Westpower

Asset Management Plan

2016 - 2026

From 1st April 2016 to 31st March 2026

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Some of the information and statements contained in the AMP are comprised of, or are based on, assumptions, estimates, forecasts, predictions and projections made by Westpower Limited (Westpower). In addition, some of the information and statements in the AMP are based on actions that Westpower currently intends it will take in the future. Circumstances will change, assumptions and estimates may prove to be wrong, events may not occur as forecasted, predicted or projected, and Westpower may at a later date decide to take different actions to those it currently intends to take.

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When considering any content of the AMP persons should take appropriate expert advice in relation to their own circumstances and must rely solely on their own judgement and expert advice obtained.

This document is publicly available, and we welcome constructive comments and suggestions. Comments may be made in writing to:

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1.0 EXECUTIVE SUMMARY

The desired intent of the Westpower Asset Management System is:

> "*To provide a systematic approach to the planning of programmes which are intended to ensure that the condition and performance of infrastructure assets are being efficiently maintained or improved to satisfy stakeholders' requirements.*"

Westpower owns electricity reticulation assets that are used to provide distribution and connection services to electricity retailers and generators. This Asset Management Plan (AMP) includes Westpower's assets that transport electricity (owned by the electricity retailers) from Transpower's seven Grid Exit Points (GXPs) to over 13,000 electricity consumers on the West Coast of New Zealand's South Island (refer Figures 1.2 and 1.3). These assets are described in Section 5.

This AMP plan is an integral part of Westpower's Asset Management System. The plan provides an asset planning framework for all work undertaken on Westpower's assets over the next 10 year period. The AMP is required to meet current disclosure requirements of the Electricity Distribution Information Disclosure Determination 2012 (Consolidated in March 2015) (EDIDD 2012). It is also used to demonstrate compliance with good asset management practice in terms of the International Standard ISO 55000:2014 (ISO 55000). Westpower is progressively working towards implementing this standard.

There have been some changes to the structure of the plan from the previous year. These include merging of the sections on assets covered and the lifecycle management of the assets. This is part of an ongoing improvement programme to better reflect the current requirements of the EDIDD 2012, better align with ISO 55000 and to streamline and condense the information included in this document to minimise duplication and improve readability.

This plan covers a planning period from 1 April 2016 through to 31 March 2026. The main focus is placed on the next three years, with full revisions being completed annually.

The plan was approved by Westpower's Board of Directors on 7 March 2016.

Key Achievements 2015-2016

- Good progress continues to be made with the development, approval and issue of Westpower Standards, Procedures, Forms, Standard Construction Drawings and Service Provider staff competency requirements. These are now available to Service Providers on the Westpower website, which also includes Safety and Engineering Advices.
- The development and implementation of electrical network safety training for emergency services, by asset management staff, has been well received by the recipient services with requests for the presentation from other sectors within the local community and further afield. This training focuses on: identifying network hazards; maintaining safe distances during incidents involving live or potentially live electricity; what information should be passed onto the company to ensure rapid and effective response to remove the electrical hazard; and enable emergency services to then carry out their emergency response work.

Most major replacement and upgrade projects are now coming to an end after a sustained period of activity. Significant projects completed during the past year include the:

- **Haupiri Statcom**

  Westpower's first Statcom was installed and commissioned at the Christian Community at Haupiri in March 2015. This unit has helped alleviate power quality and voltage support issues in the area. Remote access via SCADA communications enables Westpower to monitor the performance of the unit.

  Having successfully completed this project, Westpower now has another option for power quality and voltage support management in other areas of the network.

- **Upgrade Projects**
    - Arnold Zone Substation – replacement of CB3 & 4 with vipers and upgrade protection.
    - Cooper 11 kV Recloser Replacement Programme.

  These upgrade projects have enabled Westpower to standardise equipment across zone substations and network MV switchgear locations. Benefits achieved are: common spares and operating procedures; reduced maintenance requirements; more reliable voltage support/analysis; improved remote control capabilities; room for future growth; and improved safety of our operations for personnel and the public.

- **Decommissioning Pike River Substation**

  This aspect of the Pike decommissioning project has been completed. The Pike River 33 kV substation has been decommissioned while retaining 11 kV supply to the portal and for amenities.

Levels of Service

The network delivered 284 GWH of energy to 13,410 customers during 2015, this was similar to the delivered energy in the previous year.

Consultation with stakeholders has resulted in a strong focus on continuity of supply, which is reflected in the comparison of international reliability measures (e.g. the System Average Interruption Duration Index (SAIDI) with other Electricity Line Businesses (ELBs).

Table 1.1 provides an overview of our performance in the key areas of service. A more detailed version of this table can be found in Section 3 (Tables 3.1 and 3.2).

The SAIDI and SAIFI targets shown in Table 1.1 are based on normalised data that exclude extreme events, according to the Commerce Commission's definition. This approach better represents the underlying performance of the network and provides for a more meaningful comparison with other ELBs.

Table 1.1: Service Level Performance Summary

Service Criterion	Quality Group	Target Level of Service	Level of Service	Indicator	Measurement Process
Reliability	Faults/100 km of cct	7.69	6.45	Figures for total values disclosed in accordance with the Electricity Distribution Information Disclosure Determination 2012	Westpower network faults, logged as outages occur
	Total SAIDI	177	153		
	Total SAIFI	2.33	2.14		
	Total CAIDI	76	71		
Efficiency	Capacity Utilisation	30%	30%	% used	Maximum demand/ transformer capacity

Network Development

The West Coast economy continues to be impacted by an economic downturn following the major industrial closures including Pike River Coal Mine, Spring Creek Coal Mine, and Grey River Gold Dredge over the past 5 years and more recently the cessation of operations at Oceana Gold near Reefton and underground operations at Roa Coal Mine.

In Westpower's case, most of the sub-transmission infrastructure has been built within the past 25 years and has been prudently designed to cater for likely future demand, which means that there is usually sufficient capacity to cater for marginal load growth. In the event of proposals for major new loads crystallising, each case will be considered both in isolation and in combination with other proposals, to make sure that any impacts on zone substation capacity are taken into account.

There is one major upgrade project in the pipeline, tentatively proposed for the second half of the planning period, to cater for increased generation in South Westland. This is the South Westland Grid Upgrade Project, which is contingent on a major generation project (Westpower's proposed Waitaha Hydro Scheme) proceeding, requiring additional sub-transmission capacity.

This project involves upgrading a section of the Hokitika-Waitaha 33 kV line to 66 kV along with conversion of the Ross and Waitaha substations to a 66 kV operation. A possible variation to this plan involves the option of supplying the relatively small Waitaha load at a lower voltage from nearby Ross.

Load forecasting (refer Figure 1.1) shows that the current After Diversity Maximum Demand (ADMD) of around 47.6 MW will decrease to 44 MW following the closure of Oceana Gold and Roa underground operations then gradually increase to around 54 MW by 2025, depending on future economic growth.

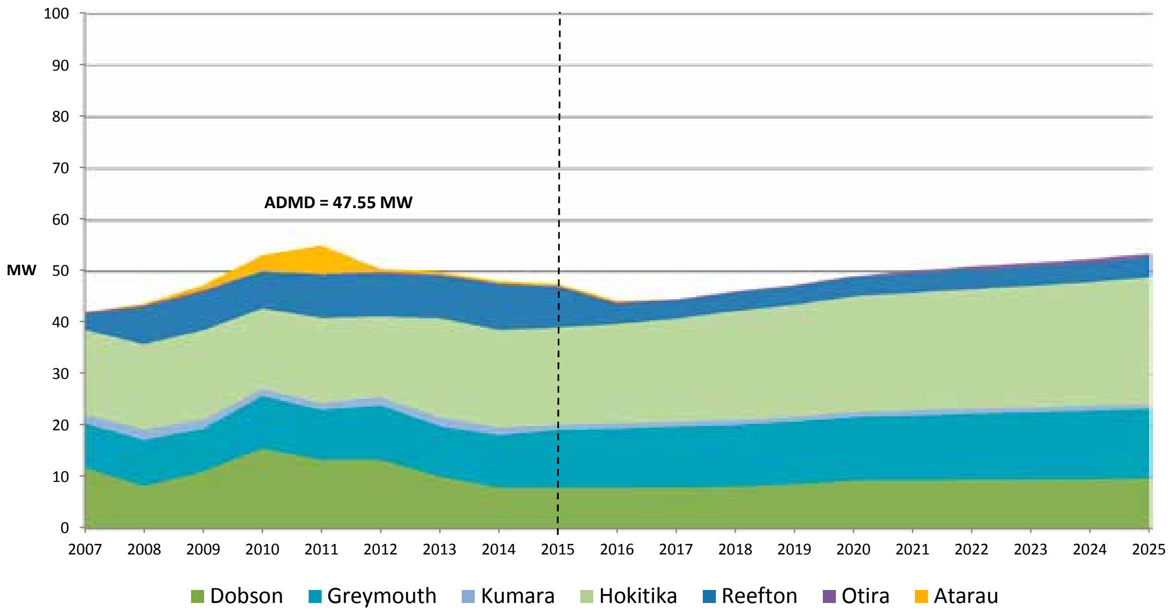

Figure 1.1: Load Trend – Actual and Forecast (Including Local Generation)

Financial Summary

Capital expenditure (CAPEX) typically represents 30% of the total AMP expenditure, while maintenance expenditure represents the remaining 70%. Table 1.2 shows the summary of forecast expenditures for the 2017-2026 period. This has been broken down into three category sub-groups for maintenance expenditure: Faults: Inspection, Service and Testing (I, S & T); and Repairs. The three category sub-groups for capital expenditure are: Development; Enhancement; and Replacement. No provisions for inflation have been made in these figures for the first 5 years of the planning period.

Table 1.2: AMP – Forecast Expenditure by Activity ($'000)

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
DEVELOPMENT	958	523	758	533	473	473	473	473	533	353
ENHANCEMENT	1399	1201	659	2243	356	296	296	271	296	231
REPLACEMENT	1148	1209	1278	623	1696	1472	832	870	922	1492
Capital Total	**3505**	**2933**	**2695**	**3399**	**2525**	**2241**	**1601**	**1614**	**1751**	**2076**
FAULTS	496	496	496	496	496	496	496	496	496	496
IS&T	4258	4163	4088	4055	4055	4023	4038	4033	4050	4128
REPAIRS	346	346	346	346	346	346	346	346	346	346
Maintenance Total	**5100**	**5005**	**4931**	**4897**	**4897**	**4865**	**4880**	**4876**	**4892**	**4970**
Total	**8605**	**7938**	**7625**	**8296**	**7422**	**7106**	**6481**	**6489**	**6643**	**7046**

Operational Expenditure

The operational expenditure (OPEX) budget is approximately $500,000 lower than the budget for the 2015/2016 year and some $200,000 below the previously forecast expenditure for the coming 2016/2017 year. Two areas of increase within the OPEX budget are:

- The vegetation budget which is required to meet minimum legislative compliance obligations; and
- The general transformer servicing budget.

The latter has been increased to allow for more refurbishment of existing assets rather than purchase of new assets, as this has been shown to be a cost-effective strategy.

Capital Expenditure

In general, CAPEX remains at historically low levels, reflecting the good overall condition of Westpower's reticulation assets and the ongoing lack of any significant demand drivers that would otherwise require investment in network growth.

Underlying CAPEX remains close to the value signalled in last year's budget, but a number of capital projects have been rolled over from the 2015/2016 budget to the 2016/2017 year. These include the:

- Pike River decommissioning;
- Relocation of 66 kV line at Ruatapu;
- Relocation of 33 kV line at Waiho River, Franz Josef; and
- Replacement of 33 kV structures in Warrens Paddock.

A description of these projects can be found in Section 4. Refer to Table 6.6 for the actual vs budget performance by asset type.

Improvement Plan

Westpower is constantly striving to find more efficient ways to carry out its daily functions, by reducing costs and improving productivity.

A key strategic goal for the business is the implementation of ISO 55000 (a replacement for PAS-55), a global specification for good asset management practice. Considerable progress has been made in this area, with Westpower's asset management practices now assessed as being 91% compliant with the standard.

The Asset Management Policy which provides the governance framework for all asset management activities has been reviewed and revised as part of this process. This policy is approved and signed off by the Board of Directors, which ensures strategic alignment between Westpower's business goals and management of the assets.

Section 7 of this document provides an overview of this standard and progress being made towards achieving this. It is expected there will be full implementation of the asset management system by year end.

Key Projects for 2016-2017

The maintenance and capital projects for the coming year are outlined in Sections 4 and 5. The key projects for this year include:

- **Waiho River Line Relocation**

  For a number of years the Waiho River has been shifting its course and has progressively been building up gravel in the vicinity of the 33 kV/11 kV line which runs along the river's path. The gravel build up is such that the 11 kV circuit has been de-energised due to ground clearance issues and the security of the line is continually under threat from the river. To ensure the supply to the Franz Josef area and the southernmost section of the network is secured, the line is to be relocated to the dry side of a recently constructed stop-bank. This approach will see both circuits re-instated and clearance issues resolved.

- **Oil filled Ring Main Units**

  A replacement programme is in place to replace the last three oil filled Ring Main Units (RMUs) in the Westpower network over the next four years. Once replaced, all RMUs on the network will be modern SF6 or vacuum units.

- **Arnold T1 and 2412 Protection Upgrade**

  Arnold T1 protection is planned to be upgraded to a modern SEL relay, ensuring that the protection is standardised as per Westpower's other substations. This project is planned to coincide with the CB2412 protection upgrade.

- **Decommission Logburn Zone Substation**

  Due to delays in the decommissioning of the Pike River mine site, the Logburn zone substation is planned to be decommissioned in this financial period.

- **SCADA**

  Investigations continue into best options for replacement of the current SCADA system.

Plan Outcomes

The major outcome of this plan is a ten-year expenditure forecast that is characterised by:

- A relatively constant level of investment in new connections and extensions to the network. This is based on an overall modest growth level.
- The ongoing maintenance cost of regulatory compliance with the tree regulations and additional requirements for tree worker safety.
- Material cost increases that are continuing to affect our construction costs because of the combined effect of raw material demand and exchange rate fluctuations.
- Increased Condition Assessment costs to meet Westpower's Safety Management System requirements of inspecting all assets over a five-year period.
- A move away from replacement strategies to a more focussed and proactive condition assessment regime, supported by repair and refurbishment programmes that reflect the very good overall condition of the existing assets. This is reflected in the reducing forward capital expenditure requirement.

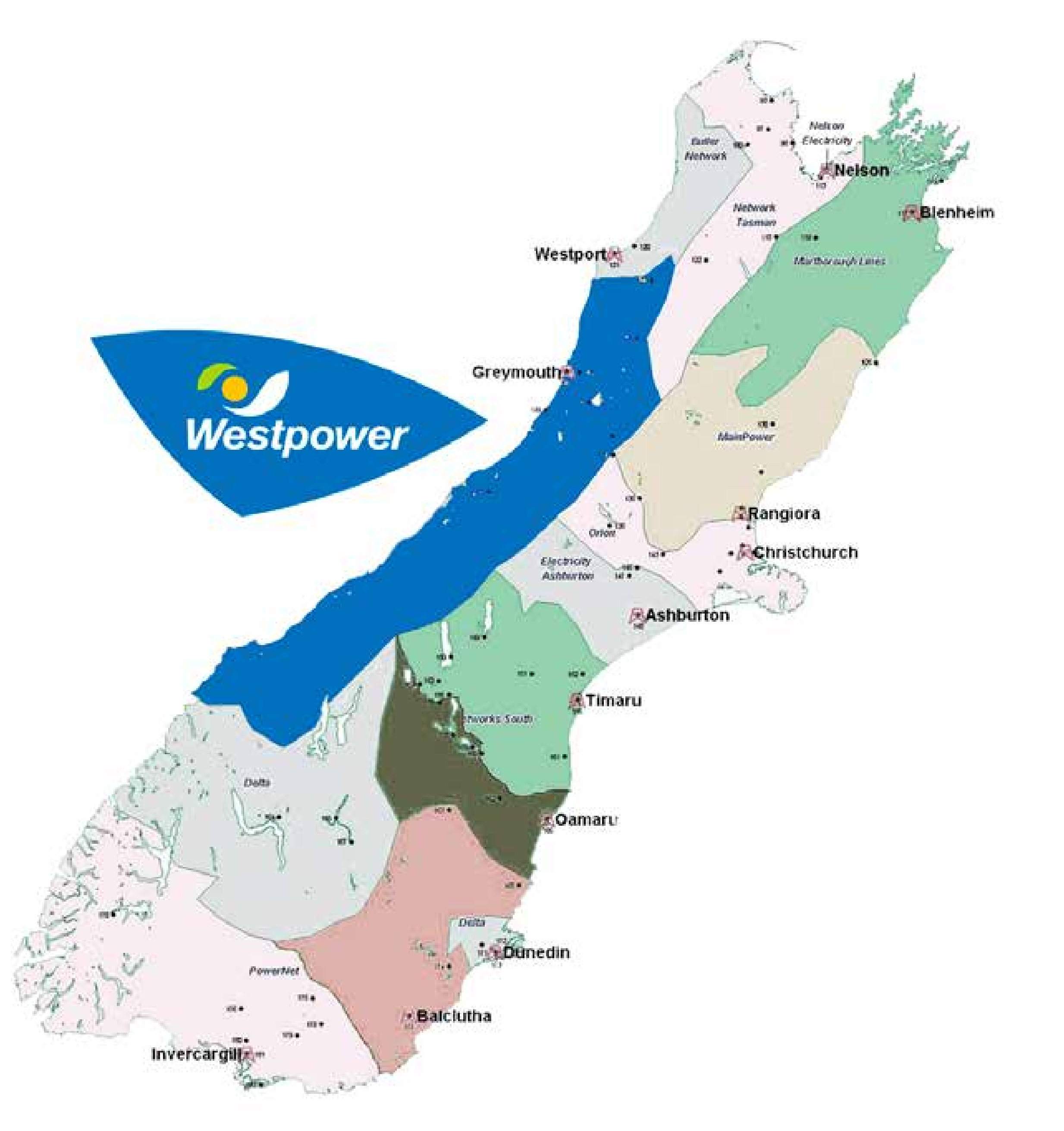

Figure 1.2: Map of Westpower's Network

Table 1.3: Network Summary

Description	Quantity
Consumer Connections	13,410
Network Maximum Demand (MW)	47.6
Network Deliveries (GWh)	284
Annual Load Factor (%)	30%
Lines & Cables (circuit km)	2174
Zone Substations	19
Distribution Substations	2433
Regulatory Asset Base ($m)	112.4

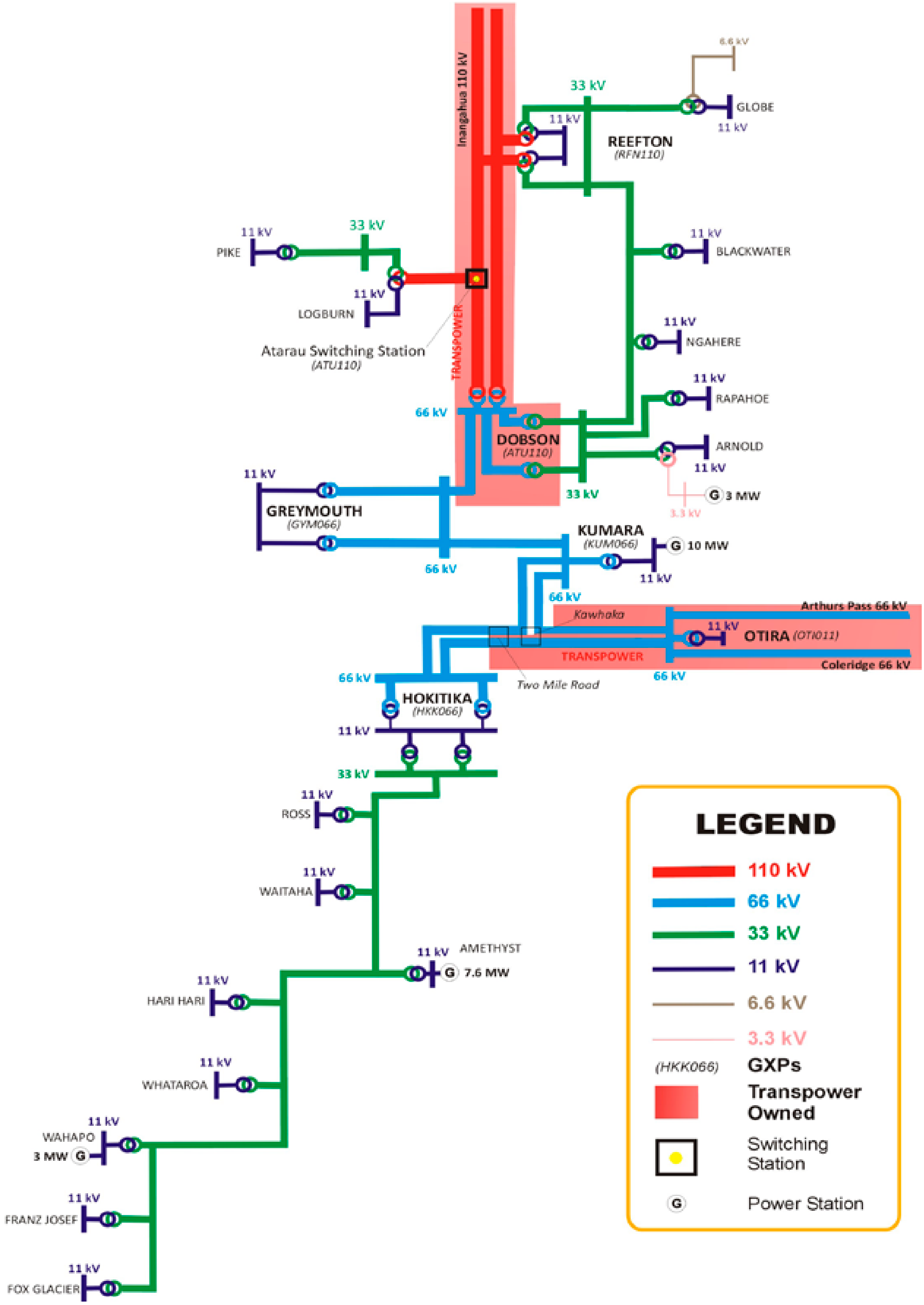

Figure 1.3: Diagram of Westpower's Network

2.0 OVERVIEW OF ORGANISATION STRUCTURE AND ASSET MANAGEMENT SYSTEM

This is the 23rd AMP to be produced for Westpower. While the plan itself includes only minor changes to the forecasting from the previous year, the document has under gone some format changes. The main change has been to merge the previous sections on assets covered with the lifecycle management of the assets. This is part of ongoing improvement to better reflect the current requirements of the EDIDD 2012, better align with ISO 55000 and to streamline and condense the information included in this document to minimise duplication and improve readability. It is also intended for general viewing, assuring Westpower's stakeholders that the Westpower network continues to be managed in a professional and cost-effective manner.

This section provides an overview of the organisational structure of Westpower, including organisational roles, responsibilities and authorities. Understanding the needs and expectations of the stakeholders is an integral part of the planning process, with the key stakeholders identified. An overview of the Asset Management System provides the context for this plan. This includes the Asset Management Policy which reflects the organisation's strategic direction and determines the framework for the plan. A description and an outline of the AMP are included.

2.1 Organisation Structure

Westpower is a 100% West Coast community owned company with its head office in Greymouth. The West Coast Electric Power Trust (WCEPT) was formed as a consequence of the passing of the Energy Companies Act 1992. The Trustees, who are elected by the community every two years, hold the shares of Westpower on behalf of the shareholders of Westpower.

The Westpower distribution network (Figure 1.2) covers 18,017 square km from Lyell in the north to Paringa in South Westland, consists of over 2,000 km of power lines, and supplies more than 13,000 consumers.

Westpower is a stand-alone ELB with a contracting subsidiary, ElectroNet Services Ltd. Westpower is essentially an electricity distribution company that is a shell or holding company; however, it will continue to own the infrastructure assets. The 100% owned ElectroNet Services Ltd performs not only work on the Westpower infrastructure assets but also the asset management function under contract from Westpower.

ElectroNet Services Ltd was formed as a subsidiary company of Westpower when it restructured its electricity distribution activities after the Government reforms in 1997. This restructure included transferring all Westpower staff into ElectroNet Services Ltd to provide electrical contracting services to Westpower. ElectroNet Services Ltd has grown significantly in recent years as the result of a planned approach to growing the organisation. The company now provides transmission, distribution and electrical contracting services.

The maintenance of the network is carried out by ElectroNet Services Ltd as the preferred contractor. They are contracted to undertake the inspection, servicing and testing (I, S & T), along with fault callout and fault repair work. Major line replacement, enhancement or development projects are also issued to ElectroNet Services Ltd as design build contracts.

ElectroNet Transmission Ltd is a Nelson and Greymouth based company, providing electricity transmission, maintenance and build services throughout the West Coast and Nelson/Marlborough regions.

Mitton ElectroNet Ltd is based in Christchurch and is the result of a merger between Mitton Consulting and the Christchurch office of ElectroNet Services Ltd. Mitton ElectroNet Ltd is 100% owned by ElectroNet Services Ltd.

Amethyst Hydro Ltd is a joint venture company between Westpower (88% ownership) and Harihari Hydro Limited (12% ownership) which owns and operates a 7.6 MW hydro scheme on the Amethyst River near Harihari.

Apart from the Board of Directors (the Board), the Chief Executive and the General Manager-Assets and Engineering Services (GM-Assets), who work directly for Westpower, all other staff are employed by Westpower's subsidiary ElectroNet Services Ltd.

The structure of the Westpower Group is shown in Figure 2.1.

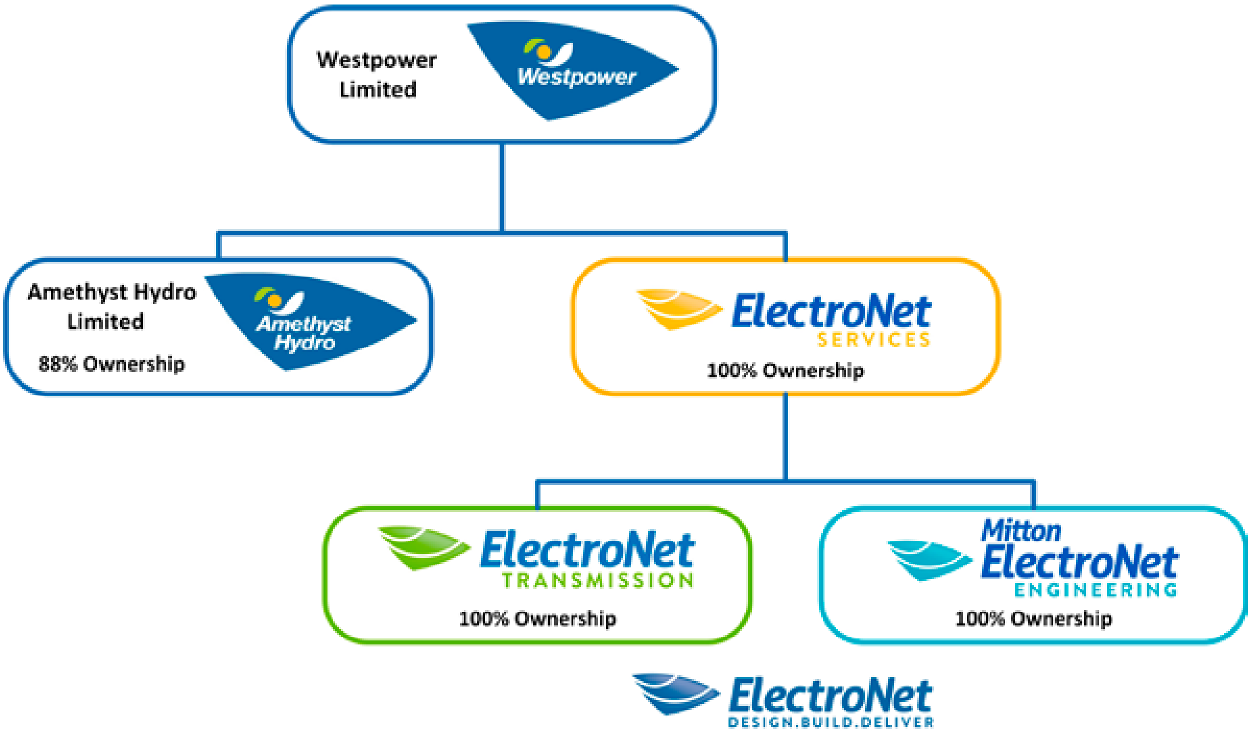

Figure 2.1: Westpower Group Structure

2.1.1 Corporate Structure

The company organisational structure is shown in Figure 2.2. The structure of the asset management division is outlined in Figure 2.3.

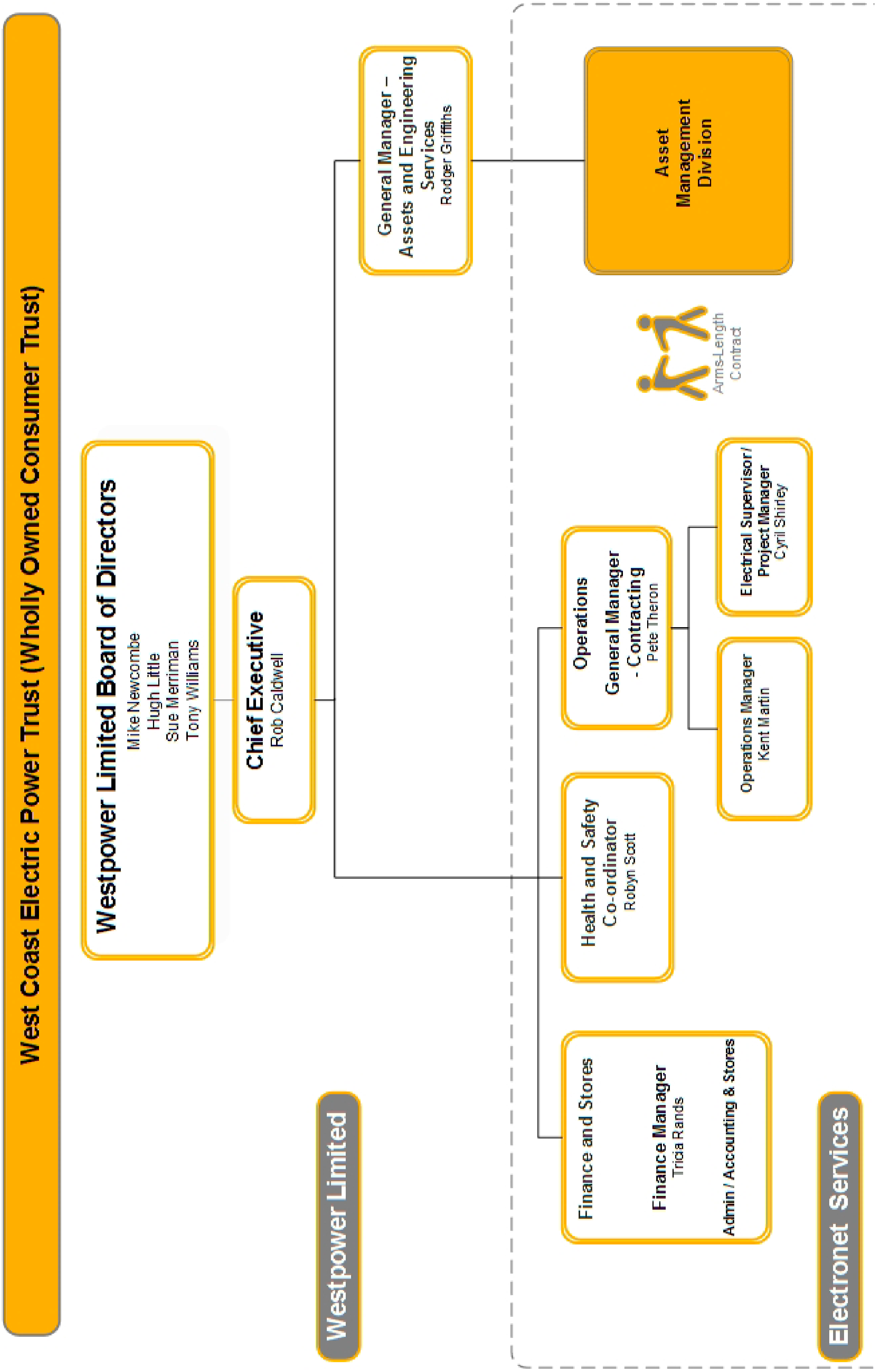

Figure 2.2: Westpower Corporate Structure

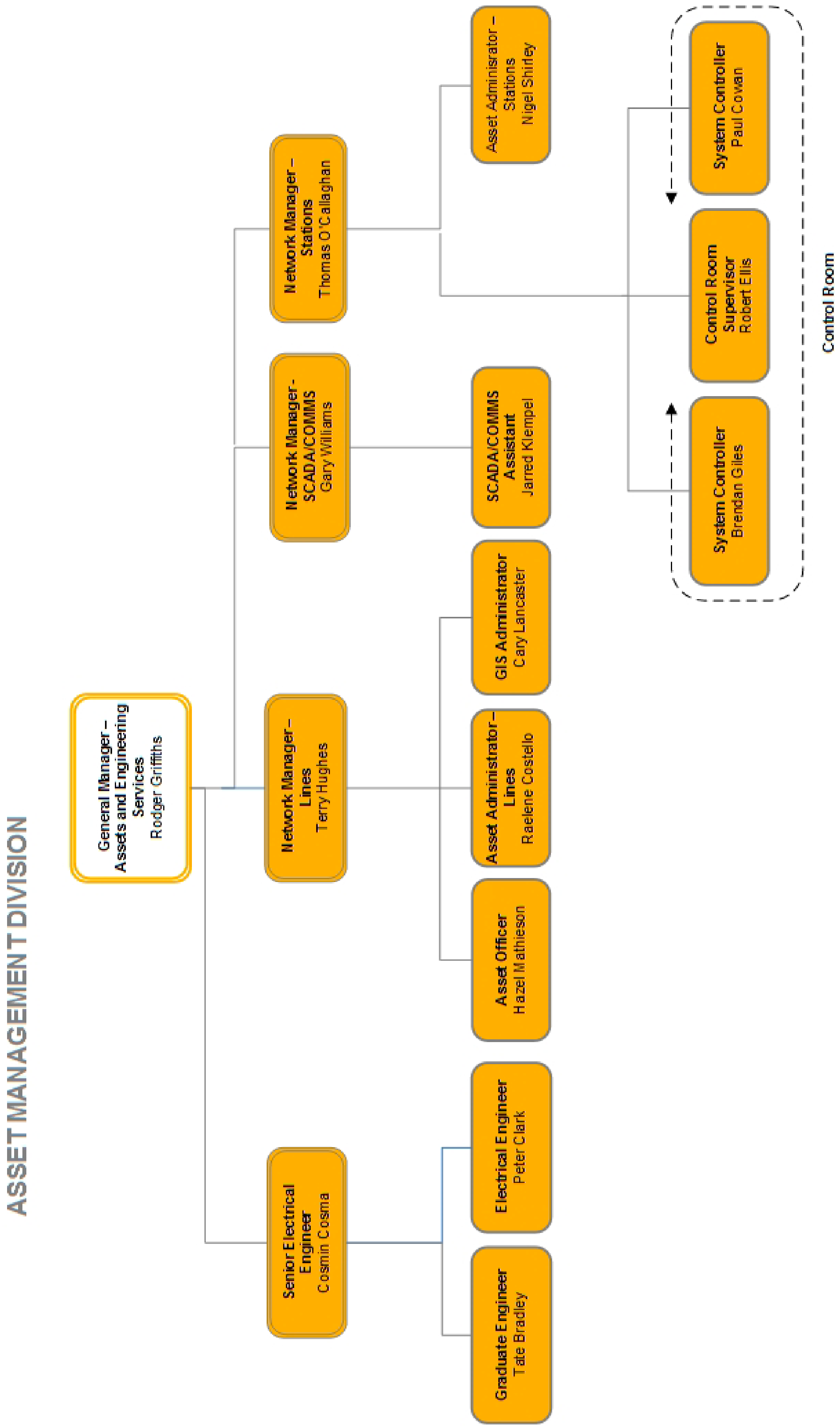

Figure 2.3: Asset Management Division

The key functions of these groups are summarised below.

Board of Directors

The Board provides overall governance of the Westpower group of companies and ensures that the following four pillars of good governance are maintained.

1. **Determination of purpose** – Drives the company's purpose, goals and strategy.
2. **Governance culture** – Ensures operation within a high-performance culture that deals effectively with the right issues in the right manner and encourages debate and candour. It maintains effective relationships with shareholders and other stakeholders.
3. **Holding to account** – Holds management to account through informed, astute, effective and professional oversight.
4. **Compliance** – Ensures the company is and remains solvent, and ensures the probity of financial reports and compliance with regulatory environments.

Chief Executive

The Chief Executive oversees the financial performance of Westpower, group executive management, the company secretariat and maintenance of revenue streams.

General Manager-Assets and Engineering Services

The GM-Assets oversees the network to maximise system availability. The duties of the GM-Assets include developing maintenance strategies, setting and managing priorities, controlling standards and issuing work orders to ensure reliability at minimum cost. The GM-Assets also acts as the key contact point with energy and generation companies wishing to use the Westpower network for the distribution of electricity.

2.1.1.1 Governance and Board Approval Processes

The Board sets the high-level business goals and strategies, and the Chief Executive and GM-Assets are responsible for implementing them through ElectroNet Services Ltd. In particular, the Board approves the Asset Management Policy that articulates the Board's overarching expectations for management of Westpower's assets and this provides a valuable governance framework within which all asset management activities must take place.

The AMP is approved by the Board each year and prior to the start of the financial year. This includes implicit approval for all included projects up to an individual value of $50,000.

All projects with a value greater than $50,000 are subject to a further and separate Board approval process involving the development of a separate business case using a pre-defined template. While financial measures such as Net Present Value and Internal Rate of Return are appropriate Key Performance Indicators (KPIs) for some projects, many others involve the evaluation of key drivers such as reliability of supply or health and safety. More details are provided in Section 4 regarding the particular planning criteria that are applied. These projects may only proceed after specific approval is given.

Financial Reports are provided to the Board on a monthly basis and these include budgeted versus actual expenditure for all work rolled up to the overall activity level. In addition, individual job cost reports are provided for the major projects approved by the Board.

Exception reports are to be provided on all projects with a value of more than $50,000 that exceed, or are likely to exceed, the budgeted figure by more than 20%, including the reasons for the variance.

2.1.1.2 Board Report

The following additional reports are also provided to the Board each month:

- **Billing statistics** – This report shows the allocation of sales amongst the various retailers active on Westpower's network, by tariff category.
- **Network delivery performance** – This shows monthly peak demands in megawatts and consumption in megawatt hours for the current year to date and the previous two years for comparative purposes.
- **SAIDI** – A monthly progressive SAIDI report is provided in both tabular and graphical format, along with explanations of major events. This report shows both the raw SAIDI statistics and the baseline SAIDI result, excluding Major Event Days (MEDs) using the 2.5 beta approach developed by the Institute of Electrical and Electronic Engineers (IEEE).
- **SAIFI** – This report is produced in graphical format only and provides similar information to the SAIDI report but focuses on SAIFI.
- **Legislative compliance** – A review of legislative compliance is provided to the Board each month and any non-compliance is noted.
- **Public Safety Management System (PSMS)** – A PSMS report is provided that shows KPI performance against targets on a monthly basis.

2.1.1.3 Asset Management Roles

The asset management division is under the overall control of the GM-Assets. A series of team leaders are responsible for the various activities carried out by the asset management division. The role of each of these team leaders is outlined below.

Senior Electrical Engineer

The Senior Electrical Engineer is responsible for setting engineering policy, overseeing all engineering design, reviewing non-conformance in the network and ensuring that the appropriate standards are in place.

Network Manager - Lines

This role involves the management of all high voltage (HV) and low voltage (LV) lines assets owned by Westpower, including control and management of the Geographic Information System (GIS) and vegetation management programmes.

Network Manager - SCADA/Communications

The SCADA/Communications Manager is responsible for all of Westpower's SCADA and communication assets, including data communication in the network, and SCADA control of substations and switching assets.

Network Manager - Stations

The Network Manager - Stations looks after all the zone substations and network switching assets, including maintenance and development, and applies the policies developed by the Senior Electrical Engineer. This role also includes responsibility for the control room and the day-to-day operations of the network.

2.1.1.4 Relationship between Asset Management and Operations Divisions

The asset management division assumes the role of the asset owner and is responsible for managing the interests of Westpower and in particular maintaining the service delivery potential and performance of Westpower's assets.

The operations division fulfils the role of the service provider and is responsible for carrying out all maintenance and development on the assets at the physical level.

The relationship between asset management and the operations and finance division is based on an arm's-length contract between Westpower and the operations division of ElectroNet Services Ltd, with asset management effectively acting as Westpower's agent and being directly under the control of the GM-Assets.

2.1.1.5 Operations Division Roles

Within the operations division, managers are responsible for particular areas of work as follows:

General Manager Contracting

The General Manager Contracting has overall responsibility for all operational matters.

Electrical Supervisor/Project Manager

This manager is responsible for the testroom, electricians and electrical fitters within zone substations.

Operations Manager

The Operations Manager is responsible for all line staff, including line mechanics and fault staff, along with a small number of fitters who work on distribution substations.

Finance Manager

This Finance Manager is responsible for the back office functions of ElectroNet Services Ltd as well as stores and procurement.

2.2 Westpower's Stakeholders

Stakeholders are defined as those parties with an interest in Westpower's asset management. The principal stakeholders are:

- Consumers
- Retailers
- Shareholders
- Board of Directors
- Employees
- Contractors.

The secondary stakeholders that may have an interest in or opinion on the affairs of Westpower are:

- Auditors
- Government agencies
- Suppliers and generators

- Transpower
- Landowners
- Insurers
- Financial institutions
- External advisors
- Pressure groups
- Press and media.

2.2.1 Identification of Principal Stakeholder Interests

Retailers and Consumers

Westpower has liaised closely with energy retailers to determine the expectations of their customers and quantify these in terms of desirable reliability indices. Westpower has conducted its own consultation with its 25 largest consumers and discussed alternative combinations of price and quality that may be available to consumers who commit to a commercial contract.

Mass market consumers have not expressed any dissatisfaction in the status quo combination of price and reliability. Some of the 25 largest consumers have expressed an interest in paying for additional reliability, mainly based on the criticality of their operations.

The main interests for retailers and consumers have been identified as reliability in terms of continuous availability of supply, restoration of supply and adequate shutdown notification, as well as receiving timely and up-to-date information if an outage occurs on the network so that they can plan accordingly.

Other interests are that Westpower is cost-effective in its service delivery and provides a good quality of service in terms of both maintenance and power quality.

Finally, stakeholders wish to be charged a fair price, with supporting information being made available to justify that price.

These interests are accommodated in the plan by:

- The SAIDI reliability target;
- The gap analysis on asset segments to ensure each customer is receiving the promised standard of service, and the targeting of expenditure accordingly;
- Reinvestment in asset renewals;
- Strong customer consultation commitment;
- Direct customer billing, including a move away from energy-based to demand-based charges for all consumers;
- Supply-point and density-based pricing structure;
- Consumers' expectations of good service at a fair price, as well as a continued distribution by shareholder trusts; and
- The efficiency of the company as judged by consumers by the size of the distribution.

Retailers' interests are identified through communication and direct discussion. Retailers are interested in selling energy to consumers with little barriers to competition. Their interests are accommodated in the plan by Westpower's direct billing programme.

Shareholders

Westpower shareholders, as owners of the assets, wish to ensure that their financial capital is protected in the long term by ensuring that the operating capability of the system is protected and that the system is maintained efficiently so that they earn an acceptable return on their investment.

The shareholders also have an interest in how Westpower provides consumer service and how it meets its obligations to other parties (as described below).

The interests of Westpower's shareholders are identified through the Statement of Corporate Intent (SCI) process and consultation with shareholders. Shareholders are interested in:

- An acceptable return being earned from the assets;
- An acceptable cash return from the network;
- The business being sustainable in the long term;
- A reasonable standard of service being provided to consumers;
- The price to consumers being equivalent to that charged in other rural areas;
- Consumer satisfaction; and
- A network that meets acceptable industry safety standards.

It is noted that the above interests are not necessarily achievable in totality if revenues are limited to below an acceptable return.

The above interests are accommodated in the plan by:

- The requirement that any customer-driven development work covers at least its cost of capital;
- Funding development work that is expected to produce future revenue by debt, rather than reducing cash returns to existing consumers; and
- The SAIDI reliability target, i.e. strong, but targeted re-investment in asset renewals to provide a long-term safe and sustainable network.

Westpower's ability to earn an acceptable return on assets is constrained by the need for price stability. The organisation can either limit investment in new customer-driven work if acceptable returns cannot be earned, or alternatively require a capital contribution from the customer to cover any shortfall. Investment in existing assets is however, a sunk cost.

Board of Directors

Westpower's shares are held by the WCEPT on behalf of the capital beneficiaries who comprise the electors within the Westpower area. As such, the WCEPT is treated as the nominal shareholder, or owner of the business, which is administered by a Board of Directors.

The WCEPT is regularly kept informed of key matters through the annual issue of an SCI and six-monthly financial reports. Each year, Westpower and the WCEPT meet together after their respective Annual General Meetings to discuss issues of mutual interest. Additionally, the Chief Executive or Chairperson will often attend regular WCEPT meetings when invited to promote good communication and answer any concerns that may arise.

The above interests are accommodated in the plan by providing direct reporting to the Board of Directors in terms of annual budget proposals, major project approvals, monthly financial reports, project exception reports and the AMP.

Employees and Contractors

Other parties with a potential interest in Westpower's asset management include: workers (including contractors) who physically work on the system; the public, through whose land the distribution system is built; and any agencies with which Westpower comes into regulatory contact.

ElectroNet Services Ltd asset management division has responsibility for the day-to-day management of the company and its assets, and for carrying out company policies. Westpower is the "owner" of the plan and is responsible for its creation and for using it as a tool for improving the efficiency and effectiveness of managing Westpower's assets.

The interests of our employees are identified through direct discussion with them and their representatives. Our employees are interested in:

- Advanced knowledge of work requirements so that they can plan their lives;
- A safe network and safe working practices so that they are not harmed;
- Fair remuneration; and
- Enjoyable work.

The above interests are accommodated in the plan by:

- The high priority given to eliminating or mitigating hazards;
- Advanced planning of work;
- The recognition that our staff have unique skills; and
- Creating a positive work environment that creates a high level of self-worth.

Contractors' interests are identified through direct discussion. Currently, they are interested in having:

- A secure work programme known sufficiently in advance so that they can plan their resource allocation;
- A safe network and safe working practices, so that their staff are not harmed; and
- A profitable work stream.

The above interests are accommodated in the plan by:

- The high priority given to eliminating or mitigating hazards; and
- Advanced planning of work, including commitment to a long-term asset renewal programme.

2.2.2 Identification of Secondary Stakeholder Interests

Auditors

Systems and processes must be suitable to meet legislation requirements.

Government Agencies (this includes District and Regional Councils and Central Government).

- Processes and reporting systems are in place to meet compliance and disclosure requirements.
- District Council interests are identified through direct discussion. Currently, they are interested in having sufficient infrastructure available so that growth in their local community is not hampered. The above interest is accommodated in the plan by the requirement that any customer-driven development work Westpower undertakes covers at least the cost of capital.

- Regional Council interests are identified mostly by correspondence and written information. Regional Council interests include promoting economic development, protecting the environment and emergency response.
- Central government interests are identified mostly by correspondence, written information and legislation. Central government interests include ensuring that a reliable, fairly priced supply of electricity is available to the West Coast region and that the network is safe.
- The interests of government agencies are recognised through compliance and submissions.

Suppliers and Generators

Westpower provides a reliable network that enables transport of energy, ensuring that the network has sufficient capacity to accommodate the required transfers of energy. Moreover, the charges for the use of Westpower's network are acceptable and there is free access to the network.

Suppliers and generators' interests are identified through communication and direct discussion. These groups are interested in protecting their connected equipment and the electricity system from harm caused by the network, and loads connected to the Westpower network. Westpower is also interested in receiving revenue and being charged a fair market price for transmission services.

The above interests are recognised in the plan by the sums we have programmed for expenditure due to anticipated growth in distributed generation. A significant proportion of this is to ensure the protection of the grid.

Transpower

Westpower provides adequate maintenance standards to keep the network operational. The network must be reliable, and effective communication should be maintained between Westpower and Transpower.

Transpower's interests are identified through communication and direct discussion. Transpower is interested in protection of its grid and the electricity system from harm caused by generators and loads connected to the Westpower network. Another of Transpower's interests is receiving regulated revenue from us.

The above interests are recognised in the plan by the sums we have programmed for expenditure due to anticipated growth and by signalling network changes well in advance.

Landowners

Issues are identified through discussion with their representatives (e.g. Federated Farmers) and the pre-access notification process. These issues include the protection of areas of heritage value, amenity values, property values, respect for private property and having an electricity supply at a competitive rate which is suitable for the activities on their land. These interests are recognised directly and managed through standard customer relationship approaches.

Insurers

The interests of insurers are for Westpower to provide adequate risk management to meet the insurance requirements and to minimise risks where possible. These interests are met by Westpower having adequate insurances in place for identified risks and liabilities to employees, assets and the general public.

Financial Institutions

Westpower should provide sufficient financial performance to cover borrowings and to maintain their corporate identity to a consistent standard. These interests are met by Westpower through reporting regularly on financial performance and through regular audits.

External Advisers

The interests of external advisers include continuity of work, contractual relationships (if applicable) and safety. These interests are met by Westpower through communication with relevant parties as necessary.

Pressure Groups

Relevant interests include policy, reliability, pricing and safety. These interests are met by Westpower through publicly issued reports, and press and media releases.

Press and Media

The interests of the press and other media relate to news, public relations, alternative energy sources, the environment, information channels and crises. These interests are met by Westpower through publicly issued reports, and via press and media releases.

2.2.3 Management of Conflicting Stakeholder Interests

There will be times when the individual interests of various stakeholders may create potential conflicts, and Westpower takes a consultative approach by listening to the concerns of the parties involved and taking these into account when making decisions.

