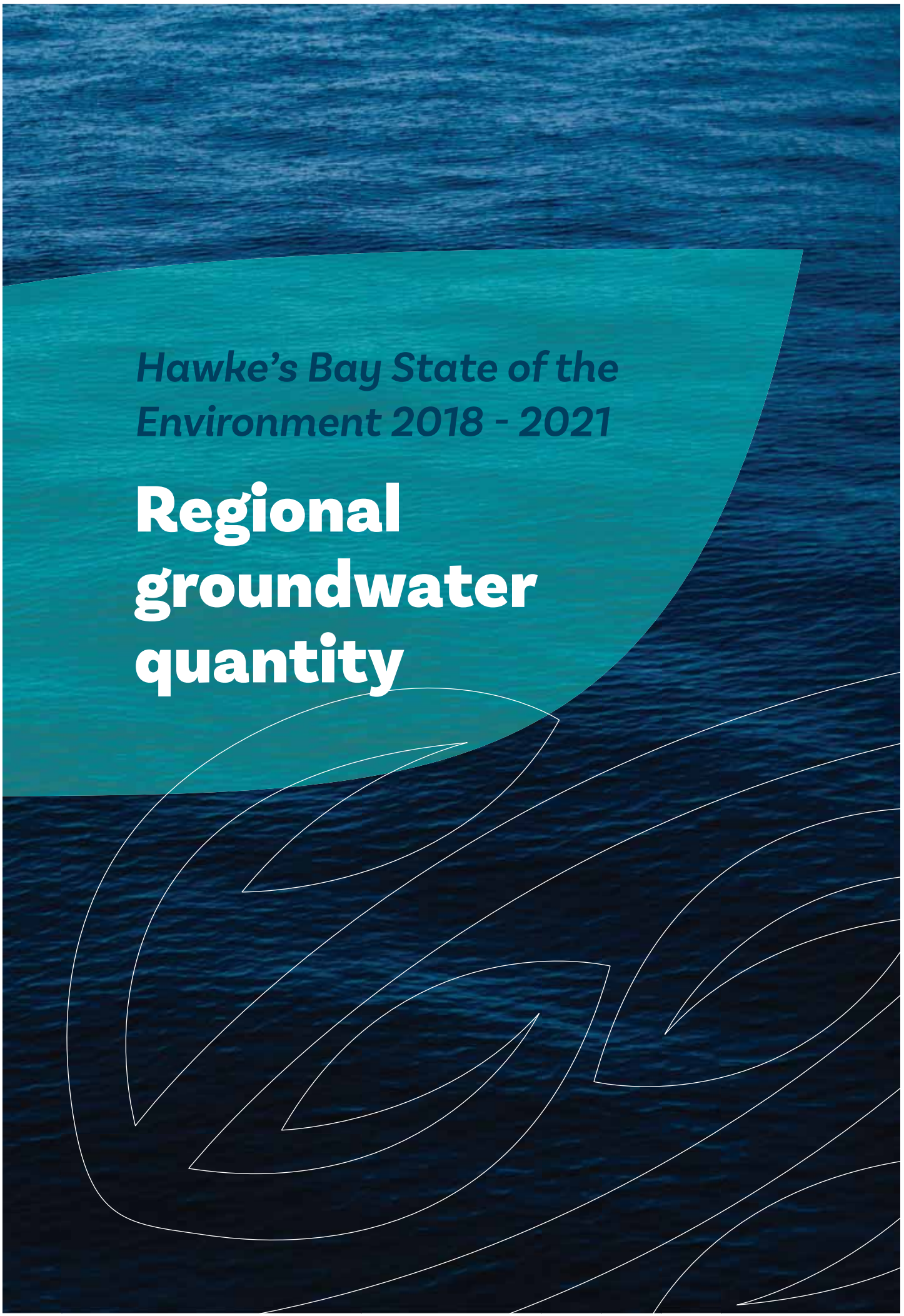

Hawke's Bay State of the Environment 2018 - 2021

Regional groundwater quantity

6. Regional groundwater

Groundwater is one of the most important natural resources in the region, providing water for drinking, irrigation, and industry, as well as sustaining the flow of surface water and maintaining riparian and wetland ecosystems. The largest and most productive groundwater resources are in the Heretaunga and Ruataniwha Plains. These two areas account for more than 92% of the groundwater used [1] and 84% of the number of wells drilled [2].

