Network Quality Report

Orion New Zealand Limited, FY18
Published May 2019

Orion

201,000

Number of customer connections

633

Network maximum demand (MW)

3,309

Electricity delivered (GWh)

11,350

Total kilometres of lines and cables

$62m

Network capital expenditure

$26m

Network maintenance expenditure

$1b

Value of network assets

Network summary
as at 31 March 2018 (FY18)

Cover: Tom Smith, Orion's Reticulation Works Manager, in the exterior yard of our refurbished Springston substation.

At Orion we are committed to ensuring our customers have a safe, reliable and resilient power supply.

We seek to find the right balance between network investment, the quality of service we provide and the cost impacts of any investment decisions on our customers.

We work hard to understand the needs and expectations of the community we serve and we strive to meet these.

This report explains Orion's approach to network reliability and resilience, and how we have performed over the past five years. It discusses how we are measuring and improving the performance of our network and how well we are doing to 'keep the lights on'.

We hope you find this report informative and we welcome any comments you may have on it or any other aspect of Orion's performance.

Rob Jamieson
Chief Executive

Orion

Contents

1 About Orion

Orion New Zealand Limited owns and operates the electricity distribution network in central Canterbury between the Waimakariri and Rakaia rivers and from the Canterbury coast to Arthur's Pass. Our network covers 8,000 square kilometres of diverse geography, including Christchurch city, Banks Peninsula, farming communities and high country.

We deliver electricity from seven Transpower grid exit points to more than 201,000 homes and businesses.

Orion's charges typically amount to around 26% of a household's electricity bill.

Our shareholders are:

- Christchurch City Council 89%
- Selwyn District Council 11%.

More information about Orion is available from our:

- Website – oriongroup.co.nz
- Annual Report
- Asset Management Plan – a document detailing our asset replacement, reinforcement and maintenance strategies over the next 10 years
- Guide to Orion's Pricing – a guide to help customers understand our prices and how they compare with those of other electricity distributors

2 Orion network overview

Orion operates New Zealand's third largest electricity distribution network. We deliver electricity to more than 201,000 customers over 8,000 square kilometres in central Canterbury.

For planning purposes, we have divided our network into two different regions, Region A and Region B. Region A incorporates the Christchurch Central Business District, Lyttelton and the Christchurch city metropolitan area. Region B covers the remaining townships and rural areas between our network boundaries.

The majority of our customers –approximately 88% – are located in Region A with the remaining 12% located in Region B. Our network covers very diverse terrain and demographics, from densely populated residential neighbourhoods through to a widely dispersed rural population.

To reach all of our customers, we manage a sophisticated network of electrical assets, load control equipment supported by our people as well as multiple computer and communication systems.

Our network is continually evolving. In the past few years we have seen the introduction of the Central Plains Water Enhancement Scheme, the rebuilding of Christchurch and substantial growth in housing estates in neighbouring suburbs and towns, all of which require network investment to meet electricity demand. Growth in maximum electricity demand, reliability and resilience are the principal drivers of our network investment.

2 Orion network overview continued

Before the 2011 and 2012 Canterbury earthquakes Orion's electricity distribution network was one of the most reliable in New Zealand. By the end of FY18, more than seven years after these seismic events, we had completed our post-earthquake recovery work. With the introduction of improvement initiatives, our current reliability places us in the top 20% of New Zealand's electricity network companies.

We analyse the performance of our network to determine how reliable it is, and monitor our performance against our reliability targets. We use this information to target areas for improvement.

In this report we review our performance against the most important reliability performance measures, which are:

- Line faults/100km
- Cable faults/100km
- SAIDI – System Average Interruption Duration Index. This is the average total duration of electricity interruptions that a customer experiences in a year.
- SAIFI – System Average Interruption Frequency Index. This is the average number of electricity supply interruptions that a customer experience in a year.

A summary of our FY18 key performance achievements is outlined in Table 2.1.

Table 2.1 Key performance statistics for reliability and power quality

Key service criteria	Quality measure	FY18 target	FY18 result	Outcome	NZ Average
Reliability	Line faults/100km	16	15.6	Achieved	15.8
	Cable faults/100km	2.7	2.6	Achieved	5.5
	SAIDI	< 82.4	79	Achieved	193.7
	SAIFI	< 1.02	1.00	Achieved	2.07
Power quality	Non compliance	< 80	17	Achieved	Not available

In FY18 we achieved all our target levels of service for the operation of our network.

A range of factors contributed to our strong reliability performance in FY18, including continued network improvements we undertook throughout the year; our comprehensive maintenance programmes and a relatively mild year weather wise.

The targets that are set by the Commerce Commission for our levels of service are based on an 'average' year of weather, not a year of unusually mild or severe weather conditions. This means we are assisted in bettering our target service levels or at risk of not meeting them due to the extent of climatic factors. We are unlikely to meet our targeted service levels when a greater than average number or severity of adverse climatic events occur. For example, in FY14 when a major wind storm hit Canterbury, we were unable to meet our targeted service levels for that year.

In FY18 we achieved all our target levels of service for the operation of our network.

3 Our risk management

Our customers and the community depend on our service, so it's essential we identify and manage our key risks. We have an important role in meeting our community's aspirations for:

- a liveable city and region – with strong, connected communities
- a healthy environment – with a prosperous economy

Electricity is a fundamental necessity in the modern world. Our customers and community depend on our electricity delivery service – all day, every day – and especially following high impact low probability (HILP) events such as major earthquakes or storms.

Our HILP responsibilities are set out in section 60 of the Civil Defence Emergency Management (CDEM) Act. As a lifelines utility, we are required to be able to function to the fullest possible extent, even though this may be at a reduced level, during and after an emergency.

As further context, our service region:

- is a significant earthquake zone
- is subject to weather extremes – including snow storms and/or wind storms
- has cold winters
- has no reticulated natural gas
- has urban 'clean air' restrictions on the use of solid fuel heating

Our risk management process is consistent with the international risk management standard ISO 31000:2018:

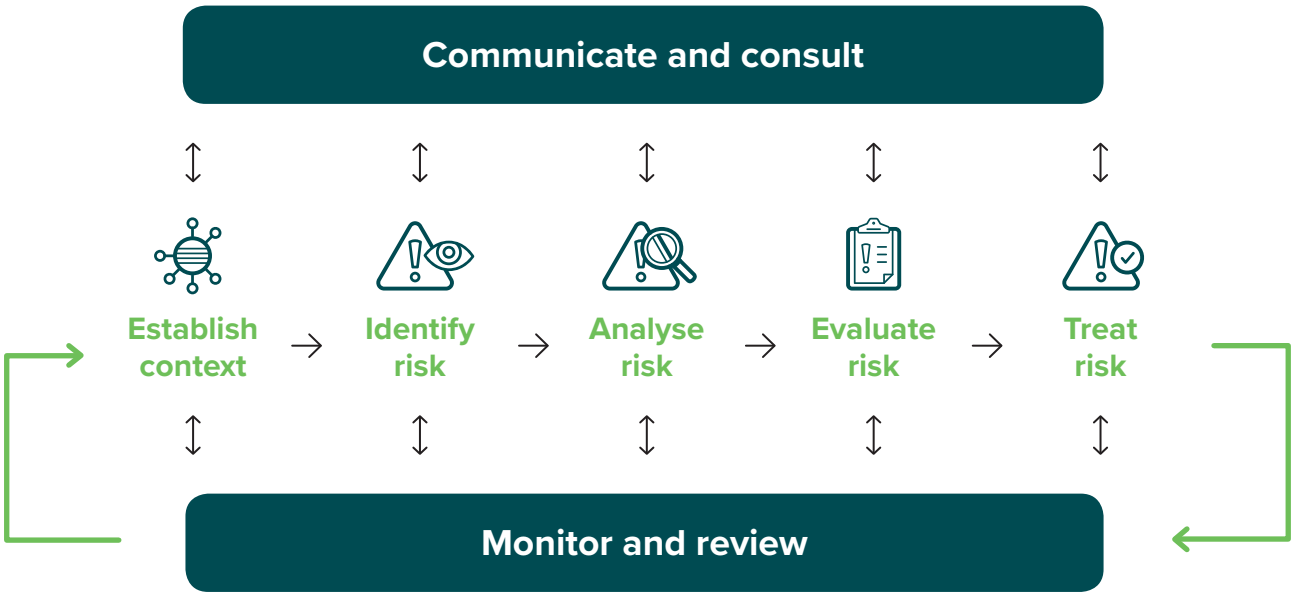
Through our ongoing customer engagement, we also know that our customers and community want us to provide a safe, reliable, resilient and sustainable electricity delivery service – and this effectively defines our purpose.

Given this context and purpose, we have a cautious, relatively risk-averse, risk appetite for our network management – consistent with our objectives to:

- act in the long-term interests of our customers, our community and our shareholders
- operate as a successful and sustainable business
- comply with relevant legislation

Our customers and the community depend on our service, so it's essential we identify and manage our key risks.

Figure 3.1 Our risk management process



3 Our risk management continued

We aim to:

- identify and understand our significant risks
- consider good evidence, experience and history to inform our judgments
- bring different experience, knowledge and perspectives to reduce bias and blind spots
- acknowledge that we can't prescribe procedures for all risks, in all contexts, at all times
- be proportionate and treat our significant risks as reasonably practicable[1]
- continually improve

We believe our key risks are:

- HILP events – for example, major earthquake, tsunami or severe storm
- fatality or permanent disability to a worker, service provider or member of the public
- cyber security breach that especially affects our network control systems
- extensive network asset damage and/or extended outages to many customers

We identify and manage our key and significant risks, consistent with:

- the international risk management standard
- good industry practice

We also aim to continuously improve. We have more detail about how we identify and manage our key significant risks throughout our ten-year network Asset Management Plan.