The overarching drivers of providing a safe and reliable supply of electricity at a reasonable cost, while ensuring that, wherever possible, all stakeholders are treated equitably, form a framework within which the best-case outcomes are determined. This may often involve some form of compromise, except where health and safety issues are concerned.

Where a good case is made that requires a change in the AMP, this can either be reviewed during the year if urgent, subject to budgetary approval from the Board, or included in the following year's AMP. In support of this, the asset management division maintains a register of recommended changes that are incorporated into the AMP each year.

Westpower's policy is that new connections to the Westpower network should not be subsidised by its existing consumer base, and therefore new consumers are charged the full cost of new connections. This is taken into account when determining the best solution to supply new or increased loads.

Communication is the key tool used to manage residual conflict between stakeholders and to ensure that stakeholders have all the relevant information so that the conflict can be resolved to the satisfaction of all parties.

Examples of how conflicting interests are managed are presented below.

2.2.3.1 Asset Renewal

Our shareholders require investment to return Westpower's cost of capital. They are not willing to lower cash returns received in order to fund network upgrades. On the other hand, consumers are unwilling to meet high price increases. Both groups want a sustainable network and improvements in reliability. This conflict is met through a targeted renewals programme, which ensures that the network does not receive over-investment, and a targeted reliability programme to ensure that reliability continues to improve without a significant increase in network investment. Innovative practices also play a major part in aligning these interests.

2.2.3.2 Network Capacity Charges

Historically, networks have based charges on transported energy, a fixed component and, perhaps, demand. The cost of transporting energy always has a demand and fixed component. Westpower has structured its line charges to better reflect costs by having separate demand and dedicated asset components. In the medium to long-term, it is expected that smart meters will be introduced to all installations. This will provide more detailed information that can be used to structure more focused tariff options related to network capacity constraints.

2.2.3.3 Contractor Resource Constraints

The isolation of the West Coast means that Westpower is directly reliant on the capabilities and resources of its main contractor for all work on the assets. At times, the contractor may be over-committed due to other work when large external projects are under way. This dichotomy between maintaining Westpower's assets to a high standard and maximising financial performance of the contractor is resolved through careful supervision of the annual AMP progress and regular discussion of forward work commitments at the management team level, including staff from both the asset management and operation divisions. Moreover, the Chief Executive retains the power to direct that priority be given to asset work as required, as a result of their dual role of managing both Westpower and the contracting subsidiary, ElectroNet Services Ltd.

2.2.3.4 Safety Improvements

Experience has shown that all of Westpower's stakeholders want a safe network. Determining what is safe or unsafe is not black and white. The definition of what is safe and unsafe is constantly evolving over time. As events occur and expectations advance, safety codes are rewritten and redrafted. This means that equipment that was considered safe when installed is, over time, eclipsed by changed and improved equipment.

This leads to conflict between funding safety improvement work and other renewal and CAPEX work, along with decisions on the definition of safe and unsafe. Fortunately, much of the renewal associated with safety also improves security, reliability and general network capacity. Available resources tend to dominate the conflict as to how much can be done at once. The conflict between what is safe and unsafe is based on:

- Observations of obvious problems;
- Industry accident reports;
- The various Acts, Regulations and Codes that control the industry;
- The application of ongoing principles to how equipment operates and the risks that come about when things go wrong; and
- Experience from investigating and being involved with various industry incidents.

2.2.3.5 Conflict between Stakeholders Interests as Consumers and Shareholders.

As shareholders, all consumers receive a return, however some consumers would prefer lower upfront charges or to see the money reinvested in the network. We believe that it is the responsibility of the Trustees, who are elected by our consumers, to resolve this conflict by consultation and advise the company through the SCI process.

2.3 Westpower's Asset Management System

2.3.1 Purpose Statement

Westpower will document, implement, maintain and continually improve an Asset Management System (AMS) in accordance with its organisation's strategic plan and, for completeness, in accordance with the ISO 55000: 2014 Standard.

2.3.2 Scope of the AMS

The AMS will:

- Establish, document and maintain a system that conforms, as a minimum requirement, to all the requirements of ISO 55000;
- Consider the level of detail commensurate with the size of the organisation;
- Cover the full portfolio of assets required for the successful delivery of the organisation's strategic plan;
- Draw upon processes already in existence; and
- Conduct a review to compare the management of the assets against the requirements of ISO 55000. The review must consider the following items:
    - The organisation's strategic plan;
    - Legal, regulatory and other mandatory requirements;
    - Evaluation of the asset management risks;
    - Existing asset management practices and processes;
    - Performance of the asset and asset systems;
    - Feedback from accidents and incidents: and
    - Relevant management systems, competencies and resources.

The AMS must provide a clear strategic vision to convert objectives and policy into a plan.

The strategic intent of the AMS is to provide a systematic and coordinated approach to the optimum management of Westpower's physical assets and their associated performance, risks and expenditures over their lifecycle for the purpose of achieving the organisational strategic plan and to satisfy stakeholders' requirements.

2.3.3 Statement of Corporate Intent

Westpower's strategic plan is portrayed in its Statement of Corporate Intent (SCI).

Salient statements from the SCI that relate to management of Westpower's assets include:

- To continue to provide West Coast communities with a safe, secure, sustainable and cost-effective electricity distribution network;
- To ensure obligations under the Energy Companies Act 1992, the Electricity Act 1992, the Electricity Industry Reform Act 1998 and their various amendments and regulations are met;
- To continue to lobby on behalf of West Coast consumers to ensure that a reliable transmission network is maintained into the West Coast.

2.3.4 Corporate Vision and Mission Statements

The asset management process and purpose is guided by Westpower's vision for the future as expressed in the Vision Statement below and supported by the Mission Statement.

The Westpower Group Vision Statement:
"Recognised for excellence in all links of the electricity value chain."

The Westpower Group Mission Statement:
"A West Coast company operating successful businesses which provide first-class electrical and technology solutions, wherever our customers take us".

2.3.5 Asset Management Policy Statement

The key document linking Westpower's organisational objectives, as outlined in the SCI, with the asset management system is the Asset Management Policy, which defines the principles by which Westpower intends to apply asset management to achieve its organisational objectives. As such, it is an overarching document that is embedded in the AMS.

The Asset Management Policy

Westpower is a provider of key electricity infrastructure services on the West Coast of the South Island and is committed to providing a safe and reliable supply at a price and quality that is acceptable to our consumers.

We will achieve this commitment by:

Maintaining and improving a strong safety culture while aiming for zero harm to employees and members of the public;

Providing a sustainable, secure, reliable and efficient electricity distribution network to meet the present and future needs of the West Coast;

Optimising the performance of our assets to meet our consumers' expectations, while taking into account the trade-off required between cost and risk;

Ensuring asset management decisions are robust and rigorously supported by effective systems with complete, accurate and timely information;

Maintaining an appropriate base of skilled and competent staff with a focus on continually improving our asset management performance;

Communication with our stakeholders in an open and transparent manner and taking their interests into account when making decisions; and

Complying with all applicable statutory and regulatory requirements and meeting appropriate industry standards.

Figure 2.4 illustrates Westpower's assessment management process which shows the key linkages between the various components of the system.

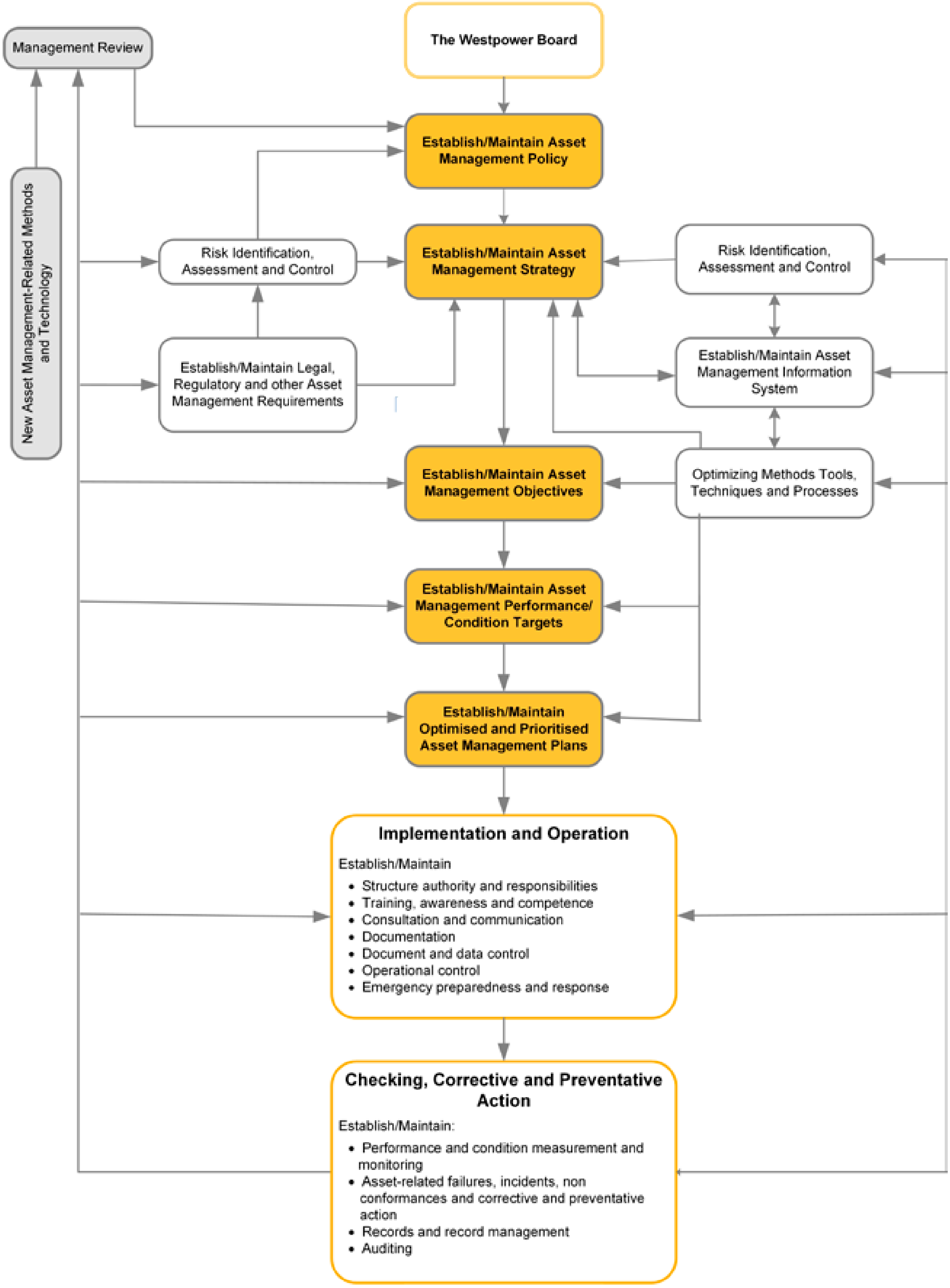

Figure 2.4: Asset Management Process

2.3.6 *Asset Management Objectives and Strategies*

To ensure the implementation of the Asset Management Policy, Westpower has established a set of objectives which are presented below. Therefore, we are committed to:

1. Provide a safe environment for employees, service providers and the public, aiming for zero harm.
2. Ensure the network reliability meets Westpower's standards and approved targets at all times.
3. Ensure the network security meets the approved levels.
4. Maintain a sustainable network by retaining the ongoing service potential and supporting the economic growth.
5. Maintain an efficient network by improving planning and prioritisation and using energy-efficient equipment in order to reduce the OPEX and CAPEX.
6. Ensure compliance with environmental requirements and mitigate any negative effects that our assets caused.
7. Maintain an effective risk management plan in accordance with AS/NZS ISO 31000, to ensure the continuity of critical asset management activities is preserved.
8. Maintain compliance with all statutory and regulatory requirements.

Specific strategies and targets to achieve the above eight objectives are outlined below.

2.3.6.1 Safety

Safety is of paramount importance in everything we do and therefore, no other objective should override safety to our employees, service providers and the public.

To achieve this objective, we need to maintain a strong safety culture within our employees, service providers and the public aiming for zero harm. This will be implemented by promoting the importance of safety throughout the West Coast community and provide our employees and service providers with a safe working environment.

Safety Objective

We are committed to provide a safe environment for employees, service providers and public aiming for zero harm.

Our safety objective includes the following indicators which are analysed against their targets yearly.

Indicator	Target
Serious incidents	0
Minor incidents	Sustained and declining trend
Near hits	Sustained and declining trend
Hazards	Sustained and declining trend
Safety assessment	Each department completes an assessment each month
Public Safety Management System Conformance	100%

Safety Strategy

In order to achieve this objective, we are pursuing or planning the following strategy:

- Safety Training – We continue our high level of safety training while refining our competency requirements and standards.
- Safety Reporting – We continue our reporting of incidents and hazards by encouraging employees, service providers and the public to report any hazard or incident identified in our network.
- Safety Assessment – We continue our programme for field safety assessments, to ensure that an appropriate safety culture is promoted.
- Safety Advertisements – We continue to promote our safety culture throughout the West Coast community.
- Public Safety Certification – We will continue to conform to NZS 7901:2014 to maintain our current certification.

2.3.6.2 Reliability

To maintain a high level of network reliability, it is critical that appropriate key performance indicators are applied consistently throughout the network, in a timely manner. These indicators are customer-oriented as defined in international standards (e.g. SAIDI and SAIFI) and are differentiated, based on the criticality of service.

Reliability Objective

Our reliability objective includes the following indicators which are recorded and analysed against their targets:

Indicator	Target
Planned SAIDI	49 [minutes/customer/year]
Unplanned SAIDI	128 [minutes/customer/year]
Planned SAIFI	0.22 [interruptions/customer/year]
Unplanned SAIFI	2.11 [interruptions/customer/year]
Faults per 100 km	7.69
Voltage	230 V +/- 6.0%
Harmonics	5%
Power Factor	> 0.95

Reliability Strategy

In order to achieve this objective, we are pursuing or planning the following strategy:

- Consumer Consultation – We carry out a formal consultation process with our consumers every five years, to understand their needs, preferences and expectations.
- Asset Condition – We inspect, assess and maintain our assets based on their criticality, to reduce the risk of failure.
- Vegetation Management – We inspect, assess and maintain a safe distance between our assets and any vegetation.
- Outage Planning – We plan our work scheduling to allow optimisation of outage planning, to minimise the number of interruptions to our consumers.

- Disaster Recovery – We have developed and maintain an effective disaster recovery plan to ensure our assets are safe to the public and the services are restored as quickly as possible, based on their criticality.
- Power Quality – We constantly monitor our network to ensure it meets the regulatory requirements. This is assessed, based on the industry standards and guidelines, and where the requirements are not met, remedial action is taken.
- Planning and Design – We ensure that reliability and power quality has been considered at the planning and design stage.

2.3.6.3 Security

The long, narrow nature of the West Coast area restricts the electricity network to one long string of lines from north to south, thereby limiting the availability for dual supply to most areas. Transmission services from the national grid are also limited due to the isolation of Westpower.

Security Objective

We are committed to ensure the network security meets the approved levels.

Our security objective includes the following indicators which are recorded and analysed against their targets:

Indicator	Target
Minutes lost to load, > 10 MW	0 minutes
Minutes lost to load, 5-10 MW	Back-fed < 1 hour; otherwise < 5hr

Security Strategy

In order to achieve this objective, we are pursuing or planning the following strategy:

- Security Policy – We have determined that, in general terms, loads above 10 MW will have n-1 security.
- Rural Areas – For loads over 1 MW, with back feed capability, 66% of the load will be restored within 1 hour.
- Urban Areas – Meshed networks in urban areas will be expanded where economic to do so.
- Mobile Substation – Westpower owns a mobile substation that is used to enhance security of supply at any of the 33 kV zone substations during maintenance or substation failure.
- Embedded Generation – We have a connection agreement that encourages power companies to invest in generation within West Coast.

2.3.6.4 Sustainability

While the company is primarily required to act in a commercial manner, it has to provide a sustainable development approach towards the communities that it serves. This involves identifying the actual and future needs of the communities and developing a strategic long-term plan to support these needs and economic growth. This long-term plan includes enhancement and development projects, which are intended to improve the capacity, and eliminate any limitations of the network.

Sustainability Objective

We are committed to maintain a sustainable network by retaining the ongoing service potential and supporting the economic growth.

Our sustainability objective includes the following indicator which is recorded and analysed against its target:

Indicator	Target
Asset Renewal ratio to Depreciation	37% to 33%

Sustainability Strategy

The following strategies are in place to maintain the sustainability of our business:

- Consumer Consultation – We carry out consultation with our consumers to understand their needs, preferences and expectations.
- Maintain Service Potential – We ensure that ongoing service potential is maintained by developing a long-term strategic plan to support the economic growth on the West Coast and continual improvement of the network.
- Energy Efficiency – We encourage the use of energy-efficient assets in the network and assist any embedded generation through the application process.

2.3.6.5 Efficiency

Another important factor which affects the price of electricity to consumers is cost-efficiency of all capital and operational projects. We maintain the expenditure level for CAPEX and OPEX projects as low as possible without affecting the performance of the network. This is achieved by improving prioritisation of the projects and enhancing the work management processes.

Efficiency Objective

We are committed to maintain an efficient network by improving planning and prioritisation and using energy-efficient equipment in order to reduce OPEX and CAPEX.

Our efficiency objective includes the following indicators which are recorded and analysed against their targets:

Indicator	Target
OPEX ratio to Total Asset Value	8.4% to 9.5%
CAPEX ratio to Total Asset Value	2.2% to 2.1%
Revenue increase per ICP	Less than CPI
Distribution Transformer Capacity Utilisation	> 30%

Efficiency Strategy

In order to achieve this objective, we are pursuing or planning the following strategy:

- Work Management Processes – We have developed and implemented optimised work management processes to reduce the operational expenditure without affecting the network performance.
- Improved Prioritisation – We ensure that optimal capital efficiency is gained through the application of a formal assessment and prioritisation process for projects.
- Asset Renewal – We have developed and implemented a targeted renewal programme to ensure that the network does not receive over-investment.
- New Technology – We ensure that appropriate technology is applied to any network development to improve the quality of service and value to our consumers.
- Capital Contribution – We ensure that any expenses for network extensions to supply new loads will be met by a consumer contribution towards the costs involved.

2.3.6.6 Environmental Impact

Westpower is responsible for the environmental impact of all its actions and assets. Therefore, an environmentally responsible culture has been promoted and integrated into all business processes and services for the entire lifecycle of the assets.

Environmental Objective

We are committed to ensure compliance with environmental requirements and mitigate any negative effects that our assets cause.

Our environmental objective includes the following indicators which are recorded and analysed against their targets:

Indicator	Target
Environmental Assessment	Each department completes an assessment each month
Major environmental incidents	0

Environmental Strategy

- Procedures and Processes – We have developed, implemented and maintain processes and procedures to ensure that the legal, regulatory and other applicable requirements are identified and applied.
- Environmental Impact – We manage and carry out all activities in a manner that will ensure there are no negative effects on the environment.
- Environmental Assessment – We have implemented an assessment programme for field work to ensure the environmental policy is applied and to promote the environmental culture.

2.3.6.7 Risk Management

Incidents and emergencies affecting Westpower's distribution network can have consequences in terms of economic and network performance, as well as environmental and safety impacts. Therefore, an effective risk management plan has been developed, implemented and maintained to help with identifying and responding to incidents and emergency situations and maintaining the continuity of critical asset management activities.

Risk Management Objective

We are committed to maintain an effective risk management plan in accordance with AS/NZS ISO 31000, to ensure the continuity of critical asset management activities is preserved.

Our risk management objective includes the following indicators which are recorded and analysed against their targets:

Indicator	Target
Internal Training Exercise	1 per year
External Training Exercise	1 every three years
Risk Management Plan Health Check	1 every six months

Risk Management Strategy

- Plan Requirements – We have identified and assessed the risk management plan requirements.
- Procedures and Processes – We have developed and maintained the emergency processes and procedures to satisfy these requirements.

- Emergency Equipment – We have the required emergency equipment, which is regularly inspected and tested.
- Performance Tests – We carry out regular training exercises to ensure the effectiveness and completeness of the risk management plan.
- Evaluation and Review – We evaluate the performance tests and review the risk management plan when required.

2.3.6.8 Legislation

Westpower must meet and comply with all relevant legislation. Where non-compliance issues are identified, these need to be dealt with promptly and transparently. To achieve this, the AMS includes processes and procedures to identify and assess legal, regulatory and other applicable requirements.

Legislation Objective

We are committed to maintain compliance with all statutory and regulatory requirements.

Our legislation objective includes the following indicator which is recorded and analysed against its target:

Indicator	Target
Regulatory Register Update	Reviewed every six months

Legislation Strategy

- Procedures and Processes – We have developed, implemented and maintain processes and procedures to ensure the legal, regulatory and other applicable requirements are identified and applied.
- Improve Communication – We communicate all relevant legal, regulatory and other applicable requirements to other interested parties to ensure they are aware of these requirements.
- Access to Information – We have developed a system to store, update and access the legal, regulatory and other applicable information.

The asset management and planning processes discussed throughout the rest of the AMP have been developed to directly support the AMS policy and strategy and must adhere to it.

The asset management division holds the requisite technical knowledge and is responsible for technical decisions regarding the asset. In addition, this division is effectively the “custodian” of the assets, and their duties include taking responsibility for all performance and safety issues.

2.4 The Asset Management Plan (AMP)

The purpose of the AMP is to document the asset management practices employed by Westpower to strategically manage its physical infrastructure assets, to support the AMS policy and strategy and to meet the requirements of the EDDID 2012. It is also intended for general viewing, assuring Westpower’s stakeholders that the Westpower network continues to be managed in a professional and cost-effective manner.

This AMP covers a period of ten years from the financial year beginning on 1 April 2016 until the year ending 31 March 2025. The main focus of analysis is the first three to five years, within which period, most of the specific projects have been identified. Beyond this time, analysis tends to be more indicative, based on long-term trends and it is likely that new development project requirements will arise in the latter half of the planning period. While the AMS provides a framework for asset management within the planning period, it is necessary to determine the longer-term direction in which the network should be developed. For example, it would not be prudent to invest heavily in enhancing a system at a particular voltage, if beyond the planning horizon but well within the life of those assets, it is likely that they would be overlaid by a new higher voltage system. Furthermore, strategic development planning must be responsive to a range of scenarios that might occur.

The AMP outlines the service objectives and gives a clear focus on lifecycle management by presenting operations, maintenance and renewal policies, needs and programmes by asset type. The AMP processes adopted by Westpower have been selected to integrate best practice to meet business, legislative and other needs, while developing optimum lifecycle asset management strategies, and resulting cash flow projections, based on assessing non-asset solutions, failure modes, cost/benefits and risk.

Westpower has been working towards aligning its asset management practices with and to demonstrate compliance with ISO 55000 Standard.

2.4.1 Relationship with Other Planning Documents

It is important for stakeholders that the manner and the basis upon which this AMP is intended to operate are clearly understood. For the purposes of clarity, and in order to avoid any confusion, the following underlying assumptions need to be taken into account by the stakeholders in dealing with this AMP:

- This AMP interacts with other Westpower working plans. Of particular importance are the annual budgets, which set out the specific resources required for asset management activities. Those parts of the annual estimates relating to the management of the system are based on the annual AMPs.
- Authorisation of expenditure results from approval of the annual estimates by the Board of Directors and from specific approvals. This AMP does not represent an authorisation by Westpower for expenditure, nor does it represent a commitment on the part of Westpower to proceed with any specific projects or programmes.

2.4.2 Assets Covered in this Plan

This AMP includes Westpower's assets that transport electricity (owned by the electricity retailers) from Transpower's seven GXPs to over 13,000 electricity consumers on the West Coast of New Zealand's South Island.

Westpower has network assets throughout the 18,017 square km of the West Coast from Lyell in the north to Paringa in South Westland, with a total of around 60,000 assets in 66 classifications.

The Westpower network includes 110 kV, 66 kV and 33 kV sub-transmission networks. The 66 kV network is supplied from Transpower GXPs at Greymouth, Hokitika, Kumara; the 33 kV network from Dobson and Hokitika. An 11 kV system is supplied from Transpower's Otira GXP whilst Reefton has a 110 kV supply from Transpower (refer Figure 1.3).

The distribution system comprises 2,174 circuit km of Alternating Current (AC) distribution lines, 19 zone substations and switch yards strategically located throughout the network which, in turn, provide an 11 kV supply for distribution to 2,433 distribution substations, one control room and a telecommunications network.

Westpower's distribution lines consist of varying line capacities, dependent upon local demands and geographical considerations. Operating voltages include 110 kV, 66 kV, 33 kV and 11 kV. Refer to Figures 2.5 and 2.6 which show the northern and southern sections of the distribution network. These lines involve a large population of poles, transformers, disconnectors and other assets of varying types that are essential to the distribution of electricity.

These assets are more fully described in Section 5.

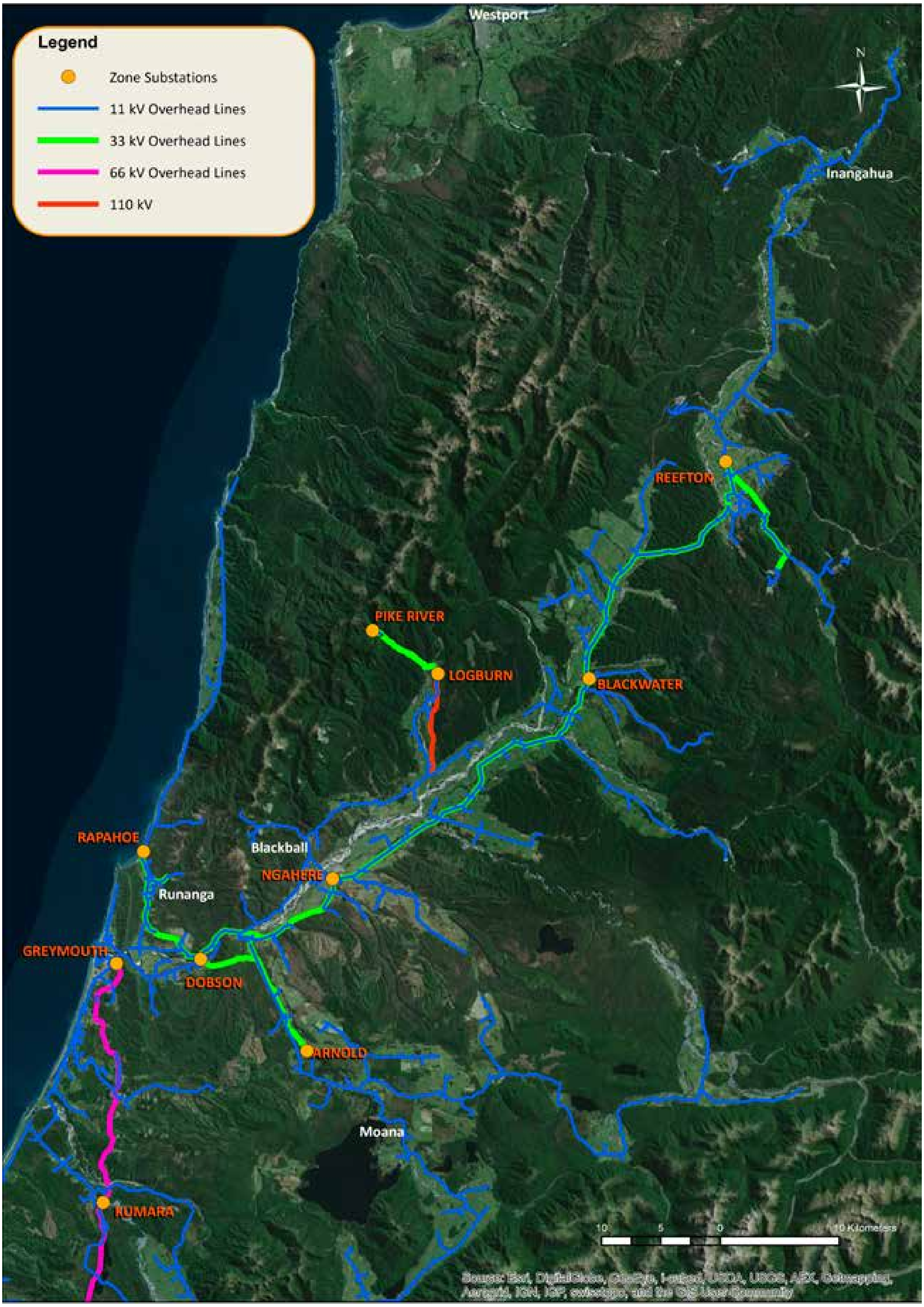

Figure 2.5: Northern Section of Westpower's Distribution Network

Figure 2.6: Southern Section of Westpower's Distribution Network

2.4.3 Issues Facing Westpower

The AMP must address growth. Projections for the West Coast are continually studied by Westpower to ensure that the capacity and performance of the sub-transmission and distribution networks are adequate for the demand and types of load connected. Load forecasting shows that the current ADMD of around 47.6 MW will decrease to around 44 MW following cessation of operations at Oceana Gold and Roa, then gradually increase to around 54 MW by 2025, depending on future economic growth.

This projection is dependent on proposed industry projects proceeding but in the current economic climate, there is no certainty of this. For this reason, this AMP is focussed on maintaining (or improving) the reliability of the network and catering for incremental growth on the basis that larger industrial developments will require project-specific augmentations that will only proceed once the various projects are committed and connection contracts are signed with developers.

Key asset management issues facing Westpower are:

- Maintaining network performance and reliability, including setting clearly defined service levels and backing these up with customer guarantees (refer to Section 3);
- The cost of environmental improvements and easements that need to be factored into planning;
- Decision-making between maintenance of assets and their renewal will be a major part of asset management (refer to Section 5); and
- Acquiring revenue funding through a pricing structure at a level that is also acceptable to consumers (refer to Section 6).

2.4.4 Asset Management Drivers

The factors that drive asset management activities and their relationship to Westpower's performance are derived from the external performance required of Westpower by its consumers, workers (including contractors), shareholders and the public.

The drivers for this plan are as follows (these are covered in more detail in Section 3 Levels of Service):

- Safety
- Consumer service
- Capacity (i.e. adequacy of service)
- Reliability (i.e. continuity of service)
- Economic efficiency
- Environmental responsibility
- Corporate profile
- Legislation and compliance.

2.4.5 Asset Management Linkage with Westpower Performance

Ultimately, Westpower's performance is judged externally and the drivers listed above are the parameters by which this performance is measured.

Different asset management and operational responses can be used to meet Westpower's external performance requirements. These may include maintenance to improve the condition of the asset, development to install assets in a new configuration, enhancements to the existing system or changes to the way in which the assets are operated. Effective management of the business involves selecting the most appropriate asset management or operational responses, as proposed in this plan.

2.4.6 Plan Structure and Approach

This plan uses a consistent set of defined activities and asset types to categorise work programmes and their associated expenditure. Budgeting and financial reporting within Westpower allows actual programme achievement and expenditure outcomes to be compared with the plan. Consistent use of this framework will facilitate comparisons over time.

It should be noted that the activity and asset definitions are independent of accounting classifications of expenditure (i.e. between maintenance and capital expenditure). Therefore trends over time should not be altered by any changes in the application of accounting policies regarding the treatment of expenditure. However, it should also be noted that, under the current application of accounting policies, all activities are classified as either entirely OPEX or entirely CAPEX.

The relationship between the defined AMP activities and the activity groups defined in the EIDD (2012) is outlined in Appendix B *Activity Group Definitions – AMP and Information Disclosure*.

Similarly, the activity and asset type definitions are also independent of Westpower's organisational structure and responsibilities, although they are closely aligned with the present structure. In the long run, adherence to the definitions will ensure that the plan remains meaningful in spite of any changes in organisational structure or responsibilities.

In addition, maintenance activities can generally be planned at the detailed asset level (e.g. servicing of transformers, circuit breakers), whereas development projects or programmes, which typically involve a combination of different asset types (e.g. lines, transformers, circuit breakers, protection, communications and network management) are kept intact rather than attempting to allocate the expenditure against the component asset types.

A further definitional distinction between projects and programmes is made throughout this plan. The word "programme" is used to define a generic activity with a generic justification, but which may apply at a number of different sites. Replacement of defective insulators, fitting vibration dampers to lines and upgrading connectors are therefore classed as programmes. On the other hand, "projects" are site (or asset) specific, e.g. adding a second circuit to a particular line or upgrading a particular transformer bank.

2.4.7 Core and Advanced Asset Management

Westpower is well advanced in aligning its asset management system to ISO 55000 as outlined in Section 7.

ISO 55000 defines the systematic and coordinated activities and practices through which Westpower optimally and sustainably manages its assets and asset systems, and our approach to performance, risks and expenditure over the lifecycle of the assets for the purpose of achieving Westpower's strategic plan.

Good asset management considers and optimises the conflicting priorities of asset utilisation versus asset care, of short-term performance opportunities versus long-term sustainability, and capital investment versus subsequent operating costs, risks and performance.

"Lifecycle" asset management is more than simply the consideration of capital and operating costs over the asset's life. Truly optimised, whole-life asset management includes risk exposure and performance attributes, and considers the economic life as a result of an optimisation process.

2.4.8 Limitations of this AMP

This AMP outlines Westpower's intended activities over the next ten years but should not be relied upon as any form of guarantee that such actions will occur within the time frames stated. People wanting certainty of any actions for development should contact the company for further information.

This AMP does not cover:

- Details of Westpower's network pricing derivation and application (these are available on our website);
- Vehicles, non-network related land, buildings, furniture or general office computer equipment; and
- The overhead costs of operating the network operating centre and other indirect overhead costs.

More detail on the systems and processes that are used in Westpower's asset management are covered in the relevant sections of this plan, including Section 7 Asset Management Process.

3.0 LEVELS OF SERVICE

3.1 Introduction

In order to properly manage the delivery of service to Westpower's consumers, it is critical that appropriate KPIs are developed to measure the performance of the network objectively, and to ensure that these KPIs can be applied consistently across the network and over time. Furthermore, these KPIs must be relevant to the service being delivered and readily understandable by interested stakeholders.

Once the KPIs are created and reporting mechanisms are put in place to monitor them routinely on an ongoing basis, performance targets can be developed to set clear benchmarks against which the service delivery performance of the business can be assessed. This has a twofold benefit of providing:

- A means of monitoring trends over time and measuring just how well the business is delivering service to its consumers; and
- A way of creating realistic goals for the future that provide a clear basis for the provision of well targeted reliability maintenance or enhancement programmes.

The targets created through this process need to be consistent with Westpower's business strategies and asset management objectives, which, in turn, are derived from the asset management policy that forms the key linkage between the corporate direction of the business and the asset management function.

Over time, the KPIs and targets will continue to be refined, based on historical performance and stakeholder requirements. In addition, the targets must reflect what is realistically achievable, given the current condition of the network and the financial expenditure capability of the business.

Furthermore, by adopting this approach of setting targets and then measuring performance against the targets, it is possible to objectively assess the success of programmes designed to enhance the service delivery performance of the asset and then make adjustments to provide optimum long-term outcomes.

The target levels of service may generally be subdivided into the following two main areas:

- Consumer-oriented performance targets; and
- Other targets relating to asset performance, asset efficiency and effectiveness, and the efficiency of the ELB activity.

This section explains the target levels of service that have been chosen based on the KPIs developed. Historical performance against these target levels is provided, along with commentary on the reasons for any underlying trends or significant perturbations. Finally, a justification is provided for current and future target levels of service based on consumer, legislative, regulatory, stakeholder and other considerations. Included in this justification is a discussion of how stakeholder needs were ascertained and translated into service target levels.

3.2 Customer-Orientated Performance Targets

The key performance indices commonly used throughout the electricity industry to assess customer-oriented performance are SAIDI and SAIFI as defined in IEEE Standard 1366:2012 *Guide for Electric Power Distribution Reliability Indices.*

These are the same indices as used by all ELBs. By adopting an approach consistent with this standard, benchmarking of Westpower's performance against other ELBs is supported.

This section describes the historical performance of the network according to these indices and compares them with related targets currently mandated by the targeted control regime under the control of the Commerce Commission.

As Westpower is exempt from such regulation, it has developed more meaningful targets that are specific to particular customer groups and types of outages, as discussed in the following sections. These have been derived from historical performance as well as expectations of the impact of particular improvement initiatives that Westpower has undertaken over recent years. Westpower does, however, still come under the EDIDD 2012 and must still disclose industry standard performance indices.

3.2.1 Extreme Events

As Westpower's area is subjected to extreme weather events from time to time, it is important to disaggregate the KPIs into baseline values that reflect the underlying performance of the business, and extreme event values that result from environmental externalities that are beyond the reasonable control of Westpower. The baseline values (i.e. those excluding major events) are the key indicators used consistently throughout this plan, and the reader needs to exercise caution in comparing these normalised statistics with information published under the information disclosure regime, which includes all events.

The method of achieving the normalisation of the measured values is based on IEEE Standard 1366:2012, where a Major Event Day (MED) is defined and then used as a threshold to exclude statistics that relate to a major event.

This process used to identify MEDs is termed the "Beta method". Its purpose is to allow major events to be studied separately from daily operation and, in the process, to better reveal trends in daily operation that would be hidden by the large statistical effect of major events.

A MED is a day in which the daily system SAIDI exceeds a threshold value, T_{MED}. The SAIDI index is used as the basis of this definition since it leads to consistent results regardless of utility size, and because SAIDI is a good indicator of operational and design stress. Even though SAIDI is used to determine the MEDs, all indices should be calculated based on removal of the identified days.

In calculating daily system SAIDI, any interruption that spans multiple days is accrued to the day on which the interruption begins.

The MED identification threshold value, T_{MED} is calculated at the end of each reporting period (typically one year) for use during the next reporting period as follows:

1. Collect values of daily SAIDI for five sequential years ending on the last day of the last complete reporting period. If fewer than five years of historical data are available, use all available historical data until five years of historical data are available.
2. Only those days that have a SAIDI/day value will be used to calculate the T_{MED} (do not include days that did not have any interruptions).
3. Take the natural logarithm (ln) of each daily SAIDI value in the dataset.
4. Find α the average of the logarithms (also known as the log-average) of the dataset.
5. Find β the standard deviation of the logarithms (also known as the log-standard deviation) of the dataset.
6. Compute the MED threshold, T_{MED}, using the following equation: $T_{MED} = e^{(\alpha + 2.5\beta)}$
7. Any day with a daily SAIDI greater than the threshold value T_{MED} that occurs during the subsequent reporting period is classified as a MED.

Activities that occur on days classified as MEDs are excluded from the measured statistics.

Westpower has calculated a T_{MED} based on all outages recorded during a five-year outage period covering April 2004 through to March 2009 and this has yielded a SAIDI figure of 19.16 system minutes. Accordingly, the reported statistics have been normalised by excluding all events that had a SAIDI value in excess of this figure.[1]

Historical performance has been based on using the same number for the T_{MED} in all years, as opposed to using a rolling five-year dataset, as there is some question around the accuracy of data collected prior to 2003.

3.2.2 Breakdown by Location

To further disaggregate the performance data and create more meaningful targets against which performance can be assessed, the data are broken down by the following locations:

- **Urban** – Including major towns and isolated areas with urban characteristics (e.g. underground distribution);
- **Rural** – Generally farming areas outside of major towns; and
- **Remote Rural** – Areas of South Westland south of Hokitika but excluding local feeders of Ross, Waitaha, Harihari and Whataroa.

The definition used for Remote Rural is slightly different than that used by the Commerce Commission (i.e. more than 75 km from the nearest base), as all of South Westland, extending up to around 150 km south of Hokitika, is fed by a single 33 kV feeder. Analysis is greatly simplified by grouping this area together for 33 kV faults only, as a mixture of areas are affected. Local faults are treated as rural, as discussed above.

The areas defined above are shown in Figures 3.1 and 3.2.

1 Note that this is slightly different from the Commerce Commission approach, where the statistic for MED is capped to a maximum value rather than excluded. The purpose of this service level performance exercise is best served by excluding the values so that the statistical effects of major events on daily operations are completely removed.

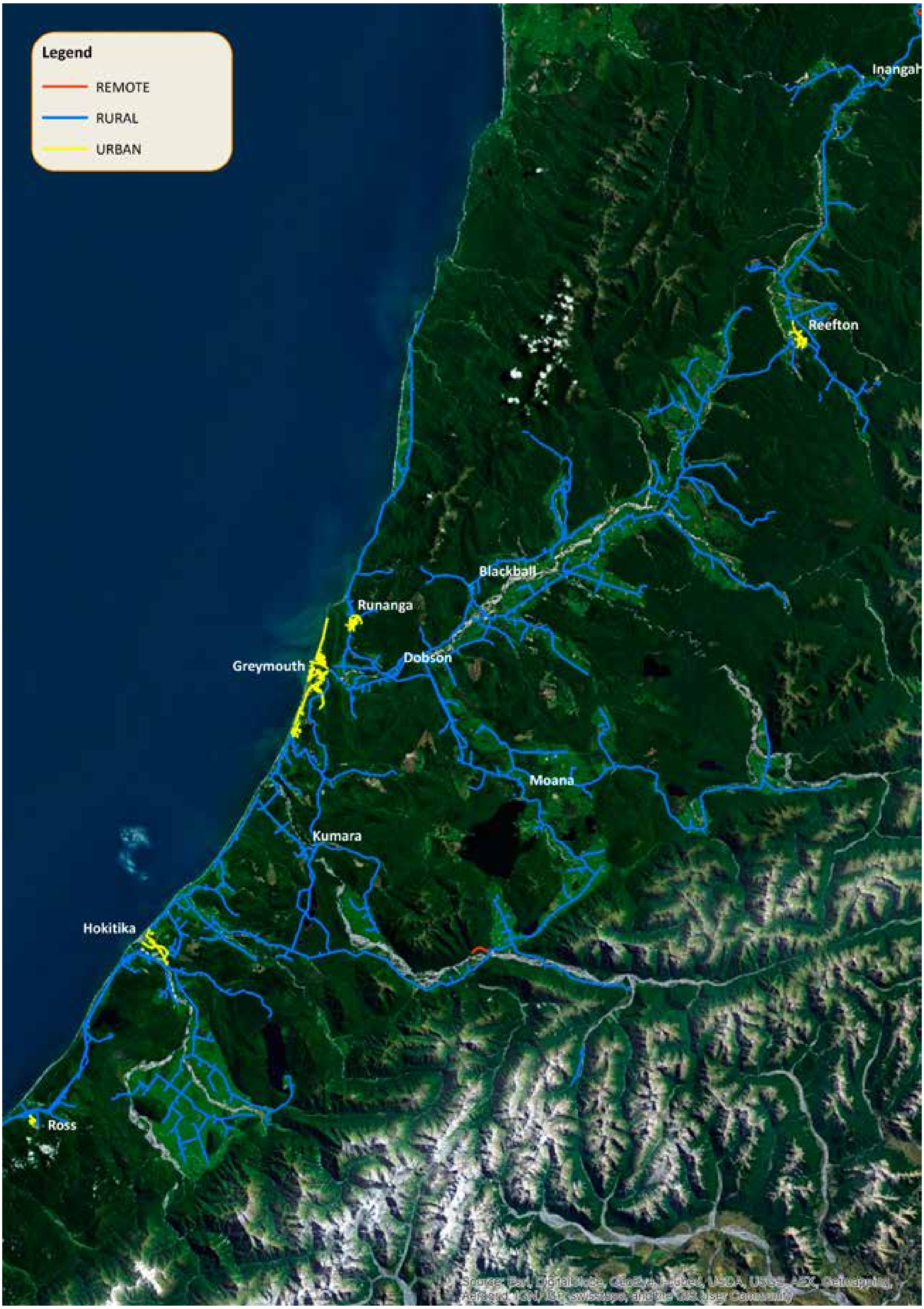

Figure 3.1: Network by Terrain Type – North

Figure 3.2: Network by Terrain Type – South

3.2.3 Planned vs Unplanned Performance

In addition to the foregoing analysis of the data, namely exclusion of MEDs and disaggregating the reliability data by location, a further refinement has been applied by splitting the service levels into planned and unplanned (fault) categories. The rationale behind this approach is that there are different drivers for each type of service level.

Planned outages result from scheduled maintenance activities that are often part of a proactive maintenance approach to improve the overall performance of the network over the long term. In addition, consumers are notified well in advance of a planned outage and are often able to take steps to minimise their exposure to the effects of the outage. In view of this, planned outages are less disruptive than unplanned outages. In addition, they are more acceptable to consumers in view of the perceived longer-term benefits.

On the other hand, unplanned outages can cause significant economic damage to industrial and commercial consumers, while residential consumers are often significantly inconvenienced. Accordingly, consumers are less tolerant of this type of outage and separate targets need to be developed that recognise the disparity between the consumer damage functions from each of these of outages.

The data included in this section of the AMP allow for this disaggregation wherever possible, including the comparison of historical performance against historical targets.

3.2.4 Historical Performance

The historical figures for SAIDI and SAIFI shown in Tables 3.1 and 3.2, and Figures 3.3 to 3.6 have been normalised by the removal of MEDs.

For the reasons discussed in Section 3.2.2, rural areas appear to have poorer performance than remote rural areas, but this is mainly due to difficulties in disaggregation of the fault data for South Westland.