Human activities, such as groundwater pumping, change the natural groundwater flow system and can affect the volume of groundwater in storage, as well as the rate and timing of recharge and discharge to and from surface water bodies, such as rivers and streams. An important aspect of groundwater management is to understand how these changes affect the water budget and to balance the environmental effects of groundwater pumping against its benefits.

Figure 6-1 shows the location of wells within the region. Most groundwater is taken from aquifer systems composed of unconsolidated sediments such as the gravels and sands that make up the aquifers of the Heretaunga and Ruataniwha Plains. Many wells are also located outside of these areas, which shows that groundwater is an important resource for the wider regional community, not just well owners on the Heretaunga and Ruataniwha Plains.

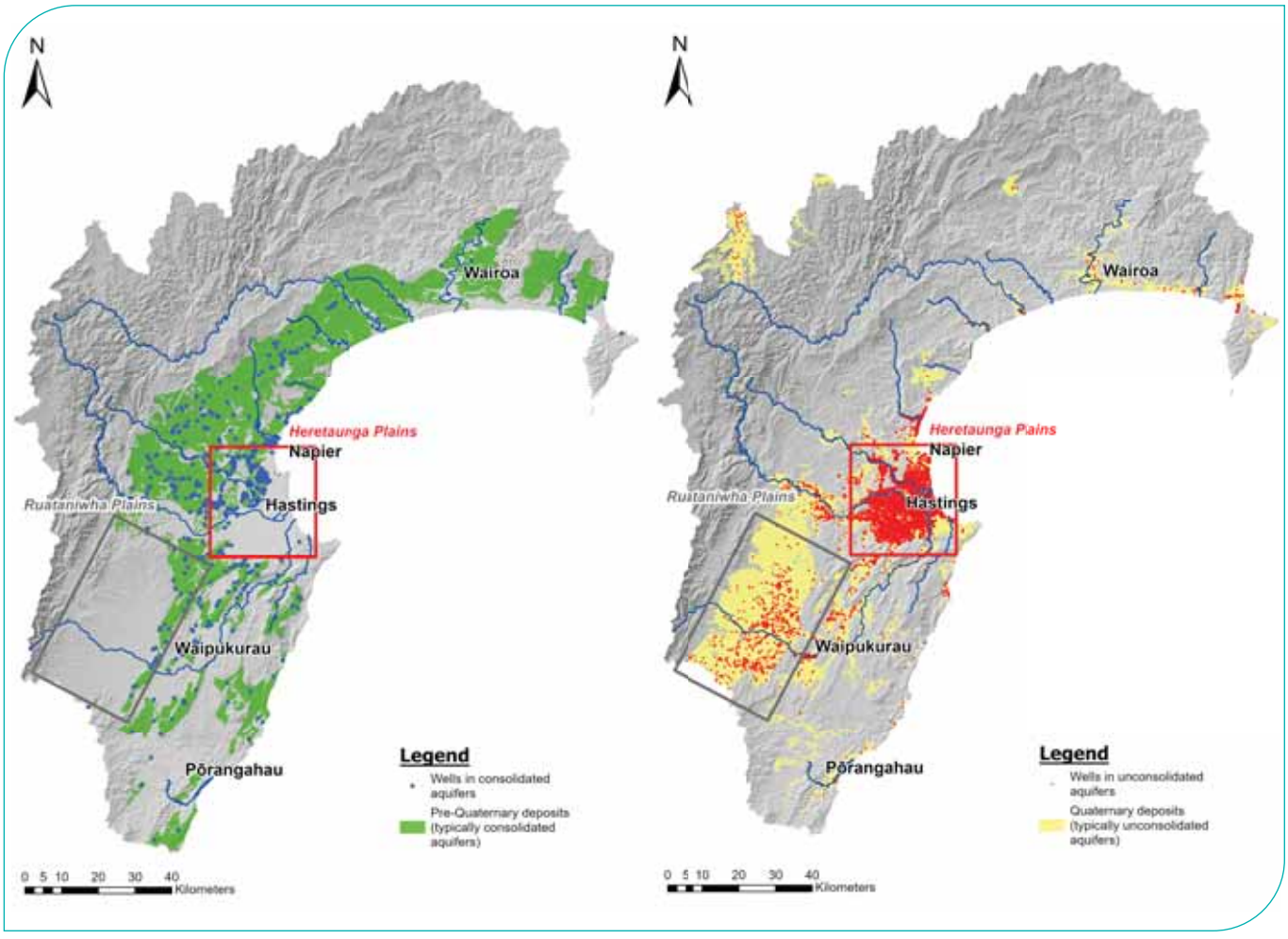

Figure 6-1. Location of groundwater resources in Hawke's Bay

[1] Based on the volume of metered groundwater used between 1st July 2020 and 30th June 2021.
[2] Based on information contained within WellStor Database, December 2021.

Monitoring groundwater

In Hawke's Bay, the largest number of monitor wells are located in the Heretaunga and Ruataniwha Plains (Figure 6-2). Pressure from groundwater pumping is greatest in these areas and therefore more monitoring is needed to understand these impacts. HBRC collects information about the groundwater resources in the Heretaunga and Ruataniwha Plains using a network of monitor wells. This provides a better spatial understanding of how the system responds to stressors, and the factors that control these changes. Outside of the Heretaunga and Ruataniwha Plains, where groundwater pressure is significantly lower, groundwater conditions are typically assessed using a smaller number of monitor wells.

The total volume of groundwater used by resource consent holders provides an indication of how much pumping pressure exists in each of the groundwater systems. The most productive and heavily used groundwater system is the Heretaunga Plains, followed by the Ruataniwha Plains. Between 2016 and 2021, the volume of groundwater used in the Heretaunga Plains ranged from 55 to 70 gigalitres (Figure 6-3). This is roughly triple the amount used in Ruataniwha and about six times more than the combined use from all other groundwater resources in Hawke's Bay.