Figure 3.2 Our five main risk evaluation options

[1] Consistent with the definition in the Health and Safety at Work Act 2015, reasonably practical is what can reasonably be done, weighing up all relevant matters, including:

- the potential harm and the likelihood of that harm
- what is known, or ought to be known, about a risk and ways to treat it
- the costs to treat the risk, including whether the costs to do so are grossly disproportionate

4 Customer expectations

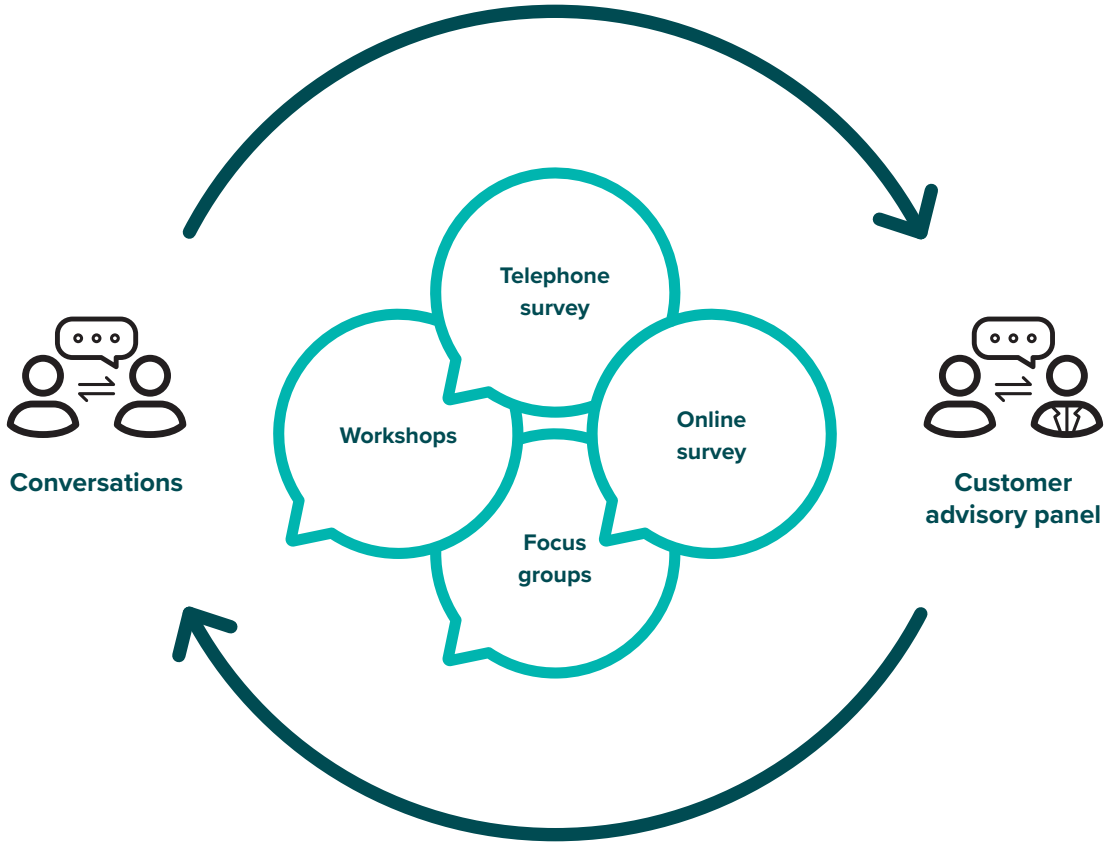
We are seeing unprecedented change in our industry. Customers want more choice and control and to have confidence that we are planning for the future. It is critical for us to understand our customers and community needs to ensure we are providing them with the services they want, not just now but also in the future.

We have an extensive programme of customer engagement to seek out our customers' views and give them a voice in our decision making. To find out what was on our customers' minds, we provide a range of opportunities for a diverse range of people in our community to interact with Orion, enlisting their help in guiding our investment decisions and customer service.

We engage with our customers in a number of ways:

- we run **"Powerful conversations" workshops** with groups of up to 15 customers exploring their views on subjects such as the price/quality trade-off inherent in network investment decisions that affect safety, reliability and resiliency; and seek their opinions on future technology options
- we **survey more than 800 residential and business customers** biennially to verify and quantify what we hear at our workshops
- we established the **Orion Customer Advisory Panel** where we host lively and informative discussions seeking their views on a range of topics
- we conduct series of **Focus Groups** led by an independent researcher which helped us learn customers' views on topics including pricing options, our customer communications and infrastructure investment options
- conduct an **annual Residential Customer Perceptions survey** to measure customer's satisfaction with our network performance, communications and other topical matters
- hold two **Major Customer Seminars** each year on key matters of relevance to people who operate intensive power dependent businesses
- we **talk with our customers** on a daily basis about the service they receive and gain an understanding of what's important to them through our 24/7 Customer Contact Centre
- we **meet regularly with key stakeholders and key influencers** in the community, our shareholders, Community Boards and local MPs to seek their views on our performance, future direction and infrastructure investment options

We have an extensive programme of customer engagement to seek out our customers' views and give them a voice in our decision making.



4 Customer expectations continued

We were reassured to find customers were generally satisfied with the reliability of our network, our level of investment in resilience and our approach to safety. Customers encouraged us to look pro-actively to the future to make sure we were ready to enable them to take advantage of new technology.

Overall, being provided with a reliable service is the top priority for our customers. They view reliability as a "hygiene factor" and tell us that focusing on providing a reliable service should be fundamental for Orion. They want us to continue to invest to maintain our standard of reliability.

Customers consider reliability to be the core function of the electricity network and our 2017 survey of residential customers found 94% were satisfied with our performance in this area.

We asked different groups of customers how satisfied they were with our current levels of reliability. This enabled us to identify areas where perceptions of reliability were below average, and areas where increased investment in the reliability of our network would be welcomed.

In 2017, we initiated a programme of network enhancements to improve reliability for the Lyttelton community and the above result shows Lyttelton residents were significantly more likely to be satisfied with reliability than in 2016 (74% compared to 53%). Our investment in laying a new 11kV supply cable through the Lyttelton tunnel is expected to further improve the reliability and resilience of power supply to this community and the Port.

In our "Powerful Conversations" workshops and Customer Advisory Panel sessions we sought a deeper understanding of the importance customers place on reliability.

In both forums, we were told that customers want current levels of reliability to be maintained, if not improved – with shorter, and fewer outages, providing this is at no extra cost. They also encouraged us to be more proactive and timely with communications around power outages, and that this would provide them with greater confidence around reliability.

Projects to improve reliability, particularly in rural areas and communications, are underway. See Appendix A for an example of how we are investing in our local community to improve reliability.

We are taking what we learned in these conversations with our customers into our future planning.

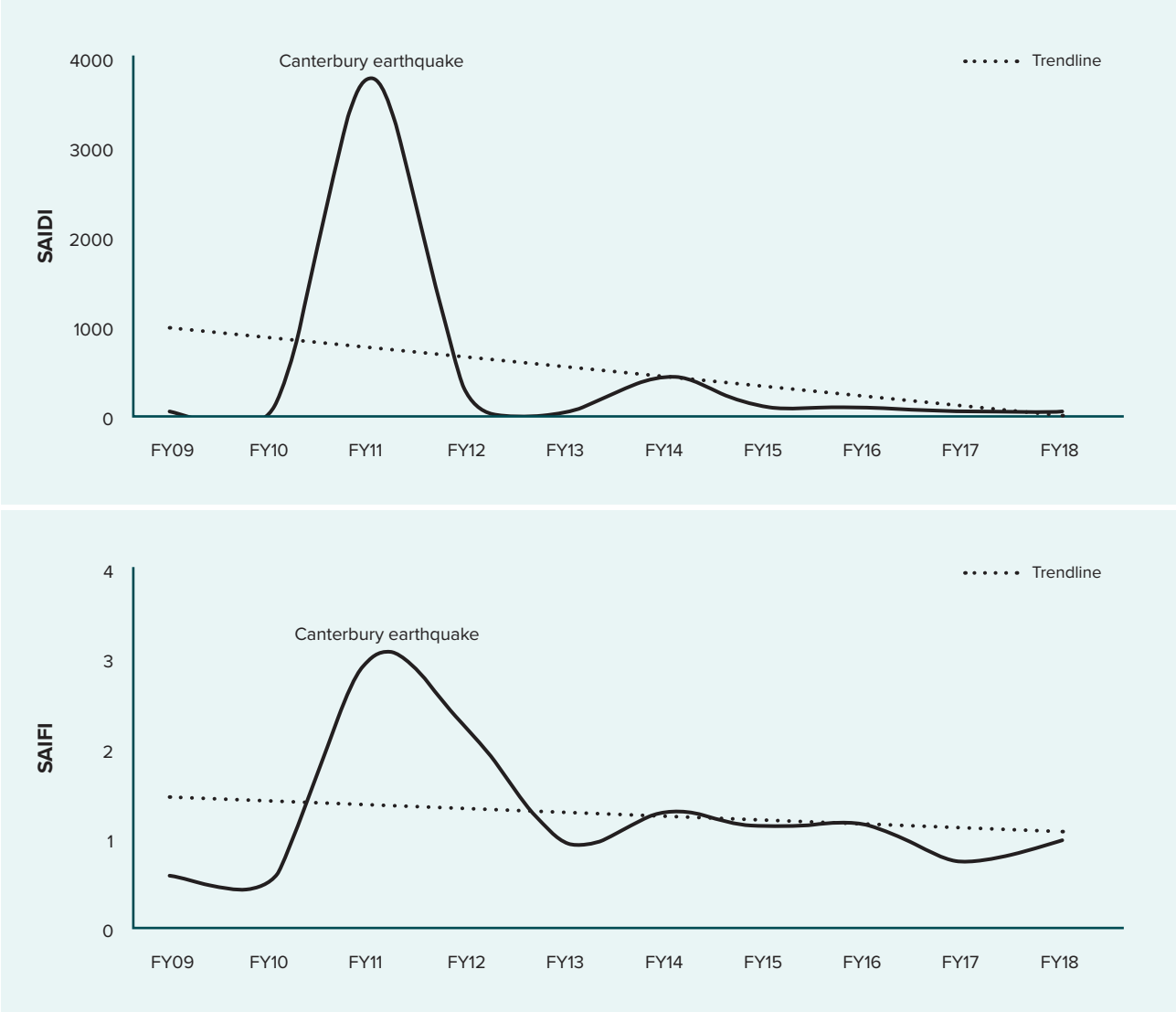
Overall, being provided with a reliable service is the top priority for our customers.