Table 3.1: Planned and Unplanned SAIDI (Urban, Rural and Remote Rural)

		2010-11	2011-12	2012-13	2013-14	2014-15
URBAN	Planned	12.88	11.90	17.50	13.53	12.54
	Unplanned	35.41	18.39	41.83	9.60	36.72
	Total	48.29	30.287	59.33	23.13	49.26
RURAL	Planned	31.48	27.87	39.09	18.36	27.77
	Unplanned	62.13	48.53	86.22	34.05	48.45
	Total	93.61	76.4	125.31	52.41	76.22
REMOTE RURAL	Planned	2.55	4.56	9.09	9.37	5.15
	Unplanned	44.03	25.78	19.17	23.37	21.95
	Total	46.58	30.34	28.26	32.74	27.10
Grand Total		188.48	137.03	212.90	108.28	152.58
Planned Actuals		46.91	44.33	65.68	41.26	45.46
Planned Targets		49.00	49.00	49.00	49.00	49.00
Unplanned Actuals		141.57	92.697	147.22	67.02	107.12
Unplanned Targets		128.00	128.00	128.00	128.00	128.00

Table 3.2: Planned and Unplanned SAIFI (Urban, Rural and Remote Rural)

		2010-11	2011-12	2012-13	2013-14	2014-15
URBAN	Planned	0.054	0.074	0.063	0.052	0.055
	Unplanned	0.877	0.705	0.641	0.175	0.887
	Total	0.932	0.779	0.704	0.227	0.942
RURAL	Planned	0.104	0.097	0.131	0.120	0.112
	Unplanned	0.791	0.727	1.841	0.798	0.730
	Total	0.895	0.824	1.972	0.918	0.842
REMOTE RURAL	Planned	0.014	0.018	0.033	0.022	0.025
	Unplanned	0.784	0.256	0.411	0.541	0.332
	Total	0.798	0.273	0.444	0.563	0.358
Grand Total		2.624	1.876	3.119	1.708	2.141
Planned Actuals		0.172	0.189	0.226	0.195	0.192
Planned Targets		0.220	0.220	0.220	0.220	0.220
Unplanned Actuals		2.452	1.687	2.893	1.513	1.950
Unplanned Targets		2.110	2.110	2.110	2.110	2.110

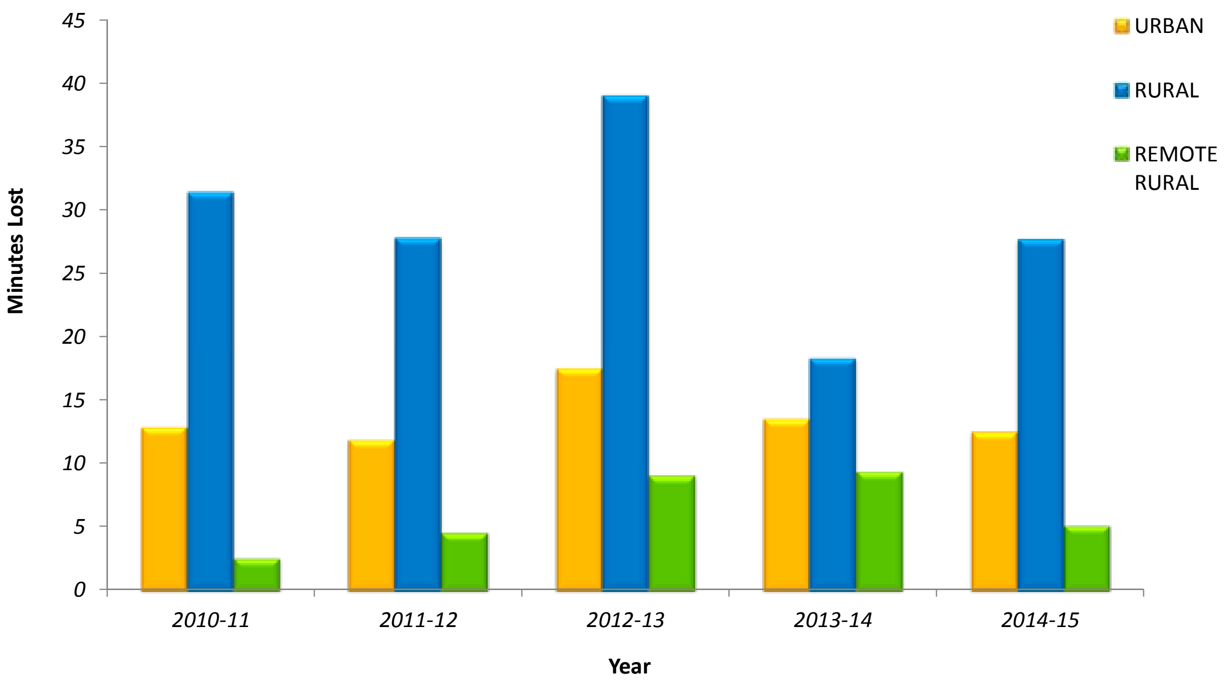

Figure 3.3: Planned SAIDI Profile for last Five Years

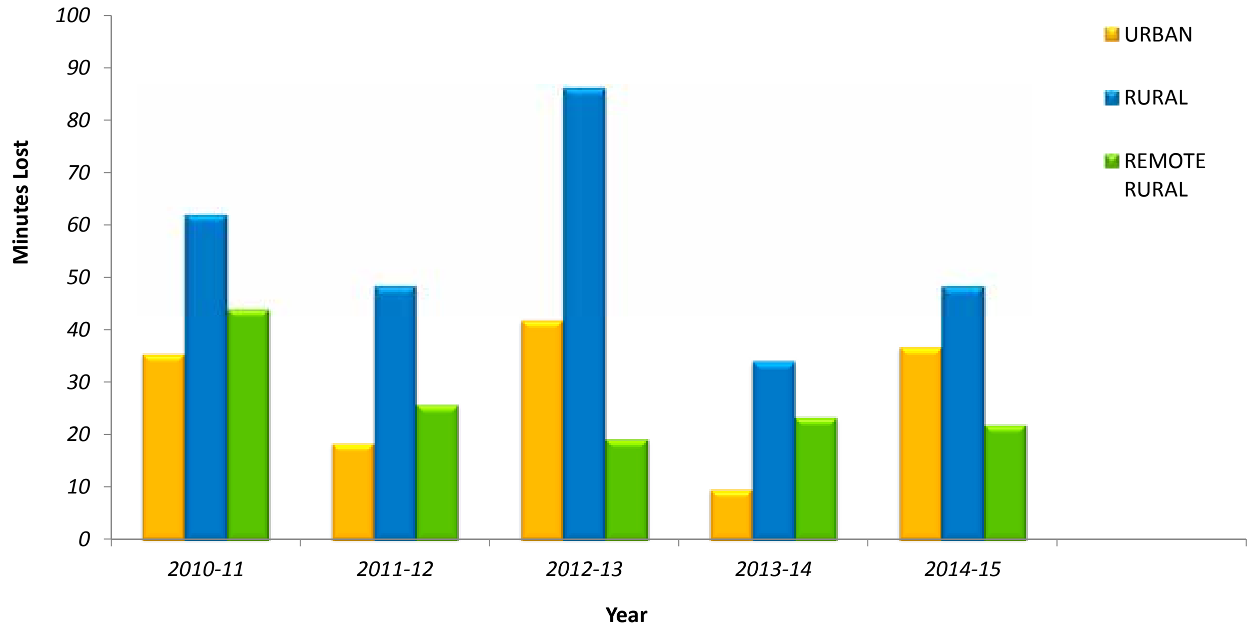

Figure 3.4: Unplanned SAIDI Profile for last Five Years

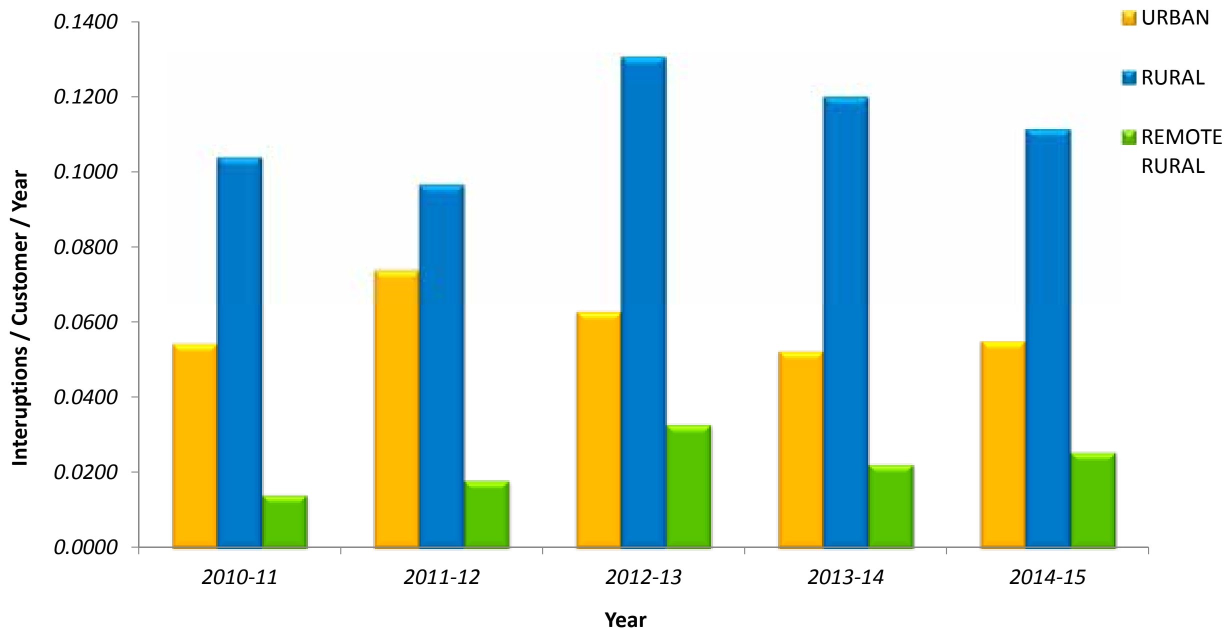

Figure 3.5: Planned SAIFI Profile for last Five Years

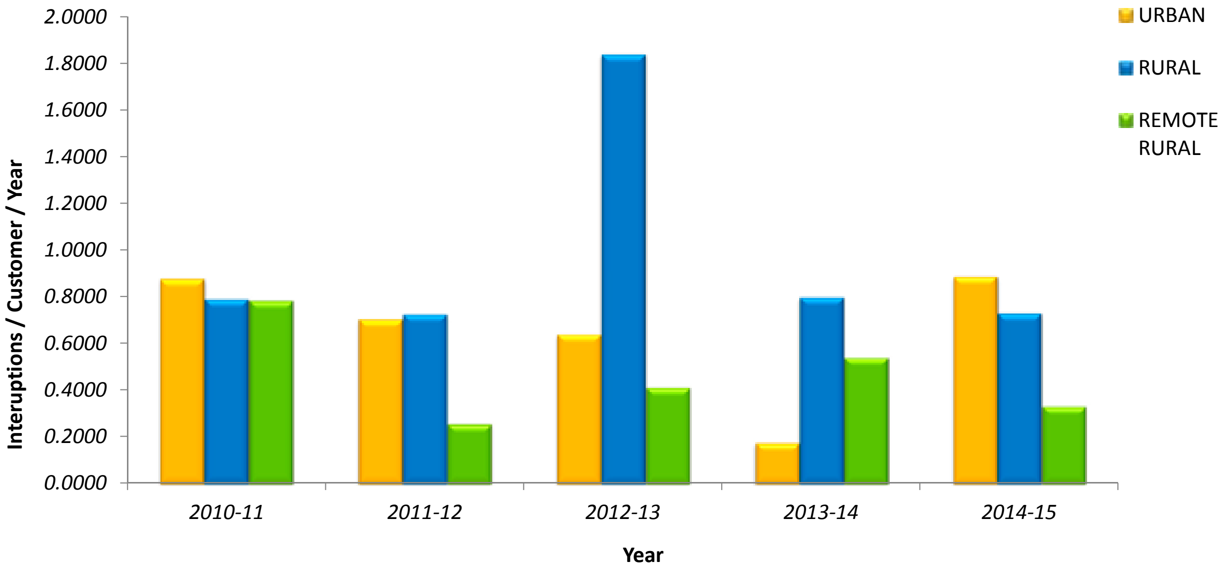

Figure 3.6: Unplanned SAIFI Profile for last Five Years

3.2.5 *Performance Targets*

Tables 3.3 to 3.5 below show the specific performance targets set by Westpower for the planning period in question. The rationale for setting the specific target levels is discussed in Section 3.4.

Table 3.3: SAIDI Targets Projected Forward 10 Years

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Planned Targets	49	49	49	49	49	49	49	49	49	49	49
Unplanned Targets	128	128	128	128	128	128	128	128	128	128	128
Totals	177	177	177	177	177	177	177	177	177	177	177

Table 3.4: SAIFI Targets Projected Forward 10 Years

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Planned Targets	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Unplanned Targets	2.11	2.11	2.11	2.11	2.11	2.11	2.11	2.11	2.11	2.11	2.11
Totals	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33

Table 3.5: Other Customer Service Targets

Service Area	Customers Affected	Performance Target
Restoration of Supply	Urban Areas	95% of faults restored within three hours of notification
	Rural Areas	95% of faults restored within eight hours of notification
	Remote Rural Areas (South of Hokitika excluding local 11 kV Feeders of Ross, Whataroa, Waitaha, and Harihari)	95% of faults restored within twelve hours of notification
Customer Outage Impact	Urban Customers	No more than two planned outages per annum. No more than two unplanned outages per annum (for 90 % of customers)
	Rural Customers	No more than two planned outages per annum. No more than four unplanned outages per annum (for 90 % of customers)
	Remote Rural Customers	No more than two planned outages per annum. No more than eight unplanned outages per annum (for 90 % of customers)

In addition to the generic targets discussed above, additional targets have been developed around:

- The maximum length of outage; and
- The number of extended faults that consumers will be exposed to in each type of area.

3.3 Other Targets

A small number of key asset performance and efficiency targets have been chosen that provide the reader with a clear understanding of the way the business is performing. It is felt that this is a better approach than to include a large number of less significant and often conflicting performance targets that would create unnecessary confusion.

Relevant standard performance and efficiency targets, as defined in the EDIDD 2012 have been chosen for inclusion in this AMP. These are:

- OPEX ratio (OPEX/system assets replacement cost);
- CAPEX ratio (CAPEX/system assets replacement cost);
- Renewal ratio (asset renewal-refurbishment OPEX and CAPEX/depreciation);
- Distribution transformer capacity utilisation; and
- Faults per 100 circuit km (disaggregated by voltage and conductor type -overhead/underground).

These indicators will be measured in a manner that is consistent with the definitions in the EDIDD 2012.

Table 3.6 below shows the historical performance of these indices and future targeted performance.

Table 3.6: Historical and Future Targeted Performance

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
					Projected										
Distribution Transformer Capacity Utilisation	31%	31%	31%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Faults per 100 km Circuit Length	5.35	5.38	5.09	7.69	6.45	4.88	4.88	4.88	4.88	4.88	4.88	4.88	4.88	4.88	4.88

Based on the historical performance disclosed in Table 3.6 and the targets for the financial ratios already defined in Westpower's SCI, the targets in Table 3.7 are provided for the planning period.

A KPI in terms of asset performance is the faults per 100 km index. As can be seen in Table 3.6, this value has been reset to reflect the values achieved over the last five years more realistically.

3.4 Justification for Targets

In general, the targets reflect:

- Historic performance while consumer engagement indicates a high level of satisfaction with existing service levels;
- Consumers have indicated an unwillingness to pay the additional costs necessary if service levels were to be significantly improved; and
- Feedback from consumers regarding current and future performance, along with historic performance achieved to date.

The financial ratio targets are based on figures disclosed to and accepted by the trustee owners of Westpower on behalf of the consumers as disclosed in the SCI.

These have been carefully derived, based on:

- Historical performance;
- Stakeholder requirements;
- Industry best practice; and
- Asset renewal requirements.

The WCEPT considers the SCI each year, and either approves the document or requests further changes. In considering a draft SCI, the WCEPT will often take independent advice, this allows benchmarking of performance against similar companies. Such scrutiny forms the basis of a regular and ongoing formal review that ensures a robust outcome that is designed to meet our consumers' needs.

The targets shown in Table 3.7 below are based on Westpower's ten-year business plan, which is built up from the AMP forecasts. The CAPEX ratio and the renewal ratio drop over time as many of the older assets will soon be replaced, leading to a lower level of steady state replacement.

Table 3.7: Future Performance of Efficiency Targets

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
OPEX Ratio	8.40%	8.70%	8.90%	9.50%	9.50%	9.50%	9.50%	9.50%	9.50%	9.50%
CAPEX Ratio	2.20%	2.20%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%
Renewal Ratio	37%	33%	30%	33%	33%	33%	33%	33%	33%	33%

As such, the financial targets represent a clear mandate that Westpower is bound to reflect in its internal planning processes.

3.4.1 Consumer Engagement

Westpower has carried out consumer satisfaction surveys with the most recent survey being completed in December 2014. This customer survey represents a continuation of the regular surveys that Westpower uses to remain informed of customer preferences for a range of matters including the former statutory requirement to consult customers on their preference for price and supply reliability.

The 2014 survey includes the following:

- Re-introduction of two questions on brand identity and ownership.
- Introduction of two questions on use of social media and Westpower's website.
- Introduction of two questions on awareness of public safety responses that Westpower can take.

This report summarises the views and preferences obtained from the following two sample spaces.

- Westpower's 25 largest consumers.
- A random sample of 491 mass market consumers pro-rated from five GXP areas.

The number of completed mass market surveys was 34%, which is slightly higher than the previous Westpower survey (30%) and also lower than similar surveys performed for other ELBs. The conclusions of this survey are:

- Recognition of Westpower as the owner of the poles and wires is reasonable, although there is confusion between Westpower and ElectroNet. There are also some lingering memories of Trustpower "having bought Westpower years ago".
- Recognition of who owns Westpower is low, with some possible confusion of the role of Trust ownership on behalf of the people. Again, the sale of the retail business to Trustpower appears to have created some confusion around Trustpower owning Westpower in its current form.
- Keeping the power on and getting the power back on remain the 1st and 2nd most important aspects of line services. No flicker or surges was considered 3rd most important by large industrial customers, with no flicker or surges and sufficient notice of planned shutdowns being approximately 3rd equal for mass market customers.
- Both large customers and mass market customers believe Westpower's performance in the 1st and 2nd most important aspects of keeping the power on and getting the power back on is very good.
- Almost all large customers and almost all mass market customers would prefer to pay about the same to have the same reliability.
- Large customers and mass market customers in Reefton, Kumara, Greymouth and Dobson would prefer to share efficiency gains in the form of paying the same price and receiving a bit more reliability. Mass market customers in Hokitika were almost evenly split.
- On the issue of allowing non-critical heat pumps to be interrupted if it meant avoiding long-term price increases, large customers were fairly evenly divided between yes and no. Mass market customers in Reefton, Kumara and Dobson indicated yes, whilst mass market customers in Greymouth and Hokitika indicated a slight preference for no.
- Very few customers appear interested in social media for advising of planned outages or restoration times, with most preferring specifically targeted text messages.
- Very few customers have looked at Westpower's website, and then only at the company information pages.

- Most large customers along with mass market customers in Reefton and Hokitika did not know that public electrical safety hazards could be reported with a free call. Mass market customers in Greymouth, Dobson and Kumara were mixed.
- Very few customers are aware that Westpower will disconnect and reconnect for free so that a roof can be painted.

As with previous surveys, keeping the power on and reliability of supply are the key issues for Westpower's consumers. Westpower will strive to maintain its SAIDI and SAIFI levels at recent levels.

While the survey suggests a lack of interest in the use of the website for advertising planned outages, Twitter and the Westpower website have been effectively used during significant outages e.g. as a result of major storm events.

3.4.2 Historical Reliability Performance

Westpower has already taken a number of steps to improve network performance over recent years, using all readily available means and to such an extent that future improvements are expected to be incremental at best. Moreover, future performance will continue to be strongly influenced by external drivers such as storms, which will far outweigh and effectively mask any improvements gained through additional technological improvements.

After a number of years, during which the actual SAIDI and SAIFI statistics significantly exceeded the mandated targets under the price/quality regime, an opportunity was taken to reset the target levels to values that more accurately and realistically reflect the expected performance moving forward.

Accordingly, after some consideration, it was decided to adopt five-year rolling average values for SAIDI and SAIFI, thus ensuring that there is no overall degradation in service, while also providing an achievable target that contractors and system operation staff can confidently aim for. To further avoid unnecessary volatility, Westpower will continue to use figures that exclude MEDs, both in the targets and the actual performance indices disclosed.

The target figures for 2016 to 2026 are thus based on the average figures achieved over the five-year period from 2010 to 2014. In addition, as there is no likelihood of significant step improvements in the future, a flat profile has been projected throughout the planning period, although this will continue to be revised each year so that any incremental improvements gained are reflected in future targets.

This is important, as Westpower will continue to seek out cost-effective reliability enhancement solutions where these can be shown to offer an opportunity for real benefits.

3.5 Stakeholder Needs

In order to set reasonable security standard targets for Westpower's customers that are compatible with end-user expectations, appropriate research must be carried out.

The needs of electricity users have changed greatly over the last 15 years with the introduction of new and rapidly evolving technology into the domestic market. A diverse range of domestic appliances including for example: entertainment units; computers and other electronic devices; kitchen appliances; heat pumps and air conditioning units has greatly increased the sensitivity of householders to power outages and minor interruptions.

Part of Westpower's role is to maintain an efficient and reliable electricity distribution network on the West Coast. In this context, "efficiency" and "reliability" are relative terms that are subject to personal perceptions. In turn, these perceptions must be viewed from the customer's viewpoint, which must be actively sought. Westpower intends to liaise closely with the energy retailers to determine the expectations of their customers and to quantify these in terms of desirable reliability indices.

Table 3.8 provides the SAIDI cause of breakdown for the period April 2014 to March 2015. Cyclone ITA in April 2014 accounted for the largest percentage (74.6%) of unplanned SAIDI followed by trees falling on lines (11.8%) with planned outages at 7.57%.

Table 3.8: SAIDI Cause of Breakdown April 2014 to March 2015

Description	Year to Date		
	Events	Time (Minutes)	% of SAIDI
Wind/Rain	73	448.09	74.60%
Tree Falling	61	70.86	11.80%
Unknown	24	14.32	2.38%
Equipment Failure	12	6.76	1.13%
Bird Strike	21	6.26	1.04%
Vehicle	8	3.39	0.56%
Earthmoving Equipment	6	1.41	0.23%
Overload	2	1.23	0.20%
Vandalism	1	0.78	0.13%
Lightning	4	0.70	0.12%
Human Error	2	0.65	0.11%
Tree	3	0.55	0.09%
Deterioration	4	0.16	0.03%
Flood	1	0.01	0.00%
Other	0	0.00	0.00%
Fire	0	0.00	0.00%
Animal	0	0.00	0.00%
Salt Deterioration	0	0.00	0.00%
Snow	0	0.00	0.00%
Unplanned Outages Sub Total	**222**	**555.17**	**92.43%**
Planned Outages	89	45.46	7.57%
TOTALS (PLANNED AND UNPLANNED)	**311**	**600.63**	**100%**

4.0 NETWORK DEVELOPMENT

4.1 Introduction

This section outlines the network development plan required to maintain, enhance and develop the operating capability of the system.

The main focus of this section is the use of condition based monitoring and risk management techniques (as described in Section 8) to schedule the projects required to meet the reliability targets and remain within the budgetary limitations imposed for this planning period, and to appropriately schedule network development programmes for future periods.

4.2 Planning Criteria and Assumptions

Future load projection is a difficult task and is based on a complex multivariate environment. Some of the drivers that affect future load include:

- Climatic conditions
- Economic activity
- Commodity prices
- Foreign exchange rates
- Major step load increases/decreases.

Some of these drivers such as climatic conditions tend to be cyclical, and therefore a long-term view of the likely trend needs to be developed rather than making assumptions based on short-term data.

Overall economic activity, which is directly affected by commodity prices, has a filter down effect on electricity consumption. The effects on underlying load range from small trends over the medium term if the economic changes are minor, through to short term step load changes if a major consumer starts up or closes down resulting in employment impacts.

With the relatively small overall demand, major step load changes also have a direct impact on system demand. Unfortunately, these are also the most difficult to predict or quantify, as they depend on investment decisions from major industries based on externalities such as interest rates and commodity prices. Historically, final decisions on these projects may also be made at relatively short notice, leaving Westpower in a difficult situation from a planning perspective.

For instance, the Pike River mine disaster, which occurred on 19 November 2010, followed by the sudden and unexpected closure of Solid Energy's Spring Creek Mine near Greymouth in November 2012, resulted in a major step load decrease of over 10 MW for Westpower, representing some 20% of system load. Notwithstanding the unpredictable nature of major load changes as noted above, a careful and rigorous approach has been taken to developing future load projections based on historical trends, available information and estimates on future changes. A load forecast spreadsheet has been developed as a key data receptacle used to store information for later input into the demand forecasting process, where load growth projections are based on the likely timing of future projects, suitably modified by an assessed probability factor.

Firstly, load trends at each GXP over the previous seven years are studied to try to identify historic baseline changes. The effects of known step load increases are extracted, leaving the underlying long-term historic load profile.

Based on GXP data and general knowledge of the local economy and other drivers discussed above, an estimate is made of the likely future trend in load growth on a GXP basis. This then provides a new baseline for further work.

4.2.1 *Enhancement and Development Criteria*

This activity outlines work which is planned to enhance and develop the system. This means increasing the capacity of the system and eliminating any limitations in order to:

- Provide more load;
- Enhance voltage regulation; and
- Improve security and reliability.

It includes projects (at specific sites) and programmes of related work. Network limitations which relate to system peak loading are:

- Acceptable standards of reliability of supply cannot be maintained;
- The acceptable network rating of plant and equipment cannot be maintained; and
- The thermal rating of plant and equipment is exceeded.

Additional network limitations are:

- The fault rating of equipment is exceeded;
- The age of equipment renders its continued use operationally unsafe or uneconomic; and
- Continued operation of the existing network is not economic, e.g. small conductor sizes or high reactive power flows causing excessive losses.

The process for evaluating network limitations is systematic and covers all items of equipment and all circuits. Particular attention to all the most common limitations is required (refer to Table 4.1).

Table 4.1: Common Network Limitations

Equipment	Common Limitations
Transformers	Rating, ageing conditions, tapping range, voltage regulation
Switchgear	Rating, age, insulation, fault rating, bus zone protection, spare feeder units, sensitive earth fault protection
Cables	Rating, age, leaks, faulty joints, long repair time, fault rating
OH Lines	Rating, physical condition, reliability, losses, clearances, voltage drops, fault rating

4.2.2 *Reliability and Security of Supply*

4.2.2.1 *Security Guidelines*

The security guidelines are the basis for analysis and for determining the future performance of the distribution system. Table 4.2 outlines some of the security guidelines for distribution planning. The levels of security that currently exist for each zone substation are summarised in Appendix C.

Table 4.2: Security Guidelines for Distribution Planning

Load (MW)	Basic Security Level	Transmission Circuits	Busbars	Transformers
Less than 10	n	One Circuit	One Busbar or Bus section.	1 x 3-phase unit, if backed up from alternative supply points
Above 10	n-1	Two circuits	Two busbars or bus sections.	2 x 3-phase units. Firm supply of peak demand using any short term overload capacity.

With regard to the design of system changes or network extensions, due consideration is made of the level of security required for the connected consumers. An industrial consumer for instance, may require a non-interruptible supply for a specific manufacturing process, whilst a domestic consumer can tolerate occasional supply interruptions. Specific criteria for interruption and quality of supply may need to be developed for individual consumers both for design consideration and commercial contractual obligations.

Table 4.3 shows the minimum security levels for Westpower's distribution systems.

Table 4.3: Minimum Security Levels for Distribution Networks

Circuit Type	Maximum Demand Under Normal Conditions	Minimum Circuit Arrangement
Overhead	Up to 1 MVA	Single circuit
Underground	Up to 300 kVA Up to 1 MVA for a single customer	Single circuit
Overhead	Greater than 1 MVA and up to two thirds of feeder capacity	Feeder backstopping

Consumers who are prepared to enter into commercial agreements can be provided with enhanced levels of security.

Westpower has investigated the use of probabilistic planning techniques to assist in the evaluation of security and reliability benefits for specified projects. These techniques are applicable to network planning processes, as power system behaviour is stochastic in nature. A justification for the use of this approach is that it instils more objective assessments into the decision-making process.

In particular, probabilistic techniques can be used to provide measurable performance indices such as:

- System availability;
- Estimated unsupplied energy;
- Number and size of load curtailments;
- Number of hours of interruption; and
- Excursions beyond set voltage limits.

While the use of a probabilistic planning approach offers significant benefits in terms of targeted CAPEX, the proper application of this technique also involves significant investment, both in terms of cost and resources. In particular, the following prerequisites apply:

- Competent staff, including experienced reliability engineers who are familiar with the application of probabilistic techniques to power systems;
- Accurate and complete historical fault outage records over a large number of years; and
- Expensive and complex reliability evaluation software packages, user-friendly versions of which have only become generally available in recent times.

Accordingly, probabilistic planning techniques are not widely used, except so far as these are applied for network development prioritisation as discussed in Section 4.3.

4.2.3 Regulatory Factors and Quality of Supply

Programmes and projects are typically justified on the basis of the following benefits from improved voltage level or controls:

- The ability to meet any regulatory requirements with respect to voltage standards;
- Specific customer requirements which the customer is willing to pay for;
- Savings in losses; and
- Improvements in transmission circuit capacity and the consequential deferment of CAPEX.

Power quality is considered to be the standard of the power supplied in an energised system. It includes voltage regulation, the level of harmonic distortion, and the frequency and magnitude of power sags and surges. Sags and surges are momentary voltage dips or increases with duration of less than a second, generally from a few milliseconds to half a second. Power interruptions of more than a second are considered to be outages, a factor of power reliability.

4.2.3.1 Voltage Regulation

Where consumers are fed from a LV distribution system that supplies more than one consumer, the distribution system will normally be designed so that the phase to earth voltage at the consumer's point of supply is maintained within the limits as set out in the Electricity Regulations (the Electricity Regulations 1997 mandate the LV variations of ± 6%, except for momentary fluctuations of the nominal voltage). The customer's point of supply will usually be taken as the consumer's service fuse or property boundary.

In special situations, or where the consumer is supplied at a voltage other than the standard LV, the distribution system should be designed so that the delivered voltage is maintained within the limits agreed by the consumer and Westpower. Where no such limits are specifically agreed on, the limits as stated in the Electricity Regulations shall be applied (the Electricity Regulations 1997 allow for voltage variations of ± 5% of the agreed voltage for installations supplied at other than standard LV).

4.2.3.2 Voltage Drop Allowances

Regulated 11 kV busbars on Westpower's distribution network are regulated to a voltage of 102% of nominal voltage. The voltage drop across the network should accordingly be distributed as follows under maximum design load conditions:

- 11 kV system 2%
- LV system 4%
- Service main 2%

In rural areas, the allocation of voltage drops must be determined on a case-by-case basis. The actual 11 kV voltage drop will depend on the distance of the consumer from the regulated busbar, and this voltage drop could exceed 2%. A voltage drop of less than 4% on the LV system is thus required. In general, the design should endeavour to place the 11 kV supply point to the LV network as close to the consumer as possible, resulting thus in relatively short LV networks.

4.2.3.3 Harmonics

Harmonic voltages and currents are generally generated by the consumer's equipment. The limits of harmonic voltage or current permitted at the point of connection between the network and the customer's installation, or the point of common coupling with any other consumers, are as specified in the New Zealand Electrical Code of Practice for Harmonic Levels, NZECP 36:1993. In general, this restricts harmonic voltages at less than 66 kV to 4% for any odd-numbered harmonic, 2% for any even harmonic and 5% for total harmonic distortion.

4.2.3.4 Rating of Network Equipment

All equipment to be installed on the network shall be adequately rated both in terms of load capacity and in terms of fault level withstanding capability. In assessing the current or load rating, due allowance should be made for future load growth. Where appropriate, allowance may be made for the cyclical nature of any load.

In terms of fault ratings, before selecting the fault level withstanding rating of a network component, the actual fault level at the location on the network at which the network component is to be installed should be determined. Any expected network reconfiguration should also be taken into account.

ADMD is the most critical variable factor in LV system design, as its accurate selection directly affects the optimum costs of an installation and quality of supply.

It is therefore important that emphasis is applied to the optimum selection of ADMD. Accordingly, ADMD has been revised and depends mainly on the development type as presented below.

4.2.3.5 Commercial Areas

In new commercial developments, where small factories, retail shops or similar require LV distribution, no ADMD can be predicted, as it is not known what operations will occupy the premises. Load estimates should be generous, because the cost of later LV cable reinforcement can be considerable. Transformer load estimates may be more conservative. The designer should discuss each case with developers and Westpower before proceeding.

4.2.3.6 Urban Residential Areas

The network shall generally be designed for a normal residential ADMD of 5 kW per dwelling.

In special areas, identified by Westpower, this may be insufficient and the design ADMD shall be as specified by Westpower. In areas where zoning allows multiple residential dwellings and the property area permits, an allowance must be made for multiple dwellings per lot.

Contrariwise, some of the older areas in Westpower's network still use coal and wood fires as a principal source of heating and water heating, and the ADMD in these areas has been measured to levels as low as 1.5 kW per dwelling. This is taken into account when design work is being undertaken in these areas.

4.2.3.7 Rural Areas

Care must be taken to determine the ADMD per consumer in rural areas. Appropriate allowance must be made if large irrigation pumps are to be connected or if significant electrical heating is to be installed in large residential buildings.

The design and selection of the equipment used for the construction of overhead lines must meet, at least, the following requirements:

- **Safety** – The line must be safe for line workers to construct and maintain, and must offer no hazard to the general public.
- **Electrical performance** – The line must adequately serve the purpose for which it has been designed. It must safely carry any load current which it may be called upon to do without creating problems of unacceptable voltage drop. It must also be able to withstand any fault current that it may carry from time to time.
- **Mechanical performance** – The line must be able to withstand reasonable natural forces such as wind, rain, snow and earthquakes.
- **Financial performance** – The line should be designed to be as economical as possible, taking into account the original cost of maintenance and cost of line losses.
- **Appearance** – Consideration must be given to the impact of the line on the environment in choosing the line route and the aesthetic appearance of the line.

4.3 Prioritising Network Development

Westpower strives to ensure that optimal capital efficiency is gained through the application of a formal project evaluation process for capital projects, as these must compete for limited capital resources. In this way, only projects that meet Westpower's strict criteria will go forward and projects will also be completed in the best merit order.

As the key drivers for network development comprise both financial and non-financial factors, the following categories have been determined so that tailored planning criteria can be applied while still providing objective outcomes:

- **Category A** – Projects with no direct financial justification;
- **Category B** – Projects with marginal financial benefits; and
- **Category C** – Projects with clear financial returns.

For Category A projects, there are a number of diverse drivers that need to be carefully evaluated and then compared on an objective and equivalent basis. These drivers are listed below.

1 Reliability/security of supply to meet consumer levels of service and contractual obligations.

2 Asset replacement and renewal requirements to maintain the service delivery potential of the asset and avoid unnecessary and unscheduled reactive maintenance.

3 Occupational health and safety to establish a safe environment both for workers and the public, and comply with Health and Safety legislative safety requirements.

4 Regulatory compliance to meet regulations imposed by external governmental agencies.

5 Environmental to comply with emission regulations to air, land and water.

6 Quality of supply to ensure that all consumers receive a quality of supply that meets Westpower's minimum performance standards.

7 Technological efficiency to ensure that appropriate current business technology is applied in the business to leverage overall performance gains.

8 Corporate image to ensure that any activity carried out by the asset management team and subcontractors will not materially damage Westpower's image.

An objective scoring system has been developed to provide an equitable comparison between projects within this category, even though they might have quite separate drivers. For instance, in the case of Driver 1, the assessed impact on both the SAIDI and SAIFI reliability statistics is determined either by empirical or probabilistic means, and the weighted score for each metric is combined to give an overall score. On the other hand, if Driver 7 were the key driver, a multivariate approach using factors such as productivity effects, equipment costs and likely usage would be applied to come up with a comparable score.

Category B projects are based on clear financial criteria that can be assessed using financial evaluation tools. The following sub-categories are listed below.

1 Efficiency improvements resulting in a reduction in losses or costs while maintaining asset performance criteria.

2 Demand side management, reducing Westpower's overall peak demand charges.

3 Renewal and replacement where a clear business case can be provided for replacement of an asset through reduced maintenance costs.

4 Capacity enhancement where additional capacity is required by a consumer and this can be funded through increased line charges.

5 Strategic, leading to long-term quantifiable strategic benefits for the company.

Westpower has developed a robust evaluation tool using industry best practice CAPEX Stratagio™ software to provide objectivity and robustness around this process. This underlying approach is based upon a Discounted Cash Flow (DCF) analysis but the product has been adapted for Westpower's needs by adding expert decision support tools.

Category C projects are similar to those included in Category B, but because of the different risk profiles involved, they have different hurdle rates and success criteria applied to them. These projects could include:

1. Network extensions, including new substations;
2. Subdivision reticulation;
3. Communication infrastructure, where there is an ability to share costs with third-party users of the network; and
4. Distributed generation, such as new hydro schemes.

As discussed above, the same evaluation tools are used for both Category B and Category C projects.

Each of these above categories is evaluated by using a weighted scoring system that is based on the available metrics.

Appropriate weighting factors can then be applied to ensure that projects can be compared across each of the categories to develop a stack of projects that can be progressed in a predetermined merit order. This method therefore provides a fair comparison between financially driven and non-financially driven projects, and this obviates the need to apply separate expert tools for the non-financially driven projects.

Whether or not a project will proceed in any given year will depend upon whether the score for that project reaches the project inclusion threshold for that year. In turn, the threshold will be determined by the stack of proposed projects, financial performance requirements and budgetary constraints, and these may vary from year to year due to a number of external business drivers. If a project fails to meet the threshold in the current year, it will be moved into the following year for reassessment along with other competing projects.

This process makes sure that only projects that meet Westpower's strict criteria proceed, and that network investment is carried out efficiently and in the right order to ensure optimum use of scarce capital resources.

In addition to the specific rating system used for key projects noted above, a number of general principles are applied when deciding the order in which projects should proceed. These generally fall into the categories below:

- **Top priority** – Is given to meeting the load requirements for new, large (mainly mining) industrial loads. As there are no new major loads that have committed at this stage, no associated projects are included in this AMP.
- **Second priority** – Is given to sub-transmission augmentation required to meet capacity limitations as a result of incremental load growth. The only project currently sitting in this category is the upgrade of the sub transmission line from Hokitika to Waitaha from 33 KV to 66 KV in the second half of the planning period. However, this project will only proceed if there is a major generation development in South Westland such as the potential Waitaha Hydro Scheme noted in Section 35.16.2.
- **Third priority** – Is given to sub-transmission asset replacement, and distribution network development and replacement. Following the completion of the Hokitika to Harihari 33 kV line upgrade, no major sub transmission replacements are planned this side of the planning horizon.

4.4 Load Forecasting

4.4.1 Introduction

A critical factor in considering network development plans is the projected load growth. The projected load growth is presented in Figure 4.1 and represents after diversity demand, including the load supplied through local generation.

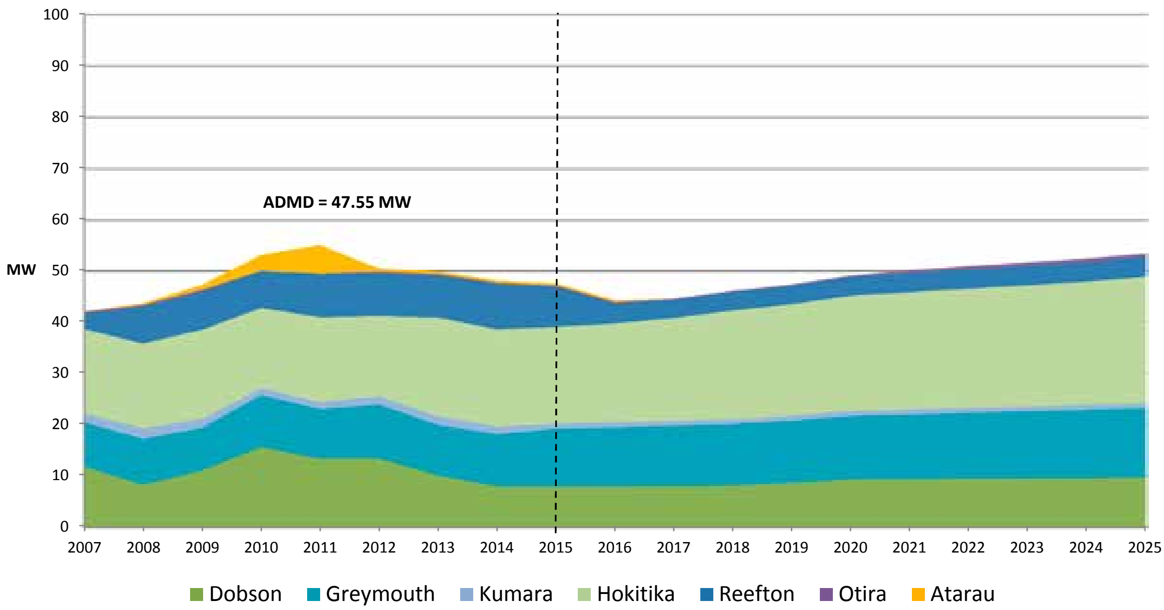

Figure 4.1: Load trends (2007-2025)

The methodology used to determine the likely level of load growth is based on the use of ADMD.

It is anticipated that the current ADMD of around 47.6 MW will increase slightly in the short to medium term, following a decrease in demand due to the cessation of operations at Oceana Gold and Roa, with future load growth driven principally by economic development and activity.

At the reticulation level, typical consumer requests relate to issues of capacity, quality and/or security of supply, and can lead to plans for asset enhancement or development.

The most common upgrade in relation to capacity is the installation of new or transferred supply transformers at connected points, thus providing sufficient capacity to allow for future demand growth. Resolution of supply quality issues typically includes provision of local voltage support in the form of regulators or capacitors to maintain the steady-state voltage within specified ranges.

Alternatively, network analysis including load projections at points of supply, power flows, network and point of supply performance leads to options for consideration by consumers and Westpower management. Table 4.4 provides a typical example of a load trend table.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
PERCENT INCREASE OR DECREASE																			
Reefton	----------	----------	1.55%	-1.83%	17.49%	-0.90%	-2.36%	8.36%	-11.65%	-50.04%	-9.92%	1.50%	1.48%	1.46%	1.44%	1.42%	1.40%	1.38%	1.36%
Atarau	----------	----------	----------	239.45%	75.95%	-89.12%	-20.13%	-6.91%	-11.35%	-6.40%	-100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Dobson	10.51%	-30.17%	33.92%	41.14%	-14.65%	0.31%	-24.45%	-20.87%	-0.62%	1.00%	0.99%	0.98%	5.73%	7.67%	0.85%	0.85%	0.84%	0.83%	0.82%
Greymouth	-8.85%	3.71%	-7.17%	21.90%	-4.07%	8.64%	-7.03%	3.40%	10.86%	2.00%	1.96%	1.92%	1.89%	1.85%	1.82%	1.79%	1.75%	1.72%	1.69%
Kumara	17.37%	16.97%	-15.04%	-23.30%	-0.15%	16.78%	10.47%	-13.76%	-35.99%	0.00%	0.31%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Hokitika	12.68%	1.09%	4.81%	-9.81%	5.70%	-5.22%	22.69%	-1.61%	-0.16%	2.00%	3.99%	5.78%	2.40%	3.54%	1.68%	1.65%	1.63%	1.60%	2.66%
Otira	-71.85%	-37.92%	69.80%	-90.12%	44.00%	341.67%	-5.66%	-24.00%	4.39%	1.00%	0.99%	0.98%	0.97%	0.96%	124.24%	27.91%	0.33%	0.33%	0.33%
Total Load	**5.70%**	**3.81%**	**8.20%**	**12.59%**	**3.59%**	**-8.40%**	**-1.26%**	**-3.50%**	**-1.22%**	**-7.99%**	**0.70%**	**3.41%**	**2.73%**	**3.62%**	**2.13%**	**1.78%**	**1.45%**	**1.43%**	**1.90%**

	Actual kW 2007	Actual kW 2008	Actual kW 2009	Actual kW 2010	Actual kW 2011	Actual kW 2012	Actual kW 2013	Actual kW 2014	Actual kW 2015	Forecast kW 2016	Forecast kW 2017	Forecast kW 2018	Forecast kW 2019	Forecast kW 2020	Forecast kW 2021	Forecast kW 2022	Forecast kW 2023	Forecast kW 2024	Forecas kW 2025
Reefton	2986	7216	7328	7194	8452	8376	8178	8862	7830	3912	3524	3577	3630	3683	3736	3789	3842	3895	3948
Atarau	0	336	948	3218	5662	616	492	458	406	380	0	0	0	0	0	0	0	0	0
Dobson	11860	8282	11091	15654	13361	13402	10125	8012	7962	8042	8121	8201	8671	9337	9416	9496	9575	9655	9735
Greymouth	8634	8954	8312	10132	9720	10560	9818	10152	11254	11479	11704	11929	12154	12379	12604	12830	13055	13280	13505
Kumara	1762	2061	1751	1343	1341	1566	1730	1492	955	955	958	958	958	958	958	958	958	958	958
Hokitika	16381	16560	17357	15655	16548	15685	19244	18935	18905	19283	20052	21212	21720	22489	22868	23246	23624	24002	24641
Otira	480	298	506	50	72	318	300	228	238	240	243	245	248	250	560	717	719	722	724
Total Load	**42103**	**43707**	**47293**	**53246**	**55156**	**50523**	**49887**	**48139**	**47550**	**44291**	**44602**	**46122**	**47381**	**49096**	**50143**	**51035**	**51773**	**52511**	**5351**

Table 4.4: Load Trends and Forecasts to 2025

4.4.1.1 Historical Factors

Future load projection is a difficult task and must be carried out in a complex multivariate environment.

Long-term trends are assessed for the drivers discussed under Section 4.2 *Planning Criteria and Assumptions*, although these are often not reliable indicators of what will happen in the future.

For instance, climatic effects such as the impact of warm winters can be reviewed, but cannot be relied upon to predict the temperatures of future winters. Therefore, a conservative approach needs to be taken.

Similarly, overall economic activity on the West Coast has led to a cyclical “boom and bust“ tradition throughout the history of power supply to the West Coast and this serves to highlight the uncertainty that needs to be taken into account during the forecasting process. High commodity prices for resources such as gold and coal can lead to major step load increases, but these loads can disappear equally quickly when the markets decline.

Nevertheless, historical trends in the underlying load are very useful tools for determining likely future load changes when used in conjunction with other intelligence. Of necessity, these projections are carried out without taking into account any embedded generation on Westpower’s network because of the need to determine an accurate consumption-only forecast.

In carrying out the assessment of historical effects, load trends at each GXP over the previous seven years are studied to identify historic baseline changes. The effects of known step load increases are extracted, leaving the underlying long-term historic load consumption profile.

Figure 4.2 shows the GXP demand for the 2015 calendar year.

Figure 4.2: GXP Energy and Demand Statistics – 2015

Based on these data, and general knowledge of the local economy and other drivers discussed above, an estimate is made of the likely future trend in load growth on a GXP basis. This then provides a new basis for determining further work on the network.

4.4.2 Future GXP Load Projections

Consumer input is sporadically sought through forums where major potential users are gathered and provided with updates on current load trends and capacity projections. More regularly, each consumer or consumer group (e.g. tourism) is asked to provide realistic forward load projections based on their specific industry knowledge. This information has proved to be extremely valuable, allowing for significantly improved projection of future loads, and has a direct impact on Westpower's future plans for network reinforcement.

The data collected from the consumers are analysed and adjusted with a weighting coefficient based on the likelihood of appearance, and the results are included into the zone substation load forecasts. The likelihood weight coefficients are:

- Load is confirmed = 100%
- Load is likely to occur = 70%
- Load is possible to occur = 30%
- Load is speculative = 10%

Table 4.5 below shows the current maximum demand, firm capacity and utilisation factor.

Table 4.5: GXP Maximum Demand and Current Utilisation

GXP Feeder	Maximum Demand 2015 (MW)	Maximum Demand 2015 (MVA)**	Firm Capacity (MVA)	Utilisation %
RFN110	10.566	11.122	30	37.07%
ATU110 (LGN110)*	0.706	0.743	20	3.72%
DOB0331	8.154	8.583	17	50.49%
GYM0661	13.850	14.579	15	97.19%
KUM0661	9.532	10.034	10	100.34%
HKK0661	14.508	15.272	20	76.36%
OTI0111	0.618	0.651	2.5	26.02%
BDMD	57.934	60.983		
***The ATU switching station feeds LGN substation and therefore the utilised factor is applicable for LGN**				
****The Maximum Demand (MVA) is calculated based on the assumption that the power factor is 0.95**				

This table shows non-coincident demands at each GXP and includes periods where load has been switched between GXPs. Nevertheless, it reflects the load that each GXP must be capable of supplying.

Although the local economy has been significantly impacted by the loss of major mining loads as noted earlier in the plan, the underlying economic activity on the West Coast from other sectors such as the dairy, gold and timber industries is underpinning a relatively stable outlook.

Currently, and as described in Section 5.4 there is sufficient n-1 transmission capacity available in the transmission network feeding the West Coast, to ensure that major new loads can be supplied on an uninterruptible basis, and so electricity supply should not be a constraint to future economic development.

The greatest challenge in planning for future network development is to accurately determine the likelihood and size of future step changes. To a large extent, this is based on discussions with existing or potential large consumers. Early load indications provided by these consumers are often very approximate and are subject to major variations if and when the project proceeds.

Furthermore, the West Coast has a history of premature major development announcements being made, only to fall through when macro-environmental changes occur such as the gold price dropping or a change in government policy. For this reason, the projected step load changes must be viewed circumspectly until there is a firm commitment.

Westland Milk Products, one of the larger industrial consumers has multiple upgrades planned for throughout the planning period which could increase their load by up to 3 MW. In addition to any new dairy farms that may be developed in the West Coast region, milk is now also being collected from Canterbury.

The impact of small embedded or distributed generation is considered on a case by case basis in the load forecast. Westpower prefers to adopt a prudent peak demand forecast approach. Factors such as location, capacity, reliability and utilisation are considered when determining the weighting given to a particular generator. For example, the combination of Amethyst and Wahapo Hydro Schemes has been considered in the load forecast due to their high availability and significant output relative to the peak demand.

The projected additional demand on Westpower's network, over the next ten years, is in the order of 5 MW. Prior to the West Coast Grid Upgrade Project (WCGUP) being commissioned, the Transpower supply capacity from the north was constrained to about 24 MW while the total after diversity system demand is around 47.6 MW. The DOB-TEE A line effectively doubled the transmission capacity, thus providing security to the West Coast.

4.4.3 Future Zone Substation Load Projections

Load forecasting is carried out at the zone substation level, and this is critical to ensure that sufficient capacity is available in Westpower's zone substation infrastructure. These forecasts are developed using a zero-based approach and load demand management from information and requests received directly from consumers, including intelligence on future load trends such as proposed dairy farm conversions.

Future zone substation load projections demonstrate that most of Westpower's zone substations have sufficient capacity to deal with expected load growth throughout the planning period. Only one substation may require a capacity upgrade within five to ten years. As these load forecasts are subject to change and involve considerable uncertainty, no projects have been committed for the zone substations at this stage, but a close watch will be kept on consumers' load expectations and maximum demand trends.

In Westpower's case, most of the sub-transmission infrastructure has been built within the last 25 years and has been prudently designed to cater for future load growth, which means that there is usually ample capacity to cater for marginal load growth. In the event of proposals for major load steps crystallising, each case is considered in isolation and in combination with other proposals to make sure that any constraints due to substation capacity are taken into account.

A summary of the results by major zone substations is shown in Table 4.6.