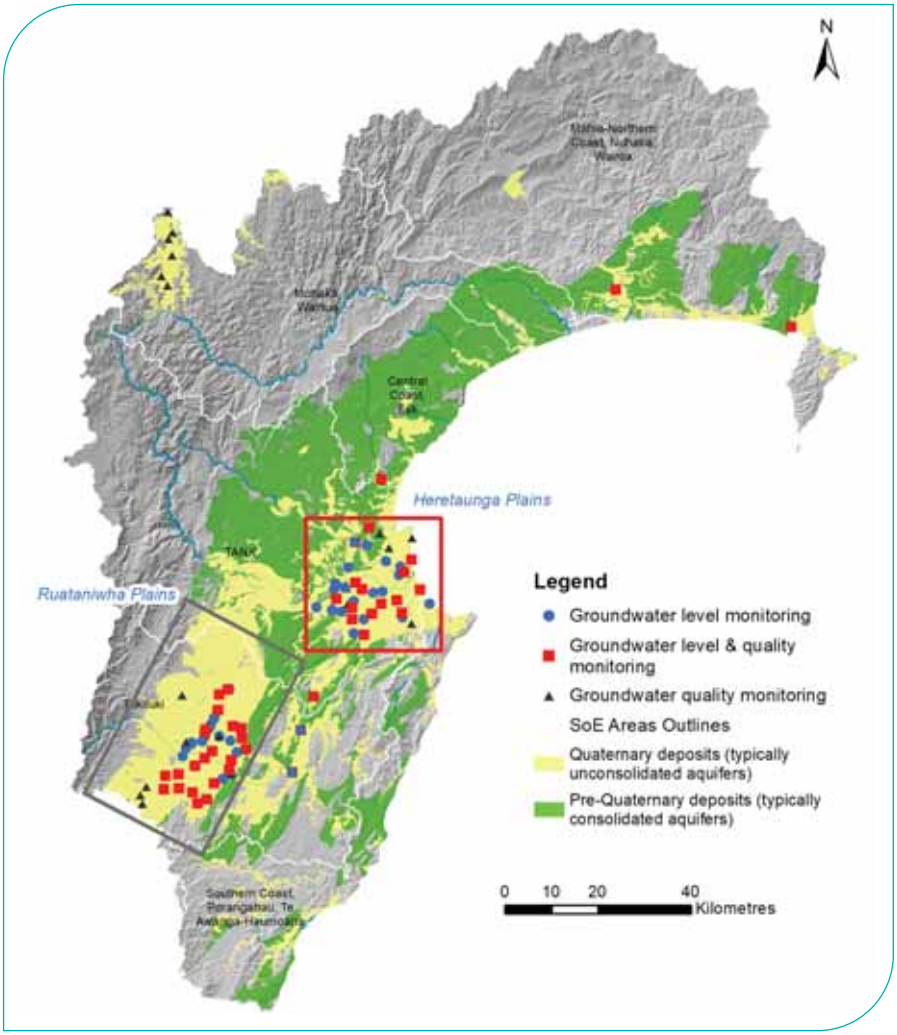

Figure 6-2. Current distribution of groundwater monitor wells within Hawke's Bay

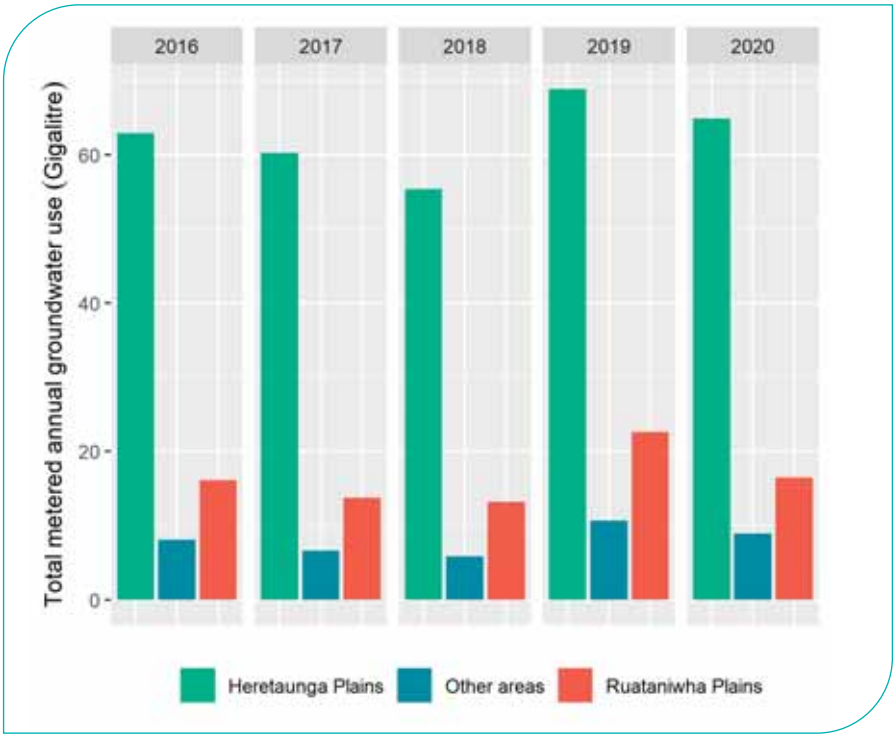

Figure 6-3. Hawke's Bay total metered groundwater use between 2016-2021. Hydrological years [3] are used for this analysis, from July 2016 to June 2021.

[3] Hydrological years are 12 months from July until end of June the following year. The purpose of using hydrological years, rather than calendar years, is to avoid splitting water use across irrigation seasons.