5 SAIDI and SAIFI

Two measures are accepted internationally as the most important indicators of electricity network reliability. These measures are known as SAIDI and SAIFI:

- SAIDI – the average number of minutes per annum that a customer is without electricity
- SAIFI – the average number of times per annum that a customer is without electricity

Figure 5.1 SAIDI and SAIFI over 10 years



5 SAIDI and SAIFI continued

Our SAIDI and SAIFI statistics were unusually high from FY10 to FY12 due to the impact and on-going residual effects of the Canterbury earthquakes and an increase in customer driven planned outages in response to the rebuild and recovery efforts.

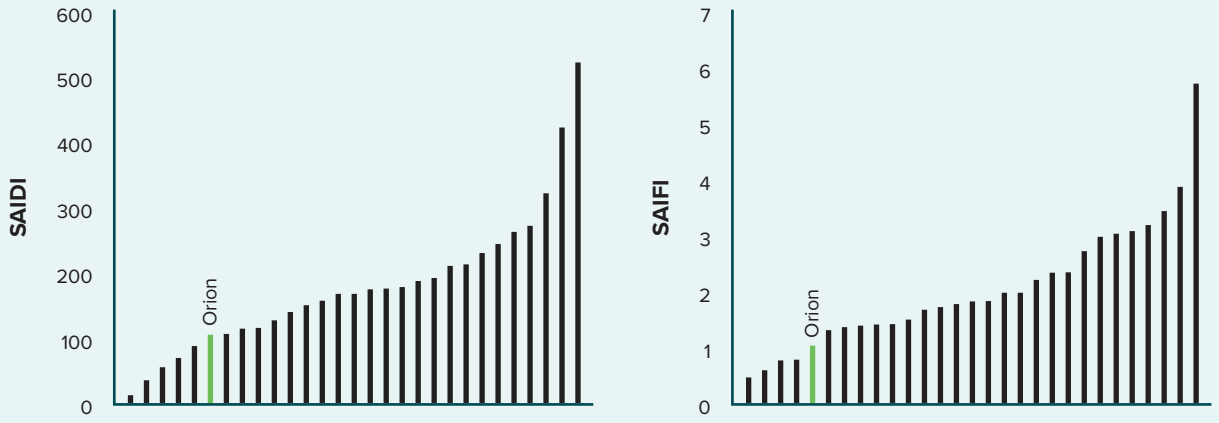
In FY14, as well as the general impact of the earthquakes and the post-earthquake construction environment, we were severely affected by a number of significant windstorms.

Since FY14, SAIDI has been on a steady decline. The ten year average trend for SAIFI also shows a decline, as the number of service interruptions decreased after the earthquakes. This decrease in both duration and number of power outages on our network is due to our proactive approach to undertaking extensive post-quake repairs to the network and identifying and resolving the areas that needed improving. We have also targeted a number of initiatives that have improved the reliability of our network, such as smart switching that allows for faster restoration times to our customers in some of our Region B townships.

Figure 5.2 shows a high-level comparison between New Zealand electricity distribution companies over the last five years. It demonstrates Orion's performance metrics are better than the national average for both SAIDI and SAIFI.

This decrease in both duration and number of power outages on our network is due to our proactive approach to undertaking extensive post-quake repairs to the network and identifying and resolving the areas that needed improving.

Figure 5.2 Industry comparisons



Source: Electricity Lines Business Information Disclosure Compendium PwC (2013 - 2018)

Note that a comparison between electricity distribution companies provides only comparative benchmarking since factors that could affect reliability such as network size, terrain and weather conditions are all different.

6 Reliability performance – Region A and B

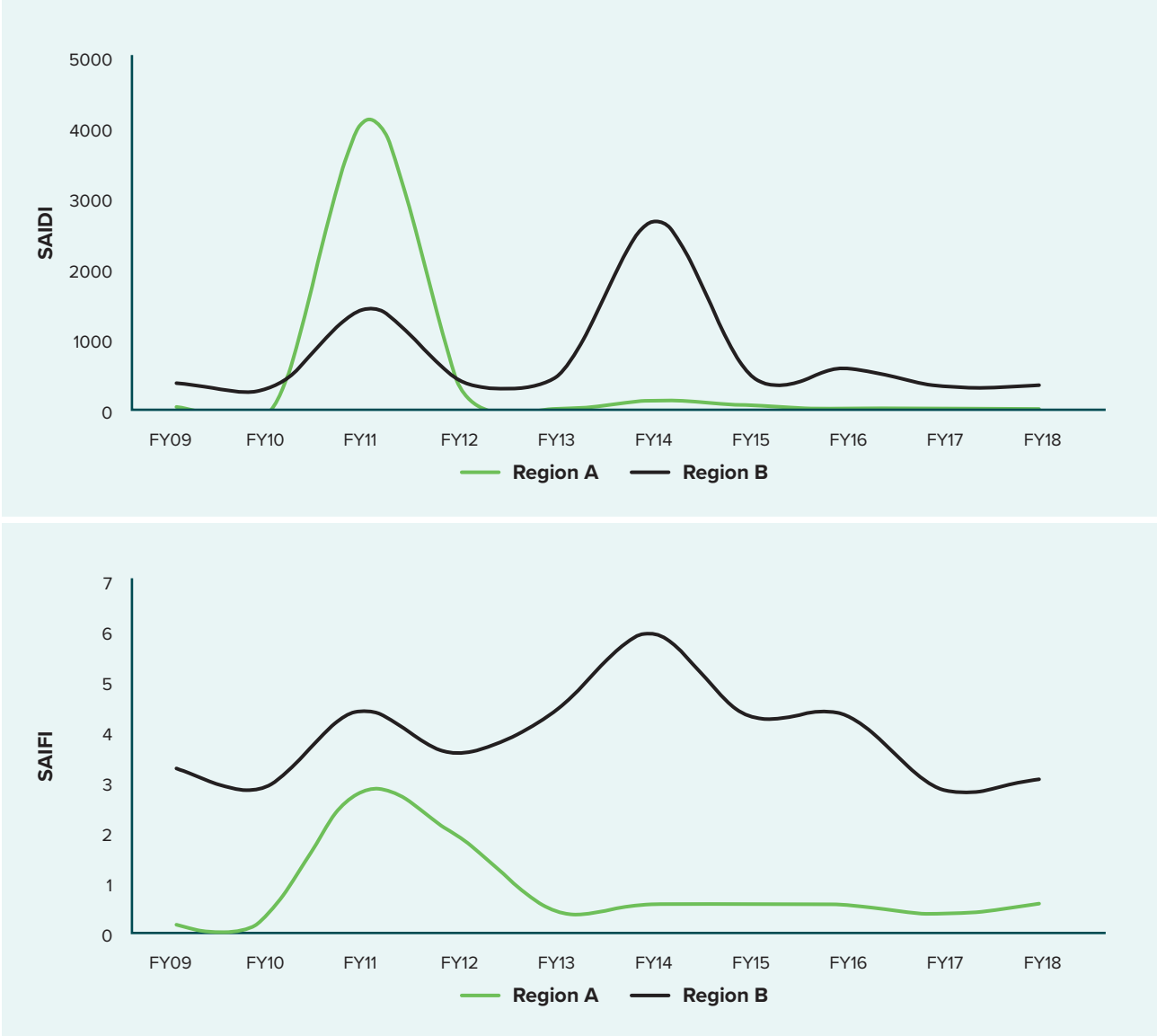
Our electricity network serves areas from high-density urban to medium-density rural and remote rural countryside. Approximately 88% of our customers are located in the urban area of Christchurch, Region A, with the remaining 12% in Region B of our network.

About 60% of our low voltage network Region A are overhead power lines however more than 95% of Christchurch's streets have 11kV electricity cables underground. In contrast, most of Region B is made up of 11kV overhead power lines, serving diverse geographical locations including Banks Peninsula, the central Canterbury plains and high country.

The overall differences in network structure mean supply to Region A is more reliable than the supply to Region B. Over the last five years, customers in Region B experienced around three times more interruptions each year than customers in Region A. Each interruption typically lasts around twice the duration of an urban interruption.

The overall differences in network structure mean supply to Region A is more reliable than the supply to Region B.

Figure 6.1 Region A and Region B comparisons



6 Reliability performance – Region A and B continued

As shown in Figure 6.1 the severe localized impact of the Canterbury earthquakes on our underground network is apparent in Region A statistics. The FY14 severe wind event impacted the overhead network in Region B.