Table 4.6: Zone Substation Forecast Demand

Zone Substation		Firm Capacity (MVA)	Peak 2014 (MVA)	Predicted Load (MVA)									
				2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Arnold		**6.25**	**3.236**	**3.27**	**3.30**	**3.33**	**3.37**	**3.40**	**3.43**	**3.46**	**3.49**	**3.53**	**3.56**
Base Growth	1.0%			0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Loadwatch Growth				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Utilisation				52%	53%	53%	54%	54%	55%	55%	56%	56%	57%
Blackwater		**5**	**1.44**	**1.46**	**1.47**	**1.49**	**1.50**	**1.52**	**1.53**	**1.54**	**1.56**	**1.57**	**1.59**
Base Growth	1.0%			0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Loadwatch Growth				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Utilisation				29%	29%	30%	30%	30%	31%	31%	31%	31%	32%
Dobson GXP		**17**	**8.154**	**8.24**	**8.32**	**8.40**	**8.88**	**9.56**	**9.64**	**9.72**	**9.81**	**9.89**	**9.97**
Base Growth	1.0%			0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Loadwatch Growth				0.00	0.00	0.00	0.40	0.60	0.00	0.00	0.00	0.00	0.00
Utilisation				48%	49%	49%	52%	56%	57%	57%	58%	58%	59%
Dobson		**5**	**3.065**	**3.10**	**3.13**	**3.16**	**3.19**	**3.22**	**3.25**	**3.28**	**3.31**	**3.34**	**3.37**
Base Growth	1.0%			0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Loadwatch Growth				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Utilisation				62%	63%	63%	64%	64%	65%	66%	66%	67%	67%
Fox Glacier		**5**	**1.005**	**1.03**	**1.05**	**1.07**	**1.09**	**1.11**	**1.13**	**1.15**	**1.17**	**1.19**	**1.21**
Base Growth	2.0%			0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Loadwatch Growth				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Utilisation				21%	21%	21%	22%	22%	23%	23%	23%	24%	24%
Franz Josef		**5**	**1.984**	**2.02**	**2.06**	**2.10**	**2.14**	**2.18**	**2.22**	**2.26**	**2.30**	**2.34**	**2.38**
Base Growth	2.0%			0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Loadwatch Growth				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Utilisation				40%	41%	42%	43%	44%	44%	45%	46%	47%	48%
Globe		**10**	**5.738**	**1.24**	**0.74**	**0.74**	**0.74**	**0.74**	**0.74**	**0.74**	**0.74**	**0.74**	**0.74**
Base Growth	0.0%			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Loadwatch Growth				-4.50	-0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Utilisation				12%	7%	7%	7%	7%	7%	7%	7%	7%	7%
Greymouth		**15**	**13.850**	**14.13**	**14.40**	**14.68**	**14.96**	**15.24**	**15.51**	**15.79**	**16.07**	**16.34**	**16.62**
Base Growth	2.0%			0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Loadwatch Growth				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Utilisation				94%	96%	98%	100%	102%	103%	105%	107%	109%	111%
Harihari		**1**	**0.820**	**0.84**	**0.85**	**0.87**	**0.89**	**0.90**	**0.92**	**0.93**	**0.95**	**0.97**	**0.98**
Base Growth	2.0%			0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Loadwatch Growth				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Utilisation				84%	85%	87%	89%	90%	92%	93%	95%	97%	98%
Hokitika		**20**	**14.508**	**14.80**	**15.39**	**16.28**	**16.67**	**17.26**	**17.55**	**17.84**	**18.13**	**18.42**	**18.91**
Base Growth	2.0%			0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
Loadwatch Growth				0.00	0.30	0.60	0.10	0.30	0.00	0.00	0.00	0.00	0.20
Utilisation				74%	77%	81%	83%	86%	88%	89%	91%	92%	95%
Kumara		**10**	**9.532**	**9.53**	**9.56**	**9.56**	**9.56**	**9.56**	**9.56**	**9.56**	**9.56**	**9.56**	**9.56**
Base Growth	0.0%			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Loadwatch Growth				0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Zone Substation		Firm Capacity (MVA)	Peak 2014 (MVA)	Predicted Load (MVA)									
				2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Utilisation				95%	96%	96%	96%	96%	96%	96%	96%	96%	96%
Ngahere		**5**	**1.942**	**1.96**	**1.98**	**2.00**	**2.02**	**2.04**	**2.06**	**2.08**	**2.10**	**2.12**	**2.14**
Base Growth	1.0%			0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Loadwatch Growth				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Utilisation				39%	40%	40%	40%	41%	41%	42%	42%	42%	43%
Otira		**2.5**	**0.618**	**0.62**	**0.63**	**0.64**	**0.64**	**0.65**	**1.46**	**1.86**	**1.87**	**1.87**	**1.88**
Base Growth	1.0%			0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Loadwatch Growth				0.00	0.00	0.00	0.00	0.00	0.80	0.40	0.00	0.00	0.00
Utilisation				25%	25%	25%	26%	26%	58%	74%	75%	75%	75%
Rapahoe		**5**	**1.749**	**1.77**	**1.78**	**1.80**	**2.22**	**2.24**	**2.25**	**2.27**	**2.29**	**2.31**	**2.32**
Base Growth	1.0%			0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Loadwatch Growth				0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00
Utilisation				35%	36%	36%	44%	45%	45%	45%	46%	46%	46%
Reefton		**30**	**10.566**	**6.17**	**5.78**	**5.88**	**5.99**	**6.09**	**6.20**	**6.31**	**6.41**	**6.52**	**6.62**
Base Growth	1.0%			0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Loadwatch Growth				-4.50	-0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Utilisation				21%	19%	20%	20%	20%	21%	21%	21%	22%	22%
Ross		**1**	**0.493**	**0.50**	**0.50**	**0.51**	**0.51**	**0.52**	**0.52**	**0.53**	**0.53**	**0.54**	**0.54**
Base Growth	1.0%			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Loadwatch Growth				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Utilisation				50%	50%	51%	51%	52%	52%	53%	53%	54%	54%
Spring Creek		**8**	**0.929**	**0.93**	**0.93**	**0.93**	**0.93**	**1.53**	**1.53**	**1.53**	**1.53**	**1.53**	**1.53**
Base Growth	0.0%			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Loadwatch Growth				0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00
Utilisation				12%	12%	12%	12%	19%	19%	19%	19%	19%	19%
Wahapo		**5**	**3.057**	**3.06**	**3.06**	**3.06**	**3.06**	**3.06**	**3.06**	**3.06**	**3.06**	**3.06**	**3.06**
Base Growth	0.0%			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Loadwatch Growth				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Utilisation				61%	61%	61%	61%	61%	61%	61%	61%	61%	61%
Waitaha		**1**	**0.310**	**0.32**	**0.32**	**0.33**	**0.33**	**0.34**	**0.35**	**0.35**	**0.36**	**0.37**	**0.37**
Base Growth	2.0%			0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Loadwatch Growth				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Utilisation				32%	32%	33%	33%	34%	35%	35%	36%	37%	37%
Whataroa		**1**	**0.801**	**0.82**	**0.83**	**0.85**	**0.87**	**0.88**	**0.90**	**0.91**	**0.93**	**0.95**	**0.96**
Base Growth	2.0%			0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Loadwatch Growth				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Utilisation				82%	83%	85%	87%	88%	90%	91%	93%	95%	96%
Legend:	**#.##**	**- represents firm capacity overloaded by up to 25%**											
	#.##	**- represents firm capacity overloaded by over 25%**											
	#.##	**- represents the substation has been decommissioned**											

4.4.4 Possible Constraints

4.4.4.1 Greymouth Substation

Recording a maximum peak demand of around 13 MW consistently for the last five years and considering no significant loads are forecast for the next ten years the transformer may reach firm capacity by 2020 but it is unlikely to reach 125% capacity before 2025. Load growth for this substation is considered to be 2%.

4.4.5 Impact of Demand Management on Load Forecast

Ripple control of water heating forms a core part of Westpower's load management strategy and provides the ability to defer network expenditure in areas where asset loadings have exceeded available capacity at peak times. With the completion and commissioning of the High Voltage Direct Current (HVDC) upgrade in 2013, New Zealand effectively became a single reserves market, additional value may become available through the ability to bid interruptible load into the market.

On the other hand, recent regulatory changes may mean that interruptible load such as water heating is no longer directly available to distribution companies to use for load control purposes, without negotiating access to this load with individual consumers. The impact of this change is still being assessed, but it is unlikely to promote efficient demand side management.

There are estimated to be around 9,000 water heaters supplied by Westpower. Approximately half of these are on a fixed night-only ripple control programme that ensures they are not energised during coincident peak periods. The after diversity demand of the remaining water heaters in the Westpower network that are available for control by Westpower's load management system is estimated to total 4.5 MW at the time of the regional coincident peak on a cold winter's evening.

Westpower supports injection telegrams for both the older Plessey Rhythmatic receivers as well as newer Decabit units. However, Westpower does not own ripple control receivers and therefore has limited ability to control their installation and maintenance.

The ripple injection system is modern and well maintained, with significant redundancy built in through the use of time-synchronised simultaneous injection across all four ripple plants spread throughout Westpower's area. As a result of significant signal "spill", the failure of a single plant has a minimal impact on overall signal levels.

After-diversity loads used for forecasting load growth inherently take into account the ability to shed load at peak times, these demands are based on historical loading figures derived from actual network performance. This is particularly true for newer houses using electric water heating, as generous cylinder capacities are supplemented by additional virtual storage through the use of tempering valves, leading to the ability to supply the load fully off-peak with a night rate only tariff.

However, for existing installations with limited storage, the increasing effects of diversity result in a dilution of the amount of after diversity demand on the network and load available to shed at the time of local peak demands, as the loads are aggregated across zone substations, GXPs and entire regions.

Magnifying this phenomenon, changes to the transmission pricing methodology have led to Westpower becoming a part of a joint load control scheme driven by Orion that focuses on minimising the Regional Coincident Peak Demand (RCPD) on Transpower's upper South Island network, rather than just controlling Westpower's own peak demands at local GXPs. This change in philosophy has resulted in markedly different peak demand shedding behaviour, and the resulting impact on diversity and individual GXP peak demands is still being analysed.

Once these effects are more clearly understood, it may well result in Westpower moving back toward supplementary control of local GXP demand in addition to the upper South Island control scheme if there are tangible benefits to be had. The forecasts would then be updated accordingly. In the meantime, the load forecasts are based upon the current demand management regime of regional load control.

Moreover, as noted above, the impact of recent regulatory changes may make it more difficult for Westpower to utilise this form of demand-side management in the future because of the cost involved in accessing it.

In any case, because Westpower's network is generally unconstrained at the distribution and sub-transmission level, it is unlikely that even a significant change in demand management practices would have a discernible impact on short-to-medium term network investment decisions.

4.5 Distributed Generation

Distributed generation is electricity generation equipment connected to the customers' installations, and capable of generating electricity back to the electricity network, as well as supplying electricity for the customers' own use at the location it is installed.

Usually, it will be a fixed installation but it may be able to be disconnected and moveable if required. The installation will include all necessary protection equipment required for the safe operation of the distributed generation system.

Westpower's policy regarding distributed generation is to assist any individuals or organisations through the application process and allow the connection of distributed generation to its network. Westpower actively encourages distributed generation as a means of reducing system losses and improving both the reliability and quality of supply to the area.

Westpower will also ensure that any new distributed generation connected to its network will comply with all relevant statutory and regulatory requirements, and applicable safety standards.

The main framework for implementing this policy is established by Electricity Governance (Connection of Distributed Generation) Regulations 2007.

In the context of Westpower's guides for connection, distributed generation comprises:

- Systems of 10 kW or smaller capacity; and
- Systems of greater than 10 kW capacity.

Depending on the maximum capacity of the distributed generation to be installed, the application process differs significantly. For 10 kW or less of capacity, the application will be a one-stage process; for over 10 kW of capacity, it will be a two-stage process. Usually, distributed generation above 10 kW consists of diesel, wind or hydro-generators; is associated with industrial sites or as dedicated generation facilities while distributed generation below 10 kW consists of large arrays of solar panels or rotating plants such as wind turbines.

Any new distributed generation installation requires contractual arrangements to be put in place with a retailer to purchase any excess electricity generated. Westpower may then credit the retailer for the energy that is exported at the same price that the retailer is charged for the delivery of energy, providing a net benefit to the distributed generator.

Formal application forms are available to ensure that the appropriate information is provided to allow Westpower to approve connection to its network and ensure compatibility with the existing reticulation network.

Customers interested in developing such facilities are invited to contact ElectroNet Services Ltd in Greymouth to obtain a copy of the distributed generation information pack. This pack, which is also available on the Westpower website www.westpower.co.nz, provides valuable assistance in planning and engineering an acceptable solution.

4.6 Non-Network Options

A number of strategies are available for dealing with load increases, as shown in Table 4.7.

Table 4.7: Options for Handling Load Increases

Strategy	Application
Economic tariff structure models	These options include demand based tariffs, off peak discounts and penalties for poor power factor. By signaling the true marginal economic costs of network extensions, the consumer is able to respond to these pricing signals by modifying their consumption behaviour and reducing their costs. This is best applied in the case of marginal load growth where optimization of the network is able to unlock its full potential.
Demand Side Management	Demand side management is typically applied by means of ripple control switching of interruptible loads such as water heating and night store heaters. Westpower routinely applies this method to reduce regional peak demand, which assists Transpower in managing existing transmission constraints.
Line Drop Compensation	On long rural feeders where most of the load is situated toward the middle or far end of the feeder, line drop compensation is a valid means of improving receiving end voltage regulation and maximising the line capacity. This is generally not applicable for 11 kV feeders with distributed load as near end customers would be adversely affected by voltage rise. Cost effective, but only applicable in limited cases.
Distributed Generation	Distributed generation is actively encouraged throughout Westpower's network, but Westpower is reliant on others investing in this technology. Furthermore, unless the generation is very reliable, or sufficiently diverse, the network must still be sized to provide full load without the benefit of generation to cater for times when the generation is unavailable or being maintained. Distributed Generation is not seen as applicable where it is the only means to supply continuous loads, but may be used by a customer who is happy to put up with occasional interruptions or constraints.
Voltage Regulation	On long 11 kV or 33 kV feeders, voltage constraints can be dealt with by installing either continuously variable or stepped voltage regulators. Westpower applies this technology in areas where either marginal or step loads increases would otherwise result in unacceptable voltage profiles. These are routinely applied in Westpower's 33 kV or 11 kV networks to cater for an increase in dairy farm loading in the rural area.

Each of these options is carefully evaluated based on economic efficiency and technical performance. Wherever possible, capital intensive development is delayed until absolutely necessary, and non-asset intensive solutions are used where these are not incompatible with future development plans.

For instance, reactive support and/or voltage regulation is routinely employed to support dairy farming load growth in rural areas as this is far more cost-effective than overlaying with a higher voltage.

Where very short timeframes are involved and permanent solutions are not possible before the load comes on stream, demand side management is often employed by making at least part of the additional load interruptible until a long-term solution can be put in place.

Ignoring such increases, the first three solutions identified in the table, are essentially non-asset intensive.

Demand-based tariffs give the end-user strong incentives to reduce peak demand and maximise plant load factors. This results in less peak demand and better regulation on the Westpower network.

Use of demand side management is linked to the tariff structure, and allows the plant or Westpower to control its internal demand by shedding nonessential load at peak periods.

Line Drop Compensation (LDC) can be used in specific circumstances to boost the sending end voltage on a feeder to improve down-line regulation. This effectively increases the available capacity on a feeder.

Westpower has also installed capacitors at strategic points in the network where voltage constraints are present or imminent. In some cases, load growth for a particular installation is dependent upon increased reactive support, and the consumer is required to contribute to the capital expenditure involved.

Distributed generation is seen as an excellent means of reducing demand on the Transpower network and enhancing the performance of Westpower's distribution network. As such, Westpower actively supports this approach. A transparent pricing methodology is in place to ensure that there are low entry barriers for new generators, and, if large enough, that these new generators receive the full Avoided Cost of Transmission (ACOT) benefits that they are entitled to.

Technical requirements for connection of distributed generation are based on the industry standard EEA Guidelines.

The process that Westpower uses to identify and pursue economic and practical alternatives to conventional network augmentation in addressing network constraints is to consider each of the feasible alternatives discussed below in ascending order of cost and complexity until a solution is found that will meet the requirements of Westpower and its consumers, without conflicting with Westpower's medium and long-term planning requirements.

Westpower is open to the development of commercial arrangements that could defer the need for network investment (such as the voluntary curtailment of load by major consumers at times of network peak demand) and would welcome discussion with stakeholders on this matter.

4.7 Network Development Options

4.7.1 Reefton Network

No significant load growth is contained in the load forecast analysis for the Reefton area. The Reefton area is supplied by a strong transmission network with n-1 security, so further development will be limited to the distribution system.

The Oceana Gold mine supplied from the Reefton GXP ceased operations in early 2016. This has been reflected in the load forecast by reducing the Globe substation peak load from 5.7 MW to 1.3 MW in 2016, with a further reduction to 700 kW in 2017 to represent care and maintenance.

Notwithstanding any significant and unexpected load growth, the existing network should be adequate to handle on-going growth with no further strengthening of the sub-transmission or distribution networks required for the remainder of the planning period.

4.7.2 Greymouth Network

The final closure of the Pike River Coal Mine site and decommissioning of the Logburn and Pike substations, MV switchgear and 110 kV transmission line will see supply reduced to 11 kV to the portal and for amenities.

The closure of the Spring Creek Coal Mine near Rapahoe in 2012 has reduced the demand on the Dobson GXP by some 5 MW. Under the current economic circumstances, coal mining projects are given a relatively low probability weighting.

Muted base load growth and continuing expansion in the tourism industries will require minor capacity increases in the long term, but probably outside the planning horizon.

The existing Westpower 33 kV sub-transmission network can support expected load growth. The recent upgrading of the DOB-RFN-IGH line to 110 kV has also strengthened the supply from Inangahua in the north, significantly improving firm capacity into the area.

Older distribution lines will be repaired and refurbished or replaced as dictated by on-going condition assessment.

Voltage support measures, including the installation of capacitors and voltage regulators, will continue to be applied at strategic points in the network to maximise performance of the existing assets, improve power quality and reduce marginal losses.

Apart from the above, no other developments are proposed throughout the planning period.

4.7.3 Hokitika Network

The upgrade of the Westland Milk Products supply in 2002, comprising a new Westpower 2 x 15/20 MVA 66/33/11 kV substation in Hokitika, vastly improved both the capacity and security of supply to the town of Hokitika and surrounding districts, including all of South Westland. This also provided for continuing expansion at the factory site, along with downstream growth in the dairy industry in general. The loading of the transformer banks will be closely scrutinised, to ensure that n-1 security is maintained throughout the planning period.

Westland Milk Products is likely to continue with plans for step load increases throughout the planning period, and this will require some reconfiguration and possible augmentation of the 11 kV feeder cables into the plant, along with changes to the network within the plant itself.

As part of the WCGUP Project, Westpower installed a 14 MVAr switched capacitor bank on the 11 kV bus Hokitika substation. This provides reactive support in order to maintain and stabilise the voltage of Transpower's 66 kV transmission systems on the West Coast. The project was fully funded by Transpower, which took over the ownership of these capacitors in June 2010.

No other major network development is planned in this area for the remainder of the planning period.

4.7.4 South Westland Network

Major step load increases are conceivable in the Franz Josef area if a resurgent tourism industry should decide to invest heavily in new accommodation units. This has been made possible by the recent development of several large, new subdivisions in the area. Mitigating this driver, however, is an increase in concern around the proximity of Franz Josef and Fox Glaciers to the major Alpine Fault and the creation of a Fault Avoidance Zone by the Westland District Council that prevents development in some areas of these townships.

Westpower replaced and re-conductored the Hokitika-Waitaha section of the existing 33 KV line in 2012/13 and this is now in new condition with sufficient capacity for the foreseeable future, excluding any major generation developments. This line was, in fact, originally constructed as a 66 kV line and so has been re-insulated at the same voltage level in order to facilitate future conversion to the higher voltage, if and when this is required.

It is possible that the Hokitika-Harihari 33 kV line may be upgraded to 66 kV in 2018 or later, depending on whether a proposed hydro generation project in the Waitaha area goes ahead. If so, this may require further work or reconfiguration at the Ross and Waitaha substations.

Security of supply is always going to be a major concern in this area as it is fed by a very long single-circuit line, however, local hydro generation schemes such as the Wahapo and Amethyst Hydro Schemes play a significant role in improving security of supply to South Westland.

4.7.5 Westpower Substations

In 2010, Westpower commissioned its first Ground Fault Neutraliser (GFN) at the Greymouth substation as a public safety initiative which is expected to reduce the likelihood of fatal electric shock or damage to property in the event of network faults on the HV network.

During a ground fault, the GFN also maintains power supply to homes and businesses while field staff are dispatched to find and repair the problem, greatly improving the reliability of supply to consumers in this area. Transient or momentary faults can be neutralised as well, eliminating many cases of flickering lights and short-term interruptions to power supply.

Once a good track record of performance during fault situations over the next few years has been collected and analysed, the value and applicability of this technology to other substations in Westpower's network will be reassessed and further planning decisions will be made at that time.

Due to network insulation coordination issues, this is currently limited to a maximum correction period of one minute, after which the faulted feeder is tripped, but this is expected to be relaxed once further upgrading work on Westpower's distribution transformers in the area is completed.

Most of Westpower's older vacuum KFE 11 kV circuit breakers have been replaced with new G & W Viper-ST vacuum interrupter circuit breakers, leading to improved network reliability. This has been driven by a number of recent failures of this equipment, which cannot be predicted or adequately covered by an enhanced maintenance programme. It is expected that all will be replaced by 2017/18. At the same time, the old protection systems will be upgraded with new digital relays to improve sensitivity and selectivity.

4.8 Capital Projects

The following sections outline the capital projects, programmes and expenditure planned for each asset group for the 2016-2026 planning period. The level of detail in the descriptions provided is dependent on the stage in the planning process. The capital projects and programmes are categorised as either: development; enhancement or replacement. These categories are defined below.

4.8.1 Development

This is work which involves the installation of new assets in sites or configurations where none previously existed. This may also include substantial upgrade work (e.g. rebuilding a substation at a higher voltage) in which the original configuration is significantly altered or extended.

4.8.2 Enhancement

This is the replacement of an existing asset with a modern equivalent asset, which materially improves on the original asset, or modifications to an existing asset that have this effect. Specifically, this will include improvements to the existing asset configuration, which are undertaken with the purpose of:

- Further improving the inherent safety of the system (e.g. installing smoke/heat detectors and entry alarms in substations);
- Improving the level of customer service (e.g. increasing capacity by replacing a transformer with a larger unit, or adding an extra circuit to it to increase security);
- Improving economic efficiency or investing to improve the asset by reducing operating or maintenance costs (e.g. fitting vibration dampers to specific lines to reduce the rate of component deterioration);
- Improving environmental risk management (e.g. fitting oil containment facilities at substations); and
- Improving the corporate profile (e.g. landscaping station grounds, although this is also fully justifiable on the basis of reduced grounds maintenance).

Note that each aspect of improvement is related to a specific asset management performance driver.

4.8.3 Replacement

This covers the replacement of an existing asset with a modern equivalent asset providing similar capacity, or other aspect of service provided. Note that the asset need not be identical in capacity etc. but should be materially similar.

4.9 Sub Transmission Assets – Capital Projects and Programmes

4.9.1 Development

There are no developments planned for the 66 kV or 33 kV networks apart from that relating to decommissioning of Pike River Mine related infrastructure.

4.9.2 Enhancement

There are no enhancement projects planned for any of the sub-transmission networks during the 10 year planning period.

As a condition of the lease of Greymouth-Kumara 66 kV line to Transpower, a circuit rating of 35 MVA must be maintained. The current Dog ACSR conductor has a summertime rating slightly below this value and re-conductoring may be required in the future. Notwithstanding this, Transpower have yet to request full rating and it is very unlikely that load growth within the planning period will require the extra capacity.

With the exception of the possible installation of enhanced lightning protection, should this prove necessary, no enhancement programmes are planned for the Kumara-Kawhaka 66 kV line.

Enhancement of any of the concrete pole sections in the North Westland 33 kV network is not envisaged unless driven by a major load increase. In this case, reconductoring is the most likely activity.

The capacity of the existing Arnold-Dobson line is sufficient for the 3 MW Arnold power station to connect into the grid, but has no spare capacity. Any significant increase in the injection demand at this site above approximately 5 MW will require the Arnold-Dobson line to be upgraded by re-conductoring and partial pole replacement.

4.9.3 Replacement

Pole replacement has been budgeted for over the planning period both as part of both discrete projects such as the Greymouth-Kumara 66 kV line, Arnold-Dobson 33 kV line and Hokitika-Waitaha 33 kV line pole replacement project or as part of the ongoing condemned replacement programme.

No replacement is foreseeable on the concrete pole lines.

Tables 4.8 and 4.9 provide a summary of the sub-transmission projects (110, 66 and 33 kV) and the planned expenditure by category for this AMP period.

Table 4.8: Sub-transmission Capital Expenditure by Category ($'000)

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7185080 REPLACEMENT	**40013 - Subtransmission Condemned Pole Replacement**	**50**	**50**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**
	To ensure safety to workers and the public, and to reduce faults, poles must be replaced if failure is imminent. Replacement must be balanced with gaining the maximum life from poles, hence the emphasis on detailed assessment before poles are changed out. Previously, most sub-transmission poles replaced were included in projects that replaced sections of line deemed to be reaching replacement criteria. With the shift in asset management strategy to be more maintenance focused, only sub-transmission poles that have been proven to have reached the end of their operational life will be replaced. To prove this, thorough inspection, including scanning and analysis with the PortaSCAN XBS pole density scanning system, will be required. Fifty five sub-transmission poles have been identified to be in poor or worse condition using the traditional dig and probe method of assessment. Consideration must be given to PortaSCAN XBS results, which are very likely to significantly reduce the number of poles requiring replacement due to the more accurate assessment that the PortaSCAN XBS provides. From time to time, it may be more prudent to replace several poles in a section of line if considerations such as reconfiguration, landowner issues or outage restrictions warrant this										
7221677 REPLACEMENT	**ALD-DOB 33kV Pole Replacement**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**0**
	To ensure the ALD-DOB 33 kV line is up to standard a sum of $20,000 has been allocated for the replacement poles identified as reaching replacement criteria. The future of the section of line between Dobson and Arnold Valley Road is uncertain with a proposed development of the Arnold Power Station not yet materialising. A decision on the fate of this section of line is pending.										
7222032 REPLACEMENT	**Fox Hills - Replace 33 kV Poles**	**0**	**160**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
7199028 REPLACEMENT	**GYM-KUM 66 kV Pole Replacement**	**57**	**88**	**49**	**42**	**80**	**24**	**30**	**30**	**30**	**0**
	Built in 1977, the GYM-KUM 66 kV cct is critical to the security of supply to Greymouth and the surrounding areas. Should a pole fail, particularly in some of the more remote areas, security of supply to Greymouth could be compromised. In previous years, poles on the GYM-KUM 66 kV cct have been replaced in sections. However, a change in replacement strategy will see poles replaced only when the poles have been proven to be at the end of their serviceable life. A sum of $57,000 has been allocated to allow the replacement of three structures and one stub pole. As mentioned, the alternative to a pole-for-pole replacement strategy is that of sections of line being replaced as a 'project'. As this strategy is no longer supported, there are no other options available.										
7219133 REPLACEMENT	**HKK-WTH 33 kV Pole Upgrade (MacIntosh Ruatapu)**	**150**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	The hardwood pole line built originally by the State Hydro Commission in 1965 between the Hokitika substation (which replaced the old Arahura substation) and the Harihari substation had reached the end of its serviceable life with many of the poles found to be in very poor condition. Three years ago a project was initiated to replace the poles between Waitaha and Hokitika and the majority of the pole replacement project has been completed between the Waitaha substation and the Hokitika substation, however continuing discussions with a landowner has seen a delay replacing a section of line at Mananui. This section of line, comprising nine poles, may be relocated closer to the road. No alternate options are available, as this supply to South Westland is a spur line with only limited alternate feed via local generation.										
7221080 DEVELOPMENT	**Pike River Mine - Dis-establish 110 kV and 33 kV Line**	**150**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Due to Solid Energy's and the Department of Conservation's decision to abandon the Pike River mine site, the 33 kV and 110 kV lines supplying the zone substations may need to be decommissioned. This budget is to cover the costs of the removal of all 33 kV and 110 kV line assets supplying the site. This will also include establishing a new 11 kV supply to the Pike administration area, utilising existing assets where possible.										
7230727 REPLACEMENT	**Waiho River - Relocate 33 kV / 11 kV line from riverbed**	**92**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
7221859 REPLACEMENT	**Warrens Paddock - Replace Structures**	**50**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	The wooden 33 kV and 11 kV structures at Warrens Paddock near Taylorville support an integral link to the North via the Rapahoe and Ngahere substations. In particular, the 33 kV line to Rapahoe does not provide n-1 security, and the mines and surrounding townships rely heavily on this supply. At present, the structures could be deemed the weakest link for this critical line and although PortaSCAN result indicate the poles are in reasonable condition and should withstand normal loads placed upon them, the criticality of the aging structures deem this project necessary. At minimal cost, risk to this circuit could be achieved by replacing the structures.										

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Total		**569**	**318**	**89**	**82**	**120**	**64**	**70**	**70**	**70**	**20**

Table 4.9: Sub-transmission Capital Expenditure Summary ($'000)

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
DEVELOPMENT	150	0	0	0	0	0	0	0	0	0
REPLACEMENT	419	318	89	82	120	64	70	70	70	20
Total	**569**	**318**	**89**	**82**	**120**	**64**	**70**	**70**	**70**	**20**

4.10 Distribution Assets – Capital Projects and Programmes

4.10.1 Development

There are two distribution development projects planned within the next five years and both are dependent on preliminary studies as to whether the expenditure to improve the level of security is justified. An 11 kV line connecting the Kowhitirangi and Kokatahi supplies and the installation of an 11 kV cable at the Fox Glacier township to develop a ring feed are the two projects being explored.

4.10.2 Enhancement

There are no general enhancement projects or programmes planned.

4.10.3 Replacement

Condition assessment generally identifies distribution poles and conductors throughout the network that have reached the end of their serviceable lives and a replacement process allows these poles to be included in forecast budgets.

From time to time poles and conductors are identified as in need of immediate replacement and others can be programmed for replacement.

Tables 4.10 and 4.11 provide a summary of the distribution projects and programmes and expenditure for this planning period by category.

Table 4.10: Distribution Capital Expenditure by Category ($'000)

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7199959 REPLACEMENT	**11 kV Conductor Replacement**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
	Age has caught up with 11 kv conductors in a number of areas and these will require replacement. Areas in the coastal strip have been identified as needing replacement immediately and the condition assessment programme is continually identifying areas which may need attention. A programme will be initiated to determine the condition of conductors in more detail and a plan will be formulated to stage any replacement required.										
7222232 DEVELOPMENT	**Fox Glacier Township - Develop 11 kV Ring**	**0**	**50**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
7219607 DEVELOPMENT	**Kowhitirangi - Kokatahi 11 kV Tie Line Construction**	**0**	**0**	**75**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
7100563 REPLACEMENT	**Replace Condemned Distribution Poles**	**208**	**211**	**215**	**158**	**158**	**158**	**158**	**158**	**158**	**158**
	To ensure safety to workers and the public, and to reduce faults, poles must be replaced if failure is imminent. Replacement must be balanced with gaining the maximum life from poles, hence the emphasis on detailed assessment before poles are changed out. Previously, most distribution poles replaced were included in projects that replaced sections of line deemed to be reaching replacement criteria. With the shift in asset management strategy to be more maintenance focused, only distribution poles that have been proven to have reached the end of their operational life will be replaced. To prove this, thorough inspection, including scanning and analysis with the PortaSCAN XBS pole density scanning system, will be required. From time to time, it may be more prudent to replace several poles in a section of line if considerations such as reconfiguration, landowner issues or outage restrictions warrant this										
	Total	**308**	**361**	**390**	**258**	**258**	**258**	**258**	**258**	**258**	**258**

Table 4.11: Distribution Capital Expenditure Summary ($'000)

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
DEVELOPMENT	0	50	75	0	0	0	0	0	0	0
REPLACEMENT	308	311	315	258	258	258	258	258	258	258
Total	**308**	**361**	**390**	**258**	**258**	**258**	**258**	**258**	**258**	**258**

4.11 Distribution Substations – Capital Projects and Programmes

4.11.1 Development

The installation of new distribution substations is generally driven by regional development and mostly funded by developers. Westpower will however fund connection to the network, which includes purchase and connection of HV fuses to the 11 kV lines.

4.11.2 Enhancement

From time to time load increases at a customer premise or additional load due to local development will render the installed transformer incapable of supporting the demand required. Westpower funds the installation of larger capacity transformers to ensure voltages remain within allowable limits at each installation.

4.11.3 Replacement

As a distribution substation ages, replacement may become necessary to ensure all public safety and operational obligations are met. When this occurs, all componentry is replaced including the earthing system and fusing.

Tables 4.12 and 4.13 provide a summary of the distribution substation-related projects and planned expenditure by category for this AMP period.

Table 4.12: Distribution Substations Capital Expenditure by Category ($'000)

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7231394 REPLACEMENT	**Distribution Substation Replacement**	**30**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
7103716 ENHANCEMENT	**Increase Transformer Site Capacity (Uprate)**	**22**	**22**	**22**	**22**	**22**	**22**	**22**	**22**	**22**	**22**
	From time to time a transformer may have insufficient capacity for the load required and needs to be replaced with a higher capacity unit. Generally this is due to load increase, however occasionally voltage issues may prompt a transformer capacity increase. Funds are made available for costs incurred in replacing these transfomers.										
7104012 DEVELOPMENT	**New 11kV Connections (Network Extensions)**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**
	Westpower provides an 11 kV connection service which generally includes installation of appropriate fusing (network connection point) and physical connection to the network connection point. As with new service connections, new 11 kV connections are largely driven by development in the area. Numbers may vary, for example, 78 applications for 11 kV supply were processed in 2008 yet the number in subsequent years has reduced to less than 50. Given this variation, funding has been set at a median level over the last 4 years.										
7102696 DEVELOPMENT	**New Transformer Sites**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
	Installation of new distribution substations is generally dependant on consumer requests. As the distribution substation is by definition, the site on which a transformer is placed, the majority of funds required are met by the consumer. There are times however, when Westpower will fund new and replacement sites for reasons such as regulation compliance.										
Total		**105**	**75**	**75**	**75**	**75**	**75**	**75**	**75**	**75**	**75**

Table 4.13: Distribution Substations Capital Expenditure Summary ($'000)

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
DEVELOPMENT	53	53	53	53	53	53	53	53	53	53
ENHANCEMENT	22	22	22	22	22	22	22	22	22	22
REPLACEMENT	30	0	0	0	0	0	0	0	0	0
Total	**105**	**75**	**75**	**75**	**75**	**75**	**75**	**75**	**75**	**75**

4.12 Distribution Transformers – Capital Projects and Programmes

4.12.1 Development

New units are purchased to Westpower's purchasing specifications as required. Independent contractors installing new substations for customers may provide new units and hand them over to Westpower on commissioning, provided that test results are satisfactory and that they meet Westpower's purchasing specifications.

The only expenditure planned is for the funding of new transformers. Westpower fund transformers for any new connection that may require a unit along with any existing transformer that may need to be replaced due to poor condition or failure. All transformers are purchased to Westpower's purchasing specifications, which prescribe galvanised tanks, stainless steel fixings and oil sampling valves to minimise the cost of future maintenance.

Regional development rates largely determine the number of transformers required during any given year, as such budget forecasts are based on expected growth within the area.

4.12.2 Enhancement

Little enhancement work is carried out on distribution transformers, as these are essentially a standard module with no capacity for upgrading.

4.12.3 Replacement

As described above, there is no replacement of transformers.

Tables 4.14 and 4.15 provide a summary of the planned expenditure by category for distribution transformer-related projects during this AMP period.

Table 4.14: Distribution Transformers Capital Expenditure by Category ($'000)

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7797 DEVELOPMENT	**Purchase of Transformers**	**200**	**200**	**200**	**200**	**200**	**200**	**200**	**200**	**200**	**200**
	Distribution transformers are regularly purchased to replace existing transformers and also to accommodate new 11 kV connections. Factors including regional development and existing transformer condition determine the amount of funding required for the purchase of new transformers therefore the forecast estimate of costs is established by assessing the previous years spend.										
Total		**200**	**200**	**200**	**200**	**200**	**200**	**200**	**200**	**200**	**200**

Table 4.15: Distribution Transformers Capital Expenditure Summary ($'000)

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
DEVELOPMENT	200	200	200	200	200	200	200	200	200	200
Total	**200**	**200**	**200**	**200**	**200**	**200**	**200**	**200**	**200**	**200**

4.13 Reticulation Assets – Capital Projects and Programmes

4.13.1 Development

There is no development work planned for this period. Any development that does occur will be on the basis of new customer requirements.

New subdivisions often involve the development of reticulation networks that are handed over to Westpower on completion. In most cases, the developer builds these to Westpower's standards.

4.13.2 Enhancement

There are no enhancement projects for the planning period.

4.13.3 Replacement

No major capital works programmes are planned. The on-going Condition Assessment Programme may identify replacements for later years. Replacement programmes for reticulation poles and pillar boxes are similar to the distribution pole process described previously, where provision is made for both programmed and immediate replacement.

Tables 4.16 and 4.17 provide a summary of the planned expenditure by category for reticulation related projects during this AMP period.

Table 4.16: Reticulation Capital Expenditure by Category ($'000)

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7167785 REPLACEMENT	**Pillar Box Replacement**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**
	With LV pillar boxes easily accessible to the public, efforts must be made to ensure these assets are kept safe and secure. It is necessary to replace damaged or condemned pillar boxes to ensure an acceptable condition standard is upheld. As with poles, LV pillar boxes are subject to condition deterioration or may be damaged and require replacement. As these pillars are identified they are replaced.										
7100886 REPLACEMENT	**Replace Condemned Reticulation Poles**	**37**	**39**	**34**	**42**	**29**	**29**	**29**	**29**	**29**	**29**
	To ensure safety to workers, the public and to reduce faults, poles must be replaced if failure is imminent. Replacement must be balanced with gaining the maximum life from poles, hence the emphasis on detailed assessment before poles are changed out. As with the sub-transmission poles, and distribution poles, reticulation poles have been included in projects that replaced sections of line that were deemed to be reaching replacement criteria. With the shift in asset management strategy to be more maintenance focused, only reticulation poles that have been proven to have reached the end of their operational life will be replaced. To prove this, thorough inspection, including the scanning and analysis with the PortaSCAN XBS pole density scanning system will be required. From time to time it may be more prudent to replace several poles in a section of line if considerations such as re-configuration, landowner issues or outage restrictions warrant this.										
Total		**57**	**59**	**54**	**62**	**49**	**49**	**49**	**49**	**49**	**49**

Table 4.17: Reticulation Capital Expenditure Summary ($'000)

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
REPLACEMENT	57	59	54	62	49	49	49	49	49	49
Total	**57**	**59**	**54**	**62**	**49**	**49**	**49**	**49**	**49**	**49**

4.14 Services – Capital Projects and Programmes

4.14.1 Development

Westpower provides new connection services which are largely driven by development in the area. An annual budget is provided to cover the cost of this, with funding set at a median level over the planning period.

4.14.2 Enhancement

There are no enhancement programmes and projects.

4.14.3 Replacement

Funding over the planning period allows for the on-going replacement of service poles.

Tables 4.18 and 4.19 provide a summary of the service-related projects and planned expenditure by category for this AMP period.

Table 4.18: Services Capital Expenditure by Category ($'000)

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
4023 DEVELOPMENT	**New Service Installations (New Connections)**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**
	Westpower provides connection service which generally includes installation of appropriate fusing (network connection point) and the physical connection to the network connection point. New connections are largely driven by development in the area. Numbers may vary, for example 309 applications for supply were processed in 2008 yet numbers have declined to less than two hundred in subsequent years. Given this variation, funding has been set at a median level over the last four years.										
5499 REPLACEMENT	**Service Pole Replacement**	**81**	**72**	**73**	**69**	**69**	**69**	**51**	**51**	**51**	**51**
	Service poles found to be condemned must be replaced to ensure a safe and reliable supply to the consumer. Previous years have seen a concerted effort to rid the network of sub-standard service poles. Although many have been replaced there are still service poles deemed condemned during the condition assessment. As safety and security of supply are the primary drivers for the replacement of service poles, there are no alternative options available.										
	Total	**131**	**122**	**123**	**119**	**119**	**119**	**101**	**101**	**101**	**101**

Table 4.19: Services Capital Expenditure Summary ($'000)

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
DEVELOPMENT	50	50	50	50	50	50	50	50	50	50
REPLACEMENT	81	72	73	69	69	69	51	51	51	51
Total	**131**	**122**	**123**	**119**	**119**	**119**	**101**	**101**	**101**	**101**

4.15 Zone Substations – Capital Projects and Programmes

4.15.1 Development

All development projects are dependent either on new investment agreements being reached with large customers or a clear economic justification.

In this planning period, the only development projects are the decommissioning of the Logburn and Pike zone substations.

4.15.2 Enhancement

There are several enhancement projects planned for the first half of the planning period, the largest of these being the Hokitika substation upgrade.

The age profile of Westpower's zone substations is such that only minimal enhancement expenditure is required throughout the planning horizon. The capacity of most of the assets is sufficient to handle normal expected load growth over the next ten years. Projected load growth in the Hokitika area may require the installation of an additional zone transformer by 2020.

4.15.3 Replacement

There are a number or replacement projects planned throughout the planning period. The largest replacement project for the 2016/2017 year is the Arnold Station T1 and 2412 Protection Upgrade.

The protection upgrade expenditure planned over the planning period is mainly in the following areas:

- Replacement of outdoor junction boxes;
- Replacement of aged feeder protection, panels and controls;
- Seismic strengthening of protection panels; and
- Installation of Direct Current (DC) monitoring and distribution panels.

As the Fox T1 and Dobson T6 transformers are nearing the end of their serviceable lives, a sum for replacement of each of these transformers has been allowed for 2020/21 and 2021/22 respectively. Similarly a sum for replacement of Greymouth T1 and T2 has been allowed for 2025/2026.

Replacement of protection relays due to obsolescence is scheduled within the planning period for the Ross and Waitaha substations.

Tables 4.20 and 4.21 provide a summary of the zone substation projects and the planned expenditure by category during the AMP period.

Table 4.20: Zone Substations Capital Expenditure by Category ($'000)

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7222269 REPLACEMENT	**ALDT1 and 2412 Protection Upgrade**	75	0	0	0	0	0	0	0	0	0
	Arnold T1 protection is the older type Combiflex protection. It is proposed to replace this protection with a modern SEL relay. This will ensure that the protection is standardised as per Westpower's other zone substations. Also the project is timed to coincide with CB2412 protection upgrade, thus ensuring better utilisation of Westpower resources and reducing the shutdown period required. Replacement of the older combiflex relays with the modern SEL relays was considered the best option. Arnold is one of the few remaining zone substations left with these relays. The relays are now ageing and compared with new modern SEL relays they have limited protection grading and no remote interrogation. This upgrade will bring the protection at Arnold in line with other new and upgraded zone substations.										
7222169 ENHANCEMENT	**Back-up Control Room**	50	0	0	0	0	0	0	0	0	0
	The Westpower control room is located at the Tainui Street depot. Control room operators are able to monitor the day to day operation of the network along with remote access and operation of key assets via the SCADA and communications networks. A back-up control room would be required in the event of an emergency where the control room is out of action or access is restricted. This is now standard practice for most network companies. Investigation is still continuing as this ties in with the outage management and SCADA replacement investigations which is currently in progress.										
7232139 REPLACEMENT	**Blackwater Protection Upgrade**	0	0	0	0	0	0	0	0	0	150
	The Blackwater zone substation was built in 2011. Due to the on-going development in communications and technology, the expected life of digital protection relays is 15 years. The sum of $150,000 has been allowed to complete this upgrade. Detailed analysis and costing will be conducted closer to the time.										
7232131 DEVELOPMENT	**Decommission Globe Zone Substation and Circuit**	0	0	150	0	0	0	0	0	0	0
	Due to Oceania decision on the Globe mine, Globe zone substation and associated circuits are to be decommissioned. This budget is to cover the costs of the removal of all assets and associated buildings/equipment from the site.										
7218594 REPLACEMENT	**Dobson Zone Substation - Replace T6 (TX:2240)**	0	0	0	0	0	757	0	0	0	0
	DOBT6 is reaching the end of its serviceable life. A sum has been allocated to replace this transformer in 2021/22. Detailed analysis and costing will be conducted closer to the time.										
7218580 REPLACEMENT	**Dobson Zone Substation Protection Upgrade**	0	0	0	0	0	0	0	300	0	0
	The sum of $300,000 has been allocated to complete the upgrade of the Dobson zone substation to allow for the on-going development in communications and technology of digital protection relays. Detailed analysis and costing will be conducted closer to the time.										
7222180 ENHANCEMENT	**ETAP Upgrade**	20	0	0	0	0	0	0	0	0	0
	ETAP is a power system modelling programme used as a tool to determine load flows and power quality on the network. To optimise this programme an upgrade is planned for ETAP which will include a module for GIS.										
7218592 REPLACEMENT	**Fox Zone Substation - Replace T1 (TX:2438)**	0	0	0	0	757	0	0	0	0	0
	FOXT1 is reaching the end of its serviceable life. A sum has been allocated to replace this transformer in 2020/21. Detailed analysis and costing will be conducted closer to the time.										
7232283 REPLACEMENT	**GYM82 CT Replacement**	15	0	0	0	0	0	0	0	0	0
	The insulators on the GYM82 CTs have sustained damage due to vandalism over time. The CTs removed from GYM102 in 2015 as part of the Transpower project have been refurbished. It is planned to replace the GYM82 CTs with these refurbished CTs.										
7232133 REPLACEMENT	**GYMT1 and T2 Replacement**	0	0	0	0	0	0	0	0	0	700
	GYMT1 and T2 are reaching the end of their serviceable life. A sum has been allocated to replace the transformers in 2025/26. Detailed analysis and costing will be conducted closer to the time.										

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7222529 REPLACEMENT	**Greymouth Protection Upgrade**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**390**	**0**
	The Greymouth zone substation protection equipment was replaced in 2009/10. Due to the on-going development in communications and technology, the expected life of digital protection relays is 15 years. The sum of $390,000 has been allowed to complete this upgrade. Detailed analysis and costing will be conducted closer to the time.										
7232136 REPLACEMENT	**Harihari Protection Upgrade**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**150**
	The Harihari zone substation protection equipment was replaced in 2010/11. Due to the on-going development in communications and technology, the expected life of digital protection relays is 15 years. The sum of $150,000 has been allowed to complete this upgrade. Detailed analysis and costing will be conducted closer to the time.										
7218528 REPLACEMENT	**Hokitika Protection Upgrade - Design, Installation and As Built Drawings**	**0**	**41**	**324**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	The Hokitika zone substation was commissioned in 2002. Due to the on-going development in communications and technology, the expected life of digital protection relays is 15 years. $41,000 has been allowed for in 2017/18 for design/drawings, etc. The sum of $324,000 has been allowed to complete this upgrade in 2018/19. Detailed analysis and costing will be conducted closer to the time.										
7218264 ENHANCEMENT	**Hokitika Zone Sub - Install new T3, 66 & 11 kV CBs - Load Growth**	**0**	**82**	**0**	**1,767**	**0**	**0**	**0**	**0**	**0**	**0**
	Due to projected load growth in the Hokitika area, a third zone transformer is required to accommodate this additional load. A budget has been allocated to install a new T3 transformer, protection, 66 and 11 kV circuit breakers at Hokitika zone substation. $82,000 has been allowed in 2017/18 for design drawings with $1,767,000 allocated for the project completion in 2019/20. Detailed analysis and costing will be conducted closer to the time.										
7209326 ENHANCEMENT	**New Security Cameras for Zone Substations**	**15**	**15**	**15**	**15**	**15**	**0**	**0**	**0**	**0**	**0**
	A programme is in place to install security cameras at all zone substations to help increase security especially at remote locations. This will enable remote monitoring of these locations from the Westpower control room. Cameras are to be installed at 2 locations per year over several years until all zone substations are being monitored.										
7218578 REPLACEMENT	**Reefton Zone Substation Protection Upgrade**	**0**	**0**	**0**	**0**	**0**	**0**	**309**	**0**	**0**	**0**
	The Reefton zone substation was commissioned in 2005. Due to the on-going development in communications and technology, the expected life of digital protection relays is 15 years. The sum of $309,000 has been allowed to complete this upgrade. Detailed analysis and costing will be conducted closer to the time.										
7218596 REPLACEMENT	**Replace HHI R1 & T1 (Load Growth)**	**0**	**0**	**0**	**0**	**309**	**0**	**0**	**0**	**0**	**0**
	Due to projected load growth in the Harihari area, a contingency budget has been allowed to replace the existing regulator and transformer at Harihari zone substation. Detailed analysis and costing will be conducted closer to the time.										
7232281 REPLACEMENT	**Replacement of Rapahoe Perimeter Fence**	**25**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	The foundation of the perimeter fence at Rapahoe zone substation is starting to deteriorate due to slumping around the eastern side. To ensure security is maintained to the site work is to be carried out to repair this damaged section of the foundation and replace sections of the fence that have corroded due to the coastal environment the substation is located in.										
7218583 REPLACEMENT	**Ross Zone Substation - Replace CB 1 & 3 with Vipers and Upgrade Protection**	**0**	**130**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	KFE type reclosers have proven to be unreliable of late. Their setting selection is limited and there have been several auxiliary switch failures. Ross CB1 and 3 Cooper oil-filled reclosers are to be replaced with Viper vacuum reclosers. Protection will be upgraded with a SEL351S type relay enabling better fault analysis, protection settings, load trending and SCADA communications. Alternative options were considered including on-going basic maintenance and refurbishment of the unit. Maintenance costs of the oil-filled reclosers have increased considerably in recent years. Reclosers have been repaired with new parts but still proved to be unreliable, resulting in high maintenance costs and unnecessary power outages. Modern vacuum reclosers are reliable and have minimal or no maintenance costs. A planned replacement of the Cooper oil-filled reclosers with new Viper reclosers with SEL relays was considered the most cost-efficient option.										

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7218428 REPLACEMENT	**Ross Zone Substation - Replace Regulator With Single Phase Units**	**0**	**0**	**0**	**0**	**0**	**151**	**0**	**0**	**0**	**0**
	Replace existing three-phase regulator with three single-phase regulators. Detailed analysis and costing will be conducted closer to the time.										
7218585 REPLACEMENT	**Ross Zone Substation - T1 Protection Upgrade**	**0**	**98**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Ross T1 protection is the older type Combiflex protection. It is proposed to replace this protection with a modern SEL relay. This will ensure that the protection is standardised as per Westpower's other zone substations. Also the project is timed to coincide with CB1 and 3 replacement and protection upgrade, thus ensuring better utilisation of Westpower resources and reducing shutdown period. Replacement of the older combiflex relays with the modern SEL relays was considered the best option. Ross is one of the few remaining zone substations left with these relays. The relays are now ageing and compared with new modern SEL relays they have limited protection grading and no remote interrogation. This upgrade will bring the protection at Ross in line with other new and upgraded zone substations.										
7232129 ENHANCEMENT	**SEL Event Reading Software**	**10**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Currently Westpower uses SEL5040 accelerator report server. All new relays are not supported by this software. It is planned to upgrade to SEL5045 accelerator team software, which will support all existing and new relays. Additionally SEL5045 provides software to accelerate root-cause fault analysis by automatically collecting events from SEL protection relays as soon as they occur. As well as event analysis, it is capable of other functions such as system performance monitoring, email notification, power quality reports, etc.										
7223020 DEVELOPMENT	**Solid Energy - Logburn Decommissioning**	**250**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Due to Solid Energy's and the Department of Conservation's decision in relation to the Pike River mine, Logburn zone substation is to be decommissioned. This budget is to cover the costs of the removal of all assets and associated buildings/equipment from the site.										
7218590 REPLACEMENT	**Waitaha Zone Substation - Replace CB1 and Protection Relay**	**0**	**0**	**98**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	KFE type reclosers have proven to be unreliable of late. Their setting selection is limited and there have been several auxiliary switch failures. CB1 Cooper oil-filled recloser is to be replaced with a Viper recloser. Protection will be upgraded with a SEL351S type relay enabling better fault analysis, protection settings, load trending and SCADA communications. Alternative options were considered including on-going basic maintenance and refurbishment of the unit. Maintenance costs of the oil-filled reclosers have increased considerably in recent years. Reclosers have been repaired with new parts but still proved to be unreliable, resulting in high maintenance costs and unnecessary power outages. Modern vacuum reclosers are reliable and have minimal or no maintenance costs. A planned replacement of the Cooper oil-filled reclosers with new Viper reclosers with SEL relays was considered the most cost-efficient option.										
7218587 REPLACEMENT	**Waitaha Zone Substation - Replace Regulator with Single Phase Units**	**0**	**27**	**173**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	The existing 1 MVA induction regulator was purchased second-hand from Transpower in the early 1990s. The manufacture date is unknown but is thought to be in excess of 60 years. It is proposed to replace the existing three-phase unit with three single-phase units. Due to its close proximity to the sea and the high rainfall in the area, the regulator has started rusting around the bottom and needs attention. Dissolved Gas Analysis (DGA) tests also indicate that the unit requires replacing. It has been decided not to carry out any expensive repairs on this regulator. With three single-phase units installed, the regulator would be as per Westpower's standard design, (spares are already in stock) and would provide more reliable voltage support, with room for future growth in the area. Remote operation can be achieved through SCADA communications, which is unable to be accomplished with the current regulator. SCADA communications are already established at the zone substation. $27,000 has been allowed for design/drawings for 2017/18 with the remaining $173,000 to complete the project in 2018/19. Refurbishment of the existing unit was considered but due to the age of the unit, difficulty sourcing parts and costs of refurbishment and future maintenance, the most viable option was to replace the unit with single phase units as per other Westpower locations.										

