	decreasing	T	0.0127	-2.4927
535812	Awarua at Awarua Block	no trend	F	0.9939	0.0077
535813	Awarua at Tokawhero Road	decreasing	T	0.0293	-2.1799
535901	Kauana Downs	no trend	F	0.6489	-0.4553
536501	Waipoua Visitor Centre	decreasing	T	0	-5.7818
536601	Whatoro	no trend	F	0.921	-0.0991
536610	Kaihu at Tutamoe	no trend	F	0.8943	0.1329
536611	Mangakahia at TY Ranch	no trend	F	0.1608	-1.4022
536613	Waima at Tutamoe	no trend	F	0.6227	-0.492
536702	Waimatenui 2	no trend	F	0.7747	-0.2862
536710	Mangakahia at Waimatenui	no trend	F	0.0788	1.7577
536711	Mangakahia at Roudershore	no trend	F	0.0561	-1.9104
536712	Mangakahia at Glenoban	no trend	F	0.7634	0.301
536811	Opouteke at Kingsclear	no trend	F	0.1603	1.4039
536812	Opouteke at Brookvale	no trend	F	0.622	0.493
536814	Mangakahia at Nukatawhiti	no trend	F	0.8683	0.1658
536816	Mangakahia at Twin Bridges	no trend	F	0.2489	1.153
536901	Pipiwai	no trend	F	0.1971	-1.2897
537510	Kahiu at Katui	no trend	F	0.2186	1.2303
537601	Whatoro 2	no trend	F	0.9695	0.0382
537602	Trounson Cws	no trend	F	0.2666	1.111
537611	Kaihu at Trounson Park	no trend	F	0.102	-1.635
537613	Kaihu at Kaiiwi Lakes(McLeod)	increasing	T	0.0173	2.3795
537614	Kaihu at Whatoro (Haywoods)	no trend	F	0.6616	-0.4377
537712	Opouteke at Aomarama	no trend	F	0.8855	-0.144
537801	Pakotai, Glenmont	no trend	F	0.5458	0.6041
537815	Tangowahine at Kereru	increasing	T	0.0003	3.648
537816	Wairoa at Paradise Road	no trend	F	0.4465	0.7612
537901	Parakao	no trend	F	0.2674	-1.1091
538611	Kaiiwi at Kaiiwi Lakes Road	no trend	F	0.1073	-1.6106
538710	Kahiu at Maropiu	no trend	F	0.0705	-1.8085
538801	Mamaranui	no trend	F	0.4021	-0.8378
538810	Awakino at Nilssons (Nash)	no trend	F	0.9086	0.1148
538811	Awakino at Booths	no trend	F	0.2255	1.2119
539710	Chases Gorge at Baylys Beach (Andrews)	decreasing	T	0.0323	-2.1401
539801	Dargaville	no trend	F	0.2835	-1.0725
539802	Dargaville Exp Farm	no trend	F	0.4837	-0.7004
539803	Dargaville N.Z.E.D.	no trend	F	0.3145	-1.0059

Gauge ID	Gauge Name	TREND	HA	p-value	Z
539807	Dargaville 2 Ews	no trend	F	0.7776	0.2825
539811	Wairoa at Dargaville County	no trend	F	0.4777	-0.71
539813	Wairoa at Dargaville (Hokianga Road)	no trend	F	0.5576	-0.5864
541001	Purerua Aws	increasing	T	0.0027	2.9971
541301	Cape Brett Lighthouse	no trend	F	0.6298	-0.482
542001	Waitangi Forest	no trend	F	0.8701	0.1636
542010	Waitangi at Wakelins Block	no trend	F	0.7877	0.2693
542101	Russell	no trend	F	0.0638	-1.8533
542102	Russell Cws	no trend	F	0.8882	-0.1406
543001	Kawakawa Water Treatment Plant	no trend	F	0.0644	-1.8493
543003	Kawakawa	increasing	T	0.049	1.9685
543010	Waitangi at McDonald Road	increasing	T	0.0071	2.6936
543012	Waitangi at Whangae	increasing	T	0.024	2.2569
543110	Kawakawa at Opua	no trend	F	0.5765	-0.5585
543111	Veronica Channel at Opua	no trend	F	0.9628	0.0466
543113	Veronica Channel M and P	no trend	F	0.218	1.2319
543310	Punaruka at Russell State Forest	no trend	F	0.5398	0.6132
543311	Oakura Bay at Murphy	no trend	F	0.7007	0.3843
543312	Oakura Bay at Te Kapua Street	no trend	F	0.252	-1.1455
544002	Motarau, Opahi Stn	no trend	F	0.7667	0.2967
544101	Towai	no trend	F	0.1548	-1.4227
544213	Mimiha at Helena Bay Hill Gallery	no trend	F	0.7395	0.3325
544311	Kaimamaku at Peach Orchard Road	no trend	F	0.4725	0.7184
545013	Waiharakeke at Motatau (Donaldson's)	no trend	F	0.6324	0.4783
545014	Waiharakeke at Okaroro Road	no trend	F	0.4522	0.7517
545111	Waiotu at Dawson	no trend	F	0.7077	-0.3749
545201	Whakapara at Puhipuhi	no trend	F	0.9228	-0.097
545210	Wairua at Forstythe Road (McHardys)	no trend	F	0.5272	-0.6322
545211	Waiotu at Morgans	no trend	F	0.64	-0.4677
545212	Waiotu at Waiotu	no trend	F	0.481	-0.7047
545213	Waiotu at Hukerenui (Morgans)	no trend	F	0.252	1.1456
545310	Whakapara at Opuawhanga	no trend	F	0.2846	-1.0701
545311	Kirikiritoki at Maureens	no trend	F	0.2064	-1.2635
545312	Whakapara at Dandelion	no trend	F	0.9731	-0.0337
545412	Ngunguru at Taihoa	no trend	F	0.9205	0.0998
545501	Matapouri	no trend	F	0.0719	-1.8
546001	Puketurua Northland	no trend	F	0.0724	-1.7964
546030	Puketurua at Pukewaenga	no trend	F	0.1599	-1.4054
546031	Puketurua at Pukeiti	no trend	F	0.4403	-0.7717
546032	Puketurua at Woolshed	no trend	F	0.099	-1.6496

Gauge ID	Gauge Name	TREND	HA	p-value	Z
546103	Ruatangata	no trend	F	0.5763	0.5589
546111	Wairua at Rarewa	no trend	F	0.7152	-0.3649
546202	Hikurangi	no trend	F	0.2645	-1.1159
546203	Ruatangata No2	no trend	F	0.2121	-1.2477
546210	Wairua at Matarau 2	no trend	F	0.7599	-0.3056
546212	Wairua at Jordan Valley	decreasing	T	0.038	-2.0751
546216	Okarika at Rowland Rd	no trend	F	0.9341	0.0827
546218	Wairua at Cathcart	no trend	F	0.4496	0.756
546301	Hatea at Glenbervie Forest HQ	decreasing	T	0.0064	-2.725
546310	Waitangi at Totara Block	no trend	F	0.7375	0.3351
546315	Hatea at Hansen Orchards	no trend	F	0.1274	1.5245
546316	Batt at Glenbervie	no trend	F	0.1201	1.5545
546411	Ngunguru at Sands	no trend	F	0.3554	-0.9242
546412	Ferguson at Kaiatea	no trend	F	0.1601	-1.4048
546416	Ngunguru at Dugmores Rock	no trend	F	0.7818	0.2769
546510	Wairua at Riponui	no trend	F	0.6171	0.4999
546512	Lambly at Whangaumu Bay	no trend	F	0.7888	0.2678
547001	Wairua Falls	no trend	F	0.2473	-1.1569
547002	Titoki	no trend	F	0.6235	-0.4909
547010	Mangakahia at Parakao (Ware)	no trend	F	0.9955	-0.0056
547112	Whatitiri at Totara Grove	no trend	F	0.679	-0.4138
547119	Waipao at Williams (Draffins Road)	no trend	F	0.3628	0.91
547201	Maungatapere	no trend	F	0.0985	-1.6523
547214	Raumanga at Totara Place	no trend	F	0.8867	0.1425
547215	Otaika at Maungatapere	no trend	F	0.1549	-1.4223
547219	Otaika at Cemetery Road (Mokupara)	no trend	F	0.4933	-0.6851
547220	Te Hihi at Te Hihi (Jongkees)	increasing	T	0.0049	2.8142
547222	Otaika at Lynwood Farm	no trend	F	0.5731	0.5635
547223	Otaika at Redwood Orchard	no trend	F	0.3815	0.8751
547224	Otaika at Valley View Rd (McIntosh)	no trend	F	0.6908	0.3978
547225	Waipao at Whatatiri (Coopers)	no trend	F	0.0666	-1.8346
547226	Otaika at Cemetery Road	no trend	F	0.5707	0.567
547302	Whangarei	no trend	F	0.3457	0.9429
547303	Whangarei Aero	no trend	F	0.8205	-0.2269
547304	Whangarei Hospital	no trend	F	0.2997	-1.0371
547305	Whangarei, Whau Valley	decreasing	T	0.0198	-2.3302
547307	Whangarei Aero Aws	no trend	F	0.8269	0.2187
547308	Whangarei Ews	no trend	F	0.1218	1.5471
547312	Glenbervie at Waitangi Rd	no trend	F	0.5148	0.6513
547315	Raumanga at Kaka St	no trend	F	0.8548	-0.183

Gauge ID	Gauge Name	TREND	HA	p-value	Z
547316	Hatea at Parahaki (Steele)	no trend	F	0.0948	-1.6704
547338	Hatea at Robert Street	no trend	F	0.6371	0.4718
547339	Waiarohia at NRC Water Street	no trend	F	0.2367	1.1833
547340	Waiarohia at Kensington	no trend	F	0.061	-1.8732
547402	Waiparera	no trend	F	0.2299	-1.2006
547411	Whangarei Harbour at Parua Bay	no trend	F	0.204	1.2703
547412	Massey at Pataua	no trend	F	0.2234	1.2174
547503	Parua Bay, Beasley Road	no trend	F	0.2873	-1.064
547512	Taiharuru at Taiharuru	no trend	F	0.4727	0.7181
548101	Tangihua	decreasing	T	0	-4.3435
548201	Mangapai	decreasing	T	0.0044	-2.8492
548210	Tauraroa at Palmer	increasing	T	0.0188	2.3494
548211	Tauraroa at Jones	no trend	F	0.5729	-0.5637
548212	Whangarei Harbour at N.Z. Refining Co	increasing	T	0.0009	3.3206
548213	Ruakaka at Fosters	no trend	F	0.6889	-0.4004
548214	Tauraroa at Ormandy Rd (Palmer)	no trend	F	0.782	-0.2768
548215	Whangarei Harbour at Marsden Point	no trend	F	0.6434	-0.4629
548310	Ahuroa at Whittles	no trend	F	0.1835	-1.3301
548311	Ahuroa at Sloanes	no trend	F	0.7693	0.2932
548313	Tauraroa at Cotton	no trend	F	0.7524	-0.3155
548314	Mangapai at McCullough Road	no trend	F	0.7959	0.2586
548315	Waikokopa at McDonnell Road	no trend	F	0.3928	0.8546
548402	Marsden Power Station	no trend	F	0.0984	-1.6525
548410	Waiwarawara at Prescotts	no trend	F	0.6787	-0.4143
548412	Waiwarawara at Wilson's Dam	no trend	F	0.0515	1.9472
548413	Whangarei Harbour at Marsden Point Oil Refinery	increasing	T	0.0371	2.0847
549010	Manganui at Monymusk	no trend	F	0.6668	-0.4305
549011	Manganui at Omana (Bull)	no trend	F	0.2817	1.0765
549201	Waikiekie	no trend	F	0.6659	-0.4317
549211	Taipuha at Keay	no trend	F	0.4647	-0.7311
549310	Taipuha at Settlement Rd	no trend	F	0.2135	-1.244
549402	Waipu, Apple Cross	no trend	F	0.2422	-1.1694
630901	Arapohue	decreasing	T	0.0295	-2.1771
640010	Nth Wairoa at Naumai	no trend	F	0.4842	-0.6996
640201	Taipuha	no trend	F	0.8736	-0.1591
640310	Ahuroa at Finlayson Brook	no trend	F	0.8266	-0.2191
640411	Waihoihoi at Glenmohr Road	no trend	F	0.76	0.3054
640436	Waihoihoi at Brynderwyn	no trend	F	0.4013	0.8393
640501	Waipu Cove	no trend	F	0.292	-1.0537
641001	Ruawai	no trend	F	0.266	-1.1123

Gauge ID	Gauge Name	TREND	HA	p-value	Z
641010	Awaroa at Wallace Road	no trend	F	0.4165	0.8125
641102	Claren Brae (Ruawai)	no trend	F	0.7351	0.3383
641201	Paparoa 1	no trend	F	0.1702	1.3717
641203	Paparoa 2	no trend	F	0.119	-1.5588
641210	Paparoa at Higgins	no trend	F	0.2498	1.1509
641213	Paparoa at Maungaturoto	no trend	F	0.56	0.5828
641214	Paparoa at Taylors	no trend	F	0.6285	0.4838
641215	Paparoa at Stubbs	no trend	F	0.2757	1.0901
641302	Maungaturoto, Melford	decreasing	T	0.0051	-2.7992
641310	Wairua at Northland Dairy CO	no trend	F	0.7976	0.2565
641410	Topuni at Saunders	no trend	F	0.5777	-0.5567
641413	Topuni at Dunn Road (Cook)	no trend	F	0.999	-0.0012
641414	Hakaru at Valley Road (Kaiwaka)	no trend	F	0.4784	0.7089
641501	Mangawhai	no trend	F	0.1424	1.4668
641511	Mangawhai Harbour at Tara	decreasing	T	0	-4.1343
641512	Hakaru at Tara	no trend	F	0.567	0.5725
642010	Okoraka at NgatawhitiRoad	no trend	F	0.2223	-1.2204
642011	Okoraka at Poutu Forest Farms Ltd	decreasing	T	0.01	-2.5764
642201	Pukehau	no trend	F	0.353	-0.9287
642401	Topuni	no trend	F	0.1215	-1.5485
642415	Hakaru at Topuni Creek Farms	no trend	F	0.2133	1.2444
643112	Tauhara at Lake Rotokawau	no trend	F	0.9625	-0.0471
643116	Swan Lake at Bishops	no trend	F	0.1663	-1.3843
643118	Kaipara Harbour at Pouto Point	no trend	F	0.425	-0.7977

Appendix F Droughts recorded at each site

Table F-1: Droughts recorded at each site with Duration, Severity, Year and Start month of occurrence.