Overhead lines typically suffer more faults than underground cables because they are exposed to weather, tree and animal related damage and other interference such as traffic accidents. However, when underground cables do have a fault, repairs can take much longer.

Most electricity supply interruptions on our network are caused by faults in Region B 11kV overhead lines. The high proportion of 11kV underground cables in Region A contributes significantly to a very reliable electricity supply within the city.

The long circuit lengths and small customer loads typical of rural networks make it uneconomic for us to install underground cables in Region B. The estimated cost of undergrounding our rural network is about 30 times that of our annual revenue. This is grossly disproportionate and it would result in a very large price increases for our rural customers. In engagement with customers in Region B, they tell us they are satisfied with their current levels of reliability and there was no appetite expressed for paying more for more reliability.

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7 Transpower's reliability in Orion's network area

Transpower is the state-owned enterprise responsible for transmitting electricity produced by generators. Transpower owns and operates the National Grid – the high voltage transmission network connecting areas of generation with towns and cities across New Zealand.

Transpower's transmission network delivers electricity to Orion's network via seven Grid Exit Points (GXPs). We deliver that electricity to more than 201,000 homes and businesses in our region. While we have no direct control over the configuration or reliability of Transpower's network, we work closely with them to ensure the transmission network provides appropriate levels of service to our customers.

Table 7.1 Transpower SAIDI and SAIFI in the Orion network area FY18

	SAIDI 5yr average	FY18	SAIFI 5yr average	FY18
Planned	0.2	0.36	0.00	0.001
Unplanned	6.1	0.05	0.14	0.001

Table 7.1 shows the impact of Transpower outages on the Orion network. Planned outages by Transpower have a very minor effect on our network. Over the last five years Transpower's unplanned outages have accounted for 12% of the total interruptions experienced by our customers, and less than 7% of the total customer minutes lost.

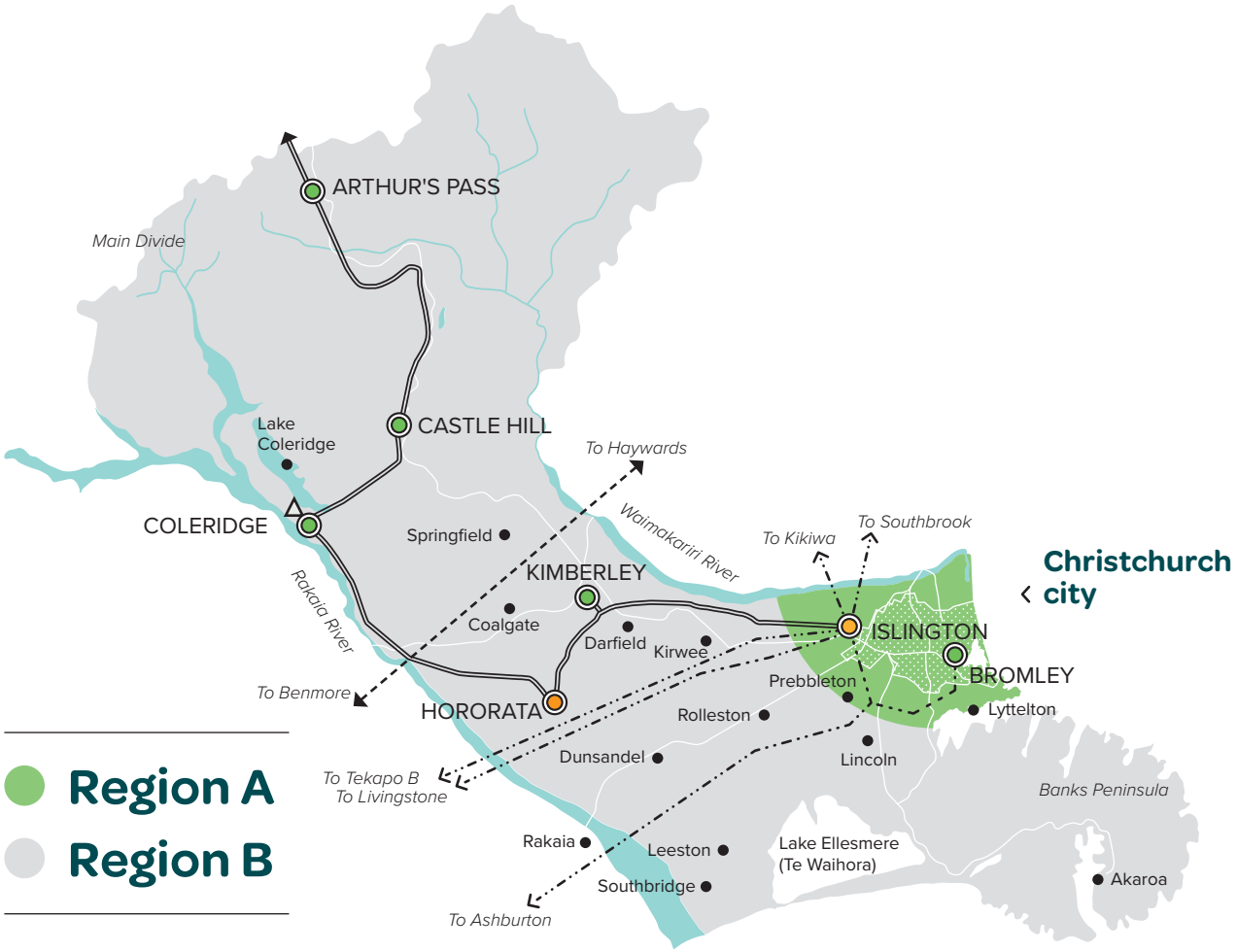
Planned outages by Transpower have a very minor effect on our network.

7 Transpower's reliability in Orion's network area continued

During FY18 we experienced one unplanned Transpower interruption that affected customers feed from our Castle Hill substation.

In 2017 our customers experienced two significant unplanned outages caused by two isolated Transpower incidents. The first incident occurred on 15 February which caused an overhead 220kV Transpower line to trip as a result of the Port Hills fires, which interrupted supply to more than 39,000 of our Christchurch city customers. The second event occurred on 2 March when Transpower's Automatic Under Frequency Load Shedding (AUFLS) system operated resulting in a loss of supply to some of our major Zone Substations. 51,940 customers had the power service interrupted as a result of this event.

We anticipate that the remote Region B GXPs at Arthurs Pass, Castle Hill and Coleridge will continue to be less reliable, as the overhead transmission lines in those areas are exposed to severe weather and difficult terrain. We will continue to work with Transpower to look for new technologies and economically appropriate solutions for those remote areas.



Key:

- Power station
- Transpower GXP
- Transpower 220kV circuit
- Transpower 66kV circuit
- High voltage direct current line

GXP maximum demand – as a percentage of firm capacity

- More than 90%
- Between 70% and 90%
- Less than 70%

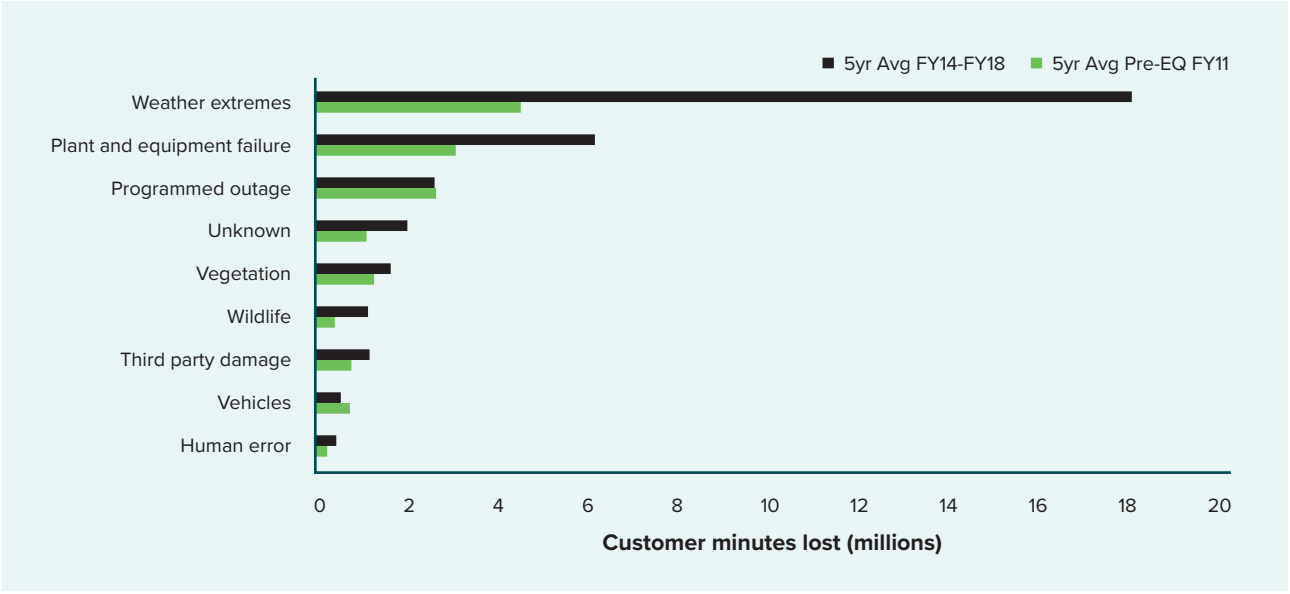
8 Causes of supply interruptions

There are two categories of service interruptions our customers' experience:

- **Planned interruptions** – occur due to scheduled maintenance or replacement work. Customers are notified in advance so that they can prepare for the disruption.
- **Unplanned interruptions** – periodic loss of supply can be caused by a number of circumstances such as severe weather events, equipment failure, traffic incidents or third party involvement.