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7134405 REPLACEMENT	**Zone Substation Battery Replacement Programme**	**25**	**28**	**35**	**36**	**55**	**44**	**15**	**25**	**28**	**35**
	Battery banks provide supply to protection relays and SCADA communications during any outages at zone substations. These are designed to ensure they can maintain a continuous DC supply for a minimum period of 24 hours. The size of the battery banks varies depending on the size of the zone substation. A programme is in place to replace battery banks at all zone substations after they have reached 7 years as per Westpower guidelines and industry best practice. This programme runs for the duration of the AMP 10 year period. The costs each year vary depending on which zone substation battery banks are due to be replaced.										
Total		**485**	**421**	**795**	**1818**	**1136**	**952**	**324**	**325**	**418**	**1035**

Table 4.21: Zone Substations Capital Expenditure Summary ($'000)

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
DEVELOPMENT	250	0	150	0	0	0	0	0	0	0
ENHANCEMENT	95	97	15	1782	15	0	0	0	0	0
REPLACEMENT	140	324	630	36	1121	952	324	325	418	1035
Total	**485**	**421**	**795**	**1818**	**1136**	**952**	**324**	**325**	**418**	**1035**

4.16 MV Switch Gear – Capital Projects and Programmes

4.16.1 Development

Budgets have been allowed throughout the planning period for the installation of reclosers on main and spur lines. Reclosers are pole-mounted circuit breakers, which automatically isolate a faulted section of the line from the rest of the network. Where a large radial network exists, reclosers are often fitted on spur lines to prevent the main line from tripping out due to a spur line fault. The addition of extra reclosers to the network improves system reliability and fault selectivity. Justification of each project is carried out on a case-by-case basis.

Voltage support utilising capacitors on the Westpower network has had varied success. At night, when the load is low, capacitors may not be required, but are required at peak load times. A study has identified a cost-effective solution to automate the switching in and out of existing capacitor banks as required to provide this voltage support.

4.16.2 Enhancement

Ongoing funding is provided throughout the planning period for the fusing of spur lines off feeders/lines classified as F1 or F2 in order to improve security of supply. Ongoing funding over the planning period is also provided for the automation and upgrade of various disconnectors which will also provide significant benefits to the network.

4.16.3 Replacement

Westpower has series 2 type oil filled Andelect switch units. There are three of these units remaining. A programme is in place to gradually replace these units over the next 3-4 years.

A budget has been allocated for disconnector replacement when they have been identified as reaching the end of their economical and serviceable life. The disconnector maintenance programme helps identify such disconnectors.

Automated switchgear and reclosers generally have batteries installed to allow for operation during power outages. These are replaced after a 5 year life cycle as per Westpower guidelines.

Tables 4.22 and 4.23 provide a summary of the MV switchgear-related projects and the planned expenditure by category for during this AMP period.

Table 4.22: MV Switchgear Capital Expenditure by Category ($'000)

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7153074 DEVELOPMENT	**Automate Capacitors at Various Locations**	**35**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Westpower have installed capacitors throughout the 11 kV network to help maintain voltage levels in areas where there is a large industrial load or where there is load on a long feeder. However voltages can rise when this significant load is reduced e.g. at night when production ceases, or when planned maintenance is carried out and the load is reduced. At present, the capacitors are in service at all times. After a detailed study, a solution to automate existing capacitor locations on the network was found. The first site was selected and trialled in 2013 providing voltage support during the outage for the Kumara project and worked successfully. With automation, the capacitors are taken out of service when the voltage increases or by remote control from the control room via SCADA. This will help Westpower maintain the voltage within regulated limits at all times. For new locations the installation of a Statcom is currently being assessed as an alternative to capacitor banks. One site per year will be automated. An investigation will be conducted to select the optimum existing or new location to automate. Alternatives considered were keeping the status quo with the capacitor banks in service at all times or changing the size of the capacitor banks. Complaints from consumers would still be experienced with the status quo. One location has been downsized and the voltages have stayed within regulated limits at all times. However this is not viable for all locations so the option to automate capacitor banks was deemed the best option. During the investigation stage for determining locations, both options of automation and downsizing will be considered.										
7105225 REPLACEMENT	**Disconnector Replacement**	**39**	**39**	**39**	**39**	**39**	**39**	**39**	**39**	**39**	**39**
	Disconnectors normally fail due to deterioration of the operating arms with corrosion, or from an arc developing across two or more phases. By identifying under-rated or defective disconnectors and replacing these, the incidence of arcing faults should be reduced. This is an on-going programme with funds allocated each year. With the disconnector maintenance programme in place, disconnectors are identified that are more cost efficient and safer to replace than to maintain, therefore the number of disconnectors to be replaced varies from year to year. This budget allows for disconnector replacement when they have been identified as reaching the end of their economic and serviceable life.										
7175972 ENHANCEMENT	**Fusing of Spur Lines by Feeder Classification**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**
	A detailed study has been conducted to classify all feeders and lines on the Westpower network. The reason for classifying these feeders and lines was to help determine what level of security was required to maintain supply to these feeders/lines. Factors taken into account included: feeders with hospitals; CBDs, commercial and large industrial customers; feeder sections with high SAIDI histories; critical sub transmission lines with no alternative means of supply; sections already protected by reclosers/sectionalisers or fused; and vegetation. These feeders/lines were classified ranging from F1 (Critical), F2 (Very High) through to F5 (Low). Over the next few years, it is planned to fuse all possible spur lines off feeders/lines classified as F1 and F2.										
7103818 ENHANCEMENT	**Install Automation to Various Disconnectors**	**39**	**39**	**39**	**39**	**39**	**39**	**39**	**39**	**39**	**39**
	Remote automated disconnectors have provided significant benefits to the network, and allow controllers to open and close switches without having to call on standby staff. Each year, Westpower is upgrading selected strategic switches with automated units. All new automation is to be achieved with the use of ENTEC load break switches or the disconnector actuator units designed by Westpower. The next best option was to fit motor drive units to disconnectors. This was rejected as motor drive units have proven to be unreliable when required for operation. They can sit for long periods of time and external parts seize up. ENTEC switches have no external moving parts, have internal CTs and VTs, are competitively priced, and provide fault selectivity and fault interrogation. Installing ENTEC load break switches at identified locations was considered the best option.										
7104674 DEVELOPMENT	**New Disconnectors**	**34**	**34**	**34**	**34**	**34**	**34**	**34**	**34**	**34**	**34**
	Several new disconnectors are to be installed to further sectionalise the network and to reduce the number of customers affected by 11 kV switching operations. These disconnector installations will also assist with the isolation of faults.										
7132604 DEVELOPMENT	**New Main Line Recloser Sites**	**0**	**0**	**0**	**60**	**0**	**0**	**0**	**0**	**60**	**0**
	Main line reclosers are being strategically positioned throughout the Westpower network to reduce the number of consumer outages incurred during faults, thus reducing SAIDI. A budget of $60,000 has been allowed every 4 years to install new main line reclosers in areas when identified.										

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7129659 DEVELOPMENT	**New Reclosers on various Spur Lines**	**16**	**16**	**16**	**16**	**16**	**16**	**16**	**16**	**16**	**16**
	Reclosers are being strategically positioned throughout the Westpower network to isolate problematic spur lines, reduce main line trippings and reduce inconvenience to consumers and SAIDI. Reclosers are being fitted to spur lines, where the number and size of consumers are too great to fit DDOs. As new locations are identified each year it is proposed to install refurbished KFME type reclosers to these locations. The addition of extra reclosers to the network improves system reliability, fault selectivity, unplanned outages, SAIDI and customer satisfaction.										
7232285 ENHANCEMENT	**Recloser Relay Upgrade**	**128**	**128**	**128**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	SEL651R relays are used as protection devices for all viper vacuum reclosers installed in the network. A new feature is the ability of the relays to detect and clear high-impedance faults that conventional overcurrent elements may not detect. This situation has happened in the past where live conductors have made contact with the ground and the upstream protection has not operated. The new feature helps in detecting and clearing high-impedance faults, improves reliability in the system and improves public safety. This is available with all new relays or by upgrading any existing relay. It is planned to purchase 3 new relays and upgrade all existing relays in the Westpower network with this feature. All alternatives were considered including replacement of all the existing relays. This option was rejected due to costs. The best solution is to purchase 3 new relays and implement a programme to upgrade all 29 relays in the network over a 3 year period. This will allow for the existing relays to be sent to the USA for upgrading, maintain protection for all viper reclosers and ensure Westpower have sufficient relays for critical spares.										
7146022 REPLACEMENT	**Remote Location Battery Replacement Programme**	**12**	**11**	**8**	**7**	**10**	**12**	**11**	**8**	**7**	**10**
	A five-year replacement programme is in place for batteries at remote locations in the network. This is an on-going programme and funds have been allocated to achieve this.										
7102188 REPLACEMENT	**Ring Main Unit (RMU) Replacement**	**30**	**45**	**40**	**40**	**0**	**0**	**0**	**40**	**0**	**0**
	A number of oil-filled RMUs have been identified as reaching replacement age due to increasing maintenance costs and health and safety concerns. A budget has been allowed for a progressive replacement programme.										
	Total	**353**	**332**	**324**	**255**	**158**	**160**	**159**	**196**	**215**	**158**

Table 4.23: MV Switchgear Capital Expenditure Summary ($'000)

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
DEVELOPMENT	85	50	50	110	50	50	50	50	110	50
ENHANCEMENT	187	187	187	59	59	59	59	59	59	59
REPLACEMENT	81	95	87	86	49	51	50	87	46	49
Total	**353**	**332**	**324**	**255**	**158**	**160**	**159**	**196**	**215**	**158**

4.17 SCADA and Communications - Projects and Programmes

4.17.1 Development

SCADA development typically follows the Stations protection upgrades projects. As these new protection devices are installed into the electricity network, communication projects cover the engineering and SCADA requirements for the new equipment.

4.17.2 Enhancement

Since GE Digital recently purchased RealFlex and have advised Westpower that they will no longer be developing the software, a major enhancement project has been initiated to investigate and if necessary replace the current SCADA system with a suitable system, and if possible, one that includes an outage management package.

There are also several small upgrade jobs planned for the SCADA and communication systems throughout the planning period.

4.17.3 Replacement

Communications equipment has, in general, a shorter life expectancy than heavy electrical equipment. Typically electronic equipment reaches technical obsolescence in 5-10 years although the equipment can in general be supported in service for 10-15 years.

Tables 4.24 and 4.25 provide a summary of the SCADA and Communications related projects and the planned expenditure by category for this AMP period.

Table 4.24: SCADA and Communication Capital Expenditure by Category ($'000)

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7220621 ENHANCEMENT	**Advanced Distribution Management System**	990	680	200	150	0	0	0	0	0	0
	The existing SCADA system has been running virtually unchanged for the last 20 years supported by regular software upgrades and hardware replacement, but GE has recently acquired the software from the previous software supplier and advised that the system will be going end-of-life in the near future. Therefore, a high level budgetary provision starting in 2016-2017 to cover likely costs, based on discussions with other companies who have recently replaced their systems. The total value of this upgrade will be of the order of $2 million spread across four years, but a more accurate figure will be developed following a scoping exercise that is currently in progress.										
7223482 ENHANCEMENT	**Arnold Zone Substation CB 3 & 4 with Vipers and Upgrade Protection**	10	0	0	0	0	0	0	0	0	0
7232147 ENHANCEMENT	**Blackwater Protection Upgrade**	0	0	0	0	0	0	0	0	0	25
7220488 REPLACEMENT	**Comms Battery Replacement**	15	30	30	30	30	30	30	30	30	30
	Most control devices in the Westpower network are supplied from batteries, so that during a power failure the device will operate as expected. These batteries are regularly discharge tested and when found to be nearing the end of their life, are replaced. This budget allows for new batteries to be purchased.										
7220513 DEVELOPMENT	**Comms to Automate Capacitors**	15	0	0	0	0	0	0	0	0	0
	This programme follows the Stations programme of installing capacitors throughout the 11 kV network to help maintain voltage levels in areas where there is a large industrial load or where there is load on a long feeder. Each site will require a communications path as alarms and indication will be monitored by Westpower's SCADA system.										
7220560 ENHANCEMENT	**Comms to MV Switchgear**	15	15	15	15	15	15	15	15	15	15
	This programme follows the stations program of installing automation to disconnectors. Remote automated disconnectors have provided significant benefits to the network, and allow controllers to open and close switches without having to call on standby staff. Each year, Westpower is upgrading selected strategic switches with automated units.										
7220516 DEVELOPMENT	**Comms to MV Switchgear Disconnector Automation & New Reclosers**	20	20	40	20	20	20	20	20	20	0
	This programme follows the Stations programme of installing new switching or protection equipment throughout the 11 kV network. Each site will require a communications path as alarms, control and indication will be monitored by Westpower's SCADA system.										
7220546 DEVELOPMENT	**Comms to field equipment for engineering and SCADA access**	40	40	40	40	40	40	40	40	40	0
	With the continual development of smarter field equipment, this programme has been set up to give access for Westpower engineers in the office to read and configure field equipment, and also where required to develop new indications and alarms for SCADA.										
7222534 DEVELOPMENT	**Communication network development programme**	20	45	45	45	45	45	45	45	45	0
	Programme to be put in place to ensure new communication sites are developed when required.										
7220640 ENHANCEMENT	**Communication network refurbishment programme**	15	80	110	110	110	110	110	110	110	0
	Programme to be put in place to ensure existing communication sites are updated to modern best practices.										
7220652 ENHANCEMENT	**Convert Abbey Sites to Digital IP Sites**	20	20	20	20	0	0	0	0	0	0
	The conversion of Abbey analogue sites to digital IP sites has the benefit of allowing engineering access from the office to field equipment, it also improves speed of indication.										
7220510 ENHANCEMENT	**Dobson Zone Substation T6 and Protection Uprotection Upgrade**	0	0	0	0	0	45	0	20	0	0
	Stations have planned projects in Dobson substation in T6 replacement 2021-22 and protection upgrade 2023-2024. A comms budget has been allocated for modification of the communications links and SCADA for these projects.										
7220509 ENHANCEMENT	**Fox Zone Substation T1 upgrade**	0	0	0	0	45	0	0	0	0	0
7232145 ENHANCEMENT	**GYMT1 and T2 Replacement**	0	0	0	0	0	0	0	0	0	40

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7222547 ENHANCEMENT	**Greymouth Protection Upgrade**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**45**	**0**
7232146 ENHANCEMENT	**Harihari Protection Upgrade**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**25**
7220511 ENHANCEMENT	**Harihari Zone Substation R1 & T1 upgrade**	**0**	**0**	**0**	**0**	**45**	**0**	**0**	**0**	**0**	**0**
7220505 ENHANCEMENT	**Hokitika Zone Sub - Install new T3, 66 & 11 kV CB's Protection upgrade**	**0**	**10**	**0**	**40**	**0**	**0**	**0**	**0**	**0**	**0**
	Stations have planned projects in Hokitika substation in 2017-2018 and 2019-2020. In 2017-2018 a major protection upgrade is planned and in 2019-2020 a third zone transformer will be added. A comms budget has been allocated for modification of the communications links and SCADA for these projects.										
7220502 DEVELOPMENT	**Mt Bonar Repeater Development**	**60**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Westpower identified this site as a critical repeater site and in 2015-16 started to develop the site to optimise comms coverage in South Westland. This budget is to complete the optimisation.										
7220506 ENHANCEMENT	**Reefton Zone Substation Protection Upgrade**	**0**	**0**	**0**	**0**	**0**	**0**	**45**	**0**	**0**	**0**
7220507 ENHANCEMENT	**Ross Zone Substation Protection upgrade**	**0**	**45**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
7220628 ENHANCEMENT	**SCADA Critical Spares**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**
	Westpower is responsible for carrying sufficient spare equipment to minimise SCADA outages during equipment faults.										
7220593 ENHANCEMENT	**SCADA Master Station Enhancement**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**
	This programme supports the SCADA system with software upgrades and hardware replacement as required.										
7221651 ENHANCEMENT	**System Security and Archives**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**
	With the increased number of radio links using public band frequencies, security of the communications network, data and equipment from hackers and viruses needs to be addressed and kept current.										
7220534 DEVELOPMENT	**VMWare Server Configuration / Equipment**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**0**
	A programme is in place for the development of the Servers and VM equipment used by Westpower.										
7220581 DEVELOPMENT	**Waitaha Repeater Development**	**0**	**0**	**40**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
7220508 ENHANCEMENT	**Waitaha Zone Substation Protection upgrade**	**0**	**0**	**45**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Total	**1280**	**1045**	**645**	**530**	**410**	**365**	**365**	**340**	**365**	**180**

Table 4.25: SCADA and Communication Capital Expenditure Summary ($'000)

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
DEVELOPMENT	170	120	180	120	120	120	120	120	120	0
ENHANCEMENT	1095	895	435	380	260	215	215	190	215	150
REPLACEMENT	15	30	30	30	30	30	30	30	30	30
Total	**1280**	**1045**	**645**	**530**	**410**	**365**	**365**	**340**	**365**	**180**

5.0 ASSETS AND ASSET LIFECYCLE MANAGEMENT

This section describes the assets covered in the AMP and the processes used by Westpower to manage the lifecycle of its assets with the focus on the maintenance and operation phase. In this way, the reader is provided with a complete picture of each asset group and the total OPEX projected costs for each asset type.

5.1 Assets Covered

Westpower owns electricity reticulation assets throughout the length of the West Coast of the South Island, a distance similar to that between Christchurch and Dunedin. Refer Figures 1.2 and 1.3 for an overview of Westpower's network.

These assets provide distribution and connection services to electricity retailers and generators. These assets generally comprise equipment that is common to all New Zealand ELBs and, wherever possible, industry standard assets have been employed. In particular, the AMP covers the electricity and associated systems owned (or managed) by Westpower as listed below. The assets listed in Table 5.1 are fully covered in Sections 5.5 – 5.16.

A description of the GXPs, which represent the gateway between the Transpower and Westpower networks, is also included in this section.

Table 5.1: Assets Covered in the AMP

Asset type	Description
Sub-transmission assets	Electric lines and cables, including associated easements and access ways, operating at voltages of 33 kV and higher.
Distribution assets	Electric lines and cables, including associated easements and access ways, operating at a voltage of 11 kV.
Distribution substations	Substations connected to the distribution network. This includes plant and equipment within the substations such as fuses, platforms, lightning arrestors and maximum demand indicators, together with land and fibreglass covers, but excluding transformers.
Distribution transformers	Standard transformers used in distribution substations ranging from 5 kVA to 1000 kVA and generally having a primary voltage of 11 kV.
Reticulation assets	400 V electric lines and cables, including associated easements and access ways.
Services	Connection assets at any voltage owned by Westpower for the purpose of supplying a single customer (not including the line on the customer's premises).
Zone substations	HV substations connected to the sub-transmission network. This includes all plant and equipment within the substations such as transformers, switchgear, structures and buswork, SCADA, protection and metering equipment, station land and buildings.
MV switchgear	Circuit breakers, reclosers, sectionalisers, regulators, disconnectors used in the distribution and sub-transmission systems.
SCADA and communications equipment	SCADA and communications equipment and associated facilities not installed at zone substations. This includes control room equipment, radio repeaters and fibre-optic systems installed, owned and maintained by Westpower.
Other:	
Ripple control	Ripple injection equipment.
Embedded generation	Generation units connected to Westpower's network but not necessarily owned by Westpower
Voltage support systems	Provides voltage support.
Mobile substation	Allows improved maintenance access to existing substations and for emergency use in case of substation failure.
Buildings	Substation buildings within the Westpower network

5.2 Asset Lifecycle Management

5.2.1 Introduction

Westpower has adopted a programme to manage the lifecycle of its assets from design and planning through to disposal. The main drivers for lifecycle management are:

- Reliability/security and quality of supply to meet customer levels of service and contractual obligations;
- Occupational health and safety to establish a safe working environment and comply with Health and Safety legislative requirements;
- Regulatory to meet regulations imposed by external organisations;
- Environmental to comply with emission regulations to air, land and water;
- Asset performance/condition use of historical data to assess the performance and condition of the assets and predict potential remaining life;
- Cost efficiency to ensure that maximum cost efficiency is achieved in accordance with asset management policy; and
- Corporate image to ensure that any activity carried out by the Asset Management division and subcontractors will not damage Westpower's image.

A typical lifecycle of any asset consists of the following stages:

1 Design and planning

2 Acquisition and installation

3 Maintenance and operation

4 Disposal

This section focuses on the maintenance and operation phase of the life of an asset and describes the methodology used to prioritise maintenance programmes and projects. The design and planning, acquisition and installation phases of the assets lifecycle are covered extensively in Section 4 *Network Development* which includes details of projected capital expenditure for capital programmes and projects for each asset group.

5.2.2 Maintenance and Operation

5.2.2.1 Replacement vs. Maintenance Trigger

Westpower has a policy of retiring older assets that have reached the end of their economic life where there is no economic means of providing life extension. Some of the triggers that would suggest a replacement strategy be employed rather than on-going maintenance would include:

- More than 50% of a line section reaching replacement criteria within the following five-year period when other work has to be carried out on that line;
- Technical obsolescence;
- Health and safety concerns (e.g. old oil-filled RMUs);
- Difficulty in obtaining spare parts; and
- Inability to meet current needs.

Westpower also experiences severe corrosion in areas near the coast, and it is often more cost effective to install new corrosion resistant fittings rather than continuing to repair existing fittings. The maintenance triggers are outlined in Table 5.2.

Table 5.2: Maintenance Triggers by Asset Category

Asset Category	Components	Maintenance Trigger
Zone substations	Fences & enclosures	Monthly checks made of fences with Zone Sub checks, breakages to be repaired. Maintenance fitters to monitor corrosion at ground of galvanised support types.
	Buildings	Landscaping. Exterior of buildings to be kept tidy, especially gardens and lawn. Foam sandwich type buildings to be washed on an annual basis. Items noted that need repair to have service request raised.
	Transformers	Annual DGA Oil sampling. Monthly zone sub checks, including Buchholz inspection, insulator integrity, no oil leaks, etc.
	11 kV & 33kV switchgear	Monthly check of gas pressure, insulator integrity, etc. Maintenance in line with manufacturers manual.
	Instrumentation	Check calibration with CB release as above, particularly transducer inputs to SCADA.
Sub-transmission lines & cables	Poles, arms, stays & bolts	Evidence of pole movement. Evidence of decay/splitting of timber. Evidence of lightning damage.
	Pins, insulators & binders	Evidence of pin corrosion - rusting/necking of the pins. Visibly loose binder. Visibly chipped or broken insulators.
	Conductor	Evidence of "birds nesting" following strand/s breaking. Electrical load increasing beyond conductor capacity.
LV lines & cables	Poles, arms, stays & bolts	Evidence of rot. Loose bolts, moving stays. Displaced arms.
	Pins, insulators & binders	Obviously loose pins. Visibly chipped or broken insulators. Visibly loose binder.
	Conductor	Visibly corroded, splaying or broken conductor.
Distribution substations	Poles, arms & bolts	Evidence of dry-rot. Loose bolts, moving stays. Displaced arms.
	Enclosures	Visible rust. Cracked or broken masonry or fibreglass.
	Transformer	Excessive oil acidity (500kVA or greater). Visible signs of oil leaks. Excessive moisture in breather. Visibly chipped or broken bushings.
	Switches & fuses	Corona discharge monitoring annually.
Distribution lines & cables	Poles, arms, stays & bolts	Evidence of dry-rot. Loose bolts, moving stays. Displaced arms.
	Pins, insulators & binders	Evidence of pin corrosion - rusting/necking of the pins. Visibly chipped or broken insulators.
	Conductor	Evidence of "birds nesting" following strand/s breaking. Evidence of vibration - fit damper.
	Ground-mounted switches	Evidence of pin corrosion - rusting/necking ofthe pins. Long rod types chalking if EPDM type.
	11 kV Switchgear	Corona discharge monitoring annually.

5.2.2.2 Maintenance

Maintenance work is largely based on the condition of the assets.

Considerable effort is put into preventative maintenance (PM). PM schedules are developed with job plans and routes and these are used for the majority of scheduled maintenance work programmes.

The scope of work planned under each maintenance activity is quantified wherever possible to assist in reviewing Westpower's achievement in future years. The estimated maintenance expenditure is projected in this section and, where relevant, the consequences of the proposed maintenance programmes are noted. It should also be noted that analysis of maintenance strategies and programmes is an on-going process, and the most cost-effective means of maintaining the system is constantly under review. In some instances (e.g. pole replacement), further investigation and analysis are required to determine a suitable strategy.

The maintenance requirements are influenced by development projects, many of which, if they proceed, will lead to dismantling and decommissioning of assets which would otherwise require significant repairs.

The base-line planned maintenance expenditure projections assume, for consistency within this plan, that development projects take place as projected. It will be necessary to monitor closely the likelihood of each project proceeding, and additional remedial work will need to be programmed if certain projects do not proceed or are significantly delayed.

Maintenance planning and expenditure is defined in terms of the following three categories.

Inspection, Service and Testing

This is expenditure on patrols, inspections, servicing and testing of assets on a routine basis. Typically, these activities are conducted at periodic intervals defined for each asset or type of asset. This work does not involve any repairs other than some minor component replacements in the course of servicing.

Special inspection, services and testing refers to expenditure on patrols, inspections, servicing and testing based on a specific need, as opposed to being time-based as is the case with routine I, S & T.

Faults

Repairs are undertaken during fault conditions to restore supply. This does not include the eventual repair of a faulted asset, where it is taken out of service in the course of repairing the fault; only the expenditure required to restore supply is included.

Repairs and Refurbishment

These are repairs to and refurbishment of an asset that may involve component replacement but not the complete replacement of the asset. This includes corrective repairs of defects identified within a year, "special" repairs (e.g. based on an identified type failure or type weakness) and planned refurbishments which may involve a significant proportion of component replacement. However, to identify refurbishments as distinct from general repairs would require identification of all specific refurbishment projects over the planning period, and this has not proved feasible for this plan.

5.2.3 Rectifying Westpower Assets

Network defect data captured in the field are incorporated into the general work plan via relevant processes. Although the primary focus of the Condition Assessment Programme is the monitoring of pole and span assets, all asset types are to be included in the near future, with each awarded equal consideration.

Depending on the priority of the identified defect, work could be carried out immediately to rectify the problem; alternatively, the job could be scheduled to be undertaken at a more suitable time.

The status of the work order generated indicates the job's completion, from which regular audits ensure all follow-up administration tasks are completed.

All asset data are returned with an updated "Condition Code". These are separated and analysed for action where needed. Below is a list of the condition codes and the corresponding action that takes place.

Condition Code	
Excellent	No further action is required on these assets.
Good	These assets have more than ten years life expectancy and will be assessed again within this term.
Fair	These assets have less than ten years life expectancy and will be assessed again within this term.
Poor	This asset could last up to five years, however, it is in poor condition and future assessment will be required.
Needs replacing	Any assets with this code are grouped into areas along with any other urgent work required. A work order is raised for the asset(s) to be replaced as soon as possible.
Red-tagged	All red-tagged assets are urgently in need of a replacement and because of this, work orders are raised individually for these assets for prompt action.

As well as condition codes, a "work required" table is utilised to drive any maintenance or replacements to assets. The work required table is split into two categories, "urgent" and "non-urgent".

Urgent work	Is grouped into geographical areas. A work order is then generated for this area including any assets marked as Needs Replacing or Red Tagged in the "condition" attribute in the asset data. Any asset that requires instant action will have a separate work order raised in order to rectify this issue as soon as possible.
Non-urgent work	Is also grouped into areas and, depending on the situation, a work order will be raised straight away or the work is set aside for action during planned outages or when time allows.

5.2.4 Asset Renewal Policy

The general renewal policy is to rehabilitate or replace assets when justified by asset performance.

Renewal of an asset is required when it fails to meet the required level of service. The monitoring of asset reliability, capacity and efficiency during planned maintenance inspections and operational activity identifies non-performing assets. Indicators of non-performing assets include:

- Structural life
- Repeated failure
- Ineffective and/or uneconomic operation
- Economics.

Renewals are programmed with the objective of achieving:

- The lowest life cycle cost for the asset (uneconomic to continue repairing);
- An affordable medium term cash flow;
- Savings by co-ordinating renewal works with other planned works; and
- Risk reduction.

The risk of failure and associated environmental, public safety, financial or social impact justifies proactive action (e.g. impact and extent of supply discontinuation, probable extent of property damage, health risk etc.).

5.2.5 Disposal

Decommissioned equipment or materials are only disposed of when they are not required as critical spares and there is a low likelihood of them being required in the future.

Where the equipment involves potentially hazardous materials, this is clearly stated and the recipient is required to provide documentary evidence that any further disposal is carried out in an approved manner.

All decisions to transfer or dispose of fixed assets must be authorised by the GM-Assets. The GM- Assets signs a Disposal/Transfer Authority Request form. Following authorisation, the appropriate network manager is responsible for the reallocation/disposal of all equipment.

These managers are responsible for maintaining a register of Westpower assets that are available for disposal or transfer. This information is used to enable the effective reallocation of plant and equipment within the network. Importantly, this information also enables Westpower to assess opportunities to defer capital expenditure by reallocating assets between sites.

5.3 Format of Asset Group Sections

For each group of key assets the following information is provided.

5.3.1 Depreciated Replacement Cost (DRC) and Optimised Depreciated Replacement Cost (ODRC) Values

These values are provided for each group of assets to enable comparison with the valuations of other ELBs.

All DRC and ODRC values are taken directly from the 2004 ODV revaluation exercise. While these values are now somewhat out of date, they do provide a constant basis for comparison with the valuations of other ELBs by using the last industry-wide valuation.

5.3.2 Asset Justification

The large area of the West Coast for which Westpower is responsible, coupled with the diverse geology encountered, has resulted in strategically placed assets throughout the region, that generally provide a reliable supply and offer scalability for the future. The sub-transmission and distribution components of the Westpower network have evolved over a number of years, with the increase of customer demand in the region being the primary driver.

Many of Westpower's lines can be very long and traverse extremely rugged terrain, often to supply very lightly populated areas. To ensure that supply meets customers' requirements, these lines have been designed to reduce line losses, and voltage support has been strategically employed.

The last 15 to 25 years have seen a push to ensure that assets are up to the task expected, with an extensive renewal and replacement programme upgrading the vast majority of sub-transmission and distribution assets.

5.3.3 Asset Description

This includes a brief description of the asset group, type, function and location.

5.3.4 Asset Condition

A brief summary of the present condition of the asset group is provided. This is based on information from routine inspections. It includes the age profile and other information required to be disclosed in Schedule 12a.

This assessment of the present condition of the assets, and the implications of this on future network asset performance after taking asset criticality into account, is the basis for the proposed maintenance programmes and network development described here and in Section 4.

5.3.5 Asset Maintenance Plan

The ongoing day to day work plans required to keep an asset serviceable and prevent premature deterioration or failure are described here. Maintenance is described according to the three categories described previously.

5.3.6 Asset Maintenance Projects and Programmes

Details of the projected maintenance expenditure for the programmes and projects for the planning period are provided for each asset group with descriptions of the projects provided. The level of detail in the descriptions provided is dependent on the stage in the planning process.

5.4 Transpower Grid Exit Points (GXPs)

5.4.1 Description

Westpower currently owns three distinct classes of sub-transmission assets running at 110 kV, 66 kV and 33 kV, emanating from seven GXP points (refer Figure 5.1), with an additional GXP at Otira providing an 11 kV supply. The primary GXPs can be found at Dobson (33 kV), Greymouth (66 kV), Hokitika (66 kV), Kumara (66 kV), Reefton (110 kV) and Atarau (110 kV). This section provides a brief overview of the GXPs.

Figure 5.1: Transpower Lines into the Westpower Network

The Electricity Commission's approval of the WCGUP in 2008 paved the way for an additional 110 kV circuit constructed from Dobson to Reefton. This circuit provides two geographically diverse and relatively strong feeds from Inangahua to Dobson, securing supply into the West Coast from the north.

The new line, termed DOB-TEE A, was commissioned in late 2011 and provides n-1 security to the Atarau GXP. An agreement between Transpower and Westpower saw Westpower construct the line which was then sold to Transpower on commissioning. Maintenance of the metering equipment at these GXPs is Transpower's responsibility.

Prior to the completion of this line, there was insufficient capacity in the Transpower network to supply this load from the south in the event of a fault on the 110 kV circuit from the north. The load was therefore interruptible.

This project, along with a related 14 MVAr switched capacitor bank installed at Hokitika, has restored security levels to a good electricity industry practice standard for loads of the size and type supplied by Westpower.

The southern part of the Westpower network is fed from a double-circuit 66 kV line from Coleridge, which is supported by a limited capacity 66 kV connection between Dobson and Kumara (refer Figure 1.3). This provides an acceptable level of supply security, although some load curtailment may be necessary should a common mode fault affect both circuits of the incoming double-circuit line at the same time. The probability of such a fault occurring is relatively low.

The construction of the twin-circuit Kumara-Kawhaka line in May 1997 by Westpower has greatly improved security of supply to the Kumara and Greymouth supply points. It is considered that the levels of security are appropriate for Westpower's network in line with industry best practice for loads of this size and type.

Details of the capacity and load profile for each GXP are provided in Table 5.3. A description of each GXP is provided below.

Table 5.3: GPXs - Capacity and Load Profiles

GXP	Asset Owner	Voltage (kV)	Transformer Max Capacity (MVA)	Present Maximum Demand (MW)
Reefton	Westpower	110	2 x 30	10.566
Atarau (Switching Station) / Logburn Rd*	Transpower	110	1 x 30	0.706
Dobson	Transpower	110	2 x 17	8.154
Greymouth	Westpower	66	2 x 15	13.850
Kumara	Westpower	66	1 x 10	9.532
Hokitika	Westpower	66	2 x 20	14.508
Otira	Transpower	11	1 x 2.5	0.618
* The Atarau switching station supplies Logburn Rd substation and therefore the transformer capacity is applicable for Logburn Rd.				

REEFTON GXP

The Reefton GXP supplies load via two 11 kV feeders between Lyell and Berlins in the north, and Blackwater to the south. The load is characterised mainly by dairy farming and domestic load, although there is some mining and commercial load in the town of Reefton.

The Reefton GXP also supplies Blackwater substation to the south and the Oceana Gold Globe mine to the east via one 33 kV feeder. The distance from an alternate GXP deems the Reefton GXP necessary, and this GXP is integral in supplying Westpower's northern network.

ATARAU GXP

The Atarau switching station is owned by Transpower, with other connection assets, including transformers, being supplied by Westpower. This will be decommissioned following final closure of the Pike River Coal Mine site.

DOBSON GXP

This GXP covers a wide area with a mix of farming, industrial, residential and holiday home load, but relatively little commercial load. It was originally constructed to supply the town of Greymouth and the coal mining load in the lower Grey Valley and Runanga areas, but was situated too far from Greymouth township to supply the growing load there. A separate GXP was constructed in Greymouth in the late 1970s.

Dobson supplies the area north of Greymouth, up the Grey Valley to Blackwater, to Punakaiki on the coast and inland to Rotomanu.

The Dobson 33 kV supply point provides capacity to supply the Westpower network northwards to Ngahere substation, the main supply point for the Ngahere Gold Dredge operations and the Roa Coal Mine. East of Dobson is the Arnold substation, which supplies the ANZCO Foods meat processing works at Kokiri and a large farming area, and also allows for the connection of Trustpower's 3 MW Arnold generation. The north-western section of the Dobson GXP connects to the Rapahoe and Spring Creek substations, which supplies Solid Energy's Spring Creek Mine facilities and the Coast Road area. These substations are supplied by the Dobson GXP's three 33 kV feeders.

The Dobson GXP also consists of two 11 kV feeders providing supply to Dobson, Kaiata, Taylorville, Stillwater and Coal Creek.

This GXP is essential for security of supply in the aforementioned areas as well as supporting the Greymouth GXP from time to time.

GREYMOUTH GXP

The Greymouth GXP supplies the town of Greymouth and the satellite townships of Cobden and Blaketown, as well as South Beach, Rutherglen and Paroa to the south. The load is mainly domestic, commercial and light industrial, with a small but growing load resulting from increased tourism to the area.

Supplying the greater Greymouth distribution network from seven 11 kV feeders, the Greymouth 66 kV GXP is supplied primarily from the GYM-KUM 66 kV cct and the Transpower's DOB-GYM 66 kV cct. This GXP is required to supply the largest domestic load on the West Coast, as well as significant industrial loads such as engineering, fishing and timber milling.

As the Greymouth load has grown significantly in the last 30 years, an independent GXP is required to satisfy the demand present in this area.

KUMARA GXP

The Kumara GXP is mainly required to provide a Grid Injection Point (GIP) for Trustpower's 10 MW Kumara hydro scheme, but also supplies local load, via two 11 kV feeders, in the area between Gladstone in the north, Jacksons in the east and Duffers in the south. When the generation is not running, a peak export demand of less than 2 MW is provided from this substation.

Apart from the significant generation, the load type is mainly farming and rural residential, although the IPL Plywood mill at Gladstone demands significant load.

The close proximity of Trustpower's hydro scheme is the primary reason that the Kumara GXP exists. Without this injection, the Kumara area could possibly be supplied from an alternate GXP.

HOKITIKA GXP

As well as supplying the greater Hokitika domestic load, there are large numbers of industrial, dairy farming and tourism-driven loads emanating from the Hokitika GXP. Included in these is the Westland Milk Products factory. South of Whataroa the load is predominantly driven by the tourist centres at Franz Josef and Fox Glaciers.

This GXP is geographically the largest in the Westpower area, supplying the South Westland area to Paringa (some 200 km away) and the flats of the Kokatahi-Kowhitirangi area. The Hokitika GXP consists of ten 11 kV feeders and one 33 kV feeder that supplies South Westland.

Constructed in 2002, the Hokitika GXP was commissioned due to the increasing demand in the area and the decommissioning of Transpower's Arahura substation. With this in mind, coupled with the distance between GXPs, the Hokitika GXP was deemed to be essential.

OTIRA GXP

The load at Otira is totally isolated from other GXPs, and, apart from a small hotel and a few houses, the majority of the load consists of the fan motors for the Otira rail tunnel. This load is supplied from a single 11 kV feeder.

Although the load in Otira is relatively small, the isolation of the area from other parts of the distribution network means that the Otira GXP is critical to supply the area. This includes the critical tunnel load needed to support the coal export trade from Solid Energy's West Coast operations and Westland Milk Product's operations, with no alternative source being available.

The Otira substation is owned by Transpower. An upgrade of this GXP was completed in 2010/11.

5.4.2 Load and Customer Characteristics by GXP

The following table provides a summary of the bulk consumers and load characteristics and which GXP they are supplied from.

Table 5.4: Bulk Consumers Supplied from the GXPs

GXP	Bulk Load	Load Type	Load Size (kW)
Reefton (RFN110)	NZSF	Timber Processing	270
	Oceana Gold Limited - Reefton	Open Cast Gold Mine	1500
Dobson (DOB003)	Solid Energy - Spring Creek Mine - Dunollie	Underground Coal Mine	930
	Roa Coal Mine - Roa (near Blackball)	Underground Coal Mine	100
	Stillwater Lumber - Stillwater Sawmill	Timber Processing	1330
	ANZCO Foods, Kokiri	Meat Processing	1240
	Gloriavale Christian Community - Hau-piri	Fishmeal Plant	460
	Ngahere Westimber	Timber Processing	430
Greymouth (GYM066)	Kingsgate Hotel - Greymouth	Hotel	340
	Westfleet - Westfleet Fish Processing - Greymouth	Fish Processing Plant	550
	New World - Greymouth	Supermarket	290
	West Coast District Health Board - Grey-mouth Hospital	Hospital	403
	IPL - Plywood - Gladstone	Timber Processing	1230
Otira (OTI011)	Tranz Rail - Otira	Fan Load	514
Hokitika (HKK066)	Westland Milk Products - Hokitika	Milk Processing Factory	9750
	Westco Lagan - Ruatapu Sawmill - Ruatapu	Timber Mill	894
	Silver Fern Farms - Hokitika Venison Factory - Hokitika	Meat Processing	360
	Scenic Circle Westland Motor Inn - Franz Josef	Hotel	440

5.5 Asset: Sub-Transmission – General and 110 kV Lines

Westpower owns three distinct classes of sub-transmission assets, running at 110 kV, 66 kV and 33 kV. The 110 kV assets owned by Westpower include the Reefton substation, where the interface points between Westpower's and Transpower's assets are the incoming disconnectors on the line side of the 110 kV circuit breaker.

Westpower also owns a 9 km stretch of 110 kV line from Transpower's Atarau switching station to an associated 20/30 MVA 110/33/11 kV substation at Logburn. This line consists of concrete poles strung with Neon All Aluminium Alloy Conductor (AAAC). This was commissioned by Westpower in 2007 as part of the reticulation to the Pike River Coal Mine and is now to be decommissioned in the 2016/2017 year following the closure of the mine.

The 66 kV assets are leased back to Transpower for operation as part of their West Coast transmission network and these assets are under Transpower's operational control.

5.5.1 Asset Justification

Sub-transmission assets, either at 110 kV, 66 kV or 33 kV, are required to transmit high levels of electrical energy over significant distances, prior to stepping the voltage back down to 11 kV for local distribution. The long distances involved in reticulation of electricity on the West Coast mean that these assets are essential for the capacity and load diversity involved.

5.5.2 Asset Condition

The condition of the sub-transmission assets largely reflects their age and the quality of materials used in construction. In general, the 66 kV lines are constructed with hardwood poles and the 33 kV lines with concrete poles. Condition is described under each of the sub-transmission categories. The age profile of sub-transmission lines by circuit length is illustrated in Figure 5.2.

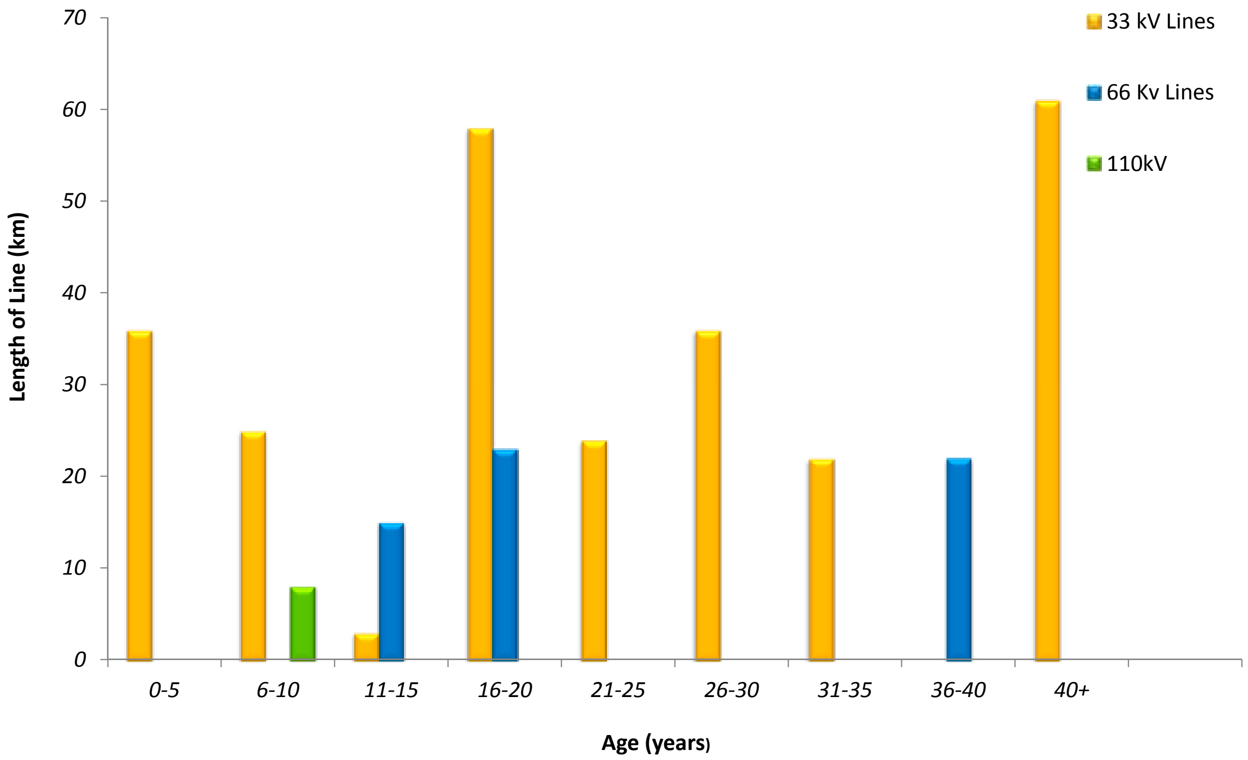

Figure 5.2: Sub-transmission Line Age Profile

5.6 Asset: Overhead Lines – 66 kV

DRC – $ 2,074,730

ODRC – $ 2,074,730

Westpower owns three overhead 66 kV sub-transmission lines. Two of these are connected to the Westpower Kumara substation, while another is an extension of the Transpower-owned TMR-OTI circuit.

5.6.1 Asset Justification

Table 5.5: Justification of 66 kV Lines

Asset	Use	System Length	Opti-mum	Justified
GYM-KUM	Single cct supplies Greymouth GXP. Westpower owned Transpower operated. Required to provide N-1 security to the Greymouth area.	23 km	Yes	Yes
KUM-KAW	Double cct. One cct supplies Kumara GXP from Transpower, the other HKK GXP from Kumara. Required to supply Hokitika south to Paringa	11 km	Yes	Yes
HKK-TMR	Double cct. One cct supplies HKK from Transpower, the other HKK from Kumara GXP. Required to supply Hokitika south to Paringa	8 km	Yes	Yes

5.6.2 Asset Description

The Greymouth-Kumara line is a 23 km hardwood pole line strung with Dog Aluminium Conductor Steel Reinforced (ACSR) conductor. This was constructed in 1977 to connect the Kumara power station to the Westpower Greymouth substation and then to the Transpower grid.

The Kumara-Kawhaka line, a 66 kV double-circuit treated hardwood pole line, was commissioned in 1997, and then subsequently leased to Transpower, allowing them to reconfigure the grid on the West Coast. The line is 11 km long and uses Iodine AAAC on both circuits.

The 66 kV line, between Hokitika and the Two Mile substations, was completed in July 2002. This is a double-circuit line; however, pre-stressed concrete poles have been used to support 8 km of Iodine AAAC.

Westpower has no underground cables at transmission voltages of 66 kV and above.

Table 5.6 summarises the quantity of 66 kV overhead line by circuit kilometre.

Table 5.6: Quantity of 66 kV Overhead Line by Circuit Kilometre.

Type	Circuit Length (km)
Light Overhead	0
Medium Overhead	61
Heavy Overhead	0

5.6.3 Asset Condition

66 kV Wood Pole Lines

The Greymouth-Kumara line was constructed with de-sapped, untreated hardwood poles, which are now showing signs of early ground-line deterioration. While there is no reason for immediate concern, the risk of premature failure is monitored and contained within the Condition Assessment Programme.

The Kumara-Kawhaka line used treated hardwood poles, which are expected to last for at least 45 years. This line is in excellent condition, with annual patrols showing no signs of deterioration, as would be expected.

Both lines use stand-off porcelain insulators and this has greatly reduced the component count on each pole.

5.6.4 Asset Maintenance Plan

The 66 kV assets are leased to Transpower and are a critical factor in the reliability of the national grid in the area. Accordingly, a higher standard of care and maintenance is required.

GENERAL – PERTAINING TO ALL AREAS

Faults

The level of fault occurrence is closely linked to condition of the asset and to external factors such as climatic conditions, with lightning and wind storms usually the greatest source of problems.

It is very difficult to predict the number of faults from year to year due to climatic conditions. An estimate for fault work is provided based on information in the Maximo assets and works management system (AWMS) now used by the asset management division.

Fault patrols and fault repairs are carried out on an as-required basis.

Repairs and Refurbishments

All line repairs are carried out to the requirements laid down in Westpower's line maintenance standards. These are based on international practice, combined with local knowledge and legislative requirements.

GREYMOUTH-KUMARA 66 KV LINE

Inspection, Servicing and Testing

The condition of this asset is monitored by:

- An annual aerial and ground patrol of the line.
- A detailed inspection of the line is regularly carried out as part of the Condition Assessment Programme. During this inspection, every aspect of the line is checked and recorded. The results will determine the extent of maintenance to be carried out in the coming years.
- A tree trimming regime has been established due to the high growth experienced on the West Coast. The vast majority of vegetation has been cleared from the lines with any remaining vegetation being monitored.

Faults

This line has also developed transient earth faults during wet weather after long dry spells, possibly symptomatic of insulator contamination, but this is very rare.

KUMARA-KAWHAKA 66 KV LINE

Inspection, Servicing and Testing

This line, although only 18 years old, will be included in the Condition Assessment Programme, with 20% of the line thoroughly inspected annually. This will be in addition to a twice-yearly ground patrol.

Faults

As far as climatic conditions are concerned, lightning is the most likely cause of problems. In the time that the line has been in service, it has only sustained one transient fault, and this was during a severe lightning storm.

Repairs and Refurbishments

No repairs or refurbishments are planned for this line. Trees likely to cause a problem were cleared from the route prior to construction and will not impact on the reliability of the line during the first half of the planning period.

5.6.5 Asset Maintenance Projects and Programmes

The expenditure for sub-transmission maintenance programmes (33 and 66 kV) for the planning period is summarised in Table 5.10. Expenditure by activity type is summarised in Table 5.11.

5.7 Asset: Overhead Lines – 33 kV

DRC – $6,566,784

ODRC – $6,566,784

This asset group includes 33 kV pole lines and 33 kV fully insulated lines using 33 kV Hendrix Spacer Cable.