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
424602	5	4.76	1997	1
424602	5	6.31	1998	1
424602	1	2.57	2004	11
424602	3	2.76	2013	8
424602	1	2.06	2017	12
424602	4	8.81	2022	5
425801	5	5.16	1931	7
425801	6	7.05	1941	4
425801	2	2.44	1950	7
425801	9	5.48	1972	4
425902	4	4.69	1972	6
425902	1	3.19	1982	8
425902	5	5.53	1987	5
425902	1	2.01	1990	2
425902	3	2.4	1992	2
425902	7	5.2	1993	1
425902	2	3.89	2004	3
425902	4	6.17	2005	1
425902	3	2.67	2007	3
425902	9	10.83	2009	11
437001	2	2.95	1987	5
437001	9	8.62	1990	9
437010	3	4.19	2020	1
437010	2	4.43	2020	9
437010	1	2.52	2023	7
439201	1	2.33	1958	6
439201	4	6.85	1963	8
439201	3	2.73	1965	9
439201	1	2.06	1967	10
439201	1	2.11	1969	3
439201	12	12.06	1973	9
439201	2	2.55	1979	11
439201	4	4.34	1982	5
439201	2	3.29	1986	3
439201	1	2.09	1990	2
439201	6	5.09	1993	3

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
439201	2	2.84	1994	11
439201	6	4	2005	1
439201	2	2.7	2006	9
439201	2	3.21	2011	8
439201	2	2.99	2012	10
439201	1	2	2013	10
439201	1	3.27	2023	7
439202	2	2.51	1984	9
439202	1	2.05	1990	12
439202	6	5.43	1993	3
439202	9	7.84	1993	11
439202	2	2.75	1994	11
439202	2	3.67	2004	3
439202	5	4.77	2005	2
439202	1	2.28	2006	9
439301	5	6.15	1970	9
439301	2	2.69	1972	8
439301	1	2.5	1974	5
439301	1	2.18	1975	7
439301	2	2.71	1982	8
439301	5	5.86	1982	11
439301	2	3.44	1984	9
439301	2	3.69	1986	3
439301	2	2.99	1987	5
439301	1	2.03	1988	1
439301	2	4.08	1993	6
439501	1	2.31	1902	10
439501	3	3.77	1903	2
439501	2	3.05	1904	4
439501	2	2.61	1904	12
439501	5	4.2	1906	4
439501	1	2.31	1907	8
439501	2	3.44	1908	1
439501	1	2.01	1913	9
439501	2	3.09	1915	11
439501	6	5.6	1918	11
439501	6	6.89	1924	6
439501	1	2.88	1930	5
439501	3	3.78	1932	11

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
439501	4	4.26	1936	4
439501	1	2	1937	10
439501	4	6.85	1940	6
439501	4	6.01	1942	12
439501	5	5.84	1945	11
439501	1	2.11	1958	6
439501	7	4.5	1963	8
439501	7	4.82	1970	7
439501	2	2.84	1975	2
439501	2	2.58	1975	7
439501	2	2.51	1979	1
439501	8	7.77	1982	8
439501	8	5.58	1984	4
439501	9	7.23	1992	12
439501	2	3.73	1994	11
439501	2	2.6	1996	3
530201	4	5.37	1949	12
530201	3	5.33	1950	7
530201	5	4.74	1952	3
530201	3	4.79	1953	12
530201	4	5.93	1958	3
530201	4	5.71	1963	8
530201	4	5.33	1967	4
530201	1	2.49	1969	3
530201	5	4.82	1972	5
530201	5	3.67	1984	8
530202	4	5.51	1958	3
530202	4	4.58	1963	8
530202	2	2.85	1965	9
530202	1	2.62	1969	3
530202	2	2.62	1972	8
530202	7	7.9	1973	9
530202	1	2.34	1975	5
530202	12	11.37	1986	3
530204	1	2.67	1969	3
530204	1	2.53	1975	5
530204	2	2.7	1975	7
530204	5	4.61	1986	3
530204	4	3.39	1989	12

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
530204	2	4.36	1990	8
530204	2	3.12	1991	5
530204	1	3	1993	7
530204	1	2.62	1995	2
530204	1	2.1	2006	11
530204	6	8.27	2009	11
530204	2	3.68	2011	8
530204	1	2.26	2013	10
530204	1	2.18	2019	1
530204	6	5.48	2020	1
530204	1	2.15	2021	8
530205	2	3.83	2004	3
530205	7	8.06	2005	3
530205	2	4.08	2010	10
530205	3	3.8	2012	4
530205	2	2.94	2013	10
530205	7	8.68	2019	1
530205	9	10.32	2019	9
530206	3	2.9	2002	6
530206	2	3.87	2004	3
530206	4	4.67	2006	6
530206	2	2.32	2007	4
530206	2	2.69	2013	10
530206	1	2.17	2015	4
530206	7	8.8	2019	1
530210	8	9.14	1982	8
530210	2	4.68	1986	3
530210	3	5.22	1987	5
530301	5	4.98	1974	5
530301	1	3.44	1977	11
530301	8	8.23	1982	8
530301	4	6.91	1988	1
530301	3	2.93	1990	12
530301	1	2.04	1992	4
530301	4	4.13	1993	5
530301	3	3.81	1994	11
530511	4	4.83	2011	6
530511	3	3.87	2012	4
530601	3	4.58	1957	5

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
530601	4	6.34	1958	3
530601	7	5.3	1962	12
530601	5	6.68	1963	8
530602	1	2.61	1972	9
530602	2	2.39	1975	7
530602	9	6.32	1977	8
530602	1	2.23	1980	8
530602	1	2.12	1980	10
530701	4	3.62	1989	11
530701	7	6.73	1990	12
530701	2	3.79	1993	6
530701	2	3.94	2004	3
530701	3	5.23	2005	3
530701	4	3.37	2006	9
530701	2	2.81	2007	4
530701	2	3.66	2011	8
530701	2	2.74	2013	10
530701	14	10.25	2019	3
530701	1	3.26	2023	7
530710	3	3.29	1983	1
530710	8	5.84	1984	4
530710	4	3.17	1990	12
530710	2	2.41	1991	5
530710	2	3.2	1993	6
530710	2	3.3	1994	11
530710	2	4.29	1999	4
530801	3	3.88	1965	9
530801	2	3.81	1968	1
530801	2	2.43	1969	3
530801	1	2.64	1969	7
530801	2	2.73	1970	11
530801	1	2.3	1975	7
530801	3	3.06	1976	5
530801	1	2.29	1982	8
530801	4	7.73	1982	11
530801	2	2.93	1984	9
530801	4	5.95	1987	5
530810	4	4.03	1989	3
530810	7	7.12	1991	1

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
530810	2	4.34	1993	7
530810	2	3.39	2004	3
530810	4	4.23	2005	1
530810	2	2.49	2006	9
530810	2	3.06	2007	4
530810	2	3.58	2011	8
530810	2	2.77	2013	10
530810	4	5.66	2015	9
530810	1	2.18	2016	12
531101	4	7.6	1963	8
531101	2	2.23	1965	9
531101	2	2.58	1970	12
531101	2	2.29	1975	4
531101	3	3.56	1984	8
531101	1	2.38	1988	1
531101	1	3.1	1988	4
531101	2	4.15	1993	7
531101	2	3.65	1994	11
531101	3	4.25	1996	6
531201	3	3.75	1895	12
531201	9	7.98	1897	11
531201	2	3.14	1904	4
531201	2	4.26	1908	1
531201	1	2.7	1909	2
531201	1	2.39	1912	10
531201	3	4.09	1913	5
531201	2	3.54	1913	9
531201	7	12.67	1914	6
531201	8	6.15	1918	11
531201	2	2.99	1919	8
531201	1	2.1	1930	5
531201	9	9.77	1932	5
531201	1	2.14	1937	10
531201	2	2.98	1939	2
531201	1	2.6	1942	6
531201	4	5.21	1949	12
531201	3	4.34	1959	6
531201	4	5.32	1963	8
531201	3	3.82	1964	5

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
531201	4	6.14	1967	4
531201	3	3.89	1968	1
531201	2	2.24	1969	3
531201	5	5.51	1972	5
531201	2	3.14	1974	5
531201	3	3.44	1974	12
531201	4	4.12	1975	5
531201	2	2.97	1984	9
531201	1	2.23	1985	10
531201	1	2.12	1988	1
531201	1	2.69	1988	4
531201	1	2.36	1993	7
531201	2	4.79	2004	3
531201	5	5.81	2005	2
531201	1	2.28	2005	11
531201	3	6.33	2009	11
531203	5	6.49	1972	5
531203	4	5.54	1975	5
531203	5	4.34	1977	8
531205	1	2.56	1988	1
531205	2	2.9	1990	12
531205	3	3.24	1993	6
531205	2	2.72	1994	11
531205	1	2.09	1997	5
531205	2	3.83	2004	3
531205	2	2.66	2007	4
531205	6	8.07	2009	11
531205	2	3.07	2013	10
531207	2	4.12	2004	3
531207	2	4.17	2005	3
531207	3	2.72	2007	4
531207	1	3.95	2007	10
531207	6	7.47	2009	11
531207	3	3.1	2012	4
531207	3	4.66	2013	1
531207	1	2.01	2017	12
531207	1	2.13	2018	7
531207	7	7.46	2019	1
531207	7	7.25	2019	12

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
531207	5	4.28	2020	9
531209	2	4.15	2011	8
531209	1	2.62	2013	10
531209	4	4.67	2018	7
531209	7	9.38	2019	1
531210	2	4.17	2013	10
531210	4	5.06	2020	9
531210	1	2.96	2023	7
531301	4	4.27	1914	1
531301	2	2.47	1916	12
531301	4	2.73	1919	3
531301	2	2.38	1920	6
531301	1	2.23	1926	2
531301	1	2.17	1926	11
531301	2	3.07	1929	1
531301	1	2.76	1930	5
531301	3	3.72	1930	10
531301	3	3.27	1932	5
531301	5	4.09	1932	9
531301	2	2.39	1933	5
531301	5	4.16	1933	10
531301	1	2.57	1937	10
531301	2	2.34	1939	2
531301	6	5.42	1942	1
531301	1	2.17	1942	9
531301	2	3.15	1943	2
531301	5	4.37	1950	6
531301	4	5.67	1958	3
531301	5	5.36	1963	10
531301	2	4.54	1967	9
531301	1	2.71	1975	5
531302	11	11.97	1982	5
531302	5	8.78	1983	5
531302	3	4.07	1984	9
531302	1	2.59	1988	1
531302	1	3.17	1988	4
531302	4	3.11	1990	12
531302	3	3.61	1991	10
531310	1	2.13	1966	10

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
531310	7	7.9	1967	4
531310	5	4.16	1972	5
531310	5	5.92	1982	11
531310	5	4.64	1984	8
531310	1	2.98	1988	1
531310	1	2.67	1988	4
531310	4	3.03	1989	11
531310	2	2.86	1990	12
531310	2	3.39	1993	7
531310	2	3.12	1994	11
531310	2	4.08	2005	3
531310	1	2.06	2005	11
531311	1	2.23	1967	10
531311	2	2.74	1969	3
531311	3	2.42	1970	11
531311	2	3.74	1972	8
531311	5	5.55	1974	10
531311	2	2.44	1975	4
531311	4	3.78	1982	6
531311	1	2.1	1982	11
531311	3	4.17	1984	4
531311	3	4.79	1987	5
531313	4	4.83	2006	6
531313	2	2.75	2007	4
531313	2	3.22	2011	8
531313	2	2.53	2013	10
531313	2	2.49	2015	6
531313	7	8.21	2019	1
531313	2	2.71	2021	3
531411	4	5.12	1967	4
531411	2	2.16	1967	9
531411	1	2.21	1969	10
531411	5	5.82	1972	5
531411	2	2.82	1975	4
531411	3	3.61	1977	8
531411	4	3.1	1982	5
531411	5	6.1	1982	11
531411	3	3.8	1984	8
531411	1	3.33	1988	1

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
531411	1	2.74	1988	4
531411	2	2.56	1990	12
531411	2	3.45	1993	7
531411	2	3.93	2004	3
531411	2	3.61	2005	3
531411	2	2.97	2006	9
531411	2	2.9	2007	4
531411	6	7.47	2009	11
531411	2	3.49	2011	8
531411	1	2	2015	12
531412	1	2.56	1981	2
531412	6	9.58	1984	7
531412	1	2.12	1988	1
531412	1	2.19	1988	4
531412	2	2.34	1990	12
531413	1	2.04	1982	8
531413	3	4.5	1984	8
531413	3	5.2	1987	5
531415	2	4.36	2004	3
531415	2	2.9	2007	4
531415	6	6.88	2009	11
531415	2	3.56	2011	8
531415	1	2.03	2017	12
531415	3	4.49	2023	7
531501	5	7.73	1963	8
531501	2	2.37	1970	11
531501	8	13.52	1972	4
531501	5	4.92	1973	12
531501	2	4.91	1980	8
531501	1	2.19	1980	11
531501	1	3.22	1981	9
531501	2	3.22	1983	7
531501	4	2.92	1984	8
531501	3	4.34	1993	6
531501	2	3.5	1994	11
531512	6	4.82	2005	1
531512	7	5.81	2006	6
531512	3	3.13	2007	4
531512	4	3.99	2011	6

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
531512	3	3.78	2012	4
531512	8	9	2019	10
531512	2	2.62	2020	12
531513	6	4.94	2005	1
531513	7	6.34	2006	6
531513	2	3.57	2007	4
531513	6	8.46	2009	11
531513	4	3.36	2011	6
531513	3	3.78	2012	4
531513	1	2.13	2013	10
531513	2	4.05	2019	1
531701	6	6.39	1918	11
531701	4	2.75	1920	9
531701	3	3.27	1926	2
531701	2	4.56	1929	1
531701	1	2.7	1930	5
531701	3	4.12	1931	8
531701	1	2.39	1932	11
531701	3	3.86	1936	4
531701	1	2.26	1940	6
531701	4	5.6	1949	7
531701	2	2.63	1950	6
531701	1	4.08	1951	9
531701	6	8.75	1952	3
531711	2	2.39	1969	4
531711	2	2.32	1975	7
531711	4	3.34	1982	5
531711	5	5.62	1982	11
531711	2	3.64	1984	9
531711	2	2.65	1990	12
531711	2	3.43	1993	6
531711	2	3.76	2004	3
531711	2	4.53	2006	6
531711	4	3.87	2006	9
531711	2	3.25	2007	4
531711	9	9.52	2009	8
531711	2	3.88	2011	8
531713	2	2.76	1970	11
531713	2	2.7	1975	7

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
531713	3	4.49	1976	5
531713	6	3.24	1977	10
531715	2	2.45	1978	3
531715	1	3.2	1982	9
531715	4	3.35	1982	12
531715	6	5.65	1984	6
531715	2	2.3	1987	2
531715	2	2.62	1988	1
531715	6	4.32	1990	9
531715	3	4.51	1991	10
531715	3	4.5	1993	6
531715	2	3.02	1994	11
531715	1	2.81	1995	2
531715	3	5.52	2004	3
531716	2	3.41	1991	11
531716	3	3.12	1992	3
531716	5	3.81	1992	11
531716	2	4.32	1993	6
531716	2	3.09	1997	10
531717	2	3.52	2004	3
531717	4	4.93	2005	1
531717	5	5.17	2006	6
531717	2	3.46	2007	4
531717	7	6.64	2009	10
531717	2	3.43	2011	8
531717	3	2.94	2012	4
531717	4	5.64	2019	11
531717	1	3.49	2023	7
531718	3	4.66	2011	7
531718	2	2.76	2012	5
531718	2	2.26	2013	10
531718	3	2.62	2014	3
531718	1	2.09	2015	6
531718	4	4.39	2019	11
531718	1	3.3	2023	7
531719	3	4.35	2005	3
531719	6	7	2009	11
531719	3	4.64	2011	7
531719	1	3.3	2013	10

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
531719	1	2.69	2014	5
531901	5	5.46	1997	1
531901	1	2.14	2001	6
531901	2	3.75	2004	3
531901	4	4.9	2005	1
531901	2	4.07	2007	4
531901	2	3.82	2008	9
531901	6	6.14	2009	11
531901	3	4.4	2011	7
531901	3	3.09	2012	4
531901	1	2.19	2014	5
531901	4	3.76	2019	11
531910	1	2.77	1982	8
531910	6	5.87	1982	10
531910	2	3.04	1984	9
531910	3	2.65	1987	1
531910	2	3.85	1993	6
531911	1	3	1988	6
531911	3	3.01	1993	6
531911	2	3.55	2005	3
531911	2	2.8	2007	4
531911	7	10.68	2009	10
531911	3	4.17	2011	7
531911	1	2.08	2011	11
532202	1	2.49	1918	8
532202	1	2.03	1919	4
532202	1	2.19	1920	7
532202	4	7.45	1922	6
532202	5	5.46	1927	10
532202	1	2.23	1930	12
532202	2	3.08	1931	2
532202	3	3.66	1932	11
532202	1	2.45	1937	10
532202	4	3.73	1938	3
532202	2	2.46	1939	2
532202	4	5.15	1940	6
532202	2	3.55	1941	4
532202	3	3.23	1942	5
532202	6	8.43	1945	10