Figure 8.1 shows the impact of various causes of service interruptions on customer minutes lost, for both pre and post earthquake periods. Overall the reliability performance of the network worsened after the Canterbury earthquakes in FY11. More specifically, unplanned interruptions have increased with the biggest contributors being weather and asset failure. The large horizontal ground movement and ongoing shaking put some equipment under stress, causing premature or latent failure.

Figure 8.1 Customer minutes lost by cause, pre and post earthquake 5 year periods



The large horizontal ground movement and ongoing shaking put some equipment under stress, causing premature or latent failure.

8 Causes of supply interruptions continued

Table 8.1 lists the weather extremes over the past five years that had a significant impact on our network's reliability.

Table 8.1 Weather extremes over the past five years that had significant impact on reliability

Year	Weather extremes
FY14	July wind storm
	September wind storm
	September wind storm (recovery)
	March wind storm
FY15	Debris vs Papanui 66kV equipment
	High Winds
	Windy day (lots of small events)
FY16	Inland June Snow - day 1
	Inland June Snow - day 2
FY17	None
FY18	None

Planned interruptions

We work hard to keep the power on to our customers during planned works where possible. Thanks to the flexibility of our network configuration, safe working techniques and mobile generators we are often able to achieve this. However there are some planned works that require the power to be interrupted affecting customers.

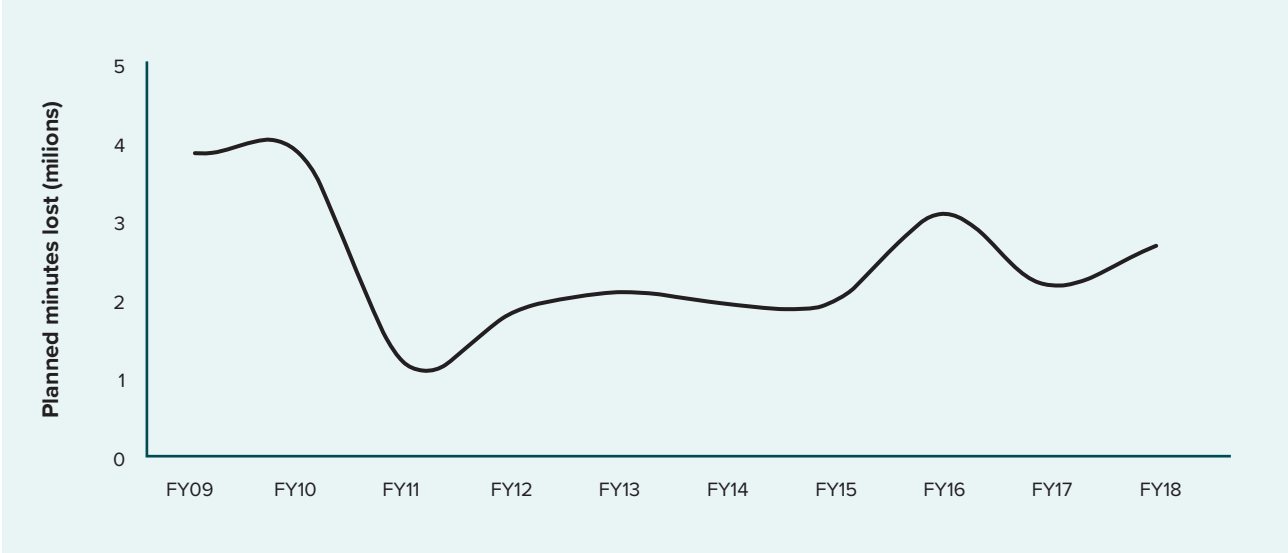
Orion typically allocates 65% of its maintenance budget to 'scheduled works'. This allows us and our approved service providers to give appropriate notice to our customers for any up and coming interruptions. The rest of the maintenance budget is divided between 'non-scheduled works' and 'emergency works'.

Orion typically allocates 65% of its maintenance budget to 'scheduled works'.

8 Causes of supply interruptions continued

On average, planned interruptions have accounted for 10% of all interruptions on the network (post-quake). The chart below shows an increase in planned interruptions after the earthquake in FY11. The years of FY09 – FY10 increased significantly due to the level of work required and a reduction in live line work by service providers, for safety reasons, instead of opting for a planned interruption.

Figure 8.1 Customer minutes lost during planned works



During FY18 there were 606 planned interruptions on our network. The 10 most significant planned interruptions accounted for 16% of the total planned interruptions on the network. The most significant interruption in terms of customer minutes lost was around seven hours and affected 170 people. The table below shows the impact of our five largest planned interruptions over the last year.

Table 8.2 The five largest planned interruptions in Region B in FY18

Date	Area affected	Reason for fault	Total customer minutes lost	Number of customers affected	Interruption duration*
29 March 2018	Diamond Harbour	Installation of new line switch	71,740	170	7 hrs 2 mins
26 April 2017	Hororata	Vegetation management	63,655	145	7 hrs 19 mins
27 November 2017	Duvauchelle	Straighten/ refound network pole	46,308	286	2 hrs 41 mins
7 June 2017	Hills Rd	Replacement Insulators	43,316	98	7 hrs 22 mins
16 May 2017	Hills Rd	Replacement Insulators	38,537	89	7 hr 13 mins

* Interruption duration times are based on the time taken to restore the last customer. The total customer minutes lost figure therefore overstates the actual number of 'in-use" minutes lost.

The planned interruptions listed in Table 8.2 were carried out as a result of necessary replacements or enhancements to our infrastructure. This type of work adds reliability and resilience to our network.

Unplanned interruptions

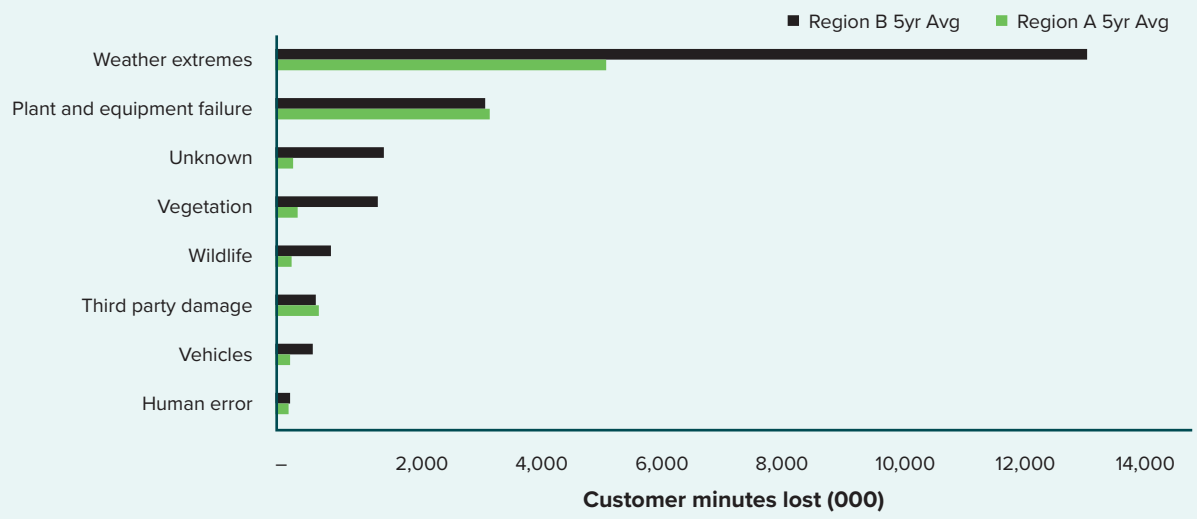
When unplanned interruptions to our service occur, we aim to get the power back on as soon as possible. In our latest residential customer surveys, our customers told us that the number and length of interruptions currently experienced is acceptable, but that they value avoiding interruptions altogether, providing that does not come with increased prices. While we appreciate very short interruptions can be inconvenient and unsettling, particularly for our business customers, in most cases a short interruption is less problematic to customers than a long supply failure.

The Canterbury earthquakes and the many aftershocks that followed during FY11 had an impact on our underground cables and overhead insulator components. The intense ground movement, liquefaction and cable displacement stressed cable joints and unsettled above ground infrastructure. Our post earthquake repair and replacement programme, together with our ongoing maintenance work mean that the impact of the earthquakes continues to recede over time.

Figure 8.2 shows the causes of unplanned interruptions in Region A and B using a five year average (FY14-FY18). It shows weather, wildlife, vegetation and faults with an unknown cause have a significantly greater effect on the rural network than the urban network. This is due to the higher proportion of overhead lines in Region B which are exposed to the elements. An example of a fault with an unknown cause could be a tree branch touching the overhead line temporarily on a windy day.

The level of equipment failure in Region A is about 30% of the annual total, however due to the population density being higher in this area, a fault affects more customers in Region A than in Region B, hence the overall customer minutes for both regions are similar.

Figure 8.2 Causes of unplanned interruptions (FY14-FY18 only)



Our post earthquake repair and replacement programme, together with our ongoing maintenance work mean that the impact of the earthquakes continues to recede over time.

8 Causes of supply interruptions continued

Table 11.1 and 11.21 show the five largest unplanned interruptions that occurred in Regions A and B respectively.

The largest unplanned interruption that occurred in Region A during FY18 that had the biggest impact on the amount of customer minutes lost was due to a cable termination fault that affected 5,186 customers with an average fault duration of 2.5hours. The remainder of the four largest faults were also attributed to plant failure.