5.7.1 Asset Justification

Table 5.7: Justification of 33 kV Lines

Asset	Use		Optimum	Justi-fied
HKK-HHI	Spur line from Hokitika to Harihari. Vital supply to South Westland which will be upgraded to 66 kV	69 km	Yes. To be up-graded to 66 kV	Yes
HHI-WAT	Spur line Harihari to Whataroa. Supplies Whataroa township - south	29 km	Yes	Yes
WAT-FRZ	Spur line – Whataroa to Franz Josef. Supplies Franz Josef township – south. Is used for injection from Trustpower's Wahapo Hydro Scheme	28 km	Yes	Yes
FRZ-FOX	Spur line – Franz Josef to Fox Glacier. Supplies Fox Glacier township – south. Upgraded to 33 kV in 2003	20 km	Yes	Yes
ALD-DOB	Arnold Substation to Dobson Substation. Used primarily for injection of Trustpower's Arnold Hydro Scheme. Also supplies the Rotomanu, Moana, Haupiri area.	17 km	Yes	Yes
DOB-RFN	Dobson Substation to Reefton Substation	71 km	Yes	Yes
DOB-RAP	Spur line -Dobson Substation to Rapahoe Substation. Supplies Spring Creek Mine and Rapahoe Substation. Essential for Coast Road supply	14 km	Yes	Yes

5.7.2 Asset Description

There are two general areas served by Westpower's 33 kV sub-transmission network, one based around the Dobson and Grey Valley areas, and the other serving South Westland. These two areas are connected between Greymouth and Hokitika via Kumara through the 66 kV network.

Figures 2.5 and 2.6 illustrate the geographical spread of these two asset areas.

Transpower's Dobson point of supply serves as the hub of the northern sub-transmission system and is used to feed substations at Rapahoe, Ngahere, Reefton and Arnold. The line to Arnold was originally built in the 1930s and uses 7/.080" copper conductor.

Except for a short length of Mink ACSR line over Mt Hercules and some fully insulated 33 kV overhead line in South Westland, the rest of the sub-transmission lines are strung with either Dog ACSR or Iodine AAAC.

Much of the 33 kV sub-transmission line from Hokitika to Harihari, originally constructed in 1966, has been recently upgraded. The Hokitika to Waitaha section was upgraded to a concrete pole line supporting Oxygen AAAC conductor to accommodate the Amethyst Hydro Station. The remaining section of line between Waitaha and Harihari is Dog ACSR on a mixture of wood and concrete poles.

The majority of the remaining 33 kV assets have been constructed since 1983 and are of concrete pole construction.

Table 5.8: **Quantity of 33 kV Overhead Line by Circuit Kilometre**.

Type	Circuit Length (km)
Light Overhead	268
Medium Overhead	0
Heavy Overhead	0

33 kV Pole Lines

These lines are mostly double-circuit under-built construction (33 kV above with 11 kV and/or 400 V circuits below) wired in ACSR and AAAC and are between 4 and 50 years old.

33 kV Cables

The highest voltage underground cables, Westpower operates, are at a voltage of 33 kV. These are of standard Paper-Insulated Lead-Covered Steel Wire Armoured (PILCSWA) construction over a very short distance of less than 100 m with backup. These are used as feeder cables at the Dobson substation.

Hendrix 33 kV Spacer Cable

In South Westland, there are two sections of fully insulated 33 kV overhead conductors both constructed using the Hendrix Spacer Cable System.

By using this specialist conductor, Westpower was able to mitigate the environmental effects on the high scenic values within the Westland Tai Poutini National Park. A two km stretch of this cable also runs close to Lake Wahapo (this uses three separate, fully insulated conductors, held apart by insulated spacers).

5.7.3 Asset Condition

5.7.3.1 Reliability

33 kV Overhead Line

Most of Westpower's reticulation consists of overhead lines. Over the past 20 years, all of the major 33 kV and 11 kV feeders have been replaced or refurbished, and are in very good condition overall.

While overhead lines are subject to more faults than underground cables, due to such things as lightning and bird strikes, it is relatively easy and quick to get them back into service.

The maximum repair time required, even when a complex pole structure is damaged, for example due to a vehicle running into it, is about four hours.

Distribution automation equipment installed over recent years has allowed Westpower to diagnose and locate rural faults quickly, and then restore supply remotely to adjacent areas without having to get staff on site.

Spares of all types of conductors and poles are kept in stock to cover most eventualities. Access to other network companies' stocks is likely in the event of a major disaster.

33 kV Cable

In general, underground cables are very reliable as they are not exposed to the external environment and, if carefully laid, should give at least 50 years of good service. The most likely mode of failure is damage by contractors using hydraulic excavators.

The failure rate of cables is relatively low; however, repair times are critical. Underground cables are the major constraint in this area.

Hendrix 33 kV Spacer Cable

The Hendrix system has proven to be very reliable. Spacer cable was installed for a 6 km stretch of line around Lake Mapourika in 2000, this replaced the existing Aerial Bundled Cable (ABC) system that had proven to be unreliable.

This system also involves fully insulated overhead conductors, but instead of the individual phases being bundled together, they are spaced apart by insulating "spacers" every ten metres, and supported by a separate, high strength catenary wire.

Experience to date with this system has been excellent, even when large trees have fallen across the catenary wire, as the system continues to operate without the conductors being damaged. Repairs can also be made quickly because there is no need to apply stress control measures when jointing.

5.7.3.2 Condition of Specific Line Components

Wood Poles

The 33 kV line south of Hokitika to Harihari was constructed in the mid-1960s. The section from Hokitika to the Waitaha substation was upgraded in 2012 with primarily concrete poles. A pole replacement programme was initiated in 2008.

Conductors and Conductor Accessories

Copper 7/.080" conductor is fitted to the Dobson-Arnold line. Much of it is still in reasonable condition and can remain in service for a further ten years. However, vibration damage and corrosion has taken its toll.

No replacement is planned at this stage, as any further hydro generation development at Arnold will require the conductor to be upgraded anyway to remove an effective constraint.

Most of the conductor installed since the 1960s up to the mid-1990s, has been conventional Dog ACSR with a greased steel core. All conventional ACSR is prone to corrosion, especially where the line is subject to wind borne salt contamination. This will be carefully watched, although there is no evidence to date of such deterioration.

Since the mid-1990s, Iodine AAAC has been used exclusively for sub-transmission lines and the enhanced corrosion protection afforded by this alloy material should result in at least 60 years' effective life.

Most lines are fitted with spiral vibration dampers, where appropriate, and this has greatly reduced the incidence of vibration damage to conductors and fittings.

Insulators and Insulator Fittings

Replacement insulators are now either glass or polymer disc insulators with round pins.

Access Roads

The Dobson-Arnold line is serviced by a good quality access road that may be used by trucks and four-wheel drive vehicles. While it is not Westpower policy to provide for this standard of access road, its existence owes much to the line's heritage as a Transpower asset. The road is in excellent condition for the purpose intended.

The Kumara-Kawhaka line had an access road constructed to allow the line to be built, and is suitable for four-wheel drive vehicle and excavator access. This road is in reasonable condition for the level of use required.

No specific access roads have been constructed to gain access to the Greymouth-Kumara or Mt Hercules lines.

5.7.4 Asset Maintenance Plan

GENERAL – PERTAINING TO ALL AREAS

Inspection, Servicing and Testing

In addition to patrols, a detailed inspection of this line is to be carried out on a rolling five-year basis, covering 20% of the route length per year. During the inspection, every aspect of the line is checked. The aim is to identify and document all components that do not meet Westpower's standards.

All pole hardware will be included in the inspections.

A regular bi-annual thermographic survey is carried out on these lines to monitor the condition of joints.

Table 5.9: Routine Patrol and Inspection Frequencies

Voltage	Routine Patrol	Condition Assessment	Thermographic Survey	Corona Discharge Survey	*Vegetation Survey
33 kV +	9 monthly	5 yearly	2 yearly	2 yearly	2-5 yearly
11 kV	as required	5 yearly	as required	-	2-5 yearly
400 V	as required	5 yearly	-	-	2-5 yearly
33 kV Hendrix Cable	Monthly	5 yearly	-	12 monthly	Monthly
***Note: Vegetation survey dependent on environmental factors.**					

Faults

Fault patrols and fault repairs are carried out on an as-required basis.

The level of fault occurrence is closely linked to condition of the asset and to external factors such as climatic conditions; with lightning and windstorms usually the greatest sources of problems.

While the level of faults in South Westland area is similar to that in North Westland, it may be reasonably argued, however, that the incidence of heavy rain, strong winds and lightning is slightly higher than in other areas.

It is therefore very difficult to predict the number of faults from year to year, due to climatic conditions. An estimate for fault work is provided based on information gathered in the Maximo and GIS software used by the asset management division.

Repairs and Refurbishments

All line repairs are carried out to the requirements laid down in Westpower's line maintenance standards. These are based on international practice combined with local knowledge and legislative requirements.

NORTH WESTLAND 33 KV NETWORK

With the exception of the Dobson-Arnold line, all of the lines in this area were constructed since 1984. The median age of this asset group is less than ten years.

The age of the Dobson-Arnold line warrants higher levels of inspection and refurbishment. In addressing this matter, a programme has been implemented to renew any pole identified as defective over a five-year period.

Inspection, Servicing and Testing

The Dobson-Arnold line had a major inspection completed in 1997 which included an assessment of pole and hardware condition as well as an estimate of the pole safety factors in terms of bending moment. All poles were shown to be adequate at the time; however, the age of the line means that annual general inspections will continue to be carried out.

SOUTH WESTLAND 33 KV NETWORK

Much of the network in South Westland was constructed at the same time as that in North Westland and the same comments apply to both areas.

South Westland does have some unique features, with the fully insulated overhead cable routes around Lakes Wahapo and Mapourika, requiring special management.

The Mount Hercules line has been progressively refurbished since 2005. This line provides an essential link to South Westland.

With the addition of the Fox Glacier 33/11 kV substation on the network in 2003, the 11 kV line from Franz Josef to Fox Glacier was uprated to 33 kV. This line had major refurbishment work carried out at this time and should not need any further major maintenance work for some years.

5.7.5 Asset Maintenance Projects and Programmes

The expenditure for sub-transmission (66 and 33 kV) maintenance programmes for the planning period is summarised in Table 5.10. Expenditure by activity type is provided in Table 5.11.

Table 5.10: Sub-transmission Maintenance Expenditure ($'000)

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7222052 IS&T	**Access Road Maintenance**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**
	A safe passage to poles and other network assets is imperative and every effort is made to ensure that access roads are kept to an acceptable standard. This may involve vegetation removal or clearing a track with an excavator. Funds have been allocated to ensure this type of work can be carried out.										
7222233 IS&T	**Corona Discharge Testing of Subtransmission Lines**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
	To identify any failing insulation on strategic sub-transmission lines, a Corona Discharge inspection programme is to be carried out every three years on a rotational basis.										
7185092 IS&T	**General Maintenance of Sub-transmission Lines**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
	As the condition assessment and line patrolling programmes have been progressively ramped up, so has the identification of general maintenance work on sub-transmission lines. A sum is included in the budget for any general line maintenance work that may need to be carried out on any of the sub-transmission lines. A variety of defects, normally identified during condition assessment or general patrol, need attention and funding is allocated accordingly. Previously work such as repairing guy clamps, straightening leaning earth brackets and poles have been carried out under this funding category.										
7190185 IS&T	**Sub-transmission Crossarm Replacement**	**50**	**15**	**15**	**41**	**15**	**15**	**15**	**15**	**15**	**15**
	To prevent conductor drop, all crossarms need to be capable of withstanding the loads placed upon them, even in the most extreme weather events. Given this, crossarms must be checked and replaced where required. Funds have been allocated to replace sub-transmission crossarms that, after detailed inspection, have been deemed to have reached replacement criteria.										
7218738 FAULTS	**Sub-transmission Fault Response**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**
7129876 IS&T	**Subtransmission Line Patrols**	**55**	**55**	**55**	**55**	**55**	**55**	**55**	**55**	**55**	**55**
	From time to time patrols are carried out on sub-transmission lines. These patrols may be scheduled or adhoc patrols to help ensure security of these assets are upheld.										
7221494 REPAIRS	**Subtransmssion Repairs**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**
7222419 IS&T	**Wanganui River - Paint Towers**	**0**	**18**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
7222064 IS&T	**Weed Spray Access Tracks and Various Line Routes**	**64**	**64**	**64**	**64**	**64**	**64**	**64**	**64**	**64**	**128**
	Swift fault response and continual inspections can only be achieved if access to poles and structures are clear of vegetation, allowing vehicle access. It is imperative that access to poles and structures is kept clear to aid in swift fault response and afford a higher level of safety to workers. Funding is allocated for spraying gorse and broom to keep these weeds under control.										
Total		**337**	**320**	**302**	**328**	**302**	**302**	**302**	**302**	**302**	**366**

Table 5.11: Sub-transmission Maintenance Expenditure by Activity ($'000)

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
FAULTS	18	18	18	18	18	18	18	18	18	18
IS&T	289	272	254	254	254	254	254	254	254	318
REPAIRS	30	30	30	30	30	30	30	30	30	30
Total	**337**	**320**	**302**	**302**	**302**	**302**	**302**	**302**	**302**	**366**

5.8 Asset: Distribution Assets

DRC – $25,183,835

ODRC – $24,988,272

Distribution assets comprise the distribution lines and cables that deliver electricity at 11 kV to the distribution substations that supply 415 V or 230 V to individual installations and include the associated easements and access ways.

Figures 2.5 and 2.6 show the extent of Westpower distribution line assets spread throughout the West Coast.

5.8.1 Asset Justification

These assets are the core assets for ELBs, and are therefore essential to the operation of the network. They make up the bulk of Westpower's infrastructure assets, in terms of numbers, distances and value and account for the greatest share of maintenance expenditure.

5.8.2 Asset Description

The key assets include 11 kV overhead lines, distribution line components and underground cables. The total overhead distribution line assets by circuit length owned by Westpower are included in Table 5.12.

Table 5.12: Overhead Line Assets by Circuit Length

Type	Circuit Length (km)
Light Overhead	993
Medium Overhead	416
Heavy Overhead	7

11 kV Overhead Lines

Westpower owns a large variety of distribution lines and cables that cover a wide age profile. Overhead lines cover three broad groups.

Early Hardwood Pole Lines

These lines are 11 kV single-circuit and double-circuit construction, with many over 40 years old. Few of the lines have had replacements of major components to keep them in service and, overall, they are generally in poor condition. Generally, the conductors (usually copper) have some limited remaining life.

Since 1972, and because of the major replacement programme recently completed, most of the major lines have been reconstructed with concrete poles, and AAAC or ACSR, with only a few remaining pockets of earlier hardwood lines in the Greymouth and Reefton areas. Wood pole lines are generally limited to spur lines or the remote ends of rural feeders.

Concrete Pole Lines

These lines are mostly single-circuit, wired in ACSR and AAAC, and are now between 5 and 30 years old. Two types of concrete poles have been used:

- The earlier heavy-reinforced type manufactured in Hokitika by Westpower from the 1970s until the early 1980s (often referred to as "Hokitika" concrete poles); and
- Pre-stressed concrete poles manufactured since the early 1980s by a local bridge-beam builder under license to Stresscrete.

The poles are structurally sound and have an expected life of 60 years.

Treated Softwood Pole Lines

Construction of treated softwood pole lines began in 1992 for economic reasons and continued through until 1994 for main lines, when the cost differential between concrete and treated softwood poles underwent a reversal. These lines are wired in ACSR or AAAC.

There are some notable exceptions, such as the Fox-Paringa and Coast Road lines, which used treated softwood poles for environmental and constructability reasons.

Softwood or concrete poles are used for all replacement or new construction work, and these types make up over 80% of the distribution pole population.

11 kV Cables

Cable makes up a very small portion of Westpower's total HV assets, and is generally limited to Central Business Districts (CBDs) or zone substations. There are, however, some exceptions to this, such as the recreational areas of Moana and Punakaiki.

Throughout the 1980s, Westpower had a policy of undergrounding cables in urban areas and this resulted in a significant amount of the overhead reticulation in those areas being replaced. As a case in point, the majority of Hokitika is reticulated underground, and underground HV cables are used throughout the CBD and near the airport.

While some of the older 11 kV cables around Greymouth were installed in the 1950s, many of these have since been overlaid or replaced with modern equivalents. PILCSWA was the standard for normal distribution purposes until the mid-1980s, when XLPE insulation gradually came into vogue.

The majority of Westpower's underground HV cable network consists of 11 kV cables of both PILCSWA and Cross-linked Polyethylene (XLPE) construction. Both of these are dry-type constructions that allow for joints to be readily made within four hours after the fault has been located and the trench dug.

In the Greymouth area, the reticulation in the CBD consists of a double-redundant ring of 11 kV cables. At least two separate HV cables would have to fail to cause an outage of a distribution transformer. Even if this was to happen, the LV networks are highly interconnected and would continue to supply most of the load.

All of Westpower's cables are operating well within their thermal ratings, even taking account of the possibility of poor thermal resistivity backfill. Table 5.13 shows the distribution of 11 kV underground cables in the Westpower network.

Table 5.13: Distribution of 11 kV Underground Cables

Type	Circuit Length (km)
Light Underground	11
Medium Underground	53
Heavy Underground	0

5.8.3 Asset Condition

Distribution Lines

The present condition of any distribution line is largely a factor of its age, the quality of materials used and the environmental corrosiveness of the locations it traverses.

A major undergrounding programme extending throughout the 1980s, coupled with an overhead feeder replacement extending from 1992 through to 1999, has resulted in an average line age of 25 years.

The main feeders in the Reefton area have been completely replaced over the last ten years, with the exception of parts of the Reefton township and Inangahua to the Iron Bridge.

The overall condition of distribution lines in the Hokitika area is very good, with almost all lines constructed using either concrete or treated wood poles.

The lines around Waitaha, Harihari and Whataroa are generally in excellent condition, requiring little planned maintenance work.

The distribution network in South Westland is contained in pockets based around Waitaha, Harihari, Whataroa Wahapo, Franz Josef Glacier and Fox Glacier south to Paringa, and is generally in good condition.

Figure 5.3 shows the age profile of distribution lines, by circuit length.

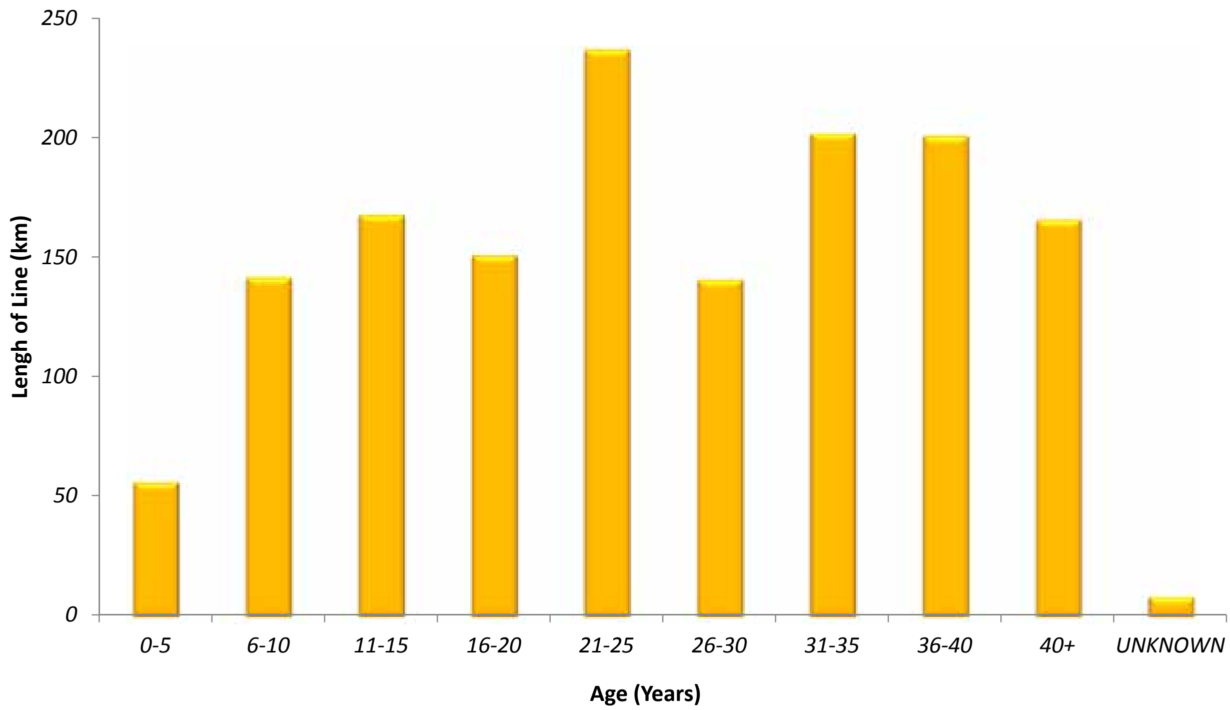

Figure 5.3: Distribution Line Age Profile

Wood Poles

There are approximately 3,000 distribution wood poles in service. An estimated 116 poles are assessed to be currently at replacement criteria, or will reach them within five years.

Conductors and Conductor Accessories

Copper conductor is fitted to the majority of older lines. Much of it is still in reasonable condition and can remain in service for a further 10 -20 years. However, vibration damage and corrosion have taken their toll.

Most of the conductor installed since the 1960s has been conventional ACSR with greased steel cores. All conventional ACSR is prone to corrosion, especially where the line is subject to wind borne salt contamination. Much of the early ACSR in exposed areas has been identified for careful inspection over the next ten years to determine what, if any, replacement programme should be undertaken.

Insulators and Insulator Fittings

There are a number of older porcelain discs now known to be unreliable due to inherent design faults plus in service internal deterioration. In particular, the relatively recent international discovery that older conventional porcelain can develop porosity during its service life (leading to punctures and mechanical separation) plus the known poor quality of much of the older porcelain insulation have provided added weight to the replacement programme. Replacement insulators are either glass or a polymer disc insulator with round pins.

Corrosion problems have been identified with the Dulmison pre-formed insulator ties used to attach aluminium conductors to insulators. When these are installed in coastal environments, severe corrosion occurs under the neoprene cover used to cushion contact between the Heli-tie and the insulator, leading to complete failure of the unit. A programme is in place to assess and replace these ties with armour rods and binder.

5.8.4 Asset Maintenance Plan

The maintenance programmes, for the distribution assets are outlined below.

Inspection, Servicing and Testing

The 2016/17 financial year will see the continuation of the Condition Assessment Programme. Each line (feeder) is to be inspected on a rolling five-year basis, covering 20% of the route length per year. During the inspection, every aspect of the line is checked.

The Okarito line (from the Wahapo substation) is a wood pole line constructed in the 1970s. Although this line is in reasonable condition for its age, it will now require a higher level of inspection and servicing as it reaches mid-life.

Faults

Faults in many areas are dependent on climatic conditions.

Trees have been a major problem In the Reefton area, particularly on the Garvey's Creek line, which runs through heavily forested areas, including a pine plantation. A major tree-trimming project in 1998, coupled with harvesting of mature pine trees in the pine plantation, has reduced this risk, but it is still considerable.

Greymouth is the largest area within Westpower's district and also involves the greatest diversity of line types and conditions. Faults in the Greymouth area are normally caused by wind and lightning. Trees have been a major problem in this area, and a regular tree-trimming programme carried out at a feeder level will contain this.

Faults in the Hokitika area are normally caused by wind and lightning, with trees falling through the line also being a common occurrence.

Faults in the South Westland area are normally caused by wind and lightning. A notable feature of South Westland, particularly the Whataroa area, is the incidence of very strong easterly winds. This can, at times, result in outages as branches and other debris gets caught up in the distribution network.

ElectroNet Services Ltd located in Reefton, Greymouth, Hokitika and Harihari serve as a fault base to minimise the repair times during outages in these areas.

Repairs and Refurbishments

Repairs of a permanent nature are carried out after a fault incident where temporary repairs have been made to restore power. This often provides a safer environment to carry out work, as many faults can occur in the middle of the night under less than ideal weather conditions.

5.8.5 Asset Maintenance Projects and Programmes

The expenditure for distribution assets maintenance programmes for the planning period is summarised in Table 5.14. Expenditure by activity type is summarised in Table 5.15.

Table 5.14: Distribution Maintenance Expenditure ($'000)

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7182274 IS&T	**11 kV Crossarm Replacement**	**49**	**40**	**40**	**40**	**40**	**40**	**40**	**40**	**40**	**40**
	To prevent conductor drop, all crossarms need to be capable of withstanding the loads placed upon them, even in the most extreme weather events. Given this, crossarms must be checked and replaced as required. Over 600 distribution crossarms have been identified to be in the "Needs Replacing" or worse condition category, however it is planned to carry out further detailed aerial inspections to more accurately determine the extent of the issue. Funds have been allocated to replace crossarms that after detailed inspection, have been deemed to have reached replacement criteria.										
7164871 IS&T	**Analysis of Network Components**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**
	From time to time analysis of various network components are required, primarily defect identification. Funds are allocated to engage consultants to carry out any analysis required.										
7213593 IS&T	**Asset Management System Updates (GIS and Maximo)**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**
	To ensure asset related records are accurate and up to date, systems such as Maximo and GIS must be updated to reflect any work carried out, be it maintenance or asset additions and disposals.										
4003 IS&T	**Cable Locations**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**
	Westpower provides a free underground cable location service on request for any contractor or other party that may be excavating in areas which may have underground cables in the vicinity. The Before-u-dig notification service is used to provide notification of those requesting a cable location.										
7100826 IS&T	**Condition Assessment Program**	**360**	**360**	**360**	**363**	**360**	**360**	**360**	**360**	**360**	**360**
	Best practice asset management calls for regular inspection and assessment of assets. The condition assessment programme allows identification of defective components and aids in forecasting asset lives, providing a platform for replacement planning. Condition assessment of all lines has become increasingly important, particularly with the recently introduced maintenance focused asset management strategy. To ensure optimum life levels are gained for each asset, particularly poles, assessment needs to be timely and accurate. The programme consists of detailed assessment of each pole, pillar box and conductor on the network on a five year rotation. A condition 'score' is allocated to each component and defects noted for action. The PortaSCAN XBS pole scanner is used to assess wood pole condition with further analyis carried out in the office.										
7224253 IS&T	**Corridor Access Request**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
7160488 IS&T	**Develop Network Standards**	**50**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**
	Funds have been allocated within the AMP to establish network standards. This work incudes standard construction drawings, standards documents and other associated services.										
7218681 FAULTS	**Distribution Fault Response**	**120**	**120**	**120**	**120**	**120**	**120**	**120**	**120**	**120**	**120**
7164140 IS&T	**Distribution Line Patrols**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**
	From time to time patrols are carried out on distribution lines. These patrols may be scheduled or adhoc patrols to help ensure security of these assets are upheld.										
4002 IS&T	**Distribution Operating**	**80**	**80**	**80**	**80**	**80**	**80**	**80**	**80**	**80**	**80**
	Switching operations for outages and network reconfiguration happen often therefore funds are allocated to perform this necessary task. This includes HV, LV and distribution substation operating.										
7219007 REPAIRS	**Distribution Repairs**	**66**	**66**	**66**	**66**	**66**	**66**	**66**	**66**	**66**	**66**
4192 IS&T	**Easement Negotiations**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**
	Generally easement registrations for new lines and cables are funded by those requesting supply, however from time to time Westpower must enter into negotiations with landowners to register easements over properties to ensure network lines and cables are legally fixed. Funds are allocated annually to carry out these negotiations as they arise.										

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
4030 FAULTS	**Faults Standby**	**125**	**125**	**125**	**125**	**125**	**125**	**125**	**125**	**125**	**125**
7218608 IS&T	**Hire of PortaSCAN Unit**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**
	The PortaSCAN XBS is a portable density gauge designed to identify variations in wood density. A gamma ray is injected into the pole with back-scatter measured to provide an instant timber density result. The PortaSCAN XBS is an integral component in determining Westpower's wood pole replacement programme.										
7218576 IS&T	**Hire of Thor Pole Testing Hammer**	**23**	**23**	**23**	**23**	**23**	**23**	**23**	**23**	**23**	**23**
	To further improve the Condition Assessment process, Westpower proposes to utilise the recently developed Thor Acoustic Pole Tester. This device, leased from PortaCAT Industries, provides an instant assessment of the condition of a wooden pole by sending a series of stress waves into the pole by a striking the pole with a purpose built hammer. On board processors within the device analyse the signal based on the duration of the wave form against the impulse force and provides the operator with a visual clue as to the state of the pole. Testing with the Thor Acoustic Pole Tester will be the precursor to a full PortaSCAN of the pole should the results show the pole is in poor condition. It is envisaged that the Thor Acoustic Pole Tester will significantly reduce wood pole assessment times than at present, where each wood pole is excavated and scanned with the PortaSCAN device.										
4004 IS&T	**IS&T Distribution**	**220**	**220**	**220**	**220**	**220**	**220**	**220**	**220**	**220**	**220**
	General maintenance on Westpower's distribution lines are identified via a number of avenues such as condition assessment and line patrols. This general maintenance is varied and not necessarily included in specific programmes therefore funds are allocated each year to allow miscellaneous maintenance work to be carried out.										
7222316 IS&T	**Inspect and Replace Helities with Armourods and Binder**	**50**	**50**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	In the eighties and the early nineties heli-ties were used to secure many 11 kV aluminium conductors to insulators. Over time some of these heli-ties have been found to have deteriorated and corroded to point where failure has occurred. A PSMS investigation has prompted a heli-tie inspection programme which will determine the condition of these components and replace with the more reliable armour rods and binder where required. As the correct securing of conductors to insulators is critical to the safe and efficient operating of any power line, no other alternatives have been considered.										
7221650 IS&T	**Install Guy Fences**	**10**	**10**	**10**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Occasionally fences need to be retrospectively installed to protect a pole support guy wire from vehicle or other impact. These instances are generally identified during Condition Assessment or inspections.										
4029 IS&T	**Management Fee**	**120**	**120**	**120**	**120**	**120**	**120**	**120**	**120**	**120**	**120**
	ElectroNet provide Asset Management services to Westpower, a predetermined sum is allocated annually to cover these Asset Management costs.										
7202692 IS&T	**Measure and Record Ground-Conductor Clearance for High Load Routes**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	From time to time high loads cross underneath Westpower lines and measures need to be taken to ensure these loads can pass inhibited by line obstructions. To assist on identifying suitable routes for these high loads a programme has been initiated to measure the conductor to ground distances and record results on GIS.										
7222283 IS&T	**Metservice Lightning Tracker Subscription**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**
	To identify and anticipate lightning strikes, strike locality data is received from the Met Service. Funds are allocated annually for this data.										
7221660 IS&T	**Repair Damaged Concrete Poles**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**
	Concrete poles may suffer damage from impact or lightning strike and often this damage is repairable. Should less than 10% of the steel reinforcing tendons be damaged or corroded a epoxy mortar can be applied to permanently repair the damage. Funds have been allocated for such repairs.										
4001 IS&T	**Safety Disconnections**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**
	Westpower provides a free safety disconnection service in instances where working near live service lines could be hazardous. This includes work such as house painting and tree trimming on a private residence.										

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7172377 IS&T	**Supply of Aerial Photography**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
	To aid in identifying areas surrounding Westpower assets, aerial photography is purchased to include in GIS. The aerial photography in some areas needs to be updated from time to time with the entire network updated at five yearly intervals.										
3326 IS&T	**System Diagrams and Schematic Drawings**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**
	To ensure an up to date record of the circuitry on the Westpower network is kept, a programme has been established that has network single line diagrams continually updated and distributed.										
7219081 IS&T	**Vegetation Control**	**600**	**600**	**600**	**600**	**600**	**600**	**600**	**600**	**600**	**600**
	Vegetation management is a key ongoing maintenance programme and has a number of drivers including:- • public health and safety • legislative compliance • network reliability Westpower funds a full-time vegetation management crew whose responsibility is to identify and then carry out vegetation management activities. The prioritisation of the work and final approval is carried out within the Asset Management division. The manner in which Westpower carries out its vegetation management obligations is determined by the Electricity (Hazards from Trees) Regulations 2003, and this also determines the level of funding required to comply with the regulations.										
	Total	**2150**	**2096**	**2046**	**2039**	**2036**	**2036**	**2036**	**2036**	**2036**	**2036**

Table 5.15: Distribution Maintenance Expenditure by Activity ($'000)

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
FAULTS	245	245	245	245	245	245	245	245	245	245
IS&T	1839	1785	1735	1725	1725	1725	1725	1725	1725	1725
REPAIRS	66	66	66	66	66	66	66	66	66	66
Total	**2150**	**2096**	**2046**	**2036**	**2036**	**2036**	**2036**	**2036**	**2036**	**2036**

5.9 Asset: Distribution Substations

DRC – $2,988,413

ODRC – $2,988,413

5.9.1 Asset Justification

Distribution substations are required to step down the distribution voltage from either 33 kV or 11 kV, to either 400 V or 230 V suitable for supplying individual installations.

5.9.2 Asset Description

Within Westpower's network, there are 2,433 distribution substations comprising single and three-phase units ranging from 5 kVA to 1.5 MVA, in the voltage range of 33 kV to 11 kV.

Distribution substations generally consist of a distribution transformer and associated equipment including:

- 11 kV drop-out fuses
- Lightning arrestors
- LV fuses
- Support crossarms
- Earthing system.

The fitting of lightning arrestors is now standard on all substations, and a retrofitting programme has ensured that virtually every existing substation meets this requirement.

In addition to these items, larger substations rated at 100 kVA and above will often be mounted on a galvanised steel platform.

Because of the extremely corrosive coastal environment, galvanised steel or Coreten steel tanks are standard for all distribution transformers.

For large substations over 200 kVA, pad-mounted construction is normally used, where the transformer is placed on the ground.

Extra assets required for these substations are:

- Concrete pad
- Fibreglass cover
- HV and LV feeder cables
- DIN LV fusegear.

All substation data, including servicing records, are stored in the Maximo system. In addition, all substations are logically linked to individual Installation Control Points (ICPs) for the purposes of outage notifications and network reliability analysis.

5.9.3 Asset Condition

The condition of these assets covers the whole range from being in need of immediate replacement to brand new.

All main line substations have been rebuilt over the last 20 years as part of Westpower's refurbishment programme and are generally in very good condition. There are still some very old substations on some spur lines however, which will need on-going refurbishment throughout the planning period.

Dominion Drop-Out Fuses

As a standard design policy, a DDO fuse unit fuses all the distribution transformers, which are fed directly from an overhead HV line.

Based on experience with a variety of fuse units over the years from E C Gough, AB Chance and AEM types, S & C Electric are now Westpower's preferred fuse type.

Earthing Systems

Regulations require that earthing systems must be tested every five years, and Westpower is now addressing this issue in earnest. To meet the requirements, a programme of regular testing has been implemented.

A programme of upgrading substandard earthing installations has been implemented.

5.9.4 Asset Maintenance Plan

Inspection, Servicing and Testing

Regular inspections of all distribution substations and their transformers are carried out in accordance with the Electricity Regulations. These inspections comprise of bi-annual visual inspections coupled with five yearly major inspections where the transformer and peripheral equipment is thoroughly checked and earth impedance tested to ensure acceptable levels of earth resistance are achieved.

All ground mounted transformers are inspected at 3 monthly intervals to help ensure any public safety issues do not arise.

Faults

Lightning damage and ingress of water cause most transformer faults. Lightning arrestors have been installed at each distribution substation on the network, greatly reducing the amount of damage sustained pre arrestor installation.

The instances of the number of failures due to water ingress caused by deterioration are reduced with rusting tanks being identified before failure can occur.

Minor repairs can be carried out on site if necessary, but most fault repairs involve the swapping of a transformer unit with a spare from the store.

Repairs and Refurbishment

Corrosion and resulting water contamination of the insulating oil in distribution transformers is a major concern. As previously mentioned, inspection programmes identifying badly corroded transformer tanks has been instigated.

Once identified, these transformers are removed for repair, re-tanking or replacement as dictated by the state and age of the unit.

Major rewinds of transformers are not undertaken unless the transformer's size is over 50 kVA and the transformer is less than ten years old. This is based on economics.

5.9.5 Asset Maintenance Projects and Programmes

The expenditure for distribution substations maintenance for the planning period is summarised in Table 5.16. Expenditure by activity type is summarised in Table 5.17.

Table 5.16: Distribution Substation Expenditure ($'000)

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
6923 IS&T	**3 Monthly Pad Mounted Sub/ RMU Inspections**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**
7231716 IS&T	**Audit LV Circuit Fuse Rating**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
7218705 FAULTS	**Distribution Sub Fault Response**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**
7219020 REPAIRS	**Distribution Sub Repairs**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**
7222132 IS&T	**Fit Protection to Exposed Distribution Sub Terminals**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**
	Some pad mounted distribution substations have live components exposed when the sub door is opened. To eliminate the possibility of inadvertent contact with live equipment perspex covers are being retrospectively fitted, providing an additional level of insulation.										
4013 IS&T	**IS&T Distribution Sub**	**120**	**120**	**120**	**120**	**120**	**120**	**120**	**120**	**120**	**120**
	General maintenance on distribution substations are identified via a number of avenues such as condition assessment, line patrols and programmed substation inspections. This general maintenance is varied and not necessarily included in specific programmes therefore funds are allocated each year to allow miscellaneous maintenance work to be carried out.										
7189952 IS&T	**Install Janitza MDI's**	**30**	**30**	**30**	**10**	**5**	**5**	**5**	**5**	**5**	**5**
	Distribution substations with a capacity of 500 kVA or greater are to be fitted with Janitza digital power quality meters to replace the analogue maximum demand units currently installed. All new substations meeting this criteria will see digital units installed with a progressive retrofit programme established for existing substations.										
7194604 IS&T	**Major Distribution Sub Inspections**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
	To ensure a safe and reliable supply, transformer sites on the network must be kept at a high standard of maintenance. Public safety is paramount, therefore any work required to minimise or eliminate potential hazards from must be promptly attended to. In accordance with best industry practice, all distribution substations are to be visited and visually inspected on a bi-annual basis and thoroughly inspected at six year cycles which include earth testing, bonding tests and a general assessment of condition observed and recorded. Of the 2320 active distribution subs on the network, 464 are to be thoroughly inspected each year.										
7202757 IS&T	**Minor Distribution Sub Inspections**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**
	To help ensure the reliability and safety of each distribution substation on the network is kept at a high level, a bi-annual inspection is carried out. This visual inspection checks that connections and distribution sub components are in an acceptable standard with defects noted and actioned accordingly.										
7152873 IS&T	**Paint Pad Mounted Distribution Sub Covers**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**
	Fiberglass pad mounted sub covers are prone to UV fade and require painting to retain a good aesthetic value and preserve the fibreglass. Funds are allocated to have eight of these units painted per annum										
7200082 IS&T	**Relocate Sub Fuses for 11 kV Spurs**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**
	Relocating spur line fuses to the main line take-off will reduce outages on 11 kV feeders by isolating the faulted spur line, avoiding main line circuit breaker trips. To assist in minimising outages on main line feeders, a programme has been initiated to relocate any HV fuses on spur lines from the substation pole to the main line take-off. This will ensure that any faulted component on the spur will only blow the fuses on the spur and not trip the nearest main line protection device.										
7102027 IS&T	**Replacement of Live Line Taps with AMP connectors**	**10**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
	Investigations have revealed that live line taps throughout the network can cause severe conductor corrosion. This corrosion has resulted in conductor drops and an effort is being made to replace these connectors with the more reliable AMP connection.										

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
4033 IS&T	**Sub (site) Upgrades**	**120**	**120**	**120**	**120**	**120**	**120**	**120**	**120**	**120**	**120**
	Westpower has adopted a probabilistic approach to distribution substation earthing, which will see a higher degree of preventive measures to mitigate potential EPR problems in areas frequented by the public such as schools, parks and meeting places. This does not, however, absolve Westpower of its responsibility to ensure all distribution substations are safe and reliable. As suitable earthing, lightning arrestors, HV and LV fuses are all essential components on a distribution transformer site, which are all prone to environmentally induced degradation, no alternative options to the upgrade programme have been considered. While the GFN in Greymouth and, to a lesser extent, the NER in Reefton have eased the emphasis previously placed on the earthing system impedance of distribution substations in those areas, maintaining effective earthing systems will continue to be a focus for the company. Due to the inherent dangers a substandard distribution substation may pose, funds have been allocated to ensure the condition of these sites are kept up to a suitable level. All distribution substations on the Westpower network are fitted with lightning arrestors, approved drop-out fuses and an earthing system installed to a standard approved by Westpower and which meet all regulatory requirements. To avoid potential EPR issues and to ensure a safe reliable supply is provided from a distribution substation, frequent earth tests are carried out and replacement of substation components are undertaken where required. Although the probabilistic approach to distribution earthing as discussed in the EEA earthing guide will be adopted by Westpower and the pending commissioning of the Ground Fault Neutraliser (GFN) will mitigate dangers posed by inadequate earthing of distribution substations in the Greymouth area, all 2433 distribution substations on the network will need to remain in good condition. The last few years have seen a push to have 9 kV lightning arrestors replaced with 12 kV units, primarily on substations emanating from the Reefton and Greymouth zone substation feeders. This was due to the installation of a NER unit in Reefton and the GFN in Greymouth which necessitated 12 kV arrestors be installed. As these areas have been completed, distribution subs in other areas will be inspected first and upgraded if required.										
Total		**542**	**520**	**520**	**500**	**495**	**495**	**495**	**495**	**495**	**495**

Table 5.17: Distribution Substation Expenditure by Activity ($'000)

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
FAULTS	18	18	18	18	18	18	18	18	18	18
IS&T	512	490	490	470	465	465	465	465	465	465
REPAIRS	12	12	12	12	12	12	12	12	12	12
Total	**542**	**520**	**520**	**500**	**495**	**495**	**495**	**495**	**495**	**495**

5.10 Asset: Distribution Transformers

DRC – $5,996,168

ODRC – $5,996,168

5.10.1 Asset Justification

Distribution transformers are the key component of a distribution substation, and the justification for these assets is the same as for distribution substations covered in Section 5.9.

5.10.2 Asset Description

A variety of styles exist on the network, from early painted steel tank units through to the current modern galvanised tank transformers.

All units used in Westpower's network must now have galvanised or Coreten steel tanks, and use stainless steel bolts to maintain resistance from corrosion.

In addition, all units have an off-load tap switch fitted to provide a range of +2.5% to –7.5% (on the HV side) for voltage regulation.

Two three-phase 33 kV/400 V units were purchased specifically to supply the remote South Westland broadcasting site at Mt Hercules; one unit was maintained in service and the other kept as a spare.

Single-phase 33 kV/400 V units supply some customers in the South Westland area who are remote from Westpower's distribution network, but close to the Hokitika-Harihari 33 kV line. The customers accept that no spare will be provided for these units.

Figures 5.4 and 5.5 show the age profile and kVA profile of the distribution transformers, respectively.

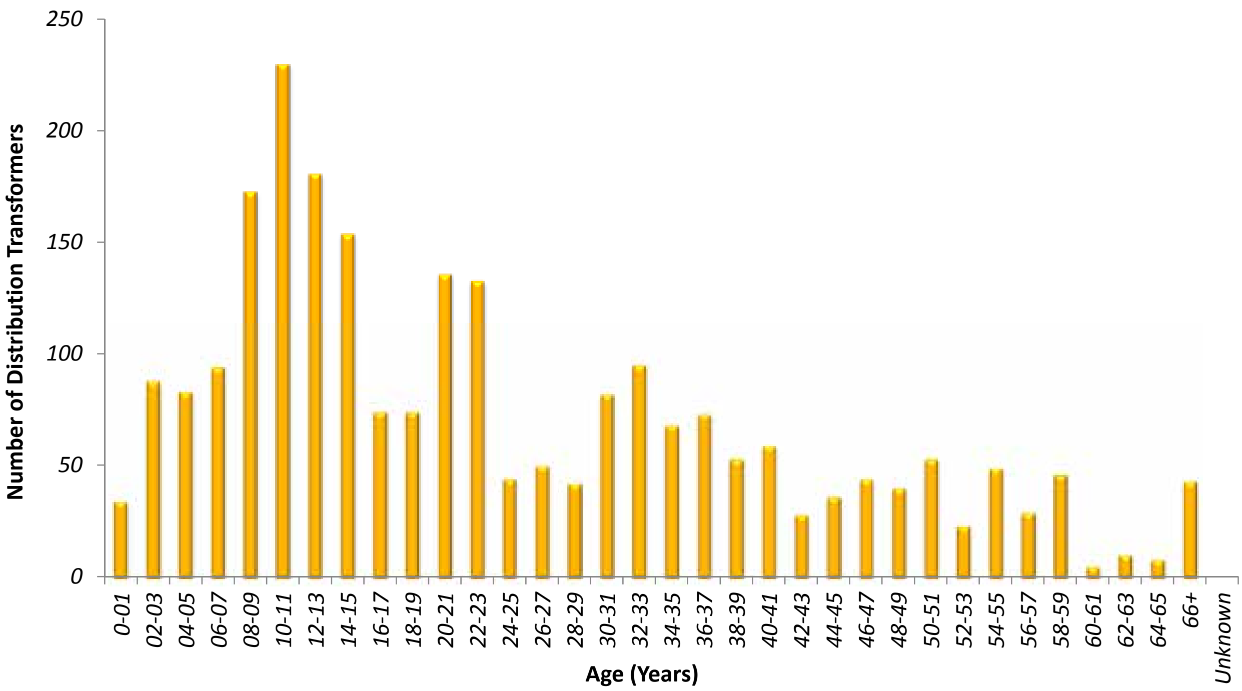

Figure 5.4: Age Profile of Transformers

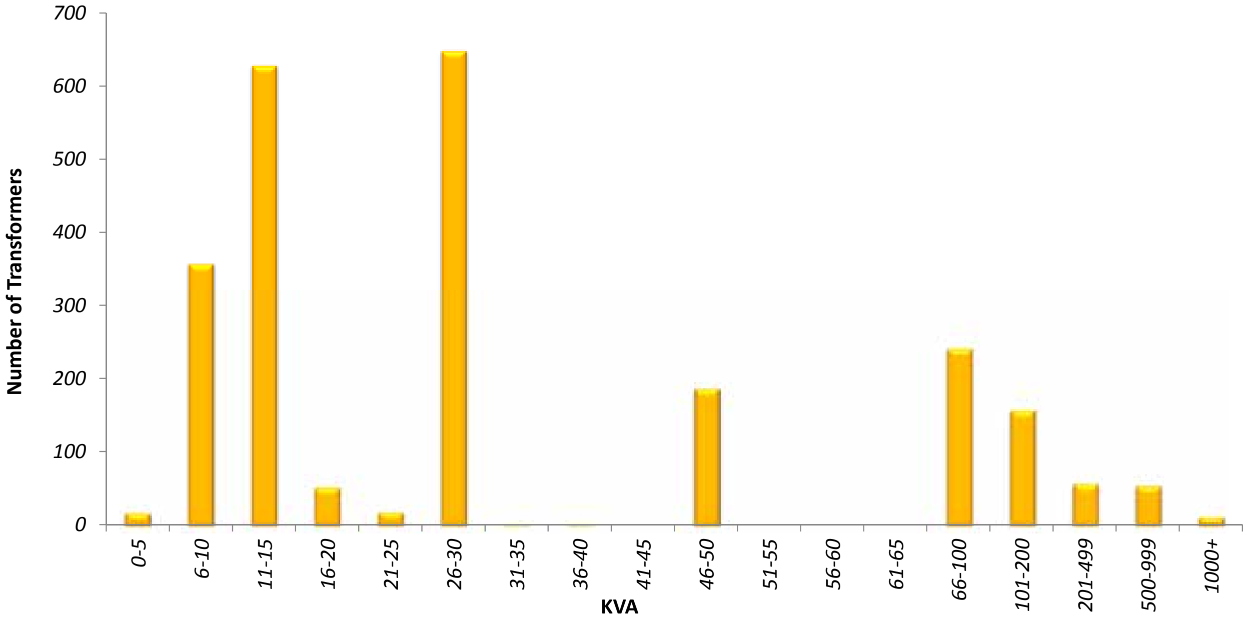

Figure 5.5: KVA Profile of Distribution Transformers

Table 5.18 provides a summary of the population of distribution transformers.

Table 5.18: Summary of Distribution Transformers

Type	11kV	33kV	Total Units
1 Phase	1035	3	1038
3 Phase	1391	4	1395
Total Units	**2426**	**7**	**2433**

5.10.3 Asset Condition

The population of distribution transformers covers a diverse range of sizes, types and ages. As such, it is important that a comprehensive management plan is put in place, as the condition of the asset is not always easily discernible on an overall basis.

Westpower's policy is to extend the life of distribution transformers where this is economically feasible. In support of this policy, many distribution transformers run well below their rated values for much of the time, resulting in long lives for the cores and windings. Provided that the tanks and oil are well maintained, the overall unit may be kept in service for up to 55 years. In this way, the maximum return can be leveraged from these high value assets.

The majority of transformers are less than 30 years old, with a median age of just over 20 years and a negligible number beyond 50 years old (3%). This coincides with the period of system development in the 1960s and early 1970s.

Transformers are generally in good condition, although for some of the older painted transformers, refurbishment and/or replacement is required rather than general maintenance.

5.10.4 Asset Maintenance Plan

Routine Patrols and Inspections

Smaller pole-mounted distribution transformers are regularly inspected on a rolling five-year basis in conjunction with Westpower's substation earth testing programme.

The inspection includes checks for:

- Tank corrosion
- Paint chips
- Breakdown
- Oil leaks
- Insulator damage
- Breather condition
- Termination faults.

Where possible, the oil level is checked and recorded.

Larger pole-mount and all pad-mount units have Maximum Demand Indicators (MDIs) which are read every quarter. These indicate loading trends to be monitored and allow for early intervention should a unit become overloaded.

Faults

The majority of faults are caused by lightning damage; it is very rare for a unit to fail because of old age or deterioration because of the regular inspection and servicing carried out.

Most faults are handled by swapping the transformer with a spare and sending the damaged unit back to the transformer workshop for inspection and repair, or scrapping if the damage is too severe.

An exception to this is bushing faults on large units, where the bushing can be easily repaired or replaced on-site.

Repairs and Refurbishments

Repairs can range from a minor paint touch-up on earlier painted units through to insulator repairs and bolt replacements. Refurbishment may include oil changes, rewinds and even tank replacements.