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
532202	2	2.92	1951	9
532202	4	5.98	1958	3
532202	2	2.58	1960	3
532202	5	6.12	1963	8
532202	2	2.64	1967	9
532202	2	2.66	1970	12
532202	5	5.55	1982	5
532202	7	6.24	1984	4
532202	1	2.8	1988	1
532202	1	2.98	1988	4
532202	2	3.43	1990	12
532202	4	3.68	1992	2
532311	5	9.45	1972	5
532311	4	3.8	1975	5
532311	2	3.11	1976	2
532311	3	5.14	1984	8
532311	1	2.03	1988	1
532311	1	2.88	1988	4
532311	2	2.74	1993	7
532311	2	3.5	2004	3
532311	3	3.04	2007	4
532311	2	2.39	2007	10
532311	2	2.96	2013	10
532311	7	7.96	2019	1
532311	8	8.9	2019	10
532312	2	2.45	2018	3
532312	8	8.87	2019	10
532312	1	2.56	2023	7
532402	1	2.69	1930	12
532402	1	2.13	1937	10
532402	2	3.44	1938	3
532402	1	2.13	1940	1
532402	5	5.34	1942	2
532402	1	2.13	1954	5
532402	1	2.03	1957	1
532402	1	2.79	1958	8
532402	5	6.03	1963	8
532402	11	16.23	1967	4
532402	5	4.41	1972	5

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
532402	5	4.31	1982	5
532402	4	3.76	1984	8
532402	2	3.89	1988	1
532501	4	4.71	1949	12
532501	1	2.62	1957	1
532501	4	5.57	1958	3
532501	3	5.48	1963	10
532501	2	2.46	1965	9
532501	1	2.03	1969	3
532501	2	3.57	1971	4
532503	9	9.23	1982	5
532503	7	8.89	1984	4
532503	1	2.39	1988	1
532503	1	2.48	1988	4
532503	3	3.89	1989	12
532503	2	2.67	1991	5
532503	4	4.64	1993	6
532510	5	4.88	1977	1
532510	2	3.76	1984	9
532601	4	4.26	1949	12
532601	1	2.33	1952	7
532601	1	2.63	1957	1
532601	4	5.12	1958	3
532601	8	6.81	1962	11
532601	5	6.61	1963	10
532601	6	7.16	1972	4
532601	4	4.05	1975	2
532611	4	4.91	1982	5
532611	2	3.23	1984	9
532611	1	2.23	1988	4
532611	1	2.31	1994	12
532611	4	4.73	2005	1
532611	1	3.08	2006	9
532611	3	6.17	2007	4
532611	7	8.82	2009	10
532611	2	3.88	2011	8
532611	4	7.4	2012	4
532710	7	7.76	1963	8
532710	2	3.16	1969	3

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
532710	1	2.38	1972	9
532710	2	2.04	1975	7
532710	1	2.7	1982	8
532710	2	3.75	1984	9
532710	8	6.92	1990	12
532710	2	3.99	2004	3
532710	3	4.26	2005	2
532710	1	2.25	2006	9
532710	3	3.91	2007	4
532710	7	7.39	2009	10
532710	2	3.64	2011	8
532710	4	3.49	2015	9
532710	2	3.6	2017	12
532711	4	5.07	1984	8
532711	2	3.04	1990	12
532711	3	3.63	1993	6
532801	6	9.22	1963	8
532801	5	4.38	1965	2
532801	2	4.89	1966	10
532801	1	2.08	1974	5
532801	4	3.65	1974	7
532801	3	2.89	1974	12
532801	2	2.05	1975	7
532801	1	2.46	1982	8
532801	2	4.27	1987	5
532801	2	3.88	1993	6
532810	2	2.42	1969	3
532810	1	2.85	1982	8
532810	5	7.16	1982	11
532810	2	4.56	1986	3
532810	3	6.1	1987	5
532811	5	4.95	1967	3
532811	1	2.42	1969	7
532811	1	2.83	1971	2
532811	1	2.87	1971	9
532811	6	4.67	1977	10
532811	1	3.02	1982	8
532811	5	6.68	1982	11
532811	3	2.83	1984	9

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
532812	3	4.52	1973	11
532812	2	2.16	1974	8
532812	2	3.43	1976	6
532813	2	3.19	1967	10
532813	3	4.41	1973	11
532813	2	2.26	1974	8
532813	2	3.02	1976	6
532814	3	3.48	1968	1
532814	4	3.75	1970	1
532814	1	2.16	1976	4
532814	2	3.25	1976	6
532814	6	6.97	1982	6
532814	5	5.44	1983	6
532820	2	3.57	1972	6
532820	1	3.37	1972	9
532820	5	7.87	1973	1
532820	5	10.33	1982	11
532820	2	2.62	1983	7
532820	1	2.36	1984	4
532820	2	3.32	1984	9
532820	1	3.53	1985	8
532821	3	2.37	1987	1
532821	3	3.38	1991	4
532821	4	3.57	1992	12
532821	2	3.13	1993	6
532821	4	3.88	2002	8
532821	2	3.76	2003	11
532821	2	3.52	2004	3
532821	2	3.17	2005	3
532821	4	4.09	2006	9
532821	2	3.56	2007	4
532821	1	3.55	2008	8
532822	3	3.24	2015	6
532822	4	4.45	2020	1
532822	1	2.73	2020	9
532822	1	2.56	2023	7
532901	3	4.73	1945	10
532901	3	4.17	1946	2
532901	4	6.73	1949	7

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
532901	4	6.8	1949	12
532901	5	6.42	1952	3
532901	4	5.13	1963	10
532901	2	2.97	1965	9
532901	2	2.52	1969	3
532901	1	2.38	1973	5
532903	1	2.79	1982	8
532903	5	6.29	1982	11
532903	11	11.44	1984	4
532903	2	3.13	1987	5
532903	3	5.53	1989	12
532903	3	3.37	1991	4
532903	3	3.68	1991	10
532903	2	3.17	1993	6
532903	2	2.96	2004	3
532903	2	3.52	2005	3
532903	2	3.22	2006	6
532903	4	3.64	2006	9
532903	2	3.19	2007	4
532905	1	2.67	2008	6
532905	7	8.42	2009	10
532905	3	4.5	2011	7
532905	1	2.17	2014	5
532905	6	4.77	2019	11
532905	2	3.05	2020	9
532910	8	5.82	1977	8
532910	1	2.89	1982	8
532910	5	6.99	1982	11
532910	3	5.98	1987	5
532913	2	3.95	1978	8
532913	5	5.57	1982	11
532913	1	2.05	1987	2
532913	1	2.17	1990	9
532915	1	3.01	2011	11
532915	3	3.2	2012	4
532915	1	2.02	2014	5
532915	2	3.56	2020	9
533201	4	5.27	1982	5
533201	3	3.87	1984	8

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
533201	1	2.84	1988	4
533201	2	4.33	1993	7
533201	2	3.51	1994	11
533201	2	2.17	2002	10
533201	4	3.65	2005	3
533201	4	3.33	2006	9
533201	3	5.53	2009	11
533301	1	3.39	1988	1
533301	1	2.16	1988	4
533301	1	2.22	1996	2
533301	1	2.07	1997	5
533301	4	4.16	2000	7
533301	4	3.43	2005	3
533301	1	2.12	2005	8
533301	2	2.56	2006	6
533301	1	3.09	2007	3
533302	1	2.02	2004	9
533302	6	5.3	2005	1
533302	3	3.66	2007	4
533302	6	6.82	2009	11
533302	2	5.23	2010	10
533302	2	4.4	2011	8
533302	3	4.44	2012	4
533302	2	2.92	2013	10
533302	9	8.32	2019	10
533302	1	4.34	2023	7
533501	4	3.52	1909	4
533501	9	10.31	1912	11
533501	9	16.42	1914	6
533501	1	2.17	1919	4
533501	3	4	1919	10
533501	5	5.78	1925	1
533501	1	2.11	1937	2
533501	1	2.47	1937	8
533501	1	2.1	1937	10
533501	2	3.06	1939	2
533501	2	4.05	1941	4
533501	2	2.11	1942	5
533501	1	2.11	1952	3

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
533501	1	3.63	1952	9
533501	1	2.11	1961	10
533502	5	5.64	1967	3
533502	2	2.88	1969	3
533502	1	2.09	1972	9
533502	2	2.23	1975	4
533502	2	2.74	1975	7
533502	2	2.5	1982	8
533601	2	2.64	1902	1
533601	2	3.46	1904	4
533601	1	2.84	1906	10
533601	2	2.97	1908	1
533601	2	2.77	1913	9
533601	11	13.66	1914	4
533601	4	3.4	1919	1
533601	1	2.21	1920	7
533601	2	3.01	1929	9
533601	1	2.52	1930	5
533601	4	3.51	1930	9
533601	2	2.92	1931	2
533601	1	2.52	1937	8
533601	3	3.31	1938	9
533601	3	2.92	1939	1
533601	2	3.97	1941	4
533601	1	2.4	1942	6
533601	5	4.53	1950	6
533610	2	2.52	1982	8
533610	5	6.27	1983	5
533610	7	7.08	1984	4
533610	2	2.03	1988	1
533610	2	2.34	1990	12
533610	4	3.39	1993	6
533610	2	2.65	1994	11
533710	2	3.38	1969	10
533710	4	5.75	1970	1
533710	6	5.78	1973	8
533710	1	2.64	1978	3
533710	3	5.27	1979	4
533710	3	4.29	1983	7

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
533710	4	4.4	1983	11
533710	1	2.05	1984	4
533810	1	2.17	1969	10
533810	1	2.36	1972	9
533812	2	2.5	1965	9
533812	1	2.38	1969	10
533812	4	3.36	1972	6
533812	2	2.68	1982	8
533812	5	5.82	1982	11
533812	5	4.5	1984	6
533812	3	3.08	1990	12
533812	3	3.26	1991	4
533812	3	3.1	1991	10
533812	3	4.33	1993	6
533813	1	3	1969	6
533813	1	2.19	1972	9
533813	1	2.08	1975	7
533813	3	2.56	1984	9
533813	8	8.34	1990	12
533813	4	3.78	1991	9
533813	3	3.99	1993	6
533813	1	4.17	2000	8
533814	8	8.28	1977	8
533814	1	2.37	1982	8
533814	3	4.01	1984	8
533814	3	6.13	1987	5
533815	2	2.61	1982	8
533815	5	7.16	1982	11
533815	2	2.93	1984	9
533815	2	2.84	1987	2
533815	3	5.63	1987	5
533817	1	3	1998	6
533817	2	2.63	2004	3
533817	6	5.84	2005	1
533817	2	2.96	2006	6
533817	1	2.1	2006	9
533817	2	3.84	2007	4
533817	3	3.43	2011	7
533817	3	3.98	2015	10

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
533817	6	5.93	2019	11
533817	2	2.16	2020	9
534402	1	2.4	1988	4
534402	3	2.97	1990	11
534402	2	5.77	1993	7
534402	3	3.85	1994	10
534402	2	2.72	1996	6
534402	9	10.08	1997	10
534402	2	3.57	1998	8
534402	1	2.4	2003	4
534402	5	4.82	2006	9
534403	1	3.28	2006	9
534403	6	5.67	2009	11
534403	2	3.17	2011	8
534403	3	3.91	2012	4
534403	2	3.25	2013	10
534403	1	2.12	2015	12
534403	1	3.19	2023	7
534503	11	14.34	1982	5
534503	5	5.73	1983	5
534503	4	4.87	1986	3
534503	1	2.43	1988	4
534503	6	5.22	1990	9
534503	1	2.14	1991	5
534503	2	3.94	1993	7
534503	2	2.75	1994	11
534503	2	3.26	2004	3
534503	4	3.59	2005	1
534503	1	2.46	2006	9
534503	4	6.91	2009	11
534610	1	2.38	2013	11
534610	8	8.06	2019	10
534610	1	2.83	2023	7
534701	4	5.46	1922	6
534701	1	3.06	1930	5
534701	2	3.39	1930	11
534701	4	4.23	1932	10
534701	1	2.18	1942	6
534701	6	6.76	1945	10

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
534701	3	4.8	1950	1
534701	2	2.14	1952	9
534701	5	5.1	1963	10
534701	1	2.16	1965	9
534701	2	2.5	1969	10
534701	2	2.38	1971	6
534711	2	2.64	1967	10
534711	2	2.36	1969	9
534711	3	3.49	1976	6
534716	6	7.31	1966	6
534716	4	5.74	1967	4
534716	1	2.13	1968	6
534716	2	2.99	1970	11
534716	6	5.58	1972	4
534716	2	3.38	1982	5
534716	3	3.95	1982	11
534716	1	3.07	1985	7
534717	2	2.55	1967	10
534717	4	4.38	1973	10
534717	3	3.47	1976	6
534722	7	5.06	1986	6
534722	1	2.07	1987	2
534722	1	2.22	1987	8
534722	1	2.38	1988	4
534722	2	4.83	1990	9
534722	2	2.75	1990	12
534722	2	3.21	1993	7
534724	1	2.51	1991	5
534724	2	2.25	1994	11
534724	6	4.97	2004	6
534724	5	7.77	2005	3
534725	3	3.91	1993	6
534725	2	3.3	1997	10
534725	1	2.13	1999	2
534801	4	4.85	1958	3
534801	2	2.23	1965	9
534801	5	4.18	1967	3
534801	2	2.79	1969	3
534801	1	2.18	1969	10

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
534801	2	2.34	1975	4
534802	1	2.55	1975	7
534802	2	2.58	1982	8
534803	4	3.91	1989	2
534803	2	2.4	1989	11
534807	1	2.53	1986	3
534807	11	14.62	1990	9
534807	3	3.37	1993	6
534807	6	4.92	1996	2
534807	2	3.1	2004	3
534807	4	5.65	2004	6
534807	2	3.65	2005	3
534807	7	7.64	2009	10
534807	6	5.04	2019	3
534807	4	4.62	2019	11
534807	4	4.4	2020	9
534811	1	2.09	2011	9
534811	3	3.17	2012	4
534811	6	6.05	2019	11
534811	2	2.87	2020	9
534811	1	2.77	2023	7
535401	5	6.6	1982	5
535401	5	5.89	1982	11
535401	3	5.28	1984	8
535401	3	3.01	1989	11
535401	1	3.17	1992	12
535412	1	2.06	1999	2
535412	5	5.21	2000	7
535412	3	3.56	2007	4
535412	2	3.48	2011	8
535412	2	2.62	2013	10
535412	3	3.63	2015	10
535413	1	3.52	1993	7
535413	4	5.73	2000	7
535413	2	2.72	2005	8
535413	6	4.8	2009	11
535413	2	2.89	2010	10
535413	2	3.26	2011	8
535413	2	2.97	2012	6

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
535413	7	5.62	2019	1
535413	6	7.41	2019	12
535501	1	2.75	1908	2
535501	1	2.23	1909	2
535501	1	2.31	1909	12
535501	2	3.42	1911	7
535501	3	3.51	1913	2
535501	2	2.24	1919	3
535501	1	2.06	1924	5
535501	1	2.1	1930	12
535501	1	2.22	1937	10
535501	2	2.54	1939	2
535501	2	3.65	1941	4
535501	6	8	1942	1
535501	5	4.29	1942	11
535501	6	5.71	1945	10
535501	6	7.45	1950	5
535501	3	2.91	1952	3
535501	2	4.47	1954	10
535501	1	3.5	1957	9
535501	3	2.97	1957	11
535510	4	5.63	1982	5
535510	5	4.53	1982	11
535510	1	2.4	1988	1
535510	1	2.77	1988	4
535510	1	2.17	1990	2
535510	2	3.9	1993	7
535510	2	2.49	1994	11
535510	4	6.59	2004	7
535512	4	4.48	1981	7
535512	5	6.43	1982	5
535512	5	4.09	1982	11
535512	1	3	1988	4
535512	1	3.72	1993	7
535512	4	3.13	2003	4
535512	8	7.22	2019	10
535513	10	10.23	2015	1
535513	2	3.47	2020	1
535513	1	2.74	2023	7