Table 8.3 The five largest unplanned interruptions in Region A in FY18

Date	Area affected	Reason for fault	Total customer minutes lost	Number of customers affected	Interruption duration*
29 May 2017	Heathcote / Sumner	Switchgear Fault	354,371	24,983	0 hrs 14 mins
17 July 2017	Dallington	Switchgear Fault	183,078	3,625	3 hrs 57 mins
24 July 2017	Spreydon	Cable Joint Fault	99,770	1,402	1 hr 51 mins
22 January 2018	Sockburn	Cable Term Fault	521,798	5,186	2 hrs 33 mins
22 January 2018	Sockburn	Cable Joint Fault	463,279	7,159	4 hrs 56 mins

* Interruption duration times are based on the time taken to restore the last customer.
The total customer minutes lost figure therefore overstates the actual number of 'in-use" minutes lost.

Region B's largest unplanned interruption in FY18 that had the biggest impact on the amount of customer minutes lost was caused by the failure of a tapchanger at our Springston substation. The failure affected 16,152 customers for an average duration of 58 minutes. The remainder of the four largest interruptions were attributed to plant failure, wildlife, unknown and vegetation.

Table 8.4 The five largest unplanned interruptions in Region B in FY18

Date	Area affected	Reason for fault	Total customer minutes lost	Number of customers affected	Interruption duration*
12 April 2017	Hills Rd	Unknown	164,468	2,133	2 hrs 18 mins
22 July 2017	Springston	Transformer Fault	880,971	16,152	0 hrs 58 mins
6 January 2018	Duvauchelle	Insulator Fault	283,304	354	13 hrs 40 mins
1 February 2018	Duvauchelle	Vegetation	175,485	1,009	14 hrs 16 mins
2 February 2018	Duvauchelle	Bird Strike	242,301	4,511	4 hrs 45 mins

* Interruption duration times are based on the time taken to restore the last customer.
The total customer minutes lost figure therefore overstates the actual number of 'in-use" minutes lost.

9 Faults per 100km of circuit

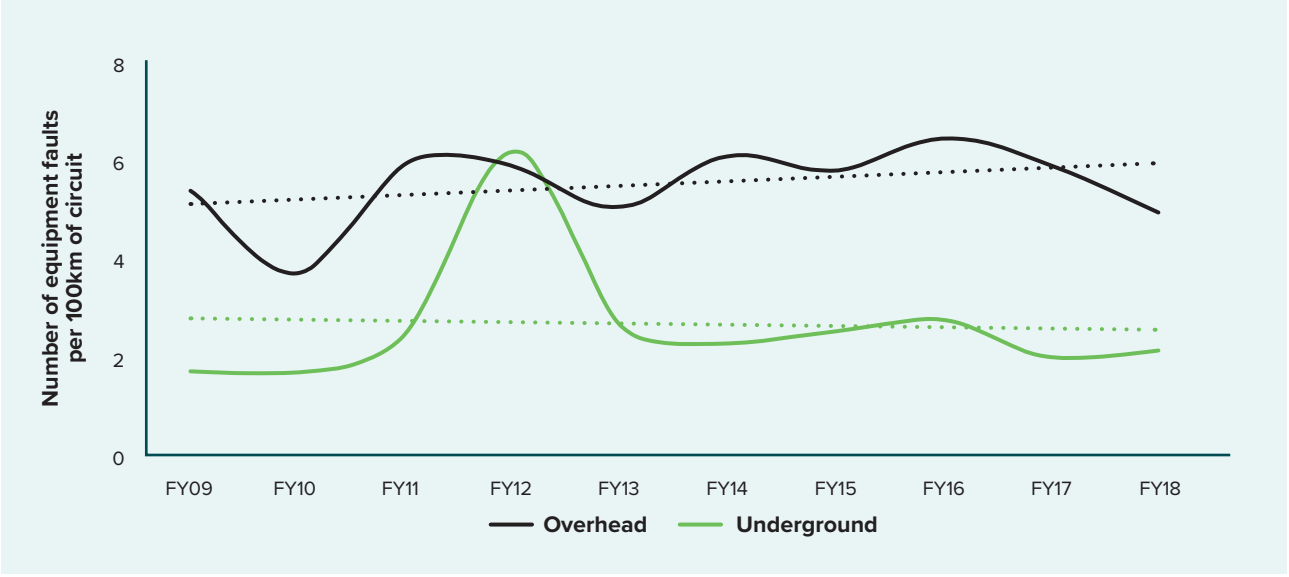
We monitor 'equipment faults per 100km of circuit' statistics to help determine which areas of our network require maintenance or upgrades, in particular for faults pertaining to plant failure. Table 9.1 shows the number of equipment related faults per 100km of circuit for each of our voltage categories.

Table 9.1 Equipment faults per 100km of circuit

Voltage	Category	Length (km)	Approx % Region A / B	Region A faults per 100km	Region B faults per 100km	Total faults per 100km
66kV	Overhead Underground	244 91	32/68 100/0	0.0 1.1	0.0 0.0	**0.0** **2.2**
33kV	Overhead Underground	276 38	12/88 60/40	0.0 4.4	2.5 0.0	**2.2** **2.6**
11kV	Overhead Underground	3,189 2,648	9/91 90/10	10.1 0.5	5.3 1.5	**5.7** **2.2**

Figure 9.1 shows the number of equipment failure faults per 100km of circuit for our overhead and underground assets over the last 10 years.

Figure 9.1 Number of equipment failure faults per 100km of circuit over 10 year period



Our overhead asset failures have been trending up over the 10 year period. Components of our overhead equipment are coming to the end of their useful life and this deterioration can be accelerated by severe weather events. The reduced fault rate in FY17 and FY18 is attributed to the benign weather experienced during this period. Looking to the future, the fault rate for our overhead assets is expected to level out as a result of maintenance and improvement initiatives we have underway. Refer to Section 14 for more detail on how we are minimising our asset failures.

Our underground cables were subject to stresses caused by the Canterbury earthquakes in FY11 and aftershocks in FY12 hence the peak in FY12 for 'underground.' After FY12, the failure trend has been reasonably steady and we anticipate this will plateau around the current level.

The Information Disclosure Compendium[2] compares the underground and overhead network fault rates per 100km of New Zealand's Electricity Lines companies. In 2018 Orion

- had a more reliable underground network, with fewer faults per 100km when compared to the national average
- sits around the national average with our number of overhead faults per 100km.

[2] The PwC Electricity Lines Business Information Disclosure Compendium summarises the disclosure information of Electricity Line Businesses on an annual basis.

10 Least reliable feeders

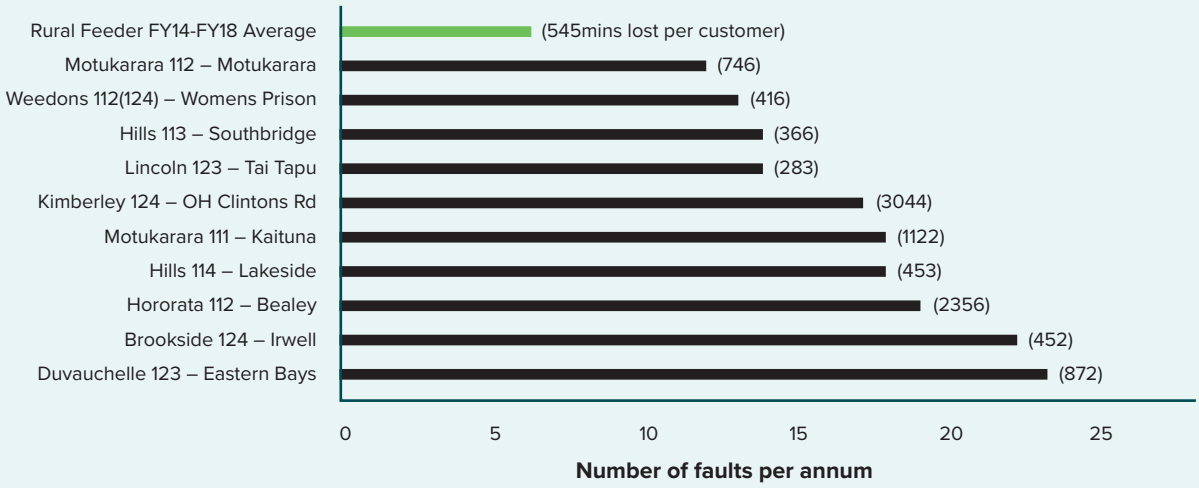
A feeder is generally defined as a circuit that originates at a zone substation and supplies several hundred households or businesses. Orion has more than one hundred rural 11kV feeders (Region B) and several hundred urban 11kV feeders (Region A).

As shown in Table 9.1 and Figure 9.1, our overall performance is predominantly impacted by the number of faults experienced on our 11kV overhead rural feeders. We have focussed our maintenance strategies on our 11kV feeders, concentrating our attention on those feeders which serve the greatest number of customers.

Our 10 least reliable rural feeders in Region B are shown in Figure 10.1. In addition to faults caused by plant failure, these totals also include interruptions caused by weather, vegetation, wildlife and third party damage. Taking this wider approach to evaluation of the performance of our feeders allows us to make a comprehensive assessment of each feeder and implement tailored improvement initiatives.

We have focussed our maintenance strategies on our 11kV feeders, concentrating our attention on those feeders which serve the greatest number of customers.