Rewinds are only attempted on relatively modern units where modular replacement windings are readily available.

Tanks are often subject to corrosion, especially in the case of older painted units. At the same time, however, the internal core and windings may be in excellent condition. For this reason, tanks are often repaired or replaced if the unit is otherwise in good condition.

Each unit is assessed on its age, condition and service history in determining whether to repair or replace the unit.

5.10.5 Asset Maintenance Projects and Programmes

The expenditure for distribution transformer maintenance programmes for the planning period is summarised in Table 5.19. Expenditure by activity type is summarised in Table 5.20.

Table 5.19: Distribution Transformer Maintenance Expenditure ($'000)

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7218694 FAULTS	**Distribution Transformer Fault Response**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
4197 IS&T	**General Transformer Servicing**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
	Transformer maintenance can range from a minor paint touch-up on earlier painted units through to insulator repairs and bolt replacements. Refurbishment may include oil changes, rewinds and even tank replacements. Rewinds are only attempted on relatively modern units where modular replacement windings are readily available. Tanks are often subject to corrosion, especially in the case of older painted units. At the same time, however, the internal core and windings may be in excellent condition. For this reason, tanks are often repaired or replaced if the unit is otherwise in good condition. Each unit is assessed on its age, condition and service history in determining whether to repair or replace the unit.										
Total		**103**	**103**	**103**	**103**	**103**	**103**	**103**	**103**	**103**	**103**

Table 5.20: Distribution Transformer Maintenance Expenditure by Activity ($'000)

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
FAULTS	3	3	3	3	3	3	3	3	3	3
IS&T	100	100	100	100	100	100	100	100	100	100
Total	**103**	**103**	**103**	**103**	**103**	**103**	**103**	**103**	**103**	**103**

5.11 Asset: Reticulation

DRC – $5,306,762

ODRC – $5,306,762

Westpower owns a diverse range of reticulation assets, ranging from brand new underground subdivisions, through to 50 year-old overhead wood pole lines. These assets include 400 V overhead lines and cables used to reticulate electricity to the boundary of consumer's premises.

5.11.1 Asset Justification

Once the electricity is "stepped down" from 11 kV to 400 V at distribution substations, the 400 V reticulation assets, comprising overhead lines and cables, are necessary to deliver electricity to the boundaries of individual installations. As such, these assets are a core part of Westpower's network.

5.11.2 Asset Description

Overhead 400 V Lines

Westpower uses a conventional overhead LV configuration with PVC covered conductors which are mounted on wooden cross arms.

In terms of conductor selection, copper was used extensively until the mid-1970s, but was gradually replaced with Polyvinyl Chloride (PVC) covered aluminium because of economic and constructability considerations.

Virtually the entire LV network from Hokitika southwards, and some within the urban area of Greymouth, have been replaced in the last 20 years by underground cable.

However, in some older areas such as Reefton, there are still sections of older wood pole LV reticulation. The Reefton area comprises a mixture of relatively new underground construction and very old overhead wood pole lines, with very little in between. One advantage Reefton holds is that it is well away from the coast and suffers less from the effects of corrosion than most other areas that Westpower supplies. For this reason, the overhead lines can remain serviceable at an older age than in other areas.

Westpower currently owns 186 circuit km of 400 V LV line assets (refer Table 5.21), and this is not expected to change dramatically over the planning period. The largest single contribution to more LV lines is likely to come from new subdivisions. In this case, the reticulation will almost certainly be of underground construction because of the requirements of local District Plans.

Many of the factors described in Section 5.8 *Distribution Assets*, apply equally to their LV counterparts.

Table 5.21: Summary of 400 V Overhead Lines

Type	Circuit Length (km)
Light Overhead	134
Medium Overhead	52
Heavy Overhead	0

Underground 400 V Cables

A variety of underground cable types have been used for LV reticulation spanning a period of over 30 years.

In the early days, single-core aluminium cables, with either a stranded or solid core, were widely used. Over time, however, multi-core cables became popular because of the cost advantages.

A standard cable now used in residential areas is 95 mm^2 stranded aluminium with a copper neutral screen. For denser CBD areas such as the town of Greymouth, four-core 185 mm^2 cables were used.

Currently, all new urban subdivisions are reticulated underground as a requirement of the appropriate District Plans.

Table 5.22: Summary of 400 V Underground Cable.

Type	Circuit Length (km)
Light	178
Medium	0
Heavy	0

5.11.3 Asset Condition

In general, the age distribution of these assets shows an average age of around 20 years (refer Figure 5.6).

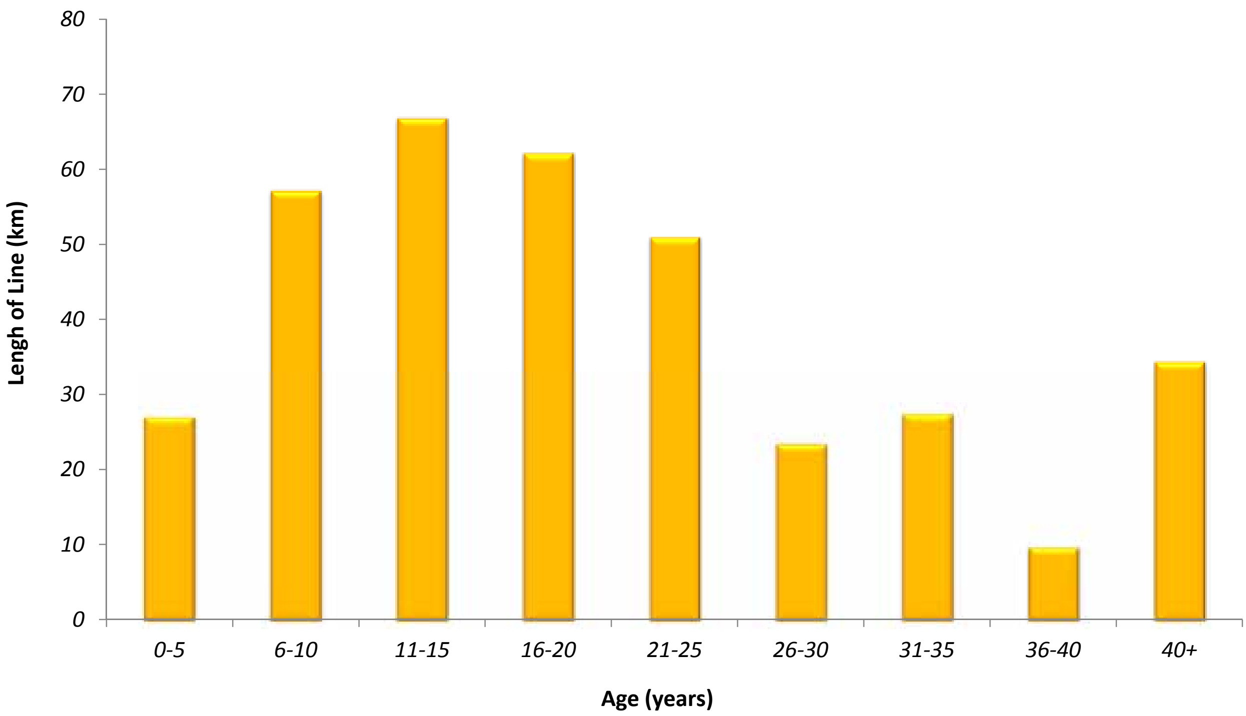

Figure 5.6: Age Distribution Profile for Reticulation Assets

5.11.3.1 Overhead Lines

South Westland

The areas of Hokitika and South Westland have largely been rebuilt over the last 20 years. During this time, most of the urban reconstruction has been carried out using underground reticulation, which has a life of up to 50 years. Little further LV work is therefore planned in these areas.

Greymouth

In the central Greymouth area, some of the oldest lines were placed underground during the 1980s. The change in focus during the late 1980s to a more commercial footing led to the demise of undergrounding because of the substantially higher capital cost involved. From the early 1990s on, the remaining refurbishment work has been carried out with overhead reticulation.

The LV networks in the satellite towns of Blaketown, Cobden and Runanga have been reconstructed overhead in the last 15 years and are currently in good condition.

Reefton

Several small pockets of LV lines will also need attention during the planning period, and the required level of replacement for these areas will be identified during condition assessment of the asset. This will enable maintenance to be effectively targeted.

5.11.3.2 Underground Cables

With the exception of a small number of old 400 V feeder cables in the Greymouth CBD, most of the underground LV reticulation throughout Westpower's area is less than 25 years old and in good condition.

The underground fittings used are also in good condition, mainly because of their age; however, constant minor maintenance is still required to overcome problems due to corrosion or water ingress.

5.11.3.3 Condition of Specific LV Line Components

Wood Poles

Most of the LV wood poles are very old, predominantly hardwoods, and range in condition from very poor to good. Their condition is monitored and assessed through an objective testing as part of the Condition Assessment Programme.

Conductors and Conductor Accessories

All of the overhead lines constructed over the last 25 years consist mainly of PVC-covered AAAC and are in generally good condition.

For about 20 years prior to this, PVC-covered copper conductors were used, and these also are in good condition. Where a LV line is replaced or refurbished, this type of conductor is reused if it is in good condition and of an adequate cross-sectional area.

Other accessories demonstrate a condition commensurate with the age of the line and are replaced as part of the overall replacement programme.

5.11.4 Asset Maintenance Plan

GENERIC – PERTAINING TO ALL AREAS

Inspection, Servicing and Testing

As with the distribution lines, the 2016/17 financial year will see the continuation of the Condition Assessment Programme. Each line (feeder) is to be inspected on a rolling five-year basis, covering 20% of the route length per year. During the inspection, every aspect of the line is checked.

It is expected that this will form the basis of a maintenance programme involving individual component replacements throughout the planning period.

Faults

Fault patrols and fault repairs are carried out on an as-required basis.

Faults are limited to the occasional substation fuse blowing or the failure of a pole, either during high winds or when hit by a vehicle. Fault staff in the area are able to handle these faults.

Repairs and Refurbishments

As with distribution poles, repairs of a permanent nature on reticulation poles are carried out after a fault incident where temporary repairs have been made to restore power. This often provides a safer environment to carry out work, as many faults can occur in the middle of the night under less than ideal weather conditions.

5.11.5 Asset Maintenance Projects and Programmes

The expenditure for reticulation maintenance programmes and projects for the planning period is summarised in Table 5.23. Expenditure by activity type is summarised in Table 5.24.

Table 5.23: Reticulation Maintenance Expenditure ($'000)

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7185787 IS&T	**Condemned Reticulation Crossarm Replacements**	27	27	25	25	25	25	25	25	25	25
	To prevent conductor drop, all crossarms need to be capable of withstanding the loads placed upon them, even in the most extreme weather events. Given this, reticulation crossarms must be checked and replaced where required.										
7149213 IS&T	**Data Collection of LV Circuits**	5	5	5	0	0	0	0	0	0	0
	It is imperative that all underground cables on the Westpower network are entered into the GIS database to allow easy identification of areas where these cables may need to be located. Funds are allocated to help ensure that cables not currently in GIS are mapped and included in GIS.										
4007 IS&T	**IS&T Reticulation**	100	100	100	100	100	100	100	100	100	100
	General maintenance on Westpower's reticulation lines are identified via a number of avenues such as condition assessment and line patrols. This general maintenance is varied and not necessarily included in specific programmes therefore funds are allocated each year to allow miscellaneous maintenance work to be carried out.										
7218426 IS&T	**LV Link Inspection and Maintenance**	4	4	4	6	6	4	4	4	6	0
	To help ensure overhead and underground LV links are in good working order an inspection programme is to be initiated that will identify defects and also provide a suitable level of maintenance, including lubrication of moving parts. Each set of links will be visited on a five yearly rotational basis.										
7200036 IS&T	**Replace Bare LV Neutrals**	15	15	15	0	0	0	0	0	0	0
	To help provide a safer LV network, all bare neutral conductors are to be replaced with PVC equivalents. This is a progressive replacement programme.										
7167782 IS&T	**Replace LV Links**	10	10	10	10	10	10	10	10	10	10
	Inspections have revealed that a number of LV links have corroded and require replacement to help ensure safe and reliable operation is carried out. With this in mind a programme has been initiated to progressively replace troublesome LV links.										
7218716 FAULTS	**Reticulation Fault Response**	24	24	24	24	24	24	24	24	24	24
7219031 REPAIRS	**Reticulation Repairs**	36	36	36	36	36	36	36	36	36	36
	Total	221	221	219	201	201	199	199	199	201	195

Table 5.24: Reticulation Maintenance Expenditure by Activity ($'000)

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
FAULTS	24	24	24	24	24	24	24	24	24	24
IS&T	161	161	159	141	141	139	139	139	141	135
REPAIRS	36	36	36	36	36	36	36	36	36	36
Total	**221**	**221**	**219**	**201**	**201**	**199**	**199**	**199**	**201**	**195**

5.12 Asset: Services

DRC – $637,381

ODRC – $637,381

This asset consists of the equipment used to connect over 13,000 consumers to Westpower's network.

5.12.1 Asset Justification

Services include assets required to make the final connection between a customer's installation and Westpower's network. These are necessary for an individual customer to take supply from Westpower.

5.12.2 Asset Description

The major components of this asset are the service protective devices, which may be one of the following:

- 400 V Re-wireable pole fuse
- 400 V High Rupturing Capacity (HRC) pole fuse
- 11 kV Dropout fuse
- 11 kV Circuit breaker

In the last case, the consumer would own the 11 kV circuit breaker and the connection asset would be an 11 kV disconnector.

5.12.3 Asset Condition

Service lines on consumers' premises are owned by the individual consumer, however Westpower will ensure service or consumer lines are maintained to a suitable standard for safety and operational reasons.

Most service lines are either PVC-covered copper or neutral screened copper, and should give good service for many years. A few of the very old services are still of the braid variety, and these are replaced as a matter of course and at Westpower's cost when a section of LV line is refurbished or replaced.

5.12.4 Asset Maintenance Plan

In general, Westpower maintains overhead consumer-owned service lines. Underground service mains are the responsibility of the consumer to maintain and they can use any competent contractor to do so.

Westpower also provides the following services free of charge to its consumers:

- Replacement of blown service fuses due to faults;
- Repair of substandard service lines where these were never brought up to standard prior to transferring to the consumer;
- Replacement of service poles on the street where these were previously shared with Telecom and are now substandard;
- Repairs to network connection equipment; and
- Repairs to service spans across road reserves.

Financial control procedures mean that only approved work is carried out, and that the consumer will be required to pay for most work on consumer-owned underground service lines.

The on-going replacement of re-wireable fuses with HRC types as part of LV replacement projects has significantly reduced the number of premature service fuse failures, which should be reflected in a reduced cost of fault work.

5.12.5 Asset Maintenance Projects and Programmes

Tables 5.25 and 5.26 provide a summary of the planned expenditure by category for service related projects during the planning period.

Table 5.25: Services Maintenance Expenditure ($'000)

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7222430 IS&T	**Condemned Service Crossarm Replacements**	**35**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**36**
	To prevent conductor drop, all crossarms need to be capable of withstanding the loads placed upon them, even in the most extreme weather events. Given this, service crossarms must be checked and replaced where required										
4010 IS&T	**IS&T Service Line**	**40**	**40**	**40**	**40**	**40**	**40**	**40**	**40**	**40**	**40**
	Westpower takes a proactive approach in ensuring service lines are maintained to an acceptable level and do not pose a safety or reliablity risk.										
4009 IS&T	**Install Voltage/Current Recorder**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**
	From time to time voltage issues are raised that need to be further investigated. These issues generally come from consumers and to aid with investigating the cause a voltage/current recorder is connected to the installation for a pre-determined period of time. This allows engineers a view of the quality of supply and helps to offer remedial recommendations.										
7204964 IS&T	**Installation of Tiger Tail Conductor Covers**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**0**
	From time to time dwelling owners may request conductor covers are temporarily installed on service lines when maintenance is such as house painting being carried out near service lines. This is a public safety imitative and although these covers are not deemed to be fully insulated they do provide an effective visual marker to remind those working in the vicinity of service conductors to remain clear.										
7218727 FAULTS	**Service Fault Response**	**120**	**120**	**120**	**120**	**120**	**120**	**120**	**120**	**120**	**120**
7219067 REPAIRS	**Service Line Repairs**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**
Total		**224**	**207**	**207**	**207**	**207**	**207**	**207**	**207**	**207**	**222**

Table 5.26: Services Maintenance Expenditure by Activity ($'000)

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
FAULTS	120	120	120	120	120	120	120	120	120	120
IS&T	92	75	75	75	75	75	75	75	75	90
REPAIRS	12	12	12	12	12	12	12	12	12	12
Total	**224**	**207**	**207**	**207**	**207**	**207**	**207**	**207**	**207**	**222**

5.13 Asset: Zone Substations

DRC – $11,810,454

ODRC – $11,786,895

Zone substations are used to transform power from transmission and sub-transmission voltages of 33 kV and higher down to Westpower's standard distribution voltage of 11 kV. Refer to Figures 2.5 and 2.6 for the location of Westpower's 19 zone substations. Details of the zone substation capacity, asset owner and current maximum demand for 2015 are shown in Table 5.27.

Table 5.27: Zone Substation Capacity and Maximum Demand

Substation	Asset Owner	Voltage (kV)	Present Maximum Demand (MW)	Transformer Capacity (MVA)
Reefton	Westpower	110	10.566	2 x 20/30
Globe	Westpower	33	5.738	1 x 8/10
Blackwater	Westpower	33	1.443	1 x 5
Logburn	Westpower	110	0.706	1 x 20/30
Pike	Westpower	33	0.207	1 x 15/20
Ngahere	Westpower	33	1.942	1 x 5/6.25
Arnold	Westpower	33	3.236	1 x 5/6.25
Dobson	Westpower	33	3.065	1 x 5
Rapahoe	Westpower	33	1.749	1 x 5
Spring Creek	Solid Energy	33	0.929	1 x 6 & 1 x 3
Greymouth	Westpower	66	13.850	2 x 10/15
Kumara	Westpower	66	1.518	1 x 10
Hokitika	Westpower	66	14.508	2 x 15/20
Otira	Transpower	11	0.618	1 x 2.5
Ross	Westpower	33	0.493	1 x 1
Waitaha	Westpower	33	0.310	1 x 1
Harihari	Westpower	33	0.820	1 x 1
Whataroa	Westpower	33	0.801	1 x 1
Wahapo	Westpower	33	3.057	1 x 5
Franz Josef	Westpower	33	1.984	1 x 5
Fox Glacier	Westpower	33	1.005	1 x 5

5.13.1 Asset Justification

These substations comprise buildings, switchyard structures and associated hardware, HV circuit breakers, transformers and a multitude of other associated power supply cabling and support equipment. These assets form an integral part of the supply chain and are strategically spread throughout Westpower's area.

Furthermore, the substations range in size from 1 MVA to 40 MVA and are used to feed large areas of Westpower's network, thus playing a critical role in the overall reliability of Westpower's network (Refer to **Appendix** C *Network Reliability by Zone Substation and Feeder* for further information).

5.13.2 Asset Description

Figure 5.7 shows Westpower's zone substation at Greymouth, which houses two 10 MVA 66/11 kV transformer banks and was constructed in 1977.

Figure 5.7: Greymouth Zone Substation

The latticework steel structure is unique within Westpower's area and reflects the common standards used by Transpower at the time. The HV bus and equipment in this substation is leased to Transpower for operation as part of the national grid.

At the other end of the scale are the 1 MVA 33/11 kV substations used at sites such as the Whataroa substation, shown in Figure 5.8.

Figure 5.8: Whataroa Zone Substation

Installations at Harihari, Ross and Waitaha use similar standard designs to the Whataroa site. These substations use a small transformer with an external regulator for economic reasons. Furthermore, they were constructed in the early 1990s and use modern construction techniques.

Westpower also owns a number of nominal 5 MVA substations, which are similar to the Arnold construction shown in Figure 5.9.

Figure 5.9: Arnold Zone Substation

These substations use On-Load Tap Changers (OLTCs), and were constructed between 1984 and 2003. Sites included in this classification are Ngahere, Arnold, Rapahoe, Wahapo and Franz Josef.

All zone substations are connected to Westpower's SCADA system for alarm monitoring and remote control operation.

A description for each zone substation is provided below.

GLOBE

The three 11 kV feeders and one 6.6 kV feeder are for supplying the Oceana Globe Gold Mining operation outside of Reefton. With the company going into care and maintenance in the 2016/2017 period there will be reduction in the load required.

BLACKWATER

Commissioned in December 2009, the two 11 kV feeders were to primarily supply the Solid Energy coal load-out facility at Ikamatua as well as the predominantly dairy farming area from Mawheraiti to the Ahaura plains. It was built in response to the increased demand from the coal load-out facility, which could not be supplied from either the Reefton or Ngahere 11 kV networks. An older refurbished transformer of optimum capacity was used for this project to allow for future growth while being cost-effective. The Blackwater zone substation can also provide backup supply to Ngahere and Reefton, when required for maintenance and faults.

LOGBURN

The three 11 kV feeders at Logburn zone substation will be decommissioned in the 2016/2017 year. The predominantly dairy farming area of Atarau from Craigieburn Creek to Moonlight will return to the existing network, with supply coming from the Ngahere substation.

PIKE

This will be decommissioned as for the Logburn substation.

NGAHERE

The two 11 kV feeders supply an area from Ahaura down the Grey Valley including Roa and Blackball, and east as far as Nelson Creek. It primarily supplies the Ngahere Gold Dredge, the Roa Coal Mine, the Ngahere timber processing mill, the Nelson Creek abattoir and numerous dairy farms. It is ideally located due to its proximity to its primary loads.

ARNOLD

Situated next to Trustpower's Arnold power station, the two 11 kV feeders supply the ANZCO Foods, meat processing plant at Kokiri and a large farming area including several Landcorp dairy farms, covering an area from Kokiri in the west, Moana township to Inchbonnie in the east and as far as Haupiri, including the Gloriavale Christian Community to the north. It also provides Trustpower with a connection for their generation (3 MW) into Westpower's network. The Arnold substation is a necessity.

RAPAHOE

Covering an area along the Coast Road between Punakaiki to the north and Coal Creek in the south, including the townships of Barrytown, Runanga, Rapahoe and Dunollie, the two 11 kV feeders primary supply is to Solid Energy's Spring Creek Mine at Dunollie and the above townships. The distance and high costs associated with supplying the Coast Road area from Dobson via an 11 kV line and the demand at Spring Creek deemed this substation to be critical to supply this area.

SPRING CREEK

The Spring Creek substation is supplied by a 33 kV feeder from the Dobson GXP and supplies Solid Energy's coal mining facilities at Spring Creek. It has two 6.6 kV and one 3.3 kV feeders.

ROSS

This substation was built in 1995 due to the 66 kV line between Arahura and Harihari being changed to a 33 kV line. Primarily supplying Ross township, the two 11 kV feeders also supply a number of farms in the area, covering an area that runs from just south of Ruatapu, including Totara Valley, as far south as Mikonui. Because of the distance and high costs associated with supplying the Ross area from Hokitika via an 11 kV line, this substation is ideally located.

WAITAHA

Supplying primarily a farming area, the one 11 kV feeder covers the areas of Fergusons Bush, Kakapotahi, Waitaha Valley and Pukekura and the Wilderness Tourist Centre. The remoteness and high costs associated with supplying the Waitaha area from Ross or Harihari via an 11 kV line makes this substation necessary at its current location.

HARIHARI

This substation was built in 1995 as a result of the decommissioning of the Transpower switchyard on Wanganui Flat Rd. Supplying primarily a farming area, the two 11 kV feeders cover an area from Lake Ianthe in the north to the Poerua Valley in the south, including Harihari township. It is required because of the remoteness and high costs associated with supplying the Harihari area from Waitaha or Whataroa via an 11 kV line.

WHATAROA

Also supplying primarily a farming area, the one 11 kV feeder at the Whataroa zone substation covers the areas of Te Taho, Whataroa Flat and Whataroa township. The remoteness and high costs associated with supplying the Whataroa area from Harihari via an 11 kV line and isolation requirements for faults/ maintenance on the 33 kV circuit between Harihari and Wahapo make this substation necessary.

WAHAPO

Located next to Trustpower's Wahapo power station, the substation's one 11 kV feeder primarily supplies the Okarito area and allows Trustpower to have a connection for their 3 MW Wahapo generator into Westpower's network.

FRANZ JOSEF

This substation is necessary for supplying the tourism industry in the Franz Josef township and the farming industry in the area. The two 11 kV feeders cover an area from Waiho Flat in the south to Lake Mapourika in the north.

FOX GLACIER

The Fox 33 kV substation was built due to the expansion of the tourism industry in the Fox Glacier township. The one 11 kV feeder covers a large area from the Fox township and Cook Flats in the north to Lake Paringa in the south. It primarily supplies the tourism industry in the Fox Glacier township and the farming industry in the area. The vast and remote nature of the area deems the Fox zone substation to be necessary.

Descriptions of the seven zone substations associated with the Transpower GXPs are described earlier in this section.

5.13.3 Asset Condition

The majority of Westpower's zone substations are less than 35 years old and demonstrate a condition commensurate with their age. Two of the older substations at Harihari and Franz Josef were substantially upgraded in 2010, along with upgrades at Fox, Dobson and Ngahere in 2011 and Wahapo and Kumara in 2013 (the control room at Kumara was upgraded in conjunction with Trustpower and Transpower) and Whataroa in 2014.

Although the Greymouth zone substation was built in 1977, upgrade and replacement work has been carried out since 2000, including the replacement of the 66 kV circuit breakers over the last 6 years; all 66 kV buswork insulators and all 11 kV indoor circuit breakers in 2002; and mid-life refurbishments and protection upgrades on both transformers during the 2009/10 financial year. The condition of specific equipment contained within substations is outlined below.

Transformers

Westpower has 55 power, voltage regulating and earthing transformers installed at its zone substations (as opposed to distribution transformers, which are used in distribution substations). Of these, 15 are fitted with OLTCs. Most of the larger power transformers (above 1 MVA) are three-phase units fitted with OLTCs.

Table 5.28 and Figure 5.10 provide a summary and age profile of the transformer population.

Table 5.28: Summary of Power Transformers

Type	11 kV	33 kV	66 kV	110 kV	Total Units
Voltage Regulating	18				18
Supply 3 Phase		17	5	3	25
Earthing	8	4			12
Total Units	**26**	**21**	**5**	**3**	**55**

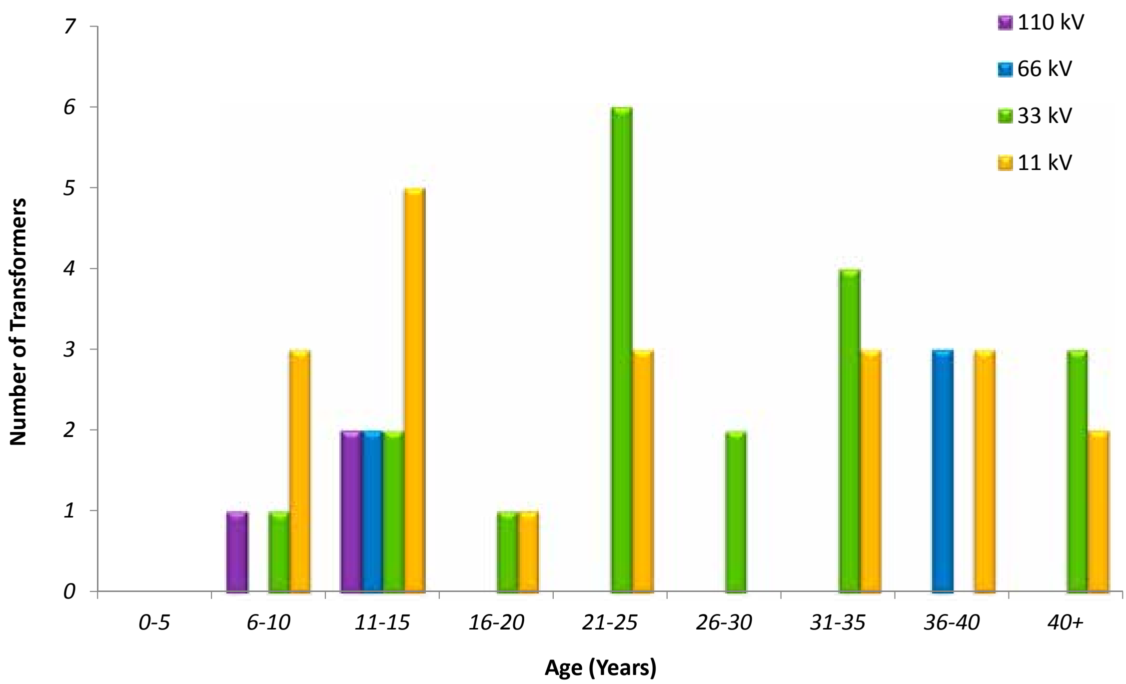

Figure 5.10: Age Profile of Transformers

Earthing transformers are used at zone substations connected to generating stations to provide appropriate source earthing requirements. These are high-impedance units designed to limit earth fault currents by providing reactance earthing. They also comprise a 400 V secondary unit to provide local service to the site.

Because of the transformers' proximity to a coastal environment, corrosion of tanks and fittings is a constant problem, which needs to be addressed by an on-going painting programme. The remaining population of transformers is now in a generally good condition, and no major maintenance will be required throughout the planning period.

DGA performed annually for the last few years, has allowed Westpower to monitor the internal condition of its power transformer population and demonstrate that, in general, there is little evidence of insulation aging or deterioration.

There is a concern that an increased replacement requirement due to deteriorating condition will be required within the next 15 to 25 years, since the transformers purchased in the 1970s are likely to begin to fail at around 50 years of age.

Regardless of whether a pre-emptive replacement programme is undertaken, it seems likely that units will fail at an increasing rate in future, and thus force replacement. Provided sufficient diagnostic tests are undertaken to identify imminent failure and provided some suitable spare units are available, this should not lead to a noticeable decrease in customer supply reliability, and could be a cost-effective replacement strategy option.

Switchgear

Table 5.29 summarises the present asset mix for this equipment used in zone substations.

Table 5.29: Circuit Breakers

Type	110 kV	66 kV	33 kV	11 kV	Total Units
Outdoor					
SF6	2	12	6	1	21
Vacuum Recloser	1	0	21	17	39
Total Outdoor	3	12	27	18	60
Indoor					
SF6	0	0	0	1	1
Vacuum Recloser	0	0	1	63	64
Total Indoor	0	0	1	64	65
Total Circuit Breakers	**3**	**12**	**28**	**82**	**125**

It is internationally recognised that 40 years is generally the “time expired” life of circuit breakers rated at 80 kV and below (International Council for Large Electric Systems (CIGRE)). Some types have an economic life greater or less than this figure. Bulk oil breakers generally have a longer life, while minimum oil breakers typically last only 30 to 35 years.

In line with this, Westpower has a policy, subject to project-specific economic analysis, of replacement rather than life extension of aged or deficient bulk oil and minimum oil circuit breakers by major refurbishment. Circuit breakers are also replaced for the following reasons:

- Where they have high maintenance costs;
- Where they are unreliable due to an increased defect rate;
- Where a system node requires a maintenance free circuit breaker; and
- Where maintenance outages cannot be tolerated.

While age, itself, is not a criteria for replacement, analysis based on the likely total economic lives for each type, make and model of circuit breaker provides a means of assessing likely future replacement requirements. The replacements would be determined by safety, economics and reliability assessments at the time.

In general, all switchgear is in very good condition, partly due to Westpower’s very low fault duty. However, the Cooper type KFE Vacuum reclosers are proving to be unreliable and have been responsible for unplanned outages from faults with their auxiliary switches, CTs and micro-switches.

A replacement programme is in place to replace these units with Viper-S Vacuum Reclosers. Circuit breakers at the Harihari and Franz Josef substations were replaced in 2010, Fox, Ngahere, Dobson in 2011, Wahapo in 2013, Whataroa in 2014, Arnold in 2015, with Ross and Waitaha zone substations to be completed in the near future. Vacuum reclosers, in particular, have very low maintenance requirements and are expected to remain in service for at least the next 20 years.

At the Kumara substation, new Siemens SF6 66 kV circuit breakers were installed in 1997 as part of an upgrade project along with an Areva SF6 66 kV circuit breaker installed in 2004; all are in excellent condition. Four similar Areva SF6 circuit breakers were installed at the Greymouth substation in 2010.

Switchgear condition is further described under the following three sub groups.

Circuit Breakers – Outdoor

This population has an age profile as shown in Figure 5.11.

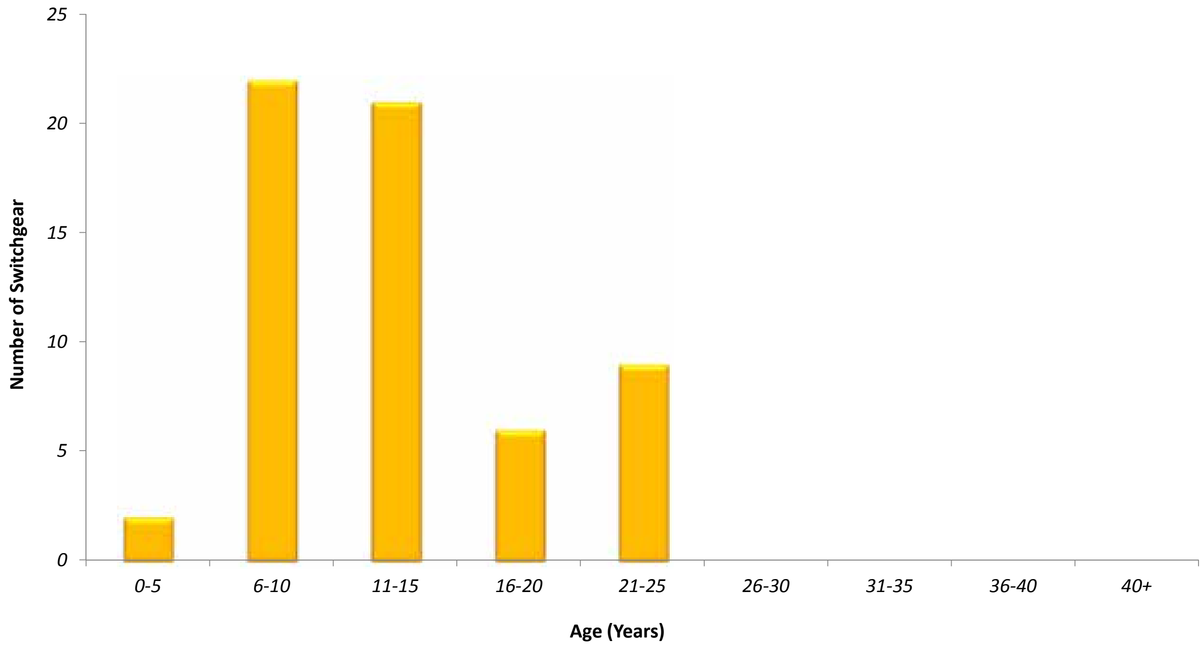

Figure 5.11: Outdoor Switchgear Age Distribution (Zone Substation)

Circuit Breakers – Indoors

Westpower's indoor switchgear installations comprise 65 vacuum circuit breakers units in ten locations. All the indoor circuit breakers are the Reyrolle vacuum type metalclad switchgear which has proven to be reliable. Modern vacuum replacement installations with air-insulated bus chambers are virtually maintenance-free.

All of Westpower's indoor metalclad switchgear is less than 15 years old, and is expected to provide a reliable and safe operation for this planning period. The typical economic life of Westpower's indoor metalclad switchgear installations (typically 11 kV) has been assessed to be 50 years based on past experience.

The last bulk oil switchgear in use was GEC type BVP equipment installed at Rapahoe in 1984. This equipment was replaced with Reyrolle vacuum type metalclad switchgear with Arc Flash protection and external venting in 2014/15. Figure 5.12 shows the age profile of Westpower's indoor switchgear.

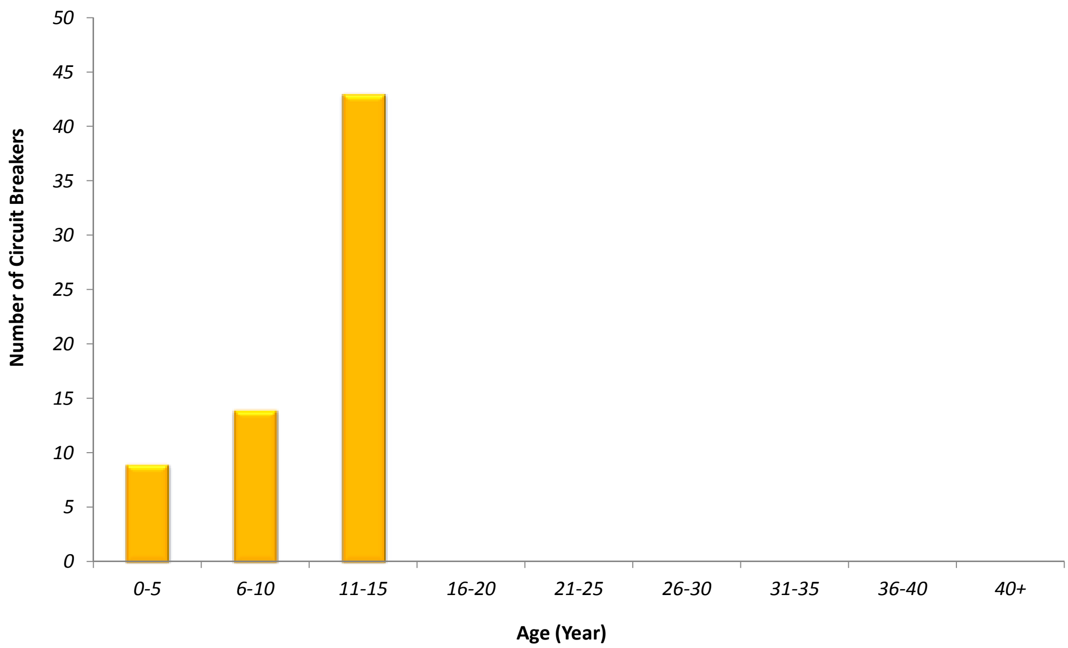

Figure 5.12: Indoor Switchgear Age Distribution (Zone Substation)

Disconnectors

Disconnectors are HV switches, which are used to disconnect sections of overhead line or other primary plant. Disconnectors are constantly subject to seizing up of bolts and operating linkages, and need continual minor maintenance to keep them in good order.

New disconnectors generally give satisfactory service, but older designs are unreliable and very old models are now becoming electrically inadequate.

Disconnectors are scheduled for replacement when they develop a history of unreliability or failures, when their maintenance costs become unacceptably high, or when they are identified as being electrically under-rated.

The five-yearly PM programme checks the condition of all disconnectors in all zone substations. General maintenance is undertaken to ensure the disconnectors are kept in a good condition for operation and have a normal operational life.

Buswork

Westpower's policy of using either galvanised steel or concrete support columns with tubular aluminium buses in switchyards means that there is only minimal maintenance required for buswork.

At the Greymouth substation, a galvanised steel lattice structure is in place and is in good condition. A concern with this type of construction occurs when they reach an age where rusting develops, which requires continuous maintenance to contain. A common problem is advanced deterioration of bolts, which gradually reduces the overall strength of the structure.

Severe structural corrosion is generally found at substations located near marine environments and where industrial works nearby give rise to a corrosive atmosphere. The proximity of the Greymouth substation to the coast means that a regular inspection programme is in place to monitor and address this. Remedial maintenance may include periodic painting of the structure. The older 66 kV porcelain disc insulators have been replaced.

Corrosion is also a problem in the metal parts of cap and pin insulators, which support buswork. On post insulators and string insulators, severe rusting of the pins leads to cracking of the porcelain, causing the insulator to fail. Also, the older type of porcelain itself has been found to deteriorate. These are the same problems that affect line insulators. In the case of strung buswork, a failure could result in collapse of the conductor. Replacement with modern insulators and general upgrading of other hardware components is necessary to reduce the risk of failures.

Cracking or spalling of concrete support structures and rusting of the reinforcing steel can be problems that require remedial action.

Instrument Transformers

Westpower has several outdoor oil-filled instrument transformers, comprising current (excluding bushing types) and voltage units in the 11 kV to 110 kV range. It is estimated that their average age is over 20 years and only a small percentage is in excess of 30 years of age. Generally, they are in a good condition and require minimal maintenance. The cost of refurbishment and regular monitoring is such that, in most instances, it is more economical to replace the units (usually a similar unit or a spare) if they fail. The most common form of failure is due to stone damage by vandals, and this is addressed as required.

Other replacements occur during site development works and, depending on whether the condition and ratings etc. of the transformer are suitable for use at another site, they may be scrapped.

Earthing Systems

Earthing systems in substations constructed within the last 20 years were designed to a high standard, and meet the current industry guidelines. All of the older zone substations that did not comply, including Greymouth, Kumara and Whataroa, underwent major upgrades of their earthing systems contemporaneous with other substation enhancement work completed within the 2014/2015 financial year. An earth injection test programme is in place where all zone substations are tested by Mitton ElectroNet Ltd every 12 years, in accordance with EEA Guidelines.

Protection Relays

Most protection relays are in 'as new' condition, and will only require minor inspection and servicing throughout the planning period.

All critical protection relays at zone substations will be brought up to the current Westpower standard, which includes modern numerical Schweitzer protection relays. Distance elements are now being used as the primary protection for 33 kV feeders.

Oil Containment

Oil containment facilities have been installed at major substations constructed since 1993, including the Dobson, Blackwater, Globe, Logburn, Pike, Fox Glacier, Reefton, Arnold, Hokitika substations and at the Amethyst switchyard. These facilities have also been retrofitted at the Greymouth, Kumara, Wahapo, Rapahoe, Ngahere and Franz Josef substations.

Battery Banks

Battery banks at all zone substations are replaced after seven years in service as per Westpower and industry standards. All banks are Gel Cell type generally using the Marathon brand which has proven to be reliable.

5.13.4 Asset Maintenance Plan

Inspections, Servicing and Testing

Westpower's station equipment is routinely inspected, tested and serviced in accordance with the requirements of Westpower's maintenance standards relevant to the actual equipment. These standard requirements, which define the scope and frequency of work, are reflected in maintenance schedules for individual stations.

PMs have been prepared for each station asset type set to a frequency as determined by Westpower's maintenance standards for that specific asset type. Job plans are attached to each PM detailing the work plan for the maintenance required. The intervals vary according to the equipment and its location. Special inspections and tests are also included in maintenance schedules or may be arranged as required.

Work identified as a result of the routine inspections and tests is budgeted for as repairs and refurbishment.

Stations

Westpower's station maintenance involves a general monthly station inspection in accordance with specified procedures, from which reports are derived. Other station inspections incorporate annual thermovision, corona discharge, partial discharge inspections, fire protection and security alarm systems.

Switchgear

Oil-insulated switchgear is regularly inspected and the oil is changed as necessary depending on the results of breakdown tests, or when there are obvious visual signs of high carbon content. Extra servicing is carried out where the switchgear has sustained a higher than normal level of "heavy" faults.

Male and female contacts are checked for wear, and dressed or replaced as necessary.

Vacuum or SF6 gas insulated switchgear undergoes regular visual inspection including checks of SF6 gas pressure.

Thermovision and partial discharge inspections are carried out on all switchgear on an annual basis.

Protection

It should be noted that "maintenance" on protection equipment is essentially "recalibration/testing" rather than the conventional view of maintenance, which would imply replacement of consumable parts. Protection maintenance is mainly required to reaffirm that the protection is calibrated within tolerance and will operate when called upon to do so.

There are international trends towards reduced maintenance. Typically, intervals are being increased to between four and eight years in other utilities comparable to Westpower, particularly where microprocessor (numerical) protection systems are used. These protections have in-built self-testing and monitoring routines which reduce the necessity for manually driven maintenance testing.

A fully-automated protection relay test set is used to facilitate maintenance testing. This is also used for commissioning of new protection (developments and enhancements) as well as maintenance.

Transformers

All major power transformers have an annual minor maintenance service which encompasses a visual inspection, routine diagnostic tests and minor repair work in accordance with Westpower's standards which incorporate manufacturers' recommendations and Westpower's experience.

In general, maintenance on the transformers consists of maintaining oil within acceptable dielectric and acidity standards, patching up corrosion, fixing oil leaks and annual diagnostic tests on the insulating oil. In addition, the units fitted with OLTCs require periodic inspection of the tapchangers, and the contacts are dressed or replaced as necessary. Additional remedial work required outside the scope of the maintenance contract is referred to Westpower for further action and budgeted as repairs and refurbishment.

Costing for minor maintenance is very dependent on location and has been based on the present maintenance expenditure.

Costing for major maintenance, e.g. OLTCs, is not only dependent on the location of the site but also the usage and types of unit. Some units have to be serviced every two years and others every six years.

Oil Testing- Oil Conductivity and Dissolved Gas Analysis

DGA tests are carried out at all zone substations at regular intervals. Where potential problems are identified, regular monitoring along with further annual oil conductivity and DGA tests are carried out until trends are reliably established. Once this is done, the period will be reviewed, possibly on an individual unit basis.

Structures, Buswork and Disconnectors

The routine maintenance of structures, buswork and disconnectors is usually performed simultaneously when a particular circuit or section of bus is released from service.

Disconnectors are scheduled for servicing every five years but this may be extended when there are operational difficulties in getting a maintenance outage. The servicing is non-invasive and is generally limited to checks, adjustments, lubrication, corrosion control and cleaning.

Buswork and associated hardware is inspected and maintained with disconnectors, and includes checking and cleaning of insulators. At sites which are subject to atmospheric pollution, insulator cleaning must be done more frequently than usual. Structures are maintained up to a maximum interval of five years, and work is limited to corrosion control, general checking of fixings and removal of any debris. Wood poles are subject to a check for signs of rotting. Earth testing is carried out as outlined in the EEA guide.

Instrument Transformers

All instrument transformers have an annual minor maintenance service which encompasses a visual inspection, routine diagnostic tests and minor repair work. Additional remedial work required is outside the scope of the maintenance contract and is referred to Westpower for action.

Other Station Equipment

The new battery banks are virtually maintenance-free, and only a basic inspection and charger check is necessary. Other switchyard equipment such as local service transformers, surge diverters, cables, etc. are maintained as necessary when the associated circuit is taken out of service.

Faults

Equipment failures occur randomly and without warning, and range from a simple circuit breaker mechanism failure due to a broken circlip, to a costly transformer winding failure. The cost budgeted is the cost to restore supply or the service following the failure, not the cost of any repair work after supply or service has been restored.

It is estimated that there are approximately two such faults per month. It is expected this frequency will be reduced as aged/defective equipment is refurbished or replaced.

The projected expenditure is based on actual expenditure incurred in recent years. It is not practicable to allocate projected expenditure against each substation asset category, given the range of faults which can occur.

Repairs and Refurbishment

This area of expenditure includes corrective work identified following inspections and tests, and while undertaking routine maintenance or following equipment failures. The magnitude and costs of the work can vary greatly. The planned expenditure also includes the cost of materials and spares.

The major causes of power transformer failures are winding and internal connection faults. These are caused, in general, by electrical causes, e.g. through faults or lightning strikes. The other major internal maintenance on a power transformer is oil refurbishment and desludging, which is carried out as required based on oil acidity test results. It is not expected that this will be required on any of Westpower's units within the planning period. At midlife, a full dry-out and core retighten is recommended.

Painting is carried out on a regular basis at a period of generally between 10 - 15 years, depending on site conditions.

On-going repairs are required to a variety of other station equipment including portable earthing equipment and battery banks.

5.13.5 Asset Maintenance Plans and Programmes

The expenditure for zone substation maintenance for the planning period is summarised in Table 5.30. Expenditure by activity type is summarised in 5.31.

Table 5.30: Zone Substation Maintenance Expenditure ($'000)

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7145955 IS&T	Carry out Thermovison Inspection of Zone Substation Equipment	12	12	12	12	12	12	12	12	12	12
7145956 IS&T	Corona Discharge Testing at Various Zone Substations	10	10	10	10	10	10	10	10	10	10
7199326 IS&T	Earthing Inspection and Reports for Zone Substation Equipment	46	46	46	46	46	46	46	46	46	46
7220594 IS&T	Monthly/ 6 Monthly Inspections of Zone Substations	70	70	70	70	70	70	70	70	70	70
7104593 IS&T	Oil Filter & Dry Out System for Transformers	28	28	28	28	28	28	28	28	28	28
7104788 IS&T	Operator Training, Site Inductions & Site Familiarisation	15	15	15	15	15	15	15	15	15	15
7186859 IS&T	PSMS - Public Communication Programme	5	5	5	5	5	5	5	5	5	5
7104750 IS&T	Perform Oil Tests at Zone Substations (DGA)	28	28	28	28	28	28	28	28	28	28
7105361 IS&T	Purchase of Portable Earths & Authorisation Equipment	9	9	9	9	9	9	9	9	9	9
7104787 IS&T	Update Zone Substation Drawing & Filing System	10	10	10	10	10	10	10	10	10	10
7135110 IS&T	WMS (Mobile substation) Storage	5	5	5	5	5	5	5	5	5	5
7104924 IS&T	WMS Relocation, Site Installation/Disconnection Costs	30	40	30	30	50	30	40	30	30	50
7105415 IS&T	Westpower Store - Storage of Key Assets in a Controlled Enviroment	12	12	12	12	12	12	12	12	12	12
5996 IS&T	Zone Sub Landscaping and Beautification	10	10	10	10	10	10	10	10	10	10
7104786 IS&T	Zone Substation Building Maintenance	44	44	44	44	44	44	44	44	44	44
7104704 FAULTS	Zone Substation Faults Response	6	6	6	6	6	6	6	6	6	6
7104700 IS&T	Zone Substation Inspection, Service and Testing	158	158	158	158	158	158	158	158	158	158
7104785 IS&T	Zone Substation OLTC & Regulator Maintenance	41	41	41	41	41	41	41	41	41	41
7100848 IS&T	Zone Substation Power Accounts	75	75	75	75	75	75	75	75	75	75
7152820 IS&T	Zone Substation Preventative Maintenance	60	65	70	85	70	60	65	70	85	70
7104705 REPAIRS	Zone Substation Repairs	78	78	78	78	78	78	78	78	78	78
7104775 IS&T	Zone Substation Transformer Refurbishment & Maintenance	31	31	31	31	31	31	31	31	31	31
Total		783	798	793	808	813	783	798	793	808	813

Table 5.31: Zone Substation Maintenance Expenditure by Activity ($'000)

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
FAULTS	6	6	6	6	6	6	6	6	6	6
IS&T	699	714	709	724	729	699	714	709	724	729
REPAIRS	78	78	78	78	78	78	78	78	78	78
Total	**783**	**798**	**793**	**808**	**813**	**783**	**798**	**793**	**808**	**813**

5.14 Asset: MV Switchgear

DRC – $1,468,901

ODRC – $1,468,901

This class of equipment includes:

- Regulators
- Disconnectors
- Reclosers
- Sectionalisers
- Load Break Switches
- RMUs
- 11 kV DDOs

5.14.1 Asset Justification

These assets cover a diverse range of devices, but generally include switches of various types that are used to protect and sectionalise the network. In the event of a fault on the network, fuses, reclosers and sectionalisers are needed to isolate the faulted section safely and quickly, and thereby maintain supply to other customers on un-faulted sections of the network. The devices are also necessary to isolate sections of line to allow maintenance to be carried out.