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
535712	1	2.07	1965	9
535712	1	2.1	1972	9
535712	2	2.86	1982	8
535712	3	4.39	1982	11
535712	5	5.97	1985	6
535812	1	3.16	1966	8
535812	2	4.89	1972	6
535812	3	4.99	1984	4
535812	4	4.58	1984	8
535812	1	2.94	1986	11
535813	1	2.18	1966	8
535813	3	5.07	1975	4
535813	1	2.12	1976	5
535901	4	5.67	1958	3
535901	1	2.29	1965	9
535901	2	2.76	1969	3
536501	1	2.34	1938	3
536501	2	3.41	1939	2
536501	1	3.07	1942	6
536501	4	4.5	1953	11
536501	2	2.77	1956	12
536501	2	2.71	1976	2
536501	1	2.25	1992	10
536501	2	2.36	1993	7
536501	5	6.78	1993	10
536501	3	4.32	1999	5
536501	9	13.04	2000	8
536501	5	6.8	2004	7
536501	9	8.4	2005	1
536501	9	11.52	2006	4
536501	10	10.42	2007	8
536501	1	2.25	2009	8
536601	1	4.44	1916	4
536601	2	2.42	1917	3
536601	5	8.12	1922	6
536601	2	3.19	1929	1
536601	2	2.98	1939	2
536601	1	2.71	1942	6
536601	8	5.66	1950	5

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
536601	1	2.08	1952	7
536610	3	6.62	1963	8
536610	4	5.33	1967	4
536610	4	4.18	1972	6
536610	2	3.04	1976	2
536611	1	2.31	1966	8
536611	2	3.14	1967	9
536611	5	6.59	1982	5
536611	5	4.63	1982	11
536611	4	4.77	1986	3
536611	4	4.99	1987	5
536611	1	2.33	1988	4
536611	1	2.02	1991	12
536611	2	3.78	1993	7
536611	2	3.18	1994	11
536611	5	5.26	2000	8
536611	2	2.96	2001	2
536613	2	2.23	2005	8
536613	2	3.51	2011	8
536613	1	2.24	2012	6
536613	2	3.55	2019	5
536613	5	5.84	2019	10
536613	1	3.87	2023	7
536702	1	2.29	1914	4
536702	2	3.21	1920	6
536702	1	2.44	1924	7
536702	4	4.29	1925	1
536702	4	6.37	1927	10
536702	2	2.73	1929	1
536702	5	6.19	1930	11
536702	10	6.35	1932	4
536702	3	4.06	1937	8
536702	4	3.11	1938	3
536702	1	2.76	1942	6
536702	6	6.9	1945	10
536702	3	4.58	1950	1
536702	1	2.01	1954	9
536702	2	2.83	1955	8
536702	1	2.29	1956	3

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
536702	1	2.01	1957	9
536702	4	4.85	1958	3
536702	1	2.73	1963	10
536702	1	2.19	1966	10
536702	5	4.57	1967	3
536702	1	2.59	1967	10
536702	9	8.89	1982	5
536702	1	2.01	1988	1
536702	1	2.04	1988	4
536702	2	4.06	1993	7
536702	2	2.61	1994	11
536702	1	2.29	1998	12
536702	1	2.01	2002	9
536702	3	3.29	2004	7
536710	1	3.02	1965	4
536710	1	2.86	1966	3
536710	2	5.68	1970	4
536710	1	2.72	1970	9
536710	2	3.42	1972	6
536710	5	7.56	1982	5
536710	3	4.82	1982	11
536711	1	2.24	1966	8
536711	4	5.73	1967	4
536711	2	3.01	1969	3
536711	4	3.77	1972	6
536711	7	7.11	1974	8
536712	1	2.59	1964	11
536712	4	5.27	1967	4
536712	1	2.89	1972	9
536811	5	6.12	1982	5
536811	5	6.44	1982	11
536811	2	2.1	1983	8
536811	1	3.25	1988	1
536811	1	2.3	1988	4
536811	1	2.11	1988	6
536811	2	4.62	1996	10
536811	6	5.79	1999	5
536811	2	3.77	2004	11
536812	1	2.18	1988	4

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
536812	3	4.9	1988	6
536812	4	5.84	1989	2
536812	2	2.91	1992	12
536812	2	3.05	1993	7
536812	5	5.34	1994	2
536812	2	3.23	1994	11
536812	3	5.41	2004	3
536812	2	3	2005	8
536812	3	3.56	2009	11
536812	1	3.57	2023	7
536814	2	2.61	1965	9
536814	5	4.85	1967	3
536814	2	3.37	1969	3
536816	2	3.32	2004	3
536816	4	3.69	2005	1
536816	2	2.23	2005	8
536816	3	3.33	2007	4
536816	6	5.92	2009	11
536816	1	2.1	2011	2
536816	2	2.93	2011	8
536816	1	2.08	2011	11
536816	7	6.72	2019	10
536816	2	2.22	2020	9
536816	1	3.55	2023	7
536901	2	3.27	1950	7
536901	2	2.92	1951	9
536901	2	3.77	1963	5
536901	2	2.86	1965	9
536901	2	4	1969	3
536901	1	2.24	1982	8
536901	5	5.22	1982	11
536901	1	3.55	1985	6
537510	3	5.52	1963	8
537510	5	3.31	1965	6
537510	1	2.44	1973	6
537510	1	3.63	1977	4
537510	11	11.86	1982	5
537510	1	3.32	1983	7
537601	2	3.1	1994	11

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
537601	1	2.36	1999	2
537601	3	3.78	2000	8
537601	2	2.21	2005	3
537601	2	2.41	2006	6
537601	2	3.22	2007	5
537602	6	10.51	2010	10
537602	1	2.09	2012	4
537602	2	3.75	2013	9
537602	1	2.95	2017	8
537611	2	3.54	1987	5
537611	1	2.01	1987	8
537611	2	2.87	1990	9
537611	2	5.35	1991	10
537611	6	10.87	1993	7
537611	1	3.32	1994	12
537611	1	2.78	1995	7
537613	1	2.03	1987	5
537613	2	3.01	1990	9
537613	5	5.28	1993	7
537614	2	3.94	2000	9
537614	6	5.51	2005	4
537614	2	2.19	2007	5
537614	4	4.12	2011	8
537614	3	5.14	2017	10
537614	9	9.7	2019	10
537712	2	2.68	1962	8
537712	4	6.43	1964	2
537712	1	2.27	1964	11
537712	2	2.66	1965	9
537801	3	3.81	1952	7
537801	4	5.15	1953	11
537801	4	4.67	1958	3
537801	4	4.71	1967	4
537801	1	2.73	1975	7
537801	6	6.25	1977	10
537801	1	4.62	1980	8
537815	3	4.57	1983	8
537815	2	3.19	1986	3
537815	1	2.12	1988	1

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
537815	2	4.06	1993	7
537815	2	2.94	1994	11
537816	2	2.33	2011	8
537816	4	5.93	2012	4
537816	3	3.42	2017	10
537901	5	5.74	1952	3
537901	1	2.06	1957	1
537901	4	4.62	1958	3
537901	3	3.95	1963	3
537901	4	3.72	1965	9
537901	1	2.02	1966	10
537901	5	4.13	1967	3
537901	4	5.61	1987	5
537901	1	2.14	1988	6
537901	3	3.55	1990	12
537901	3	2.58	1991	5
537901	3	4.36	1993	6
537901	2	4	1994	11
537901	3	4.59	2000	8
537901	2	2.64	2004	3
537901	4	4.48	2005	1
537901	3	2.7	2007	4
537901	3	6.19	2009	11
538611	3	3.57	2017	10
538611	2	3.51	2020	1
538611	1	2.71	2023	7
538710	2	3.55	1976	2
538801	2	2.15	1951	1
538801	1	2.57	1951	9
538801	2	2.1	1957	1
538801	1	2.49	1958	6
538801	1	2.19	1959	6
538801	3	3.62	1963	3
538801	3	3.47	1972	7
538801	8	6.45	1982	8
538801	1	2.9	1983	11
538801	1	2.25	1988	4
538801	3	4.18	1989	2
538801	5	5.63	1990	9

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
538801	2	4.45	1993	7
538801	3	4.17	1994	10
538801	4	3.55	2000	7
538801	2	3.6	2004	3
538801	3	3.48	2005	2
538801	2	3.16	2005	8
538801	3	2.77	2007	4
538801	3	4.97	2009	11
538810	3	4.28	1963	4
538810	1	2.04	1964	12
538810	3	5.44	1972	8
538810	6	6.17	1982	8
538810	2	2.67	1986	3
538810	1	2.59	1988	1
538810	1	2.03	1988	4
538810	2	3.94	1990	12
538810	2	4.1	1993	7
538810	2	3.18	1994	11
538810	2	3.77	1996	6
538811	1	2.18	1971	6
538811	2	3.22	1975	4
538811	1	2.12	1977	8
538811	3	4.49	1981	7
539710	1	2.67	1988	1
539710	1	2.26	1988	4
539710	2	3.46	1993	7
539710	1	2.78	1994	12
539710	6	7.48	2000	7
539710	4	3.24	2005	1
539710	4	4.92	2006	6
539710	1	3.32	2008	5
539801	1	3.18	1907	10
539801	5	7.22	1922	5
539801	3	4.19	1923	7
539801	4	5.79	1925	1
539801	4	7.15	1927	10
539801	5	3.1	1928	7
539801	3	3.69	1930	5
539801	1	2.09	1937	8

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
539801	3	3.9	1937	10
539801	2	3.38	1939	2
539801	1	2.03	1939	5
539801	2	2.65	1942	6
539801	1	2.49	1943	5
539801	5	7.61	1945	11
539801	4	4.75	1950	5
539801	2	3.52	1951	9
539801	2	2.33	1953	9
539801	3	4.13	1953	12
539801	1	2.17	1954	4
539801	2	2.48	1957	1
539801	1	2.52	1958	6
539801	1	2.52	1959	6
539801	3	3.71	1959	9
539801	1	2.58	1963	10
539801	4	3.49	1965	4
539801	2	2.55	1965	9
539801	3	3.95	1972	7
539801	2	3.8	1982	11
539801	1	2.49	1983	11
539801	1	2.59	1988	1
539801	1	2.68	1988	4
539802	3	2.32	1943	1
539802	1	2.16	1943	5
539802	5	6.4	1945	11
539802	4	3.5	1949	5
539802	8	10.57	1950	1
539802	1	2.11	1950	12
539802	1	3.58	1952	11
539802	3	3.88	1953	12
539802	2	2.68	1957	1
539802	1	2.04	1959	6
539802	3	3.39	1982	10
539802	1	2.15	1983	11
539802	1	2.5	1988	1
539802	1	2	1988	4
539802	1	5.1	1988	8
539802	1	2.18	1990	7

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
539802	2	3.91	1993	7
539802	2	2.2	1994	11
539802	5	8.29	1999	5
539803	1	2.17	1965	9
539803	4	8.42	1972	6
539803	5	4.56	1987	4
539803	1	2.27	1988	1
539803	1	2.75	1988	4
539803	1	3.76	1988	8
539807	1	3.33	2003	10
539807	2	3.35	2005	8
539807	2	3.45	2007	5
539807	1	2.36	2008	9
539807	2	3.34	2010	10
539807	4	5.72	2012	4
539807	2	2.77	2015	6
539807	6	6.12	2019	12
539807	2	2.25	2020	9
539811	3	4.63	1982	10
539811	4	2.97	1987	5
539811	1	2.26	1988	1
539811	2	4.21	1989	7
539813	2	2.93	2007	5
539813	2	5.58	2008	8
539813	2	3.83	2010	10
539813	4	5.13	2012	4
539813	3	4.06	2020	1
541001	13	16.76	1986	3
541001	6	9.68	1987	5
541001	13	19.8	1990	9
541001	4	4.31	2005	1
541001	2	2.45	2007	4
541001	4	8.16	2008	8
541301	1	2.21	1935	8
541301	3	3.49	1943	1
541301	6	8.65	1945	10
541301	2	2.19	1950	12
541301	4	3.67	1955	4
541301	2	3.9	1957	1

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
541301	2	2.46	1957	6
541301	2	3.51	1958	3
541301	1	2.38	1958	6
541301	4	5.04	1965	3
541301	2	3.11	1969	3
541301	6	7.06	1972	6
541301	2	2.65	1978	8
542001	2	3.27	1965	9
542001	2	2.99	1969	3
542001	1	2.19	1969	7
542001	1	2.22	1978	3
542001	1	2.36	1981	12
542001	6	6.89	1982	10
542010	1	2.9	1982	8
542010	6	6.15	1982	10
542010	1	2.76	1984	10
542010	1	2.06	1990	12
542010	2	3.57	1993	6
542010	1	3.22	1995	2
542010	4	4.98	2005	1
542010	5	5.67	2006	9
542101	2	4.25	1930	5
542101	5	5.11	1930	8
542101	4	3.76	1932	11
542101	6	6.97	1945	10
542101	4	6.14	1949	12
542101	1	2.16	1950	7
542101	5	5.81	1952	3
542101	2	4	1958	3
542101	2	3.01	1969	3
542101	1	2.34	1975	10
542101	2	2.12	1977	8
542101	1	2.34	1979	11
542101	1	2.34	1981	12
542101	6	6.12	1982	10
542101	1	2.07	1989	9
542101	3	5.26	1991	4
542101	1	4.15	1992	8
542101	3	3.49	1993	6

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
542101	1	2.09	2004	3
542101	5	5.3	2005	1
542101	2	3.08	2006	6
542101	2	3.27	2007	4
542101	9	9.2	2009	8
542101	5	6.58	2011	7
542101	1	2.28	2013	10
542101	2	3.91	2016	12
542101	18	15.44	2019	1
542101	1	2.34	2021	2
542102	3	5.28	2011	7
542102	1	2.47	2011	11
542102	3	2.65	2012	4
542102	1	2.6	2013	10
543001	1	2.07	1930	5
543001	2	2.55	1940	8
543001	4	5.21	1949	12
543001	3	3.58	1965	9
543001	4	4.33	1967	4
543001	2	2.35	1969	3
543001	1	2.19	1975	5
543001	2	2.3	1978	2
543001	4	4.35	1978	11
543001	1	2.02	1985	11
543001	1	2.11	1990	9
543001	3	3.41	1993	6
543001	4	5.47	1997	1
543001	1	2.3	1997	10
543001	2	2.84	2004	3
543001	2	3.88	2006	6
543001	4	5.33	2006	9
543001	1	2.02	2007	2
543001	2	4.81	2007	4
543001	1	2.3	2007	10
543001	5	7.78	2009	6
543001	2	3.43	2009	12
543003	8	8.87	1982	8
543003	1	2.04	1985	7
543003	6	7.57	1987	5