Impacts of groundwater pumping

The most common impact of groundwater pumping is a lowering of groundwater levels. Lowering increases as the rate, volume, and number of takes increase. In Hawke's Bay, the volume and number of groundwater takes has been increasing for decades, and as a result groundwater levels have declined from their natural state. The most pronounced changes occur over the summer and autumn months when groundwater use is at its peak. Groundwater use has increased the most during these periods, resulting in a lowering of groundwater levels at a faster rate over time compared to other times of the year.

Figure 6-4 shows the number of groundwater level trends detected from monitor wells for the main groundwater resources in Hawke's Bay. The largest number of downward trends versus upward trends occur in the Heretaunga and Ruataniwha Plains, where groundwater use has increased the most[4]. This is because groundwater levels lower further when more groundwater is pumped.

Limits on groundwater use have been set for the Heretaunga and Ruataniwha Plains. Limiting the volume of groundwater used will allow the impact on groundwater levels to stabilise. This means groundwater levels will eventually stop declining and begin fluctuating about a new long-term average. Long-term monitoring of groundwater levels is needed to help assess the effectiveness of these limits.

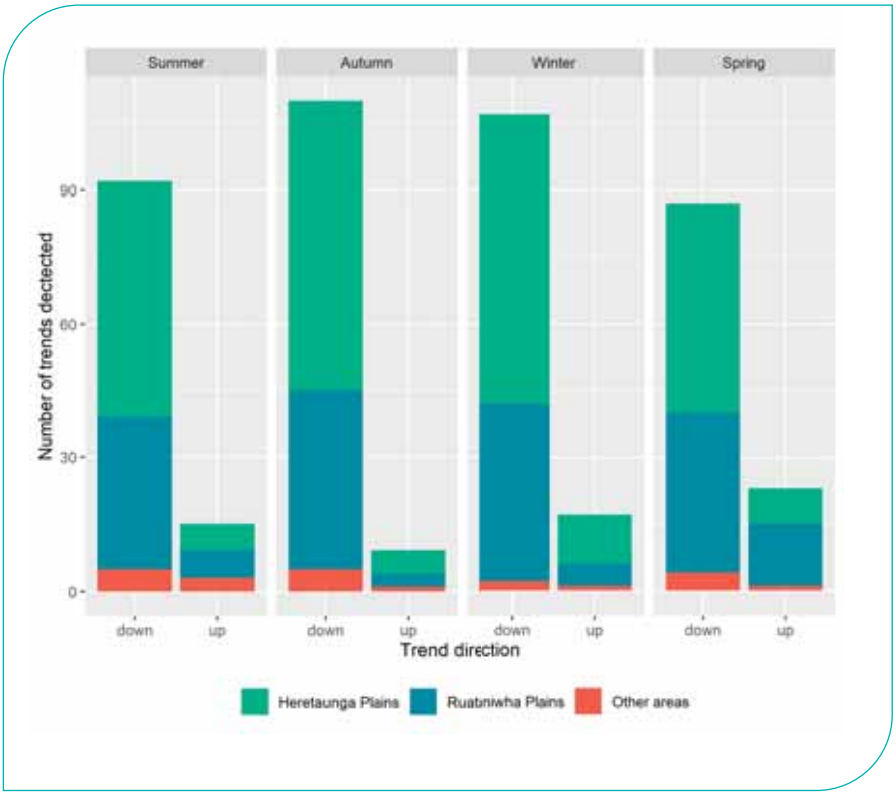

Figure 6-4. Number of statistically significant groundwater level trends detected in Hawke's Bay.

[4]A larger number of trends were detected in autumn and winter, probably because of a smaller variation in these data sets. During summer and spring, groundwater pumping causes larger variations in groundwater levels, which decreases our ability to detect trends.

The rate of change observed in the Heretaunga and Ruataniwha Plains is highly influenced by the pumping stressors on these systems. In these areas, the rates of decline are highest in summer when demand for groundwater is greatest (Table 6-1).