5.14.2 Asset Description

This asset group does not include the MV switchgear contained within zone substations.

Line regulators are installed on long 11 kV lines with significant loads near the end. Westpower has such installations at Longford Corner (near Kokatahi), Cronadun (north of Reefton) and the Haupiri area. There is also a 33 kV regulator at Harihari.

In general, disconnectors are standard three post DA2 type units made by Schneider Electrical (ex-Canterbury Engineering). Some units are fitted with CE Break load-break heads.

Westpower has used a range of reclosing equipment over the last 50 years, but has now standardised the use of G & W Viper St vacuum reclosers and ENTEC load break switches for all future installations.

Small numbers of old 11 kV circuit breakers are still in use as distribution substation breakers.

The RMUs are mainly Reyrolle or ABB “Safelink” type, SF6 SD insulators or ABB oil insulators, and are all less than 25 years old. There are three remaining Andelect RMUs. Some Hazemeyer dry-type equipment has also been installed in the network, but its use is not widespread.

Table 5.32 summarises the present population of MV switchgear. Figures 5.13 and 5.14 show the age profiles of various switchgear and RMUs respectively.

Table 5.32: MV Switchgear

Type	33 kV	11 kV	Total Units
Disconnectors	14	388	402
Load Break Disconnectors	2	19	21
Motorised Disconnectors	13	6	19
Vacuum Reclosers	3	43	46
Load Break Switch (ENTEC)	0	21	21
Ring Main Unit	0	55	55
Ganged Expulsion Drop-outs	0	29	29
Total Units	**32**	**561**	**593**

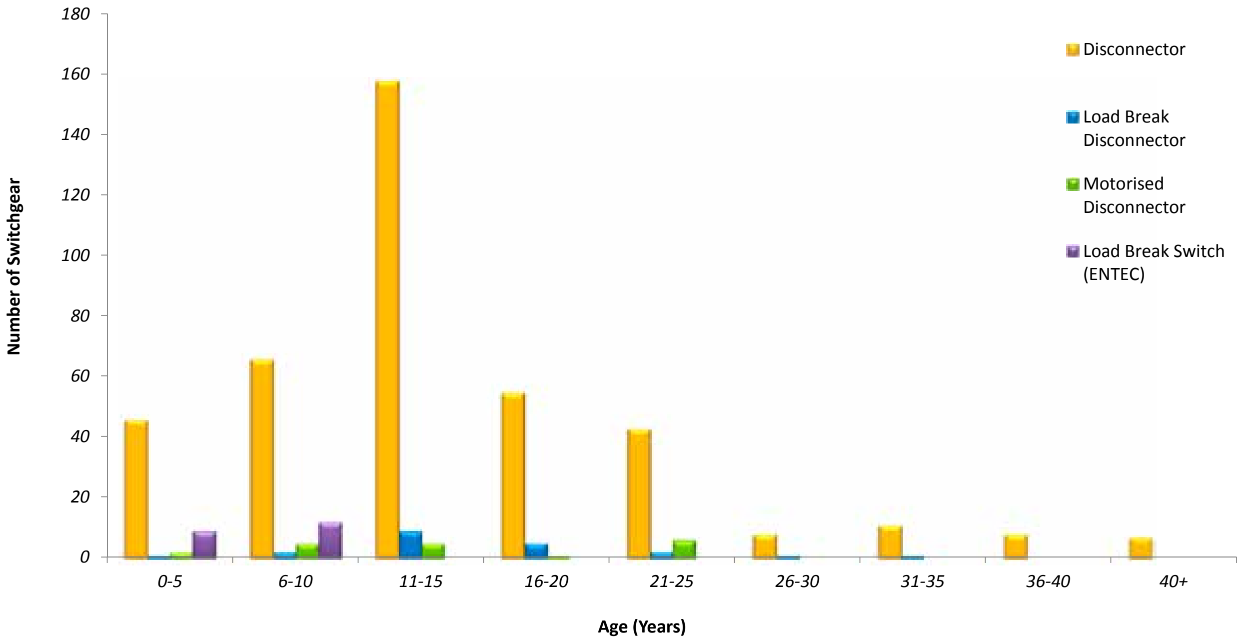

Figure 5.13: Switch Gear Age Profile

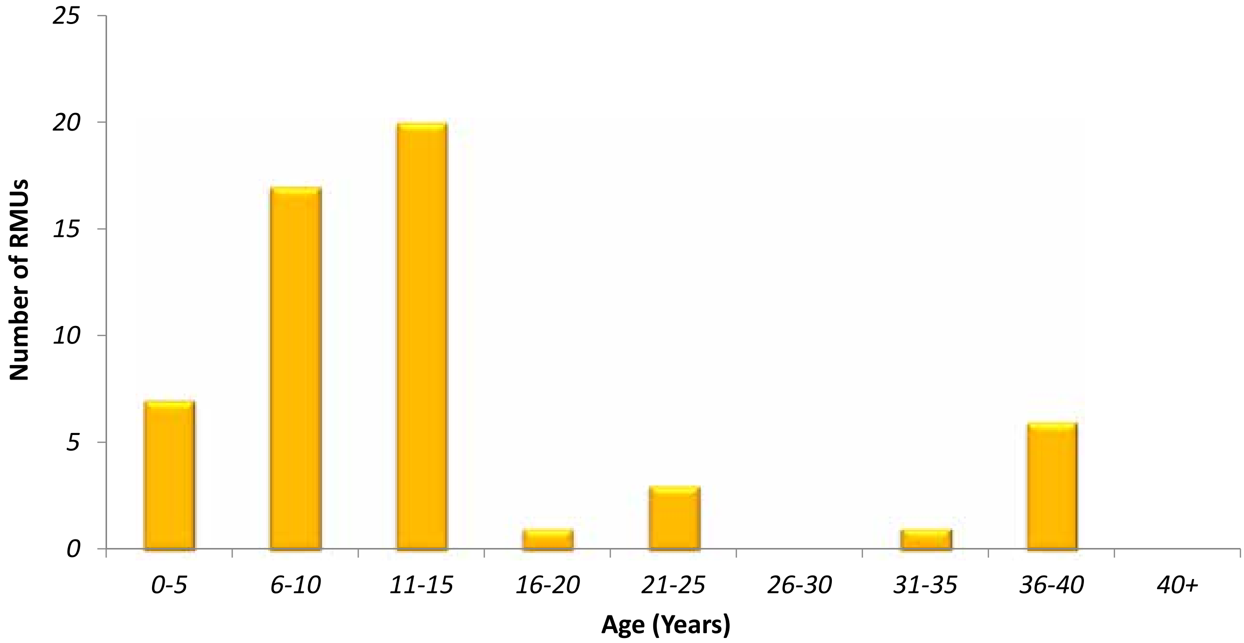

Figure 5.14: RMU Age Profile

5.14.3 Asset Condition

Most of Westpower's MV switchgear is relatively modern and in good condition. However, a recent series of faults on the Andelect 0utdoor type RMU has given reason for replacement of these units over the last five years with new SF6 units. Westpower no longer uses Series I Andelect oil-insulated ABB RMUs to close onto expected faults.

Other exceptions to this are the large and diverse population of disconnectors, which will need to be managed on an asset-wide basis.

Circuit Breakers

Aged indoor bulk oil circuit breakers supplying indoor distribution transformers have reached the end of their economic lives. These will be replaced with fused switch units or modern equivalents over the next five years.

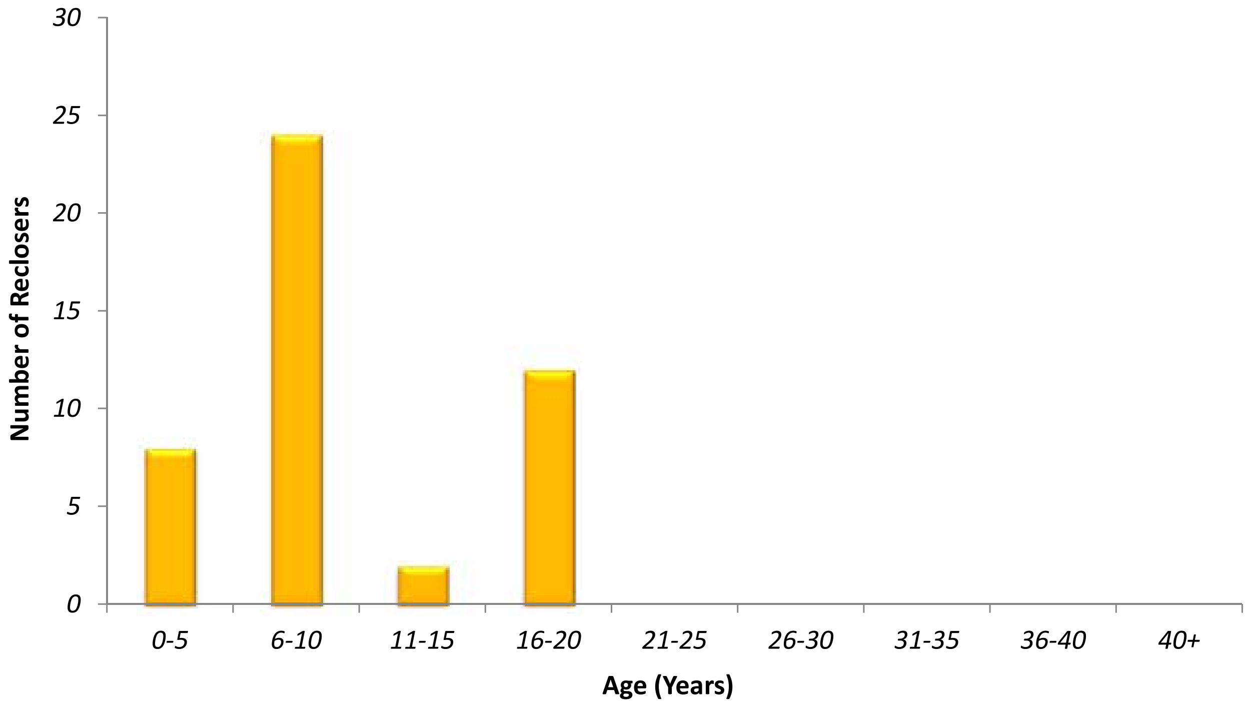

Figure 5.15: Vacuum Recloser Age Profile

Pole-Mounted Reclosers

There are a total of 46 pole-mounted reclosers (43 x 11 kV, 3 x 33 kV) at various locations throughout the network. All of these reclosers are controlled remotely by SCADA. These reclosers are a combination of Cooper type KFME and G & W Viper ST reclosers.

Cooper KFE type reclosers have been progressively replaced with G & W Viper ST reclosers, protected by modern digital SEL651R protection relays. This project was completed in the 2011/12 financial year.

Remote Controlled Motorised Disconnectors

Westpower has been using either ENTEC load break switches or Schneider motor drive units on the 11 kV network. Westpower developed a hydraulic actuator to be used on the 33 kV disconnectors. These are fitted to various locations on the network.

Disconnectors

A five-yearly PM programme is in place to ensure all disconnectors are maintained to a good and safe operating condition. The first maintenance cycle was completed at the end of March 2014. The majority of the disconnectors have been assessed as being in good condition. Crews have carried out necessary repair work to the disconnectors as identified while completing the maintenance.

A small number were identified as needing to be replaced immediately or in the near future. Immediate replacement was carried out where identified and a replacement plan is in place to be completed in the next PM cycle. Rust was one of the major issues identified when maintenance was carried out. These disconnectors were predominantly in coastal areas.

In conjunction with the maintenance programme, a disconnector refurbishment programme is in place. As most disconnector maintenance is carried out using Live Line techniques, all disconnectors are assessed before maintenance is carried out to determine if it is safer and more cost effective to replace the disconnector instead of carrying out repairs/maintenance. These are replaced with refurbished disconnectors. A stock of refurbished disconnectors is kept at the Greymouth depot ready to install at any location. These are disconnectors that have been removed from services and refurbished at the Greymouth depot.

As maintenance is carried out, earthing is checked to ensure all locations meet Westpower's current standards and are upgraded as required.

Protection

Protection systems are mainly restricted to zone substations, with the notable exception of line reclosers. Schweitzer Engineering Labs protection relays are now used across the network.

The new reclosers approved by Westpower are G & W Viper ST controlled by a SEL651R protection relay. Refurbished KFME Reclosers with SEL Protection have been installed to protect spur lines. All protection units are less than 30 years old and are of solid state construction.

5.14.4 Asset Maintenance Plan

Inspection, Servicing and Testing

Circuit breakers are subjected to minor and/or major maintenance routines in accordance with the requirements of Westpower's maintenance standards. Maintenance is also carried out when a circuit breaker has completed a specified number of fault trips.

Modern vacuum circuit breakers are subjected to minor services and condition monitoring tests at five-yearly intervals only. Invasive major services are not scheduled and would be carried out only if required as indicated by condition monitoring tests.

As with power transformers, there are two levels of servicing:

- Minor servicing, involving external servicing (non-invasive); and
- Major servicing, which involves invasive servicing.

Faults

Circuit Breakers

Fault repairs to switchgear are carried out as required, but as the population of older oil insulated type reclosers diminishes in line with Westpower's recloser replacement programme, the occurrence of these faults has been greatly reduced.

Disconnectors

Disconnectors normally fail due to deterioration of the operating arms with corrosion or from an arc developing across two or more phases. By identifying under-rated disconnectors and replacing these, the incidence of arcing faults should be reduced. The PM programme for disconnectors is working very well at identifying most potential problems before they occur.

Repairs and Refurbishment

Circuit Breakers

Planned repair work in respect to circuit breakers would include additional corrective work and refurbishment identified during routine services, inspections and tests or following failures. Refurbishment work planned includes overhaul of decommissioned circuit breakers, identified as suitable for future use at remote spur line locations or for spares prior to placing them in storage.

5.14.5 Asset Maintenance Projects and Programmes

The expenditure for MV Switchgear maintenance for the planning period is summarised in Table 5.33. Expenditure by activity type is summarised in Table 5.34.

Table 5.33: MV Switchgear Maintenance Expenditure ($'000)

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7105328 IS&T	**Disconnector Maintenance**	**80**	**80**	**80**	**80**	**80**	**80**	**80**	**80**	**80**	**80**
7199327 IS&T	**Inspection of Earthing of MV Switchgear Equipment**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**
7104702 FAULTS	**MV Switchgear Fault Response**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**
7104701 IS&T	**MV Switchgear Inspection, Service and Testing**	**62**	**62**	**62**	**62**	**62**	**62**	**62**	**62**	**62**	**62**
7104703 REPAIRS	**MV Switchgear Repairs**	**62**	**62**	**62**	**62**	**62**	**62**	**62**	**62**	**62**	**124**
7129661 IS&T	**Network Recloser/RMU Maintenance**	**34**	**34**	**34**	**34**	**34**	**34**	**34**	**34**	**34**	**34**
7105502 IS&T	**Perform Partial Discharge Tests on Network Switchgear**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**
7209329 IS&T	**Removal of Temporary Links for Shutdowns**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**
Total		**305**	**305**	**305**	**305**	**305**	**305**	**305**	**305**	**305**	**367**

Table 5.34: MV Switchgear Maintenance Expenditure by Activity ($'000)

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
FAULTS	6	6	6	6	6	6	6	6	6	6
IS&T	237	237	237	237	237	237	237	237	237	237
REPAIRS	62	62	62	62	62	62	62	62	62	124
Total	**305**	**305**	**305**	**305**	**305**	**305**	**305**	**305**	**305**	**367**

5.15 Asset: SCADA and Communications

DRC – $233,333

ODRC – $233,333

This includes all communications equipment and radio repeater sites, as well as vehicle-mounted equipment and the SCADA plant including the master station in the Greymouth Depot server room. Any equipment installed at zone substations has already been covered under that area.

5.15.1 Asset Justification

The SCADA and communications networks are essential to allow Westpower to monitor and operate its network. In the event of a fault, these systems allow safe isolation of the defective plant and also fast restoration of supply to as many consumers as possible. The system is also required for Westpower to monitor the real time performance of the assets.

5.15.2 Asset Description

SCADA System

Westpower's master SCADA station is based upon the RealFlex 6 product. This was recently purchased by GE Digital, who has informed Westpower that they have been developing their own Next Gen Human-Machine Interface (HMI) for industrial internet solutions which means RealFlex is no longer being developed and will soon come to the end of its life cycle. As a result of this information Westpower, has been investigating options around the future of its SCADA and outage management systems.

The RealFlex HMI is a Windows-based client running on standard desktop networked PCs. Storage of historical data is via a MySQL DBMS. The operator HMI for data and control is done via RealFlex software, which is run in the control room on a standard Windows PC fitted with three 22-inch LCD screens. This gives the operator the ability to not only view SCADA data but also simultaneously use any other PC software. The ability of Flexview to run on PCs allows the SCADA information to be viewed from almost anywhere within Westpower's computer network.

The information viewed within Flexview is captured by RealFlex which runs on a pair of dedicated Servers located in Westpower's secure server room, one being the online server, while the other acts as a hot standby in case of hardware failure. These servers run the latest version of RealFlex, on an operating system called QNX Neutrino RTOS, which is a network operating system designed for real-time applications.

All vital SCADA equipment is powered via an Uninterruptible Power Supply (UPS), which provides an eight-hour backup in case of a major power outage. Furthermore, a three-phase generator has been installed to provide power to all equipment including the UPS, further extending this back-up period if required.

Remote Terminal Units

RealFlex has the ability to communicate with many different types of Remote Terminal Units (RTU) and field equipment such as communication processors, protection relays and PLCs via most of today's standard communication protocols.

For smaller sites and pole tops in remote areas where digital radios are not practicable, Abbey Systems TopCat II and TopCat RTUs are installed.

The TopCat II is a small unit with fixed I/O and also has two local communication ports to connect to a PLC or protection relay, which provides additional control and equipment status data.

A feature of these units is the pre-emptive communications protocol, which allows the RTU to be polled very infrequently, while simultaneously providing the ability for the RTU to update the master station whenever a change of state occurs.

Abbey RTUs use Westpower's VHF speech and data radio channels to communicate with the master station.

Communication System

Westpower's communications network provides vital SCADA, telephony and tele-protection services for the Westpower distribution network, the Transpower transmission network, Trustpower and Solid Energy. The communication network is a mix of fibre, analogue radio and digital radio.

Communication Cables

A fibre-optic cable runs from the server room in the Tainui St building to the Greymouth substation. This fibre link is used for speech, SCADA and surveillance monitoring of the Greymouth substation.

A second fibre cable runs from the server room to Chapel St. This fibre link is used for SCADA and offsite computer backups.

VHF Network

The VHF speech network is an extensive system used by Westpower, ElectroNet Services Ltd and Trustpower (West Coast Generation).

As vehicles are replaced, regular removal and reinstallation of existing mobile sets takes place.

Digital Network

The digital radio network consists of a mixture of radio technologies, consisting of licensed point-to-point radio frequencies. Digital radio links provide Transmission Control Protocol and Internet Protocol (TCP/IP) and where required, serial and voice channels to all major Westpower substations. Current sites covered by the digital network are the Greymouth, Dobson, Hokitika, Reefton, Ngahere, Arnold, Rapahoe, Kumara, Globe, Logburn, Blackwater, Pike, Harihari, Whataroa, Wahapo, and Amethyst substations and 39 smaller sites spread the length of the Coast from Inangahua in the north to Jacobs Ridge in the south.

5.15.3 Asset Condition

Communication System

All VHF communication equipment is in excellent condition after a complete replacement programme required for the recent change to narrow band frequencies. Tait 2000 series equipment is now used throughout the network and rarely gives trouble.

5.15.4 Asset Maintenance Plan

Inspections, Servicing and Testing

SCADA System

The integrity of the main hardware and software system at the control room is of the highest importance to the on-going management and safety of the grid network. Westpower's asset management staff, manage the computer system and maintain the operational state of the software and hardware systems. This is a 24-hour task, with staff on call if required to ensure high availability of equipment. The main computer hardware and software are protected by a maintenance contract with the supplier.

An approved contractor manages all communication and SCADA equipment external to the computer system. This provides for continuous maintenance and fast response for fault repairs.

Communications

All major communications assets are inspected six-monthly and serviced on an annual basis. The six monthly inspection is, as far as possible, non-intrusive. No adjustments are made until items are out of tolerance or performance is affected.

Antenna support structures e.g. wood poles, towers and monopoles, are inspected every two or three years.

Antennae are to be checked annually with a spectrum analyser.

Repairs and Refurbishment

Communications

Westpower maintains communications assets at approximately 32 base sites, 110 pole-top or RMU sites and on 15 repeater sites. The planned repair and refurbishment estimates are based on past expenditure.

Contract maintenance technicians are expected to respond to approximately 12 major faults per annum.

5.15.5 Asset Maintenance Projects and Programmes

The expenditure for SCADA and Communications maintenance for the planning period is summarised in Table 5.35. Expenditure by activity type is summarised in Table 5.36.

Table 5.35: SCADA and Communications Maintenance Expenditure ($'000)

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
7219981 IS&T	**Comm Site General IS&T**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**
7220003 IS&T	**Comm Site Location Fees**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
7219965 IS&T	**Comm Site Planned Inspections**	**75**	**75**	**75**	**75**	**75**	**75**	**75**	**75**	**75**	**75**
7220660 IS&T	**Comm Site Power Accounts**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
7220454 IS&T	**Comms General Planning and Documentation**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**
7220477 FAULTS	**SCADA Comms Faults**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**
7220465 REPAIRS	**SCADA Comms Repairs**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**
7219992 IS&T	**Software Hardware Support Contracts or Licence Fees**	**116**	**116**	**116**	**116**	**116**	**116**	**116**	**116**	**116**	**116**
Total		**425**	**425**	**425**	**425**	**425**	**425**	**425**	**425**	**425**	**425**

Table 5.36: SCADA and Communications Maintenance Expenditure by Activity ($'000

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
FAULTS	50	50	50	50	50	50	50	50	50	50
IS&T	325	325	325	325	325	325	325	325	325	325
REPAIRS	50	50	50	50	50	50	50	50	50	50
Total	**425**	**425**	**425**	**425**	**425**	**425**	**425**	**425**	**425**	**425**

5.16 Asset: Other

5.16.1 Ripple Injection Plants

DRC – $180,000

ODRC – $180,000

Westpower owns five ripple injection plants, located at Reefton, Greymouth, Hokitika, Dobson and Wahapo. These plants are used for load control purposes as well as providing tariff-switching signals for use by retailers.

Retailers use this system, by contractual arrangement with Westpower, to shift load from high-cost to low-cost periods, provided that load control operational requirements are not compromised.

5.16.1.1 Asset Justification

Ripple injection plants are a key part of Westpower's demand side management strategy and are used to send ripple signals to receivers in consumers' premises that allow interruptible loads such as water heating to be switched on or off. This is critical to maximise use of existing assets and avoid unnecessary asset expenditure to cover unnecessarily high peak demands.

5.16.1.2 Asset Description

Hokitika and Greymouth have Enermet SFU-K303 series 120 kVA injection plants installed, while Dobson and Reefton have Enermet SFU-K 203 series 80 kVA plants. All plants have associated injection transformers, coupling cells and HV circuit breakers. In all cases, the injection plant and major coupling cell components are housed inside a building.

All plants are controlled remotely by the SCADA load management system and locally via Abbey Powerlink Injection controllers.

Four of the five on-line plants run synchronously, i.e. they are able to inject the identical ripple waveform at each of the four sites at the same time. GPS technology has made this possible by providing an accurate time base at each site which is perfectly synchronised in frequency and phase with the other bases.

A stand-alone ripple plant was installed at Wahapo zone substation in 2011/12 financial year. This was installed in the existing shed and is used on occasion to provide ripple control to the South Westland area when Wahapo generation is running islanded from the remainder of Westpower's network. This plant consists of the best available parts from the decommissioned Plessey TR series 75 kVA plants at Reefton, Greymouth and Hokitika.

5.16.1.3 Asset Condition

Westpower sold all of its ripple relays to the new incumbent retailer on 31 March 1999 along with exclusive use of channels existing at that time. The ripple injection plants were retained for the purpose of load control as well as to provide a load switching service to retailers under contract.

All ripple injection plants are either new or in good order, as would be expected from their age profile.

5.16.1.4 Asset Maintenance Plan

Inspection, Servicing and Testing

Monthly checks are carried out as part of regular zone substation visits, which includes the visual inspections of the:

- Converters
- Coupling transformers
- Coupling cells
- GPS time base receivers.

Every three years, independent experts determine injection levels, current balance, optimum tuning and load sharing with other units during a full inspection.

Faults

The solid state construction of the injection plants and the fact that they operate well below their maximum power levels means that faults are very uncommon.

On rare occasions, the high-power output transistors may require replacement or the logic board may require repair. At other times, vermin may get into the HV coupling cells, causing flashover.

The redundancy built into the injection network means that the failure of any single plant will not severely impact on overall ripple signal propagation, and faults are able to be handled without undue time pressure on restoration.

Repairs and Refurbishment

Minor repairs are required on the coupling equipment and converters from time to time as a result of fault events.

There is no planned repair and refurbishment programme planned for this equipment, which is relatively young and in good condition. It is expected that the plants will give at least ten years of trouble-free service.

5.16.1.5 Asset Maintenance Projects and Programmes

The maintenance expenditure for ripple control systems is included as Other Maintenance in Tables 5.41 and 5.42.

5.16.2 Embedded Generation

Westpower currently owns no generation plant, but has re-entered this market segment through a joint venture with other partners to construct a 7.6 MW hydro scheme on the Amethyst ravine near Harihari. The Amethyst Scheme was commissioned in May 2013.

A concession application for a 16-20 MW hydro scheme on the Waitaha River has been lodged with the Department of Conservation.

Table 5.37: Customer-embedded generation onto the Westpower network (greater than 0.5 MW)

Site	Owner	Year in Service	KW Generated	Connection Point	Connection Voltage
Amethyst Power Station	Westpower	2013	7400	Hari Hari	11 kV
Kumara Power Station	TrustPower	1978	6500	Kumara	11 kV
Dillmans Power Station	TrustPower	1978	3500	Dillmans	11 kV
Wahapo	TrustPower	1991	3100	Wahapo	11 kV
Arnold Power Station	TrustPower	1932	3000	Arnold	11 kV
Inchbonnie Power Station	Inchbonnie Hydro	2015	1700	Inchbonnie	11 kV
McKays Creek	TrustPower	1931	1100	McKays Creek	11 kV
Duffers Power Station	TrustPower	1979	550	Duffers	11 kV
Fox Power Station	NZ Energy	2009	500	Fox	11 kV
Kaniere Forks	TrustPower	1931	500	Kaniere Forks	11 kV

5.16.3 Voltage Support Systems

Westpower regularly uses voltage regulators throughout its distribution network. 11 kV regulators are installed at Cronadun, Haupiri and Longford Corner along with a regulator connected to its 33 kV sub transmission network at Harihari to support the voltage in South Westland when Trustpower's Wahapo generator is not running. Although this regulator is generously rated, it was bought second-hand for a price well below modern replacement cost and could be replaced by a smaller unit if it had to be replaced in the future.

Table 5.38 shows the schedule of voltage regulators installed in Westpower's network.

Table 5.38: Schedule of Voltage Regulators

Regulator Site	Voltage	Size
Cronadun (north of Reefton	11 kV	2250 kVA
Haupiri (east of Dobson)	11 kV	2000 kVA
Longford Corner (east of Hokitika)	11 kV	2000 kVA
Harihari	33 kV	10 000 kVA

In addition to voltage regulators, a number of HV capacitors have been strategically installed throughout the 11 kV distribution network. This improves the apparent power factor of the loads seen from Transpower's GXPs, resulting in improved voltage regulation throughout the West Coast. It also improves the voltage profiles in individual 11 kV feeders leading to improved capacity and reduced losses.

Capacitors have been installed at various locations throughout the 11 kV network. There are a total of 17 capacitor sites, varying in size from 0.3 MVAr to 7 MVAr, with a total capacity of 19 MVAr. All of these capacitor locations are between 3-15 years old, and are a combination of pad-mounted and pole-mounted. All of the above are under Westpower's operational control.

Most of the capacitors installed in the network are fixed, where they are in service at all times. An automated site has now been installed at Kumara Junction, which was used for voltage support during the Kumara project. This site has proved to be successful in switching the capacitor banks in and out of service when required. All sites will be gradually assessed to determine if they are required to be automated. Switched capacitor banks also exist in Hokitika, Haupiri and Shantytown. The Shantytown capacitor bank is LV.

Because capacitors can absorb ripple signals, depending on the size of the capacitor and the system configuration, they are often installed with separate blocking chokes to avoid this problem.

In 2015, a 0.5 MVAr STATCOM (Static Var Compensator) was installed at the Gloriavale Christian Community to supplement the 1.0 MVAr switched capacitors at that location. The STATCOM is an LV device and employs high frequency inverter technology to provide fully dynamic voltage support. This technology provides advantages over switched capacitors such as improvements in power quality through reduction of flicker and improved voltage regulation. The combination of switched capacitors and STATCOM results in a dynamic range of 0 to 1.5 MVAr.

Table 5.39 details the 11 kV distribution capacitors installed on Westpower's network and the zone substation that they are connected to.

Table 5.39: Location of 11 kV Distributor Capacitors in the Westpower Network

Location	Zone Substation	Voltage	Capacity	Automated
South Highway 6 - Hokitika	Hokitika	11 kV	1000 kVAr	No
Kaniere Tram	Hokitika	11 kV	1000 kVAr	No
Hokitika Substation	Hokitika	11 kV	7000 kVAr	Yes
Strongman	Rapahoe	11 kV	1000 kVAr	No
Fox Substation	Fox Glacier	11 kV	500 kVAr	No
Reefton Saddle	Reefton	11 kV	1000 kVAr	No
Kokiri	Arnold	11 kV	1200 kVAr	No
Wahapo Substation	Wahapo	11 kV	500 kVAr	No
Punakaiki	Rapahoe	11 kV	300 kVAr	No
Rotomanu	Arnold	11 kV	500 kVAr	No
Kokatahi	Hokitika	11 kV	1000 kVAr	No
Kotuku	Arnold	11 kV	500 kVAr	No
Haupiri	Arnold	11 kV	300 kVAr	No
Gladstone	Greymouth	11 kV	500 kVAr	No
Christian Community	Arnold	11 kV	1200 kVAr	Yes
Kumara Junction	Kumara	11 kV	1000 kVAr	Yes
Shantytown, Rutherglen	Greymouth	0.4 kV	500 kVAr	Yes

In addition, a 7 MVAr capacitor bank at Greymouth substation and a 19.2 MVAr bank at Hokitika substation are under Transpower's operational control.

Westpower Mobile Substation

Westpower's mobile substation (WMS) pictured below, was developed to provide an effective means of maintaining electricity supplies to areas served by zone substations with single transformers. Essentially, it is a self-contained zone substation on wheels, and is rated at 33/11/3.3 kV and 8/10 MVA.

Figure 5.16: Westpower Mobile Substation

The 33 and 11 kV cables are stored on reels and rolled out on-site to connect to the local 33 and 11 kV networks. All of the switchgear, SCADA, control and protection systems are on board and ready to go at short notice.

This substation can be used to:

- Reduce restoration time in the event of a forced outage of a transformer at a single transformer substation;
- Provide for a temporary or augmented supply to an area near to the sub-transmission system when a new build is not warranted for short duration peaks or loads; and
- Allow for extended maintenance outages at substations without interrupting supply to consumers for significant periods.

This is one of only four such substations that Westpower is aware of, with three of these permanently in the South Island. This innovation has improved security and reliability in Westpower's network. So far, it has been used on several occasions, saving loss of supply or extra cost from temporary hire of generators.

A number of substations have been modified to accommodate the mobile substation. The zone substation sites prepared for mobile substation connection so far are the Arnold, Dobson, Ngahere, Rapahoe, Franz Josef, Fox Glacier, Whataroa, Globe, Harihari, Blackwater and Waitaha.

5.16.4 Substation Buildings

Westpower has a number of substation buildings of different types located around its network. Some house substations and some house control equipment. Table 5.40 lists the substation buildings within the Westpower network, their location, purpose and type of construction.

Building maintenance is an important part of maintaining the condition of assets within the Westpower network. The condition of the buildings was assessed in the 2004 Lifelines Survey report for Westpower and a number of issues were highlighted. These included checking for the presence of reinforcing steel in the early permanent buildings and ensuring that the sandwich panel buildings were restrained sufficiently to mitigate the effects of earthquake loads.

A zone substation building climate control programme has seen air conditioning units installed at various zone substations. Units have been installed at Reefton, Globe, Blackwater, Pike, Logburn, Ngahere, Rapahoe, Greymouth, Hokitika, Whataroa and Franz Josef. These units provide a constant temperature in zone substations, allowing for a more stable environment for all equipment in zone substation control rooms.

Table 5.40: Substation Buildings within the Westpower Network

Building Location	Purpose	Materials of Construction
Reefton Substation	Switchgear & control gear	Permanent
Blackwater Substation	Switchgear & control gear	Transportable sandwich panels
Logburn Substation	Switchgear & control gear	Permanent
Globe Substation	Switchgear & control gear	Transportable sandwich panels
Pike Substation	Switchgear & control gear	Transportable sandwich panels
Ngahere Substation	Control equipment	Light timber framed
Arnold Substation	Storage and office	Light timber framed
Dobson Substation	Control equipment	Transportable sandwich panels
Dobson Substation	Switchgear & control gear	Light timber framed
Rapahoe Substation	Switchgear & control gear	Light timber framed
Greymouth Substation	Switchgear & control gear	Permanent
Mawhera Quay Substation	Switchgear & control gear	Permanent
Badger Lane Substation	Switchgear	Permanent
Hokitika Substation	Switchgear & control gear	Permanent
Ross Substation	Control equipment	Transportable sandwich panels
Harihari Substation	Control equipment	Transportable sandwich panels
Harihari Regulator	Control equipment	Transportable sandwich panels
Waitaha Substation	Control equipment	Transportable sandwich panels
Whataroa Substation	Control equipment	Light timber framed
Wahapo Substation	Control equipment	Light timber framed
Franz Josef Substation	Control equipment	Light timber framed
Fox Substation	Control equipment	Transportable sandwich panels

5.16.5 OTHER ASSET MAINTENANCE EXPENDITURE

Table 5.41: Other Maintenance Expenditure ($'000)

ID/Act	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
5339 IS&T	**IS&T Other**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
7221590 FAULTS	**Other Fault Response**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**
Total		**11**	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**11**

Table 5.42: Other Maintenance Expenditure by Activity ($'000)

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
FAULTS	6	6	6	6	6	6	6	6	6	6
IS&T	5	5	5	5	5	5	5	5	5	5
Total	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**11**

6.0 FINANCIAL SUMMARY

This section outlines the financial forecasts, both CAPEX and OPEX for the next ten year period with a brief discussion on any changes to the previous forecasts. The assumptions on which these forecasts are based are outlined as well as other factors that may impact on network expenditure. The actual deviations from previous AMP forecast budgets are listed, and include unallocated, uncommenced or uncompleted works.

6.1 Financial Forecasts

The financial expenditures in this section are forecast for a ten year period. These forecasts have been built up from the individual project and programme expenditures developed in Sections 4 and 5, and demonstrate a generally stable expenditure over the duration of the planning period.

Table 6.1 shows the projected ten year AMP expenditure by activity and Tables 6.2, 6.3 and 6.4 show this expenditure by asset type. No provisions for inflation have been made in these figures.

Table 6.1: AMP – Forecast Expenditure by Activity ($'000)

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
DEVELOPMENT	958	523	758	533	473	473	473	473	533	353
ENHANCEMENT	1399	1201	659	2243	356	296	296	271	296	231
REPLACEMENT	1148	1209	1278	623	1696	1472	832	870	922	1492
Capital Total	**3505**	**2933**	**2695**	**3399**	**2525**	**2241**	**1601**	**1614**	**1751**	**2076**
FAULTS	496	496	496	496	496	496	496	496	496	496
IS&T	4258	4163	4088	4055	4055	4023	4038	4033	4050	4128
REPAIRS	346	346	346	346	346	346	346	346	346	346
Maintenance Total	**5100**	**5005**	**4931**	**4897**	**4897**	**4865**	**4880**	**4876**	**4892**	**4970**
Total	**8605**	**7938**	**7625**	**8296**	**7422**	**7106**	**6481**	**6489**	**6643**	**7046**

Table 6.2: OPEX – Forecast Expenditure by Asset Type ($'000)

Asset Type	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Sub-Transmission	337	320	302	302	302	302	302	302	302	366
Distribution	2150	2096	2046	2036	2036	2036	2036	2036	2036	2036
Reticulation	221	221	219	201	201	199	199	199	201	195
Services	224	207	207	207	207	207	207	207	207	222
Zone Substations	783	798	793	808	813	783	798	793	808	813
Distribution Substation	542	520	520	500	495	495	495	495	495	495
MV Switchgear	305	305	305	305	305	305	305	305	305	305
SCADA/Comms	425	425	425	425	425	425	425	425	425	425
Distribution Trans	103	103	103	103	103	103	103	103	103	103
Other	11	11	11	11	11	11	11	11	11	11
Total	**5100**	**5005**	**4931**	**4897**	**4897**	**4865**	**4880**	**4876**	**4892**	**4970**

Table 6.3: CAPEX (Replacement) – Forecast Expenditure by Asset Type ($'000)

Asset Type	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Sub-Transmission	419	318	89	82	120	64	70	70	70	20
Distribution	308	311	315	258	258	258	258	258	258	258
Reticulation	57	59	54	62	49	49	49	49	49	49
Services	81	72	73	69	69	69	51	51	51	51
Zone Substations	140	324	630	36	1121	952	324	325	418	1035
Distribution Substation	30	0	0	0	0	0	0	0	0	0
MV Switchgear	81	95	87	86	49	51	50	87	46	49
SCADA/Comms	15	30	30	30	30	30	30	30	30	30
Other	18	0	0	0	0	0	0	0	0	0
Total	**1148**	**1209**	**1278**	**623**	**1696**	**1472**	**832**	**870**	**922**	**1492**

Table 6.4: CAPEX (Development and Enhancement) – Forecast Expenditure by Asset Type ($'000)

Asset Type	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Sub-Transmission	150	0	0	0	0	0	0	0	0	0
Distribution	0	50	75	0	0	0	0	0	0	0
Services	50	50	50	50	50	50	50	50	50	50
Zone Substations	345	97	165	1782	15	0	0	0	0	0
Distribution Substation	75	75	75	75	75	75	75	75	75	75
MV Switchgear	272	237	237	169	109	109	109	109	169	109
SCADA/Comms	1265	1015	615	500	380	335	335	310	335	150
Distribution Trans	200	200	200	200	200	200	200	200	200	200
Total	**2357**	**1724**	**1417**	**2776**	**829**	**769**	**769**	**744**	**829**	**584**

It should be noted that the estimates for the first half of the planning period are based on known drivers and hence are more accurate than those for the second half, which are more in the nature of forecasts due to a large number of unpredictable factors. Nevertheless, in developing these figures, Westpower has had several years of experience in budgeting and controlling this expenditure, and there is a high degree of confidence in these values.

Capital expenditure typically represents 30% of the total AMP expenditure, while maintenance expenditure represents the remaining 70%.

Typically, 83% of current maintenance expenditure on network assets is scheduled in advance (i.e. planned work). Another 5% of maintenance is not planned but is required to be done as repairs to the network's assets. The remaining 12% of maintenance expenditure is for remedial work (i.e. fault repairs) to restore the network to its full initial service potential following the restoration of supply after a fault event.

A management fee is included in I, S & T, this is part of a fixed annual fee paid to the maintenance contractor to cover costs such as spare transformer management and the provision of otherwise uneconomic fault bases at Reefton and Harihari.

A contingency sum has also been provided to allow for unexpected events. This is especially necessary in the fault activity area where expenditure is highly dependent on weather conditions. In fact, just a few severe lightning storms can have a major impact on the annual result.

6.1.1 Capital Expenditure

In general, CAPEX remains at historically low levels, reflecting the good overall condition of Westpower's reticulation assets and the ongoing lack of any significant demand drivers that would otherwise require investment in network growth.

Underlying CAPEX remains close to the value signalled in last year's budget, but a number of capital projects have been rolled over from the current year's budget to the next financial year. These include the:

- Pike River Decommissioning;
- Relocation of 66 kV line at Ruatapu;
- Relocation of 33 kV line at Waiho River, Franz Josef; and
- Replacement of 33 kV structures in Warrens Paddock.

A description of these projects can be found in Section 4.

6.1.2 Operational Expenditure

The maintenance expenditure is approximately $500,000 lower than the budget for the 2015/2016 year and some $200,000 below the previously forecast expenditure for the coming 2016/2017 year. Two areas of increase within the OPEX budget are: the vegetation budget which is required to meet minimum legislative compliance obligations: and the general transformer servicing budget. This has been increased to allow for more refurbishment of existing assets rather than purchase of new assets.

6.2 Assumptions and Sensitivity Analysis

Some basic assumptions have been made. These include:

- As an ELB, Westpower will continue to be a going concern under the new regulatory regime.
- Asset management, system control and corporate services functions will be provided by ElectroNet Services Ltd and be based in Greymouth.
- The ELB will continue to own ElectroNet Services Ltd and to operate it on an arms-length basis.
- The ELB must satisfy the twin constraints of providing a risk-adjusted normal profit for its beneficiaries sufficient to retain investment, while simultaneously performing within the regulatory limits set by government regulations.

Refer to Table 6.5 Sensitivity Analysis. Other factors that will impact on network expenditure are discussed below.

Table 6.5: Sensitivity Analysis

Forecasting Assumption	Level of Uncertainty	Risk Assessment (Low/Med/High)	Reasoning for Assessment
Load Growth	It is likely that the projected load growth will in reality be different	High	The Asset Management Plan has assumed growth will occur in the low range of the NZ Statistics projections, which is the best information we have available, supplemented by knowledge of particular regional developments based on the Loadwatch spreadsheet. The impact of any change from the projection will be on capital expenditure as many step loads require augmentation of the network. The impact on maintenance expenditure is less significant. If growth slows then expenditure will be deferred and the asset will still have sufficient capacity. Many of the engineering solutions cater for growth up to 20 years out; however if growth is faster than forecast it may mean at some stage in the future upgrades may need to occur sooner than anticipated. This considered a high risk, but largely beyond Westpower's control.
Continuance of Supply	It is possible, but unlikely, that Westpower will not need to continue supplying existing customers	Low	A key assumption is that Westpower will need to continue to maintain and replace older lines that feed customers in rural areas. It is hard to see any government removing the protection that many farming communities rely on in terms of having a long term guarantee that electricity supply will continue to be available at current prices, after taking inflation into account. At the same time, Westpower's network is in very good condition with few areas requiring major refurbishment within the planning period and so any extended obligation will have little impact in the short to medium term.
Governance Structure	It is improbable that the governance structure will change	Low	Recent ownership reviews and the currently supportive regulatory framework for trust-owned lines businesses means that there do not appear to be any significant drivers for a change in the current governance structure.
Activities Undertaken	It is likely that new activities will be undertaken.	Low	Although Westpower is involved in a number of related activities through its subsidiary companies, and this is likely to increase over time, the impact on the AMP is not great as a clear focus will always be maintained on the asset.

6.2.1 Weather Impacts

Weather affects the fault expenditure through the level of storm damage experienced, as was the case with Cyclone Ita in April 2014. As it is very difficult to predict weather patterns over a 12-month period, the budget for fault expenditure can only be an estimate based on historical averages and general knowledge of the asset condition.

The sensitivity of the network to storm damage has greatly reduced over the last 20 years as major sub-transmission and distribution feeders have been progressively replaced with better quality materials. Lightning arrestors have been placed on all substations and reclosers to protect that equipment during lightning storms. In addition, a continuing distribution automation programme has reduced the amount of time and effort required for fault location and repair.

On the other hand, extreme weather events over the last five-years have had a notable impact on performance statistics such as SAIDI and so a continuation of the five year rolling average has been assumed to estimate forward fault and repair expenditure.

6.2.2 Growth Forecasting

Growth has been allowed for at a rate equivalent to the Statistics New Zealand low growth projections for the district. The AMP assumes that the region's population will increase by an average of approximately 0.4% per annum.

Gross Domestic Product (GDP) on the West Coast has a direct effect on Westpower's revenue stream through reduced distribution to large customers. It also has an indirect effect as secondary and tertiary level consumers in the commercial and domestic area contract.

The use of a Loadwatch spreadsheet to collect all available information on future load growth trends has been used as a starting point in the planning process. Where the loads are not yet committed, probabilities have been applied according to an assessment of the likelihood of a project proceeding. In addition, the diversity of any load needs to be considered and a diversity factor of 30% has been applied, as this is the average load factor experienced on the network. Where a load will clearly have a different profile, such as an industrial process industry that runs around the clock, an individual diversity factor is applied that is relevant to that particular load.

Within the AMP, growth has been based on known step changes. If there are no known step loads, then growth is assumed to be straight-line between years. These assumptions have been applied when projecting expenditure and growth over the ten-year period. The projections for different asset types will vary depending on the amount of system reinforcement required for each load.

6.2.3 Continuance of Supply

A key assumption is that Westpower will be required to continue to supply existing customers on its network for the foreseeable future in accordance with Section 105 of the Electricity Industry Act 2010.

6.2.4 Governance Structure

It is assumed that the governance structure will remain in the state as anticipated by this plan over the duration of this plan.

6.2.5 Devolutions of Responsibility

For the purposes of this plan, it is assumed that there will be no devolutions of additional responsibility from a regulatory perspective, particularly not without the ability to recover any increased costs through a commensurate increase in revenue.

6.2.6 Assumptions as to Activities Undertaken and Levels of Service Provided

Westpower is assuming that the range of activities that it has signalled to undertake will not change.

Westpower is also assuming that the levels of service to which its activities are provided will not change, except as a consequence of planned expenditure programmes mentioned in this plan. The reality is that any change to service level and/or activities undertaken may place an additional cost on Westpower, and the recovery of this cost would need to be fairly and equitably allocated to the chief beneficiaries.

6.2.7 Fixed Asset Useful Life

A number of assumptions have been made about the useful lives of Westpower's infrastructure assets. The detail for each asset category is generally based on the guidelines provided in the latest Optimised Deprival Value (ODV) handbook. The useful lives are consistent with the assumptions applied to valuing each asset category and were determined by experienced and qualified asset engineering staff.

Individual asset lives are applied to assets that are either expected to last longer or less than the standard values because of the asset, condition or environmental factors, such as proximity to a corrosive coastal environment.

6.2.8 Resource Consents and Concessions

Westpower is assuming that the major resource consents and concessions that it needs for delivery of the services outlined in this plan will be obtained and granted with conditions that can be met within anticipated expenditure estimates.

6.2.9 Vesting Assets

For the purposes of this plan it has been assumed there will be vesting of assets in Westpower. This has been based on historical information. However, it is noted that they are:

- Beyond Westpower's control and their number and value are very difficult to predict;
- Likely to be immaterial in the context of overall asset values; and
- Being brand new, unlikely to impose any significant extra costs from those generated over the life of this plan.

6.2.10 Sustainability

Westpower has considered the sustainability of each of its services and activities in its preparation of the AMP alongside how the services it provides will meet the needs of present and future generations, and how its activities will protect and enhance the natural environment in the long term. While the company is primarily required to act in a commercial manner and remain a going concern, it is also cognisant of its responsibilities to take a sustainable development approach to providing for the social, economic, environmental and cultural wellbeing of communities. This involves taking account of the needs of people and communities now, the reasonably foreseeable needs of future generations, and the need to maintain and enhance the quality of the environment.

Taking a sustainable development approach is reflected in the way Westpower plans for a sustainable supply of electricity throughout its area.

Westpower has a significant role in the provision and operation of key infrastructure that is critical for the sustainable development of the communities that it serves.

6.2.10.1 Effects of Climate Change

It is assumed that the climate change reports provided by the Intergovernmental Panel on Climate Change (IPCC) are reliable and provide a reasonable indication of what Westpower needs to consider in its planning processes. Based on the IPCC reports, it is assumed that the sea level will rise by 0.5 m over the next 100 years.

6.2.10.2 Emissions Trading Scheme

This ten-year AMP has been prepared based on the broad scientific community view that human-induced climate change through increased greenhouse gas emissions is occurring and may accelerate in the future. National and international efforts are underway to control emissions in response to agreements that the government is a signatory to.

Many of the climate change-induced changes are likely to eventuate over the longer term and will occur beyond the ten-year horizon upon which the activities and service levels are described in this AMP. There are, however, factors to be taken into account such as increased electricity prices driving additional investment in distributed renewable generation and this needs to be catered for in Westpower's planning processes.

6.3 Actual Deviations from Previous AMPs

Refer to Table 6.6 for Actual vs Budget Performance by Asset Type.

6.3.1 Unallocated Works

Additional works (over $10,000) that were not included in the 2014/15 financial year of the AMP, but which for various reasons, were undertaken are outlined below.

6.3.1.1 Distribution

Mawheraiti Thompsons Road - 11 kV Pole Replacement (TP Undercrossing)

Deferred from the previous financial year, this essential work was carried out during the 2014/15 financial year due to design delays.

Seaview - Remove Redundant 11 kV Line

Deferred from the previous financial year, work was carried out during the 2014/15 financial year as landowner issues needed