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
543010	3	4.14	1986	5
543010	3	6.33	1987	4
543010	3	3.12	1990	11
543010	4	4.1	1992	2
543010	5	5.46	1992	12
543010	2	3.05	1993	6
543010	2	2.29	2004	3
543010	4	3.8	2005	3
543010	2	3.27	2007	4
543010	7	6.72	2009	10
543010	3	3.84	2011	7
543010	4	3.37	2019	11
543010	2	3.62	2020	9
543012	2	3.57	1981	12
543012	1	2.47	1982	8
543012	4	5.1	1982	10
543012	1	2	1983	5
543012	2	2.29	1984	9
543012	5	5.22	1987	5
543012	3	3.9	1991	10
543012	3	5.78	1993	6
543012	2	2.8	2004	3
543012	4	4.68	2005	1
543012	2	3.21	2006	6
543012	2	3.69	2007	4
543012	6	6.28	2019	11
543012	2	3.92	2020	9
543012	2	2.53	2020	12
543110	3	2.93	1994	10
543110	6	6.04	1997	10
543110	4	3.33	2005	8
543110	4	6.72	2006	6
543110	3	2.89	2007	4
543111	6	7.48	2009	11
543111	3	5.44	2011	7
543111	1	2.56	2013	10
543111	5	3.4	2014	1
543113	1	2.36	2009	4
543113	2	3.73	2009	8

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
543113	2	2.62	2010	10
543113	2	3.27	2011	8
543113	1	2.72	2013	10
543113	2	2.38	2016	12
543310	2	2.62	1976	2
543310	2	3.53	1982	8
543310	4	6.12	1986	3
543311	3	3.77	1993	6
543311	4	4.69	2005	1
543311	2	2.85	2006	6
543311	1	3.03	2007	5
543311	3	4.14	2011	7
543311	1	2.32	2012	6
543311	3	2.85	2014	3
543311	2	2.94	2020	9
543312	1	2.12	2006	12
543312	2	4.16	2007	4
543312	2	5.24	2008	6
543312	1	2.81	2009	1
543312	2	5.09	2009	11
543312	4	8.9	2020	1
543312	5	6.81	2020	9
543312	3	2.99	2021	3
544002	3	4.53	1950	1
544002	1	2.35	1957	1
544002	4	6.5	1958	3
544002	3	3.38	1961	9
544002	3	2.49	1967	5
544002	2	2.31	1969	10
544002	6	7.11	1974	7
544002	3	4.69	1976	5
544101	2	3.55	1958	3
544101	1	2.21	1958	6
544101	1	2.63	1980	3
544101	1	2.55	1981	2
544213	2	2.53	2012	5
544213	2	3.85	2018	7
544213	4	5.78	2019	11
544213	2	2.79	2020	9

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
544311	1	2.91	1982	8
544311	5	5.19	1982	11
544311	3	4.2	1986	10
544311	4	4.62	1987	5
544311	3	3.63	1991	4
544311	2	3.44	1993	6
544311	2	2.83	2004	3
544311	2	3.07	2006	6
544311	2	2.64	2007	5
544311	3	4.26	2011	7
544311	2	2.26	2012	5
545013	2	3.57	2004	3
545013	4	4.61	2004	6
545013	4	4.95	2005	1
545013	2	3.46	2006	6
545013	3	4.04	2007	4
545013	4	5.4	2009	10
545013	3	3.68	2011	7
545013	4	4.03	2012	4
545013	1	2.26	2013	10
545013	2	2.99	2016	12
545014	2	4.71	2011	8
545014	3	3.86	2012	4
545014	1	2.39	2020	9
545014	1	3.09	2023	7
545111	1	2.67	1982	8
545111	2	3.12	1993	6
545111	5	4.15	1994	8
545111	1	2.03	2001	6
545111	2	3.51	2004	3
545111	2	3.82	2005	3
545111	2	3.33	2006	6
545111	4	3.87	2006	9
545111	3	3.07	2007	4
545111	1	2.05	2011	2
545111	3	3.21	2011	7
545111	2	3.03	2012	5
545111	1	2.06	2013	10
545111	5	5.13	2020	1

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
545111	2	3.24	2020	9
545111	2	2.71	2020	12
545201	12	13.88	1912	8
545201	2	3.67	1913	9
545201	15	20.66	1913	12
545201	2	2.73	1918	7
545201	6	7.32	1918	11
545201	3	3.26	1929	1
545201	4	5.46	1930	9
545201	2	2.33	1969	10
545201	8	7.46	1972	11
545201	3	4.36	1976	5
545201	3	4.1	1976	12
545201	1	2.78	1982	8
545201	3	3.94	1991	4
545201	2	3.15	1993	6
545201	3	3.33	2001	6
545201	2	3.71	2004	3
545201	2	4.4	2005	3
545201	3	3.62	2007	4
545201	3	3.73	2011	7
545201	2	2.59	2012	5
545201	1	2.01	2014	5
545201	6	5.79	2019	11
545201	2	2.42	2020	9
545201	1	2.39	2023	7
545210	2	2.94	1969	3
545210	5	6.52	1975	4
545210	1	2.52	1982	5
545211	2	3.05	1965	9
545211	3	3.1	1969	3
545212	3	3.96	1969	3
545212	5	5.4	1974	7
545212	1	2.55	1982	8
545212	2	3.5	1987	5
545213	1	2.81	1982	8
545213	2	3.31	1984	9
545213	5	4.96	1987	5
545213	2	2.41	1990	12

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
545213	4	3.26	1992	12
545213	3	3.45	1993	6
545213	5	3.35	1994	8
545213	1	2.01	2001	6
545213	2	3.23	2004	3
545213	3	3.64	2005	3
545213	2	3.29	2006	6
545213	5	4.39	2006	9
545213	3	3.94	2007	4
545310	1	3.11	1974	10
545310	1	2.97	1982	8
545310	3	4.81	1982	11
545310	4	4.86	1987	5
545310	3	3.55	1991	4
545310	2	3.32	1993	6
545310	2	3.27	2004	3
545310	4	4.71	2005	1
545310	3	4.43	2005	8
545311	4	4.28	2005	1
545311	1	2.18	2007	7
545311	1	2.18	2009	1
545311	3	4.13	2009	10
545312	2	2.99	2004	3
545312	2	3.81	2005	3
545312	2	3.32	2006	6
545312	3	3.27	2007	4
545312	3	4.24	2011	7
545312	2	2.9	2012	5
545312	2	2.09	2013	10
545312	1	2	2014	5
545312	8	7.41	2019	1
545312	7	6.55	2019	11
545312	1	2.09	2020	9
545312	2	2.52	2020	12
545412	1	2.29	1982	8
545412	3	5.62	1987	5
545501	1	2.49	1982	8
545501	1	2.31	1984	10
545501	2	2.83	1986	10

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
545501	3	2.38	1987	1
545501	5	4.54	1987	5
545501	5	5.39	1991	2
545501	3	3.09	1991	10
545501	8	7.89	1993	6
545501	3	2.48	1994	10
545501	4	3.53	1999	7
545501	2	2.71	2004	8
545501	4	3.91	2011	6
545501	2	2.54	2012	6
545501	1	2.63	2013	7
545501	1	2.23	2013	10
545501	1	2.1	2015	8
545501	1	2.05	2016	5
546001	3	3.17	1965	9
546001	2	3.35	1967	6
546001	2	3.24	1969	3
546030	2	2.28	1965	9
546030	2	2.92	1969	3
546030	7	5.7	1970	1
546030	3	5.48	1984	4
546031	3	3.13	1965	9
546031	3	3.48	1978	9
546032	2	2.67	1967	6
546032	4	9	1972	6
546032	1	2.96	1974	5
546103	1	2.65	1910	11
546103	11	13.97	1914	4
546103	1	2.07	1918	8
546103	6	6.99	1918	11
546103	3	3.3	1921	3
546103	1	2.51	1922	8
546103	1	2.04	1928	8
546103	1	2.2	1930	5
546103	6	7.46	1930	7
546103	2	2.62	1937	9
546103	1	2.2	1939	5
546103	3	3.36	1943	1
546103	2	3.11	1949	9

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
546103	3	2.85	1950	6
546103	2	3.2	1951	9
546103	5	5.5	1952	3
546103	2	2.08	1956	12
546103	4	6.49	1958	3
546103	1	2.12	1963	1
546111	2	2.96	1969	3
546111	1	2.48	1972	9
546111	2	3.33	1976	5
546202	5	5.34	1957	4
546202	2	3.23	1958	3
546202	1	2.36	1958	6
546202	1	2.44	1963	10
546202	4	3.09	1965	9
546202	1	2.16	1969	10
546202	6	6.66	1987	1
546202	4	4.47	1988	8
546202	4	6.45	1989	2
546202	5	4.37	1992	12
546202	2	3.39	1993	6
546202	5	4.3	1994	8
546202	2	2.77	1999	10
546203	2	2.75	1965	9
546203	2	2.42	1969	3
546203	1	2.26	1982	8
546203	2	4.64	1988	10
546203	2	2.13	1990	11
546203	3	2.76	1991	4
546203	3	4.32	1993	6
546203	3	3.3	1994	10
546203	2	2.71	2004	3
546203	2	4.13	2005	3
546210	5	4.12	1967	3
546210	2	2.7	1969	3
546210	4	4.55	1972	6
546210	7	4.84	1972	11
546210	2	3.54	1975	7
546212	2	2.58	1969	10
546212	3	2.82	1973	1

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
546212	8	6.68	1982	8
546212	1	2.02	1984	10
546212	2	3.64	1987	5
546212	2	2.22	1990	11
546212	3	3.91	1991	10
546212	3	3.36	1993	6
546212	5	6.01	1994	8
546212	3	3.2	2001	6
546212	2	3.77	2004	3
546212	2	3.64	2005	3
546212	2	4.78	2006	1
546212	3	3.45	2007	4
546216	2	2.56	1988	1
546216	1	2.69	1988	9
546216	1	2.11	1990	9
546216	3	3.23	1992	2
546216	2	3.01	1993	6
546216	2	3.22	1994	11
546216	2	3.26	2004	3
546216	3	3.61	2007	4
546216	4	4.66	2009	10
546216	3	3.03	2012	4
546216	5	3.69	2014	1
546216	3	4.56	2015	10
546216	2	4.33	2023	7
546218	2	3.03	1991	5
546218	1	2.46	1992	7
546218	6	6.16	1994	1
546218	2	3.14	2004	3
546218	3	5.08	2007	4
546301	2	2.44	1951	9
546301	4	2.89	1965	9
546301	1	2.49	1982	8
546301	1	2.23	1988	6
546301	3	3.36	1989	12
546301	7	7.62	1990	12
546301	3	3.18	1993	6
546301	12	11.79	1993	10
546301	2	4.08	1994	11

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
546301	1	2.98	2002	4
546301	2	3.15	2004	3
546301	6	5.46	2004	6
546301	2	4.92	2005	3
546301	3	4.34	2007	4
546301	2	2.79	2010	3
546301	2	3.57	2011	8
546301	3	2.52	2012	4
546301	1	2.28	2014	5
546301	6	6.39	2019	11
546301	2	2.6	2020	9
546301	2	2.52	2020	12
546310	3	4.25	1976	5
546310	4	5.18	1977	12
546310	1	2.01	1982	8
546315	1	2.33	1990	2
546315	3	3.38	1991	4
546315	3	3.15	1993	5
546315	5	4.4	1994	8
546315	2	4.27	2005	3
546315	2	2.94	2006	6
546315	4	6.32	2007	3
546315	3	3.41	2011	7
546315	1	2.09	2013	10
546315	6	6.09	2019	11
546315	2	2.11	2020	9
546316	7	6.97	1990	12
546316	2	2.96	1993	6
546316	2	3.46	1994	11
546316	2	3	2004	3
546316	4	3.52	2004	6
546316	2	4.36	2005	3
546316	3	3.27	2007	4
546316	3	3.74	2011	7
546316	3	2.19	2012	4
546316	1	2.43	2013	10
546411	3	3.08	1967	4
546411	2	3.05	1969	3
546411	1	2.02	1969	7

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
546411	6	6.6	1973	1
546411	5	3.57	1977	12
546411	3	3.49	1978	9
546411	1	2.64	1982	8
546411	6	6.15	1982	10
546412	5	4.99	1973	1
546412	1	2.66	1982	8
546412	4	4.68	1987	5
546412	7	6.73	1990	12
546412	2	2.14	1992	12
546412	2	3.34	1993	6
546412	2	2.41	1994	11
546412	2	2.41	2004	3
546412	1	2.36	2004	9
546412	2	3.64	2005	3
546412	3	4.07	2007	4
546412	6	6.24	2011	6
546412	1	2.82	2012	6
546412	1	2.26	2013	10
546412	1	2.19	2014	5
546412	3	3.09	2015	6
546412	2	2.97	2020	9
546416	5	4.8	1991	2
546416	3	3.53	1993	6
546416	2	2.84	2004	3
546416	6	5.28	2004	6
546416	4	6.07	2005	1
546416	2	4.01	2007	4
546416	1	2.64	2012	6
546416	2	2.78	2015	6
546416	4	5.42	2019	11
546416	2	2.96	2020	9
546416	2	2.51	2020	12
546416	1	3.7	2023	7
546510	2	3.03	1973	2
546510	3	4.14	1989	2
546510	3	3.95	1991	10
546510	3	3.37	1992	2
546510	2	3.7	1993	6

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
546510	3	2.57	1994	10
546512	3	3.05	1994	10
546512	4	3.32	1999	7
546512	1	2.02	2004	3
546512	3	3.08	2004	9
546512	2	3.73	2005	3
546512	1	2.15	2006	2
546512	2	2.9	2006	6
546512	3	4.21	2007	4
546512	4	4.39	2011	6
546512	2	2.18	2012	6
546512	1	2.21	2014	5
547001	4	6.26	1916	4
547001	8	10.94	1918	11
547001	3	3.55	1922	6
547001	1	2.08	1925	7
547001	2	2.83	1929	1
547001	2	3.76	1930	11
547001	1	2.14	1939	5
547001	5	6.82	1945	11
547001	2	3.1	1951	9
547001	4	2.84	1952	7
547001	3	4.33	1958	4
547001	1	2.75	1963	10
547001	2	2.61	1965	9
547001	4	4.72	1984	4
547001	1	2.24	1988	1
547001	7	6.37	1989	12
547001	1	2.24	1990	9
547001	2	2.27	1991	5
547001	4	3.44	1991	9
547001	2	4.44	1993	7
547001	2	2.51	1994	11
547001	4	5.61	1995	8
547002	2	2.8	1982	8
547002	3	4.29	1982	11
547002	1	2.08	1990	9
547002	4	4.01	1990	11
547002	2	3.67	1993	7

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
547002	3	3.25	1994	10
547002	3	4.64	2000	8
547002	2	2.87	2002	4
547002	1	3.15	2004	7
547010	3	3.21	2007	4
547010	3	3.39	2009	11
547010	3	3.08	2011	7
547010	4	4.32	2012	4
547010	2	2.25	2013	10
547010	7	5.49	2019	10
547010	2	2.79	2020	9
547112	2	2.61	1975	4
547112	1	2.07	1975	12
547112	3	4.76	1983	7
547119	2	3.21	2007	9
547119	3	3.7	2009	11
547119	2	3.57	2011	8
547119	3	3.3	2012	4
547119	1	2.05	2013	10
547119	3	3.69	2015	10
547119	4	5.23	2020	1
547119	1	3.21	2023	7
547201	3	4.53	1950	1
547201	2	2.08	1950	7
547201	2	2.6	1951	9
547201	1	2.37	1952	7
547201	3	3.87	1963	8
547201	4	3.33	1967	4
547201	5	3.82	1977	12
547201	3	3.57	1978	10
547201	9	9.71	1982	5
547201	3	4.03	1986	10
547201	2	4.09	1987	5
547201	1	3.64	1988	4
547201	2	3.58	1989	12
547214	1	2.05	1982	8
547214	5	4.22	1994	8
547214	3	4.2	2000	8
547214	2	2.46	2001	6