Table 6-1. Average annual rate of change in groundwater levels (m/year) [5]

Area	July	August	September	October	November	December	January	February	March	April	May	June
Heretaunga Plains	-0.03	-0.02	-0.03	-0.02	-0.03	-0.02	-0.04	-0.05	-0.04	-0.04	-0.05	-0.03
Ruataniwha Plains	-0.18	-0.14	-0.11	-0.10	-0.10	-0.12	-0.26	-0.31	-0.31	-0.31	-0.28	-0.20
Other areas	-0.04	NA	-0.05	-0.05	NA	-0.06	-0.02	-0.09	-0.07	-0.03	-0.10	-0.11

Management issues

Lower groundwater levels can increase pumping costs and impact water availability by drawing groundwater below the pump intake. Localised drawdown effects can be minimised by ensuring wells are adequately spaced, while longer-term impacts can be managed by limiting groundwater use and installing deeper pumps.

In Hawke's Bay, most wells are drilled deep enough to cope with the changes occurring. However, in some areas such as Bridge Pa, Tikokino, and Ongaonga, the pump systems are not always installed deep enough, or the full well depth cannot be accessed during extreme events. In these locations, particularly during late summer and early autumn, a decline in groundwater levels can cause water supply issues.

Another less commonly observed impact of lower groundwater levels is a decline in surface water flows. For many lowland streams, the discharge of groundwater to surface water helps sustain flow throughout the year. This is particularly important for maintaining healthy aquatic ecosystems during low flow periods. Pumping can extract groundwater that would have otherwise contributed to the flow of streams and rivers.

HBRC identifies the effects of groundwater pumping on surface water flows through analytical and numerical modelling. This modelling indicates that groundwater pumping has reduced most of the surface water flows on the Heretaunga Plains, and this reduction increases with greater groundwater use [6]. It is difficult to detect these changes in our surface flow monitoring data. However, the annual seven-day low flows in the Awanui and Irongate Streams – both of which are groundwater-fed – have become significantly lower over time.

[5] Calculated using Sen's slope method using the full monitoring record for wells with statistically significant trends.

[6] https://www.hbrc.govt.nz/assets/Document-Library/Publications-Database/5018-Heretaunga-Aquifer-Groundwater-Model-Scenarios-Report-final.pdf

Environmental influences on groundwater levels

The different rates of change in groundwater levels across the region not only reflect variations in pumping pressure but also the physical properties of each groundwater resource. In the Ruataniwha Plains, where the largest rates of groundwater level change occur, less transmissive aquifers with lower storage properties contribute to deep drawdown impacts.

In contrast, on the Heretaunga Plains, declines in groundwater levels are smaller despite the greater volumes of groundwater pumped out annually. This is because aquifers in this area are highly transmissive and have strong surface water connections, which results in shallow and widespread drawdown impacts.

Climatic conditions also influence groundwater levels. Periods of dry weather intensify declining water levels by reducing aquifer recharge and increasing the demand for groundwater. During dry periods, pumping also occurs for longer, which further impacts groundwater storage.

Over the autumn months of 2019-2020, groundwater levels were below-normal, and many sites had their lowest ever monthly readings (Figure 6-5 and Figure 6-6). These extremely low levels followed consecutive months of below-normal rainfall and record high groundwater abstraction. The drought conditions continued over the summer and autumn months of 2020-21, resulting in even more groundwater use and below-normal groundwater levels.

In contrast, groundwater levels during the summer of 2018-2019 were near normal, with some sites experiencing their highest ever readings. This followed a period of above-normal rainfall and relatively low metered groundwater use (second lowest on record since 2012).