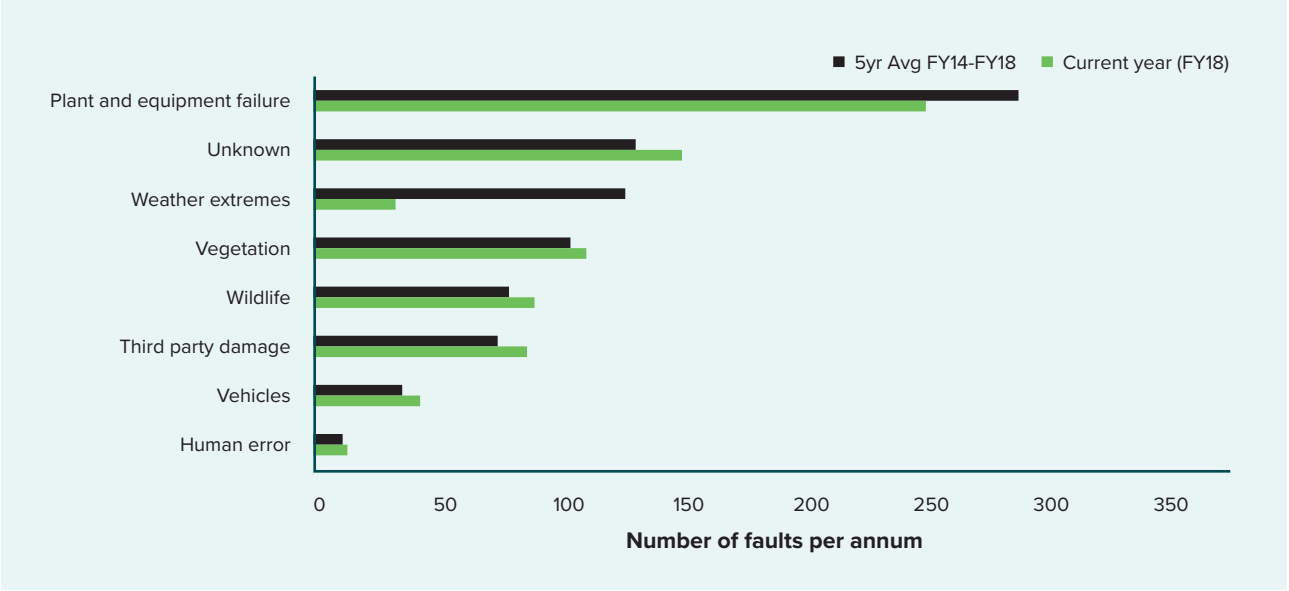
Figure 10.1 10 least reliable feeders – unplanned interruptions (FY14-FY18 average)



11 Reducing interruption numbers

The two biggest fault categories that contribute to 30% of the total number of interruptions in FY18 are plant failure and unknown. Both of these categories align with the five year average.

Figure 11.1 Causes of unplanned interruptions



Plant and equipment failure

We carefully assess equipment options and any trade-off between price and reliability to determine which equipment will provide the best results for our customers. However, even new equipment is prone to failure from time-to-time. For this reason, to minimise or remove the risk of failure we have effective maintenance regimes and regular monitoring programs to identify risks before they become a problem.

For example, in 2016 we enhanced our visual inspection for our of pole fleet. As a result of this process, operators and external contractors have been more vigilant in identifying suspect poles. More poles are now being replaced under emergency works, reducing risk to the community.

We use technology such as partial discharge[3] tests, corona camera visual checks and infrared camera checks. For example, on our overhead high voltage network, our infrared camera checking programme has revealed instances of extreme corona discharge on insulators, identifying them for urgent and immediate replacement.

Over the previous five years, we have gathered more asset related failure data than in the past to enhance our proactive asset management programme. This risk based approach has allowed us to prioritise our maintenance, replacement and refurbishment programme based on the actual condition of equipment rather than simply its age.

Weather extremes

Strong wind, heavy rain, snow and lightning can damage equipment and interrupt power supply. While the weather is beyond our control, we have design standards, and select plant and equipment that can withstand most of the vagaries of our local climate.

Historically extreme wind and snow storm events have been few and far between. However, it is not unusual for a weather event to occur nearly every year that has a significant effect on our network reliability.

We carefully assess equipment options and any trade-off between price and reliability to determine which equipment will provide the best results for our customers.

[3] Partial discharge – these are small electrical sparks that occur within the insulation of electrical equipment. These discharges erode insulation and eventually result in insulation failure.

As travelling time has a substantial impact on the time it takes to repair faults, particularly in Region B, we continue to expand our network's remote control capabilities. This allow us to restore electricity supply to customers at a quicker rate.

Our use of line circuit breakers and installation of remote controlled line switches in key locations helps to reduce the impact of unpredictable events on our customers.

Vegetation

Keeping tree branches at a safe distance from overhead lines reduces the number of interruptions. However tree debris can travel large distances during storms and network operators have limited authority to reduce vegetation risk.

Orion has an ongoing programme of vegetation management. Cutting trees and branches in advance reduces the probability of tree debris causing faults during storms. Trees account for 10-20% of all unplanned interruptions and our annual expenditure on tree maintenance is around $4m.

We use the services of qualified arborists to ensure that tree trimming is carried out in an environmentally responsible and safe manner.

Supporting our efforts on the ground, we encourage property owners to trim their trees around power lines through a comprehensive community advertising campaign in local newspapers and radio. See Appendix B for an example of our tree trimming advertising.

Other

Third party damage such as cable strike and line strike has been higher over the last five years. This is due to the extensive post-earthquake excavation and demolition work near road reserves where cables are often situated. There has also been higher than normal heavy vehicle movement for rebuild activities carrying demolition material and house removals as well as construction vehicles carrying tilt slabs/ steel beams. The number of third party faults in FY18 is more than the five year average due to a higher amount of line and cable strikes. Going forward this number is expected to decrease due to a reduction in Christchurch's infrastructure rebuild work and less heavy vehicle movement.

The number of bird strikes and possum related interruptions has increased over the last few years. We are in the process of searching for an effective mitigation strategy.

Our use of line circuit breakers and installation of remote controlled line switches in key locations helps to reduce the impact of unpredictable events on our customers.

12 Energy delivery performance

In order to help run our network as efficiently as possible the following three factors are considered in our design and investment decisions:

- Line losses
- Load factor
- Capacity utilisation

Line losses

As electricity passes through lines, cables and transformers it creates a small amount of heat which is then 'lost' into the surrounding air. Such 'losses' are natural physical phenomena and are experienced in all electricity distribution networks. They cannot be avoided completely and mean that electricity retailers must purchase more energy from generators than is actually delivered to households and businesses.

Our policy is to maintain what is termed a 'low loss network', where overall losses are estimated at below 5% of energy delivered. We achieve this by following good industry practice with sound network design principles. For instance, when deciding which transformer to purchase, we take into account the 'loss factors' as well as the price.

We also control operational voltage levels on our rural network to limit line losses. We choose transmission and distribution voltages and conductor sizes that best suit the load density, as overloaded conductors produce more line losses.

Load factor

The amount of electricity passing through an electricity network is not always constant. In Christchurch city for instance, electricity demand is higher on cold winter days than on warm summer days. The average load that passes through a network divided by the maximum load the network experiences that year produces a statistical measure called a network's 'load factor'. Load factor measures the constancy of load on an electricity network throughout a year.

Our policy is to maintain what is termed a 'low loss network', where overall losses are estimated at below 5% of energy delivered.

For FY18 Orion's load factor was 59.6%, indicating effective use of our network assets.

Load factors vary across different electricity networks. Varying weather conditions and networks having different mixes of industrial, residential and rural customers all effect a network's load factor. For instance, a network in an area with an even climate will typically have a higher load factor than networks in areas with large temperature variances because the average load is likely to be higher.

Nevertheless, all networks seek to maximise their load factor. This is because a high load factor indicates better use of network assets - assets are more frequently used up to their electrical rating. For FY18 Orion's load factor was 59.6%, indicating effective use of our network assets.

Capacity utilisation

Capacity utilisation is a measure of how well a network's transformers are utilised. It is calculated as the maximum demand experienced on an electricity network in a year divided by the transformer capacity on that network.

In FY18 our capacity utilisation factor for zone substation transformers was 27.2%. This figure is expected to increase as customer numbers continue to grow, and customers return to the Christchurch city centre.

13 Power quality

Power quality refers to an electricity network's ability to deliver a stable power supply and is commonly determined by the following:

- 'steady state' level of voltage supplied to customers
- level of 'harmonics' or distortion of the voltage of the power supply
- transient faults

Steady state level of voltage

The steady state level of voltage supplied to customers has traditionally been the most common measure of power quality. As the term suggests, in 'steady state' the voltage is stable with only very small rates of change. If however voltage drops, then the steady state disappears and there is a corresponding drop in the quality of power supplied to the customer. This can result in a 'brown out', where the voltage drops somewhere between full power with bright lights, and a blackout, causing lights to dim.

The steady state level of voltage supplied to customers has traditionally been the most common measure of power quality.

This 'voltage drop' is often the result of carrying large electrical loads over long cables. The larger the load and longer the cable, the more likely the voltage will be affected at a customer's point of connection to the electricity distribution network.

We monitor voltage issues and reinforce our network to reduce the probability of voltage drop. Where voltage drop does occur, it is generally due to unexpected changes in customer's electrical loads. These load changes are normally rectified back at the zone substation or at the transformer if a single premises is affected. On some occasions it is necessary for the customer to upgrade the supply from the road into their property.

Harmonics

Harmonics, or wave form distortion, can cause poor power quality as they distort the supply voltage. Harmonic issues can be caused by network components and equipment such as electrical motors and computers owned by customers.