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
547214	6	4.7	2004	6
547214	2	4.76	2005	3
547214	3	3.6	2007	4
547214	9	7.37	2009	8
547214	3	3.22	2011	7
547214	3	2.74	2012	4
547214	1	2.06	2013	10
547214	3	2.12	2014	3
547214	2	2.47	2020	9
547214	2	2.63	2020	12
547214	1	2.02	2023	7
547215	2	2.35	1980	12
547215	3	4.55	1983	7
547215	2	3.7	1984	9
547215	3	5.06	1986	10
547219	1	2.17	1982	8
547219	5	5.01	1987	5
547219	4	4.32	1989	2
547219	3	2.95	1993	6
547219	3	3.8	2000	8
547219	2	3.96	2005	3
547219	2	2.45	2006	6
547219	3	3.18	2007	4
547219	2	3.42	2007	9
547219	6	7.62	2009	11
547219	2	2.95	2011	8
547219	3	3.71	2012	4
547219	3	3.78	2014	3
547220	4	5	1988	7
547220	2	3.28	1989	8
547220	3	3.53	1990	12
547220	3	3.77	1991	4
547220	3	2.71	1993	6
547222	4	3.59	1967	4
547222	2	3.04	1969	3
547222	1	2.42	1982	8
547222	3	3.42	1986	10
547222	4	4.21	1989	2
547222	1	2.08	1990	9

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
547222	3	2.8	1990	12
547223	2	2.97	1984	9
547223	1	2.45	1990	9
547223	3	3.5	1993	6
547223	2	2.41	1994	11
547223	2	4.79	2005	3
547223	2	2.56	2006	6
547223	3	4.09	2007	4
547223	6	7.69	2009	11
547223	2	3.67	2011	8
547223	4	4.57	2020	1
547224	8	5.43	1997	10
547224	1	2.3	1999	2
547224	3	3.37	2000	8
547224	2	3.03	2001	6
547224	4	6.03	2005	1
547224	3	3.62	2007	4
547225	2	3.06	2006	6
547225	3	3.33	2007	4
547226	3	4.25	2012	4
547226	3	2.62	2014	3
547226	4	4.77	2020	1
547226	1	2.57	2020	9
547226	1	2.84	2023	7
547302	8	9.71	1912	10
547302	3	4.13	1913	12
547302	11	13.08	1914	4
547302	2	2.32	1918	7
547302	6	6.28	1918	11
547302	1	2.36	1922	8
547302	2	2.74	1929	1
547302	3	4.92	1930	10
547302	1	2.06	1939	5
547302	4	4.11	1942	12
547302	2	2.11	1944	11
547302	2	3.06	1949	9
547302	2	2.64	1951	9
547302	1	2.05	1957	1
547302	4	4.93	1958	3

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
547302	1	2.52	1963	10
547302	3	3.6	1965	9
547302	4	5.57	1967	4
547303	1	2.02	1943	11
547303	1	2.02	1944	3
547303	2	2.74	1951	9
547303	1	2.12	1952	7
547303	2	3.04	1956	12
547303	1	2.48	1958	6
547303	3	3.2	1963	8
547303	4	3.16	1967	4
547303	7	5.57	1972	11
547303	1	2.38	1982	8
547303	5	4.74	1987	2
547304	7	5.85	1972	11
547304	1	2.47	1982	8
547304	2	3.76	1988	9
547305	3	4.66	1977	8
547307	5	3.89	2002	1
547307	6	8.8	2004	4
547307	2	3.89	2005	3
547307	2	2.64	2006	6
547307	6	5.62	2009	8
547307	5	6.05	2011	7
547307	3	2.9	2012	4
547307	1	2.02	2013	10
547307	6	5.22	2019	11
547308	6	6.74	2019	11
547308	2	2.76	2020	9
547312	2	3	1977	9
547312	1	2.04	1982	8
547312	2	3.62	1987	5
547315	3	5.09	1983	7
547315	2	3.09	1990	11
547316	2	3.09	1986	10
547316	2	3.1	1993	7
547316	1	2.92	1995	6
547338	3	2.95	1991	4
547338	3	2.53	1993	6

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
547338	1	2.53	1999	2
547338	3	3.45	2000	8
547338	3	5.15	2003	10
547338	2	3.1	2004	3
547339	6	5.75	2004	6
547339	2	4.45	2005	3
547339	2	3.39	2011	8
547339	3	2.86	2012	4
547339	3	2.29	2014	3
547339	1	2.2	2020	9
547339	4	3.49	2020	12
547339	1	3.01	2023	7
547340	3	4.29	2007	4
547340	1	2.29	2008	9
547340	2	3.28	2010	3
547340	2	4	2011	8
547340	2	2.54	2012	5
547340	3	2.57	2015	10
547340	1	2.77	2020	7
547402	1	2.73	1966	8
547402	2	3.2	1969	3
547402	5	4.64	1969	10
547402	2	2.55	1971	11
547402	1	2.06	1972	9
547402	3	3.39	1973	1
547402	2	3.93	1976	5
547411	5	4.96	1987	5
547411	2	2.71	1993	7
547411	2	2.89	1994	11
547411	2	2.53	2006	6
547411	1	2.58	2008	5
547412	8	7.66	1992	12
547412	2	2.86	1994	11
547412	2	3.94	2000	9
547412	2	2.9	2001	6
547412	2	2.9	2004	3
547412	2	3.43	2005	3
547503	6	4.02	1977	12
547503	5	5.33	1978	9

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
547503	1	2.53	1982	8
547503	1	2.46	1984	4
547503	1	2.21	1985	6
547512	5	3.38	1991	2
547512	2	2.7	1993	7
547512	2	2.75	1998	1
547512	3	3.25	2001	6
547512	2	2.84	2004	3
548101	3	2.84	1963	8
548101	3	3.89	1973	1
548101	3	4.41	1981	6
548101	14	12.63	1986	10
548101	2	4.13	1990	12
548101	2	2.31	1991	5
548101	9	9.28	1991	8
548101	2	5.06	1992	6
548201	3	3.37	1991	10
548201	2	3.46	1995	8
548201	3	4.37	2000	8
548210	3	4.39	1989	2
548210	1	2.02	1990	9
548210	3	3.03	1991	4
548210	2	3.49	1993	7
548210	2	3.05	1994	11
548211	6	4.27	1972	12
548211	4	4.51	1982	5
548211	5	3.86	1986	10
548211	5	3.56	1990	11
548211	2	2.95	1993	7
548211	3	3.79	1994	10
548211	2	3.03	2004	3
548211	2	4.4	2005	3
548211	2	2.8	2006	6
548211	3	5.1	2007	4
548211	1	4.17	2008	9
548212	10	21.19	1987	5
548212	2	2.61	1994	11
548213	1	2.04	2014	5
548213	5	5.94	2020	1

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
548213	4	6.99	2020	9
548213	2	2.99	2022	8
548214	2	3.23	2005	3
548214	3	3.34	2007	4
548214	6	7.09	2009	11
548214	3	4.22	2011	7
548214	3	3.78	2012	4
548214	1	2	2013	10
548215	6	6.41	2009	11
548215	3	3.93	2012	4
548215	1	2.05	2014	5
548310	3	2.78	1965	9
548310	1	2.19	1966	10
548310	5	5.97	1969	7
548310	2	2.38	1980	4
548310	5	5.21	1987	5
548310	2	5.14	1987	12
548310	2	4.19	1988	10
548310	3	2.85	1994	10
548311	1	2.08	1969	10
548311	6	7.09	1973	8
548311	1	2.92	1984	4
548313	8	8.62	1977	8
548313	2	2.31	1982	8
548313	3	4.28	1982	11
548313	3	5.1	1983	7
548314	2	2.51	1993	6
548314	2	2.49	1994	11
548314	2	3.26	1995	8
548314	1	2.18	1998	1
548315	3	4.39	2011	7
548315	3	4.29	2012	4
548315	4	4.91	2020	1
548315	2	3.22	2020	9
548315	1	2.87	2023	7
548402	1	2.05	1982	8
548402	2	2.8	1984	9
548402	3	3.98	1989	2
548410	1	2.84	1981	3

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
548410	2	5.69	1984	4
548410	2	3.52	1993	7
548410	5	4.89	1994	8
548410	3	5.13	2000	8
548412	3	4.95	2011	7
548412	3	4.37	2012	4
548412	2	2.51	2013	6
548412	1	2.06	2014	5
548412	4	5.09	2020	1
548412	2	2.72	2020	9
548413	2	3.15	2015	11
548413	4	4.52	2020	1
549010	1	2.38	1983	11
549010	2	3.21	1993	7
549010	4	3.35	1994	11
549010	2	3.93	2000	9
549010	2	5.54	2007	8
549011	1	2.15	1983	11
549011	5	7.37	1987	4
549011	1	3.41	1988	9
549011	4	2.47	1989	6
549011	1	2.07	1991	5
549011	1	2.3	1998	7
549201	4	4.61	1958	3
549201	1	2.3	1960	8
549201	2	2.79	1964	11
549201	4	4.17	1965	9
549211	10	7.85	1982	8
549211	3	4.18	1987	4
549211	2	3.36	1993	7
549211	2	2.89	2004	3
549211	2	3.5	2005	3
549211	3	4.24	2006	11
549310	8	7.24	1969	7
549310	1	2.5	1971	12
549310	2	3.78	1975	7
549310	1	2.32	1982	8
549310	3	3.29	1983	7
549310	1	2.43	1983	11

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
549310	4	4.28	1986	3
549402	2	2.46	1958	3
549402	1	2.44	1958	6
549402	1	2	1960	8
549402	3	4.35	1963	8
549402	4	4.1	1965	9
549402	3	3.19	1967	5
549402	2	3.11	1969	3
630901	1	2.03	1957	1
630901	1	2.29	1958	6
630901	2	2.61	1965	9
630901	1	2.1	1977	2
630901	4	7.8	1982	5
630901	2	4.51	1993	7
630901	2	3.08	1994	11
630901	4	4.56	2000	8
630901	2	3.44	2004	3
630901	3	4.15	2007	4
630901	3	3.29	2008	9
630901	3	7.14	2009	11
640201	2	3.21	1960	7
640201	1	2.34	1963	7
640201	4	5.43	1969	3
640201	2	2.32	1970	1
640201	3	3.33	1973	1
640201	2	3.1	1975	11
640201	2	4.9	1977	4
640310	1	2.23	1990	9
640310	5	5.24	1993	7
640310	2	2.74	1994	11
640310	1	3.5	1996	6
640411	2	3.48	1975	2
640411	5	4.73	1982	11
640411	2	2.11	1988	10
640411	2	3.05	1993	7
640411	2	2.54	1994	11
640411	3	4.06	2000	8
640436	4	3.7	1982	5
640436	2	2.27	1993	7

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
640436	2	3.44	1994	11
640436	3	4.61	2000	8
640436	2	2.93	2004	3
640436	3	4.32	2007	4
640436	2	2.36	2013	10
640436	3	3.78	2015	10
640436	4	5.25	2020	1
640436	2	3.39	2020	9
640436	1	3.71	2023	7
640501	2	2.95	1949	9
640501	3	4.33	1950	1
640501	1	2.13	1950	12
640501	1	3.02	1951	9
640501	1	2.16	1957	1
640501	1	2.08	1958	6
640501	1	2.53	1963	10
640501	3	3.11	1965	9
640501	3	3.48	1967	5
640501	2	3.13	1981	12
640501	4	5.94	1982	5
640501	2	2.77	1991	5
640501	2	2.63	1993	7
640501	2	3.03	1994	11
640501	2	3.62	2005	3
640501	2	2.11	2005	8
640501	3	4.54	2007	4
640501	1	2.14	2009	11
641001	7	4.86	1949	5
641001	3	4.86	1950	1
641001	6	5.84	1950	7
641001	2	4.08	1951	9
641001	1	2.36	1958	6
641001	1	2.28	1959	6
641001	1	2.41	1963	10
641001	8	6.91	1967	3
641001	2	3.93	1982	11
641010	1	2.03	2007	9
641010	2	3.47	2010	10
641010	2	2.96	2011	8

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
641010	4	4.66	2012	4
641010	1	2.31	2013	10
641102	6	3.77	1974	7
641102	5	5	1982	11
641102	1	2.04	1983	11
641102	1	2.33	1988	4
641102	1	2.59	1994	12
641102	2	3.74	2000	9
641201	2	3.12	1939	2
641201	5	4.63	1940	8
641201	1	2.05	1943	5
641201	3	3.97	1945	6
641201	1	3.95	1951	9
641201	2	5.58	1958	6
641201	1	3.34	1959	4
641201	1	4.59	1963	8
641201	2	3.92	1970	12
641203	3	3.98	1978	1
641203	1	2.29	1988	1
641210	5	5.85	1993	7
641210	3	2.83	1994	11
641213	1	2.79	2005	4
641213	3	3.98	2007	4
641213	1	2.23	2008	9
641213	5	4.06	2011	7
641213	2	2.02	2013	10
641213	1	2.13	2015	12
641213	4	5.46	2020	1
641213	1	2.04	2020	9
641214	2	5.54	2005	7
641214	1	3.64	2006	9
641214	1	2.08	2006	11
641214	1	3.05	2008	5
641214	2	2.4	2011	8
641214	3	4.61	2012	4
641214	2	2.4	2013	10
641215	3	4.23	2007	4
641215	1	2.24	2008	9
641215	2	3.33	2010	10

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
641215	4	3.68	2011	8
641215	1	2.16	2013	10
641302	1	2.06	1957	1
641302	1	2.32	1958	6
641302	3	4.05	1965	9
641302	2	2.39	1969	3
641302	4	4.45	1972	12
641302	1	2.58	1982	8
641302	5	4.15	1982	11
641302	1	2.21	1983	11
641302	2	3.12	1991	5
641302	7	6.33	1993	7
641302	3	3.17	1994	11
641302	3	2.96	1997	1
641310	2	2.85	1993	7
641310	2	2.82	1994	11
641310	2	3.46	2007	4
641310	3	3.22	2007	10
641310	1	2.35	2008	3
641310	1	3.29	2008	6
641410	3	3.94	1983	7
641413	3	3.71	1989	12
641413	16	12.75	1993	1
641413	2	2.96	1994	11
641414	2	2.56	2005	8
641414	2	3.2	2006	6
641414	3	4.13	2011	7
641414	3	4.62	2012	4
641414	1	2.18	2013	7
641414	1	2.22	2013	10
641414	4	3.4	2015	5
641414	3	3.67	2019	5
641414	4	5.03	2020	1
641414	1	2.23	2020	12
641501	7	8.45	1921	2
641501	6	6.19	1922	3
641501	4	5.71	1923	2
641501	2	2.4	1925	9
641501	5	5.85	1949	6

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
641501	6	4.66	1951	5
641501	3	2.66	1965	9
641501	2	3.89	1971	6
641501	6	6.31	1982	3
641501	3	4.18	1984	9
641511	6	5.86	1951	5
641511	1	2.09	1958	6
641511	1	2.02	1963	10
641511	3	3.22	1965	9
641511	3	3.12	1967	5
641511	1	2.01	1969	3
641511	6	3.11	1977	10
641511	4	4.7	1982	5
641511	1	2.18	1983	7
641511	4	3.78	1991	5
641511	2	2.2	1993	7
641511	2	3.24	1994	11
641511	6	6.49	1999	5
641511	3	3.43	2001	6
641511	2	3.66	2004	3
641511	2	5.01	2005	3
641511	2	2.63	2005	8
641511	3	5.45	2007	4
641511	2	2.39	2008	8
641511	4	3.51	2011	6
641511	3	5.28	2012	4
641511	5	11.75	2013	10
641512	2	2.78	2013	10
641512	3	3.45	2015	6
641512	4	5.99	2020	1
641512	2	3.08	2020	9
642010	11	7.55	2019	1
642010	5	6.29	2020	1
642011	1	2.37	1988	4
642011	1	2.07	1991	12
642011	1	2.88	1993	7
642011	2	3.66	2004	3
642011	6	7.51	2004	6
642011	9	7.68	2005	1

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
642011	2	2.96	2007	5
642011	2	4	2010	10
642201	1	2.09	1959	6
642201	3	3.96	1963	8
642201	4	4.19	1965	9
642201	4	3.99	1972	11
642201	2	2.88	1975	7
642201	2	3.11	1980	4
642201	4	5.79	1982	5
642201	5	5.71	1982	11
642201	1	2.17	1983	11
642201	1	2.21	1988	4
642201	1	2.14	1991	12
642201	2	3.62	1993	7
642201	3	2.62	1994	11
642201	1	2.03	1998	3
642201	1	2.03	2001	1
642401	2	5.14	1950	7
642401	2	2.75	1951	8
642401	1	2.01	1952	3
642401	2	3.43	1954	1
642401	2	2.45	1955	1
642401	1	2.59	1957	6
642401	1	2.25	1958	8
642401	2	2.38	1958	10
642401	1	2.1	1982	8
642401	4	2.73	1988	9
642401	3	4.25	1992	2
642415	1	2.56	2011	9
642415	3	4.22	2012	4
642415	2	2.22	2013	6
642415	1	2.12	2013	10
642415	4	3.3	2018	7
643112	12	17.76	1979	8
643112	4	6.43	1986	3
643112	1	2.29	1988	4
643116	2	2.97	1986	3
643116	2	3.34	1988	4
643116	1	2.52	1990	6

Gauge ID Number	Duration (D, months)	Severity (S)	Year	Start month
643116	12	14.04	1993	7
643118	3	4.13	2007	4
643118	2	2.94	2011	8
643118	1	2.61	2012	4
643118	3	3.66	2013	6
643118	2	2.88	2015	6
643118	3	4.3	2017	10

Appendix G Number of drought events

Table G-1: Number of drought events (nEvt) for different categories (Table 3-1) for each site and arrival rate, presented in ascending Gauge ID number.