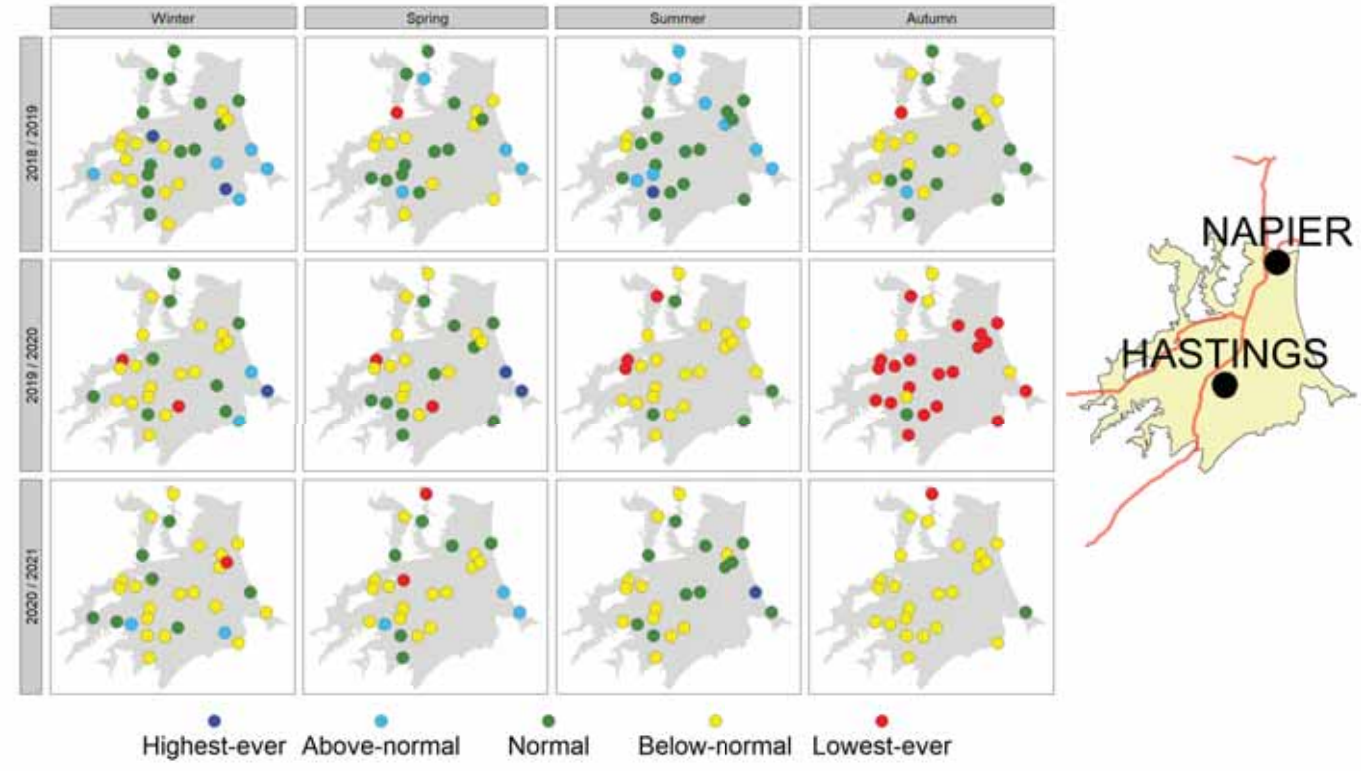

Figure 6-5. Seasonal groundwater levels in the Heretaunga Plains between 2018 and 2021. Categories are: Below-normal (0-25th percentile), Normal (25-75th percentile), Above-normal (75-100th percentile). Wells with fewer than 10 years of records are excluded from the analysis.