Some equipment and appliances are affected by significant levels of harmonics. In most cases where this occurs the customer's electronic equipment is the cause.

Harmonics and distortion within our network are increasing – a trend that is mirrored internationally. While these increases do not appear to be affecting our customers, we have seen some impacts on the equipment that monitors and controls our network. Customers that produce high levels of harmonic distortion, over 30%, are advised by Orion on ways to mitigate the problem.

Transient faults

Transient or momentary faults occur on Transpower's transmission network and within our distribution network, causing flickering lights and short term interruptions to power supply. We design and build our network to minimise the effects of these faults.

As customer equipment can have similar momentary impacts on our network, we limit the extent to which customers' problematic equipment can be connected, if we find problematic equipment on the network we consult with the customer on how to rectify the issue.

Harmonics and distortion within our network are increasing – a trend that is mirrored internationally.

14 Enhancement initiatives

Our proactive programme of enhancement initiatives identifies a need to reduce risk and opportunities to improve the reliability and performance of our network.

Over the past six years we have carried out some of the following enhancement initiatives to improve our network resilience and respond to our customers' encouragement to invest in the resilience of our network:

- Invested $60m on a 66kV Northern loop. The installation of these 66kV underground cables allows us to re-route power across the city in the event of an emergency. This investment played an essential role in restoring a large amount of our customers that were affected by the Port Hills fire after losing the incoming 220kV Transpower line.
- At our Papanui 66kV zone substation we have installed additional equipment and technology to provide alternatives for re-routing supply if needed, this will significantly reduce the chance of an outage for more than 30,000 customers.
- Relocated Connetics[4] to a fit for purpose depot in Waterloo Business Park, which provides a better geographical location and improved resilience and operational efficiency.
- Installed a number of remotely operated smart switches that will allow for quicker restoration times for our customers in the Leeston and Banks Peninsula areas.

We will continue to deliver a reliable and cost effective power supply in the interest of our community, we intend to carry out the following major projects over the next financial year:

- Complete the $3.2m installation of new 11kV cable through Lyttleton tunnel and connect to the existing 11kV network, to provide better resilience, reliability of power supply and allow for expected load growth in this community, and at the port that provides an essential lifeline for Canterbury.
- Waimakariri stage 2 will see $1.3m spent on the network to allow for load growth in the North of Christchurch and the recent replacement of our Papanui zone substation transformers, providing addition security of supply that is otherwise likely to be exceeded.

Our proactive programme of enhancement initiatives identifies a need to reduce risk and opportunities to improve the reliability and performance of our network.

In addition, we will spend more than $58m in FY19 on other capital expenditure projects to connect new customers, relocate assets, reinforce the network and replace ageing equipment. We will also spend more than $29m on maintenance. More information on our capital expenditure and maintenance plans can be found in our Asset Management Plan.

Table 14.1 Capital and maintenance expenditure projections

FY	FY19	FY20	FY21	FY22	FY23
Capital expenditure ($m)	58.7	58.1	54.5	57.6	58.0
Maintenance expenditure ($m)	29.0	28.5	27.6	27.6	27.4

When we extend, replace, maintain and operate our network we consider the balance between cost, quality and safety of supply provided. The optimum point of investment in the network is achieved when the value of further expenditure would have exceeded the value of benefits to our customers. We seek to achieve this optimal point by whole-of-life economic analysis when we develop and review our asset management practices and expenditure requirements.

[4] Connetics Limited is a wholly owned subsidiary of Orion. Connetics constructs and maintains substations, overhead and underground lines and associated equipment. Connetics also operates an equipment supply and distribution business and provides engineering design and consultancy services.

15 Glossary of terms

CAIDI: an index which measures the average duration of interruptions to supply for customers that have experienced an interruption to supply, in a year.

Capacity utilisation: a ratio which measures the utilisation of transformers in the system. Calculated as the maximum demand experienced on an electricity network in a year, divided by the transformer capacity on that network.

Conductor: includes overhead lines which can be covered (insulated) or bare (not insulated), and underground cables which are insulated.

Distribution transformer: a device that changes voltage up to a higher voltage or down to a lower voltage.

Zone substation: a major building substation and/or switchyard with associated high voltage structure where voltage is transformed from 66 or 33kV to 11kV, two or more incoming 11kV feeders from a grid exit point are redistributed or a ripple injection plant is installed.

Fault: an electricity supply outage caused by an unplanned event (e.g. weather, trees). Faults do not include electricity supply outages caused by planned events (e.g. planned maintenance).

Feeder: a physical grouping of conductors that originate at a zone substation and supply a number of customers.

Grid exit point: a point where Orion's network is connected to Transpower's transmission network.

Harmonics (wave form distortion): a distortion to the supply voltage which can be caused by network equipment and equipment owned by customers including electric motors or even computer equipment.

High voltage: voltage exceeding 1,000 volts, generally 11,000 volts (known as 11kV).

Interruption: an electricity supply outage caused by either an unplanned event (e.g. weather, trees) or a planned event (e.g. planned maintenance).

Line circuit breaker: a device which quickly cuts off power to a line after a fault so that no permanent damage is caused to the line. It switches power back on to the line after a few seconds if the cause of the fault has gone (e.g. a branch has fallen off a line).

Low voltage: voltage not exceeding 1,000 volts, generally 230 or 400 volts.

Maximum demand: the maximum demand for electricity during the course of the year.

Network deliveries: total energy supplied to our network through Transpower's grid exit points. Usually measured as energy supplied over the course of a year.

Network substation: a building substation which is part of the 11kV network and provides protection to connected cables and overhead lines.

Outage: when supply of electricity fails.

Region A: the area that consists of our Central Business District, Lyttleton and the Christchurch city metropolitan area.

Region B: the area that consists of our townships and rural network that fall outside of Area A and sit between our network boundaries.

Ripple control system: a system used to control the electrical load on the network by, for example, switching load such as domestic water heaters off, or signalling to large users that they are in a high price period (thereby encouraging them to use as little power as possible during that time).

Rural: the rural network covers all areas other than Christchurch city and includes rural towns.

SAIDI: an index which measures the average duration of interruptions to supply that connected customers experience in a year.

SAIFI: an index which measures the average number of interruptions to supply that connected customers experience in a year.

Transpower: the state-owned enterprise that operates New Zealand's transmission network. Transpower delivers electricity from generators to various networks around the country.

Urban: the urban network largely covers Christchurch city.

16 Directory

Board of directors

Jane Taylor (Chair)
John Austin
Dr Nicola Crauford
Bruce Gemmell
Jason McDonald
Geoff Vazey

Corporate management

Rob Jamieson	(Chief Executive)
Vaughan Hartland	(Chief Financial Officer)
Brendan Kearney	(General Manager Governance & Risk)
David Freeman-Green	(General Manager Commercial)
Craig Kerr	(General Manager Information Solutions)
Steve Macdonald	(General Manager Infrastructure)
Andy Miller	(General Manager QHSE)
Adrienne Sykes	(General Manager People & Capability)
Paul Deavoll	(General Manager Customer & Stakeholder)

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Appendix A Springston community advertisement

Appendix B Tree trimming advertisement

To all of you who have had your trees trimmed before they became a problem, thank you for keeping all the farms working and families in your community warm, happy and healthy.

You can be proud of the fact that you kept the local cowsheds milking, water pumps pumping and sheep shearers shearing. You may not think that what you've done has had much impact on your neighbours, but from all of us here at Orion, we just want to say thank you.

Power line voltage	A. Growth limit zone	B. Notice zone
66,000 volts	4.0m	5.0m
33,000 volts	2.5m	3.5m
11,000 volts	1.6m	2.6m
400/230 volts	0.5m	1.5m

We're not exaggerating.

On our network, 10-20% of all unplanned power outages are caused by trees – including vegetation – coming into contact with power lines. Other than this, fire damage to property from branches sparking in dry conditions and serious injury from electrocution from contact with trees touching power lines are also possible consequences of not maintaining your trees.

How close is too close?

While most damage is caused by trees falling on power lines, significant risk exists from trees merely touching them. This risk increases the higher the voltage of the power line.

The minimum distances that must be maintained between trees and power lines, as defined in the Electricity (Hazards from Trees) Regulations 2003, are outlined in the diagrams above. All vegetation should be kept out of the growth limit zone and preferably the notice zone.

Sometimes it may not be practical to have a tree trimmed at the rate at which it grows and unfortunately, this means it may need to be removed. Other situations may require trees to be removed, most commonly when they are at a high risk of falling due to disease or adverse weather events.

Where do I start?

Before you begin, remember to keep yourself, and those around you, safe. We recognise that not everyone is experienced in tree trimming and are happy to advise you on what to do. We can arrange for trees near power lines to be trimmed at your expense, however we recommend you hire professionals to safely carry out the work.

If you or someone working for you intends to work within four metres of power lines, a close approach consent is required from Orion before you start. As a tree owner, you may be liable for any damage caused by carrying out trimming or felling of trees.

Will I be fined if I don't comply?

If a cut or trim notice is given to you and you fail to have the tree trimmed and/or advise us of the time and location of the trim without a reasonable excuse, this is an offence. This will make you liable for a fine not exceeding $10,000. If the offence continues, you will be liable for a further fine of not more than $500 for every day or part day during which the offence continues.

More info can be found on our website and if you have any questions or notice any trees touching power lines in your area, please call us on **03 363 9898** or **0800 363 9898**.

oriongroup.co.nz

Orion New Zealand owns and operates the electricity distribution network in central Canterbury between the Waimakariri and Rakaia rivers and from Canterbury coast to Arthur's Pass.

Orion

Orion

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