		Near Normal		Moderately dry		Severely dry		Extremely dry	
Gauge ID	Gauge Name	nEvt	Rate	nEvt	Rate	nEvt	Rate	nEvt	Rate
424602	Cape Reinga Aws	45	1.56	26	0.90	10	0.35	6	0.21
425801	Te Paki Stn, Te Hapua	67	1.56	23	0.54	24	0.56	4	0.09
425902	Paua Blk Parengarenga	67	1.60	25	0.60	20	0.48	10	0.24
437001	Cape View	37	1.24	27	0.90	19	0.64	2	0.07
437010	Waihopo at Kimberley Road	13	1.31	6	0.61	4	0.40	3	0.30
439201	Waiharara	88	1.30	52	0.77	32	0.47	18	0.27
439202	Waiharara 2	38	1.31	18	0.62	13	0.45	8	0.28
439301	Rangiputa	51	1.46	25	0.72	11	0.32	11	0.32
439501	Mangonui	134	1.40	64	0.67	40	0.42	29	0.30
530201	Kaitaia Aero	53	1.44	19	0.51	19	0.51	10	0.27
530202	Waipapakauri	48	1.42	26	0.77	15	0.44	8	0.24
530204	Aupouri Forest at Forest HQ	79	1.41	31	0.55	28	0.50	16	0.29
530205	Wiessing at Kaitaia	49	1.54	16	0.50	15	0.47	7	0.22
530206	Kaitaia Aero Ews	35	1.46	14	0.59	13	0.54	7	0.29
530210	Awanui at Temples	15	1.51	3	0.30	4	0.40	3	0.30
530301	Kaingaroa North	55	1.62	19	0.56	18	0.53	8	0.24
530511	Oruru at Bowling Club	14	1.01	13	0.93	9	0.65	2	0.14
530601	Oruaiti	21	1.32	9	0.57	6	0.38	4	0.25
530602	Oruaiti 2	15	1.16	10	0.77	6	0.46	5	0.39
530701	Kaeo Northland	48	1.30	18	0.49	13	0.35	11	0.30
530710	Pupuke at Giesbers	28	1.17	14	0.59	13	0.54	7	0.29
530801	Matauri Bay	38	1.59	19	0.79	6	0.25	11	0.46
530810	Matauri Bay at NZ China Clays	48	1.37	19	0.54	13	0.37	11	0.32
531101	Ahipara	50	1.35	22	0.60	20	0.54	10	0.27
531201	Kaitaia (Vincent)	174	1.48	72	0.61	45	0.38	36	0.31
531203	Kaitaia 3	18	1.39	11	0.85	3	0.23	3	0.23
531205	Kaitaia Observatory	51	1.50	30	0.88	11	0.32	9	0.27
531207	Kaitaia Ews	36	1.34	15	0.56	8	0.30	12	0.45
531209	Pukepoto	22	1.70	9	0.70	3	0.23	4	0.31
531210	Tarawhataroa at Larmer Road	14	1.08	7	0.54	6	0.46	3	0.23
531301	Rangitihi	104	1.55	33	0.49	29	0.43	23	0.34
531302	Rangitihi Sub Stn	43	1.35	19	0.60	20	0.63	7	0.22
531310	Takahue at Wallace	58	1.42	26	0.64	19	0.46	13	0.32
531311	Takahue at Diggers Valley	30	1.43	10	0.48	7	0.33	10	0.48
531313	Takahue at Te Rore	21	1.11	9	0.48	12	0.63	7	0.37

		Near Normal		Moderately dry		Severely dry		Extremely dry	
Gauge ID	Gauge Name	nEvt	Rate	nEvt	Rate	nEvt	Rate	nEvt	Rate
531411	Victoria at Kitchen	88	1.70	30	0.58	17	0.33	20	0.39
531412	Mangamuka at Forest Veiw	15	1.08	8	0.57	8	0.57	5	0.36
531413	Te Puhi at Stanton	12	1.10	8	0.73	4	0.37	3	0.27
531415	Te Puhi at Mangakawakawa Trig	30	1.37	8	0.37	16	0.73	6	0.27
531501	Honeymoon Valley	33	0.89	27	0.73	14	0.38	11	0.30
531512	Kanekane at Coopers Beach	35	1.25	20	0.72	11	0.39	7	0.25
531513	Mangonui at Mangonui	33	1.38	18	0.75	5	0.21	8	0.33
531701	Kaeo	42	1.20	24	0.69	14	0.40	13	0.37
531711	Kaeo at Paitu	60	1.18	41	0.81	24	0.47	13	0.26
531713	Kaeo at Waihuka	12	0.93	11	0.85	5	0.39	4	0.31
531715	Kaeo at Bramley (Manual)	44	1.23	24	0.67	17	0.47	12	0.33
531716	Kaeo at Kaeo	14	1.08	7	0.54	4	0.31	5	0.39
531717	Kaeo at Bramleys	36	1.72	9	0.43	8	0.38	9	0.43
531718	Touwai at Weta	20	1.34	8	0.54	4	0.27	7	0.47
531719	Kaeo at Bennetts	28	1.17	16	0.67	10	0.42	5	0.21
531901	Kerikeri EWS	37	1.24	17	0.57	11	0.37	11	0.37
531910	Kerikeri at Laurenson	24	1.27	13	0.69	10	0.53	5	0.26
531911	Kerikeri at KiaKaha	46	1.65	16	0.57	14	0.50	7	0.25
532202	Herekino	104	1.35	64	0.83	27	0.35	27	0.35
532311	Takahue at Takahue Top	80	1.51	33	0.62	23	0.43	13	0.25
532312	Takahue at Saddle Road	20	2.02	1	0.10	4	0.40	3	0.30
532402	Broadwood	83	1.39	35	0.58	27	0.45	14	0.23
532501	Mangamuka Bridge	23	1.00	16	0.70	10	0.44	7	0.31
532503	Omahuta 2	34	1.31	15	0.58	7	0.27	7	0.27
532510	Mangamuka at Mangamuka	13	1.19	5	0.46	8	0.73	2	0.18
532601	Omahuta 1	39	1.45	15	0.56	10	0.37	8	0.30
532611	Waipapa at Waihou Valley (Grahams)	70	1.56	31	0.69	20	0.45	10	0.22
532710	Waipapa at Puketi Road (Candy)	82	1.47	38	0.68	26	0.46	15	0.27
532711	Waipapa at Puketi R/V	12	1.01	10	0.84	8	0.67	3	0.25
532801	Taus Falls	79	1.49	36	0.68	22	0.42	10	0.19
532810	Maungaparerua at Tyrees	27	1.23	17	0.78	11	0.50	5	0.23
532811	Maungaparerua at Black Poll	28	1.28	16	0.73	11	0.50	8	0.37
532812	Maungaparerua at Airstrip	14	1.17	6	0.50	8	0.67	3	0.25
532813	Maungaparerua at Flats	12	1.10	6	0.55	7	0.64	4	0.37
532814	Maungaparerua at Roadside	22	1.16	14	0.74	8	0.42	6	0.32
532820	Waipapa at Puketi State Forest	6	0.38	5	0.31	6	0.38	8	0.50
532821	Maungaparerua at Tyrees Ford	30	1.20	18	0.72	7	0.28	11	0.44
532822	Waitangi at Wiroa Road 2	13	1.31	7	0.71	3	0.30	4	0.40

		Near Normal		Moderately dry		Severely dry		Extremely dry	
Gauge ID	Gauge Name	nEvt	Rate	nEvt	Rate	nEvt	Rate	nEvt	Rate
532901	Kerikeri 1	42	1.40	15	0.50	16	0.53	9	0.30
532903	Kerikeri Aero 2	48	1.55	13	0.42	9	0.29	13	0.42
532905	Kerikeri Aerodrome AWS	23	1.45	10	0.63	5	0.31	6	0.38
532910	Wairoa at Kerikeri (Carver)	21	1.51	11	0.79	4	0.29	4	0.29
532913	Kerikeri at Waikimihia	35	1.60	19	0.87	8	0.37	4	0.18
532915	Kerikeri at BOI Golf club	14	1.08	5	0.39	6	0.46	4	0.31
533201	Puhata	51	1.60	24	0.75	11	0.34	9	0.28
533301	Rotokakahi at Adams	25	1.14	15	0.68	8	0.37	9	0.41
533302	Rotokakahi at Kohe Road	26	1.00	14	0.54	9	0.35	10	0.39
533501	Kohukohu	85	1.49	31	0.54	28	0.49	15	0.26
533502	Umawera	14	0.74	9	0.48	11	0.58	6	0.32
533601	Rangiahua	69	1.36	23	0.45	26	0.51	18	0.35
533610	Waihou at Crawfords	27	1.36	16	0.80	6	0.30	7	0.35
533710	Lake Omapere at Rototiro	16	0.95	10	0.59	5	0.30	8	0.47
533810	Lake Omapere at Conelley	12	1.10	8	0.73	5	0.46	2	0.18
533812	Utakura at Lake Acres	43	1.31	25	0.76	15	0.46	10	0.30
533813	Waitangi at Ohaeawai (Woods)	44	1.30	31	0.91	12	0.35	8	0.24
533814	Waitangi at Highrisings	14	1.17	9	0.76	3	0.25	4	0.34
533815	Lake Omapere at Faithfull	23	2.32	4	0.40	2	0.20	5	0.50
533817	Waitangi at Ohaeawai	35	1.35	17	0.66	9	0.35	10	0.39
534402	Opononi	59	1.44	31	0.76	18	0.44	9	0.22
534403	Hokianga Harbour Omapere/Opononi	28	1.56	11	0.61	7	0.39	7	0.39
534503	Rawene 2	41	1.21	21	0.62	11	0.32	12	0.35
534610	Whawharu at Topu B Taheke	12	1.10	6	0.55	3	0.27	3	0.27
534701	Kaikohe	71	1.42	32	0.64	31	0.62	12	0.24
534711	Opahi at Norwest Corner	16	1.34	8	0.67	7	0.59	3	0.25
534716	Opahi at Auto Site	37	1.86	9	0.45	9	0.45	8	0.40
534717	Opahi at Long Valley	16	1.34	8	0.67	8	0.67	3	0.25
534722	Opahi at Cocksfoot	13	1.31	2	0.20	3	0.30	7	0.71
534724	Mangamutu at Kaikohe Hill	26	1.24	15	0.72	10	0.48	4	0.19
534725	Punakitere at Kaikohe Woolshed	15	1.37	7	0.64	10	0.92	3	0.27
534801	Kaikohe Aero	28	1.22	20	0.87	14	0.61	6	0.26
534802	Kaikohe Grasslands, D.S.I.R	18	1.29	16	1.15	5	0.36	2	0.14
534803	Kaikohe M.W.D	22	2.02	5	0.46	2	0.18	2	0.18
534807	Kaikohe AWS	63	1.62	18	0.46	13	0.33	11	0.28
534811	Otiria at Ngapipito	16	1.24	10	0.77	5	0.39	5	0.39
535401	Waiotemarama	20	1.26	12	0.75	5	0.31	5	0.31
535412	Waiotemarama at Tooremburg	34	1.71	9	0.45	10	0.50	6	0.30

		Near Normal		Moderately dry		Severely dry		Extremely dry	
Gauge ID	Gauge Name	nEvt	Rate	nEvt	Rate	nEvt	Rate	nEvt	Rate
535413	Whirinaki at King	43	1.39	22	0.71	15	0.49	9	0.29
535501	Wekaweka	78	1.53	29	0.57	21	0.41	19	0.37
535510	Waimamaku at Waiora Farm	52	1.80	24	0.83	9	0.31	8	0.28
535512	Waimamaku at Wekaweka(Russell)	70	1.63	38	0.89	18	0.42	7	0.16
535513	Waimamaku at Wekaweka Road	13	1.31	6	0.61	2	0.20	3	0.30
535712	Awarua at Gammons Rd	28	1.28	15	0.68	15	0.68	5	0.23
535812	Awarua at Awarua Block	12	0.55	12	0.55	13	0.59	5	0.23
535813	Awarua at Tokawhero Road	15	1.26	13	1.09	5	0.42	3	0.25
535901	Kauana Downs	14	0.94	15	1.01	9	0.60	3	0.20
536501	Waipoua Visitor Centre	128	1.56	45	0.55	35	0.43	16	0.20
536601	Whatoro	55	1.38	32	0.80	16	0.40	8	0.20
536610	Kaihu at Tutamoe	17	0.90	20	1.06	4	0.21	4	0.21
536611	Mangakahia at TY Ranch	53	1.48	27	0.75	14	0.39	12	0.33
536613	Waima at Tutamoe	35	1.67	10	0.48	10	0.48	6	0.29
536702	Waimatenui 2	132	1.45	46	0.51	45	0.49	30	0.33
536710	Mangakahia at Waimatenui	29	1.46	9	0.45	7	0.35	7	0.35
536711	Mangakahia at Roudershore	13	1.09	8	0.67	4	0.34	5	0.42
536712	Mangakahia at Glenoban	11	1.01	6	0.55	7	0.64	3	0.27
536811	Opouteke at Kingsclear	46	1.21	21	0.55	20	0.53	9	0.24
536812	Opouteke at Brookvale	49	1.33	27	0.73	15	0.41	11	0.30
536814	Mangakahia at Nukatawhiti	24	1.34	10	0.56	11	0.61	3	0.17
536816	Mangakahia at Twin Bridges	30	1.20	13	0.52	11	0.44	11	0.44
536901	Pipiwai	55	1.45	27	0.71	22	0.58	8	0.21
537510	Kahiu at Katui	27	1.23	13	0.59	7	0.32	6	0.27
537601	Whatoro 2	23	1.45	11	0.69	7	0.44	6	0.38
537602	Trounson Cws	19	1.27	9	0.60	6	0.40	4	0.27
537611	Kaihu at Trounson Park	41	1.47	16	0.57	11	0.39	7	0.25
537613	Kaihu at Kaiiwi Lakes(McLeod)	9	0.91	13	1.31	3	0.30	3	0.30
537614	Kaihu at Whatoro (Haywoods)	39	1.50	13	0.50	15	0.58	6	0.23
537712	Opouteke at Aomarama	14	1.01	12	0.86	8	0.57	4	0.29
537801	Pakotai, Glenmont	55	1.49	27	0.73	16	0.43	7	0.19
537815	Tangowahine at Kereru	44	1.47	19	0.64	16	0.53	5	0.17
537816	Wairoa at Paradise Road	22	1.30	11	0.65	10	0.59	3	0.18
537901	Parakao	86	1.44	38	0.63	27	0.45	18	0.30
538611	Kaiiwi at Kaiiwi Lakes Road	12	1.21	8	0.81	4	0.40	3	0.30
538710	Kahiu at Maropiu	14	1.17	14	1.17	6	0.50	1	0.08
538801	Mamaranui	74	1.24	47	0.78	23	0.38	20	0.33
538810	Awakino at Nilssons (Nash)	49	1.40	24	0.69	13	0.37	11	0.32