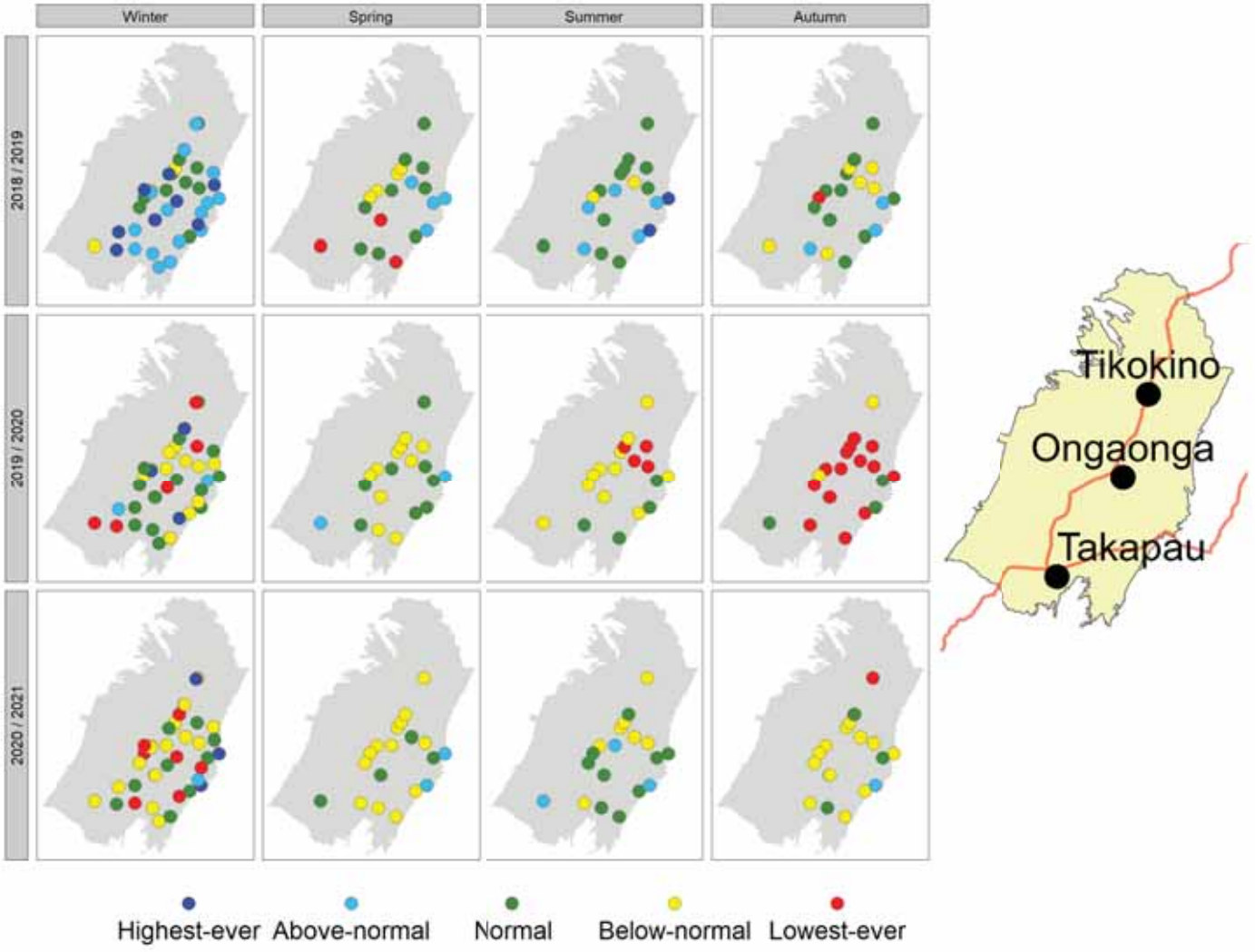

Figure 6-6. Seasonal groundwater levels in the Ruataniwha Plains between 2018 and 2021. Categories are: Below-normal (0-25th percentile), Normal (25-75th percentile), Above-normal (75-100th percentile). Wells with fewer than 10 years of records are excluded from the analysis.

Managing groundwater impacts

HBRC has developed Catchment Plans for the Heretaunga and Ruataniwha Plains to manage groundwater resources by setting allocation limits. Catchment Plans seek to control the impacts caused by groundwater pumping, while balancing its benefits. Information on the rules and policies used to manage groundwater use in your catchment can be found on our website (https://www.hbrc.govt.nz/services/policy-and-planning/about/).