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Gauge ID	Gauge Name	nEvt	Rate	nEvt	Rate	nEvt	Rate	nEvt	Rate
538811	Awakino at Booths	10	0.92	12	1.10	2	0.18	4	0.37
539710	Chases Gorge at Baylys Beach (Andrews)	55	1.67	18	0.55	17	0.52	8	0.24
539801	Dargaville	96	1.12	52	0.61	33	0.38	31	0.36
539802	Dargaville Exp Farm	86	1.51	37	0.65	15	0.26	19	0.33
539803	Dargaville N.Z.E.D.	32	1.34	14	0.59	14	0.59	6	0.25
539807	Dargaville 2 Ews	25	1.14	12	0.55	9	0.41	9	0.41
539811	Wairoa at Dargaville County	10	1.01	6	0.61	6	0.61	4	0.40
539813	Wairoa at Dargaville (Hokianga Road)	19	1.27	12	0.80	4	0.27	5	0.34
541001	Purerua Aws	67	1.64	14	0.34	15	0.37	6	0.15
541301	Cape Brett Lighthouse	63	1.40	31	0.69	18	0.40	13	0.29
542001	Waitangi Forest	32	1.28	18	0.72	14	0.56	6	0.24
542010	Waitangi at Wakelins Block	31	1.07	22	0.76	13	0.45	8	0.28
542101	Russell	141	1.37	68	0.66	41	0.40	28	0.27
542102	Russell Cws	16	1.61	6	0.61	5	0.50	4	0.40
543001	Kawakawa Water Treatment Plant	136	1.46	54	0.58	51	0.55	22	0.24
543003	Kawakawa	20	1.34	9	0.60	5	0.34	3	0.20
543010	Waitangi at McDonald Road	51	1.35	27	0.71	12	0.32	13	0.34
543012	Waitangi at Whangae	60	1.37	33	0.75	14	0.32	15	0.34
543110	Kawakawa at Opua	22	1.23	14	0.78	6	0.33	5	0.28
543111	Veronica Channel at Opua	15	1.26	10	0.84	4	0.34	4	0.34
543113	Veronica Channel M and P	14	1.17	7	0.59	5	0.42	6	0.50
543310	Punaruka at Russell State Forest	21	1.51	7	0.50	7	0.50	3	0.22
543311	Oakura Bay at Murphy	39	1.26	19	0.61	17	0.55	8	0.26
543312	Oakura Bay at Te Kapua Street	4	0.25	2	0.13	3	0.19	8	0.50
544002	Motarau, Opahi Stn	42	1.40	14	0.47	18	0.60	8	0.27
544101	Towai	25	1.00	24	0.96	15	0.60	4	0.16
544213	Mimiha at Helena Bay Hill Gallery	13	1.19	6	0.55	6	0.55	4	0.37
544311	Kaimamaku at Peach Orchard Road	38	1.12	23	0.68	16	0.47	11	0.32
545013	Waiharakeke at Motatau (Donaldson's)	33	1.44	17	0.74	6	0.26	10	0.44
545014	Waiharakeke at Okaroro Road	17	1.22	8	0.57	8	0.57	4	0.29
545111	Waiotu at Dawson	62	1.35	33	0.72	16	0.35	16	0.35
545201	Whakapara at Puhipuhi	178	1.50	84	0.71	50	0.42	24	0.20
545210	Wairua at Forstythe Road (McHardys)	18	1.21	9	0.60	6	0.40	3	0.20
545211	Waiotu at Morgans	19	1.27	15	1.01	9	0.60	2	0.13
545212	Waiotu at Waiotu	35	1.46	20	0.84	13	0.54	4	0.17
545213	Waiotu at Hukerenui (Morgans)	44	1.10	31	0.78	17	0.43	13	0.33
545310	Whakapara at Opuawhanga	57	1.50	25	0.66	18	0.47	9	0.24
545311	Kirikiritoki at Maureens	15	1.51	6	0.61	6	0.61	4	0.40

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545312	Whakapara at Dandelion	39	1.35	20	0.69	4	0.14	12	0.41
545412	Ngunguru at Taihoa	17	1.71	8	0.81	5	0.50	2	0.20
545501	Matapouri	67	1.34	34	0.68	23	0.46	17	0.34
546001	Puketurua Northland	14	1.17	11	0.92	5	0.42	3	0.25
546030	Puketurua at Pukewaenga	25	1.14	17	0.78	13	0.59	4	0.18
546031	Puketurua at Pukeiti	19	1.19	11	0.69	10	0.63	2	0.13
546032	Puketurua at Woolshed	19	1.59	9	0.76	4	0.34	3	0.25
546103	Ruatangata	77	1.31	39	0.66	22	0.37	19	0.32
546111	Wairua at Rarewa	15	1.08	14	1.01	7	0.50	3	0.22
546202	Hikurangi	53	1.21	29	0.66	18	0.41	13	0.30
546203	Ruatangata No2	64	1.49	35	0.82	21	0.49	10	0.23
546210	Wairua at Matarau 2	17	1.07	15	0.94	5	0.31	5	0.31
546212	Wairua at Jordan Valley	60	1.43	36	0.86	11	0.26	14	0.33
546216	Okarika at Rowland Rd	52	1.45	19	0.53	17	0.47	13	0.36
546218	Wairua at Cathcart	23	1.10	12	0.57	12	0.57	5	0.24
546301	Hatea at Glenbervie Forest HQ	102	1.33	68	0.88	25	0.33	21	0.27
546310	Waitangi at Totara Block	13	1.09	10	0.84	6	0.50	3	0.25
546315	Hatea at Hansen Orchards	51	1.38	16	0.43	18	0.49	11	0.30
546316	Batt at Glenbervie	42	1.28	24	0.73	11	0.33	10	0.30
546411	Ngunguru at Sands	33	1.74	9	0.48	5	0.26	8	0.42
546412	Ferguson at Kaiatea	82	1.47	42	0.75	22	0.39	17	0.30
546416	Ngunguru at Dugmores Rock	49	1.33	28	0.76	10	0.27	12	0.33
546510	Wairua at Riponui	34	1.10	30	0.97	17	0.55	6	0.19
546512	Lambly at Whangaumu Bay	25	1.14	17	0.78	4	0.18	11	0.50
547001	Wairua Falls	119	1.49	44	0.55	40	0.50	22	0.28
547002	Titoki	54	1.42	27	0.71	20	0.53	9	0.24
547010	Mangakahia at Parakao (Ware)	33	1.51	14	0.64	9	0.41	7	0.32
547112	Whatitiri at Totara Grove	15	1.16	11	0.85	8	0.62	3	0.23
547119	Waipao at Williams (Draffins Road)	18	1.06	13	0.77	5	0.30	8	0.47
547201	Maungatapere	47	1.10	40	0.93	14	0.33	13	0.30
547214	Raumanga at Totara Place	64	1.39	31	0.68	19	0.41	15	0.33
547215	Otaika at Maungatapere	12	1.10	8	0.73	6	0.55	4	0.37
547219	Otaika at Cemetery Road (Mokupara)	58	1.42	23	0.56	18	0.44	13	0.32
547220	Te Hihi at Te Hihi (Jongkees)	19	1.12	11	0.65	7	0.41	5	0.30
547222	Otaika at Lynwood Farm	34	1.26	24	0.89	13	0.48	7	0.26
547223	Otaika at Redwood Orchard	63	1.54	24	0.59	18	0.44	10	0.24
547224	Otaika at Valley View Rd (McIntosh)	17	1.22	9	0.65	4	0.29	6	0.43
547225	Waipao at Whatatiri (Coopers)	14	1.08	11	0.85	5	0.39	2	0.15

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547226	Otaika at Cemetery Road	15	1.16	6	0.46	6	0.46	5	0.39
547302	Whangarei	79	1.34	38	0.64	25	0.42	18	0.31
547303	Whangarei Aero	60	1.31	35	0.76	26	0.57	11	0.24
547304	Whangarei Hospital	26	1.37	12	0.63	14	0.74	3	0.16
547305	Whangarei, Whau Valley	33	1.38	17	0.71	20	0.84	1	0.04
547307	Whangarei Aero Aws	39	1.30	13	0.43	19	0.64	9	0.30
547308	Whangarei Ews	11	1.11	6	0.61	4	0.40	2	0.20
547312	Glenbervie at Waitangi Rd	14	1.08	14	1.08	6	0.46	3	0.23
547315	Raumanga at Kaka St	10	0.92	10	0.92	5	0.46	2	0.18
547316	Hatea at Parahaki (Steele)	8	0.67	6	0.50	8	0.67	3	0.25
547338	Hatea at Robert Street	18	1.13	11	0.69	7	0.44	6	0.38
547339	Waiarohia at NRC Water Street	23	1.15	14	0.70	8	0.40	8	0.40
547340	Waiarohia at Kensington	14	0.94	8	0.54	7	0.47	7	0.47
547402	Waiparera	16	1.34	5	0.42	5	0.42	7	0.59
547411	Whangarei Harbour at Parua Bay	28	1.08	17	0.66	16	0.62	5	0.19
547412	Massey at Pataua	21	1.41	10	0.67	4	0.27	6	0.40
547503	Parua Bay, Beasley Road	18	1.51	8	0.67	4	0.34	5	0.42
547512	Taiharuru at Taiharuru	25	1.48	11	0.65	6	0.35	5	0.30
548101	Tangihua	50	1.43	18	0.52	16	0.46	8	0.23
548201	Mangapai	39	1.09	27	0.75	24	0.67	3	0.08
548210	Tauraroa at Palmer	25	1.48	9	0.53	7	0.41	5	0.30
548211	Tauraroa at Jones	57	1.54	25	0.68	18	0.49	11	0.30
548212	Whangarei Harbour at N.Z. Refining Co	30	1.51	12	0.60	6	0.30	2	0.10
548213	Ruakaka at Fosters	32	1.34	15	0.63	12	0.50	4	0.17
548214	Tauraroa at Ormandy Rd (Palmer)	11	1.11	7	0.71	2	0.20	6	0.61
548215	Whangarei Harbour at Marsden Point	21	1.76	8	0.67	6	0.50	3	0.25
548310	Ahuroa at Whittles	61	1.46	26	0.62	23	0.55	8	0.19
548311	Ahuroa at Sloanes	16	1.01	13	0.82	8	0.50	3	0.19
548313	Tauraroa at Cotton	14	1.01	13	0.93	4	0.29	4	0.29
548314	Mangapai at McCullough Road	14	1.41	8	0.81	3	0.30	4	0.40
548315	Waikokopa at McDonnell Road	18	1.29	10	0.72	7	0.50	5	0.36
548402	Marsden Power Station	24	1.15	20	0.96	11	0.53	3	0.14
548410	Waiwarawara at Prescotts	20	0.91	13	0.59	10	0.46	5	0.23
548412	Waiwarawara at Wilson's Dam	22	1.30	16	0.95	5	0.30	6	0.35
548413	Whangarei Harbour at Marsden Point Oil Refinery	11	1.11	5	0.50	4	0.40	2	0.20
549010	Manganui at Monymusk	45	1.37	26	0.79	18	0.55	5	0.15
549011	Manganui at Omana (Bull)	24	1.34	14	0.78	7	0.39	6	0.33
549201	Waikiekie	29	1.32	17	0.78	14	0.64	4	0.18

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Gauge ID	Gauge Name	nEvt	Rate	nEvt	Rate	nEvt	Rate	nEvt	Rate
549211	Taipuha at Keay	55	1.45	32	0.84	16	0.42	6	0.16
549310	Taipuha at Settlement Rd	33	1.07	20	0.65	16	0.52	7	0.23
549402	Waipu, Apple Cross	27	1.13	22	0.92	14	0.59	7	0.29
630901	Arapohue	84	1.50	40	0.72	23	0.41	12	0.21
640010	Nth Wairoa at Naumai	19	1.37	10	0.72	11	0.79	0	0.00
640201	Taipuha	38	1.27	24	0.80	17	0.57	7	0.23
640310	Ahuroa at Finlayson Brook	19	1.19	15	0.94	8	0.50	4	0.25
640411	Waihoihoi at Glenmohr Road	45	1.19	37	0.98	20	0.53	6	0.16
640436	Waihoihoi at Brynderwyn	68	1.58	26	0.61	23	0.54	11	0.26
640501	Waipu Cove	82	1.32	51	0.82	30	0.48	18	0.29
641001	Ruawai	47	1.18	30	0.75	21	0.53	9	0.23
641010	Awaroa at Wallace Road	19	1.12	13	0.77	6	0.35	5	0.30
641102	Claren Brae (Ruawai)	53	1.56	27	0.80	17	0.50	6	0.18
641201	Paparoa 1	52	1.53	22	0.65	13	0.38	9	0.27
641203	Paparoa 2	28	1.17	17	0.71	16	0.67	2	0.08
641210	Paparoa at Higgins	19	1.47	12	0.93	4	0.31	2	0.15
641213	Paparoa at Maungaturoto	30	1.59	12	0.63	7	0.37	8	0.42
641214	Paparoa at Taylors	25	1.32	10	0.53	8	0.42	7	0.37
641215	Paparoa at Stubbs	23	1.22	16	0.85	8	0.42	5	0.26
641302	Maungaturoto, Melford	53	1.15	32	0.70	23	0.50	12	0.26
641310	Wairua at Northland Dairy CO	23	1.36	10	0.59	8	0.47	6	0.35
641410	Topuni at Saunders	9	0.82	11	1.01	7	0.64	1	0.09
641413	Topuni at Dunn Road (Cook)	29	1.21	16	0.67	11	0.46	3	0.13
641414	Hakaru at Valley Road (Kaiwaka)	27	1.29	7	0.33	9	0.43	10	0.48
641501	Mangawhai	106	1.43	52	0.70	42	0.57	10	0.14
641511	Mangawhai Harbour at Tara	86	1.25	51	0.74	22	0.32	22	0.32
641512	Hakaru at Tara	13	1.19	9	0.82	2	0.18	4	0.37
642010	Okoraka at NgatawhitiRoad	6	0.61	8	0.81	3	0.30	2	0.20
642011	Okoraka at Poutu Forest Farms Ltd	34	1.31	16	0.62	13	0.50	8	0.31
642201	Pukehau	66	1.41	31	0.66	20	0.43	15	0.32
642401	Topuni	49	1.09	35	0.78	26	0.58	11	0.24
642415	Hakaru at Topuni Creek Farms	16	1.24	7	0.54	7	0.54	5	0.39
643112	Tauhara at Lake Rotokawau	10	0.67	4	0.27	5	0.34	3	0.20
643116	Swan Lake at Bishops	16	1.34	8	0.67	1	0.08	4	0.34
643118	Kaipara Harbour at Pouto Point	22	1.23	10	0.56	9	0.50	6	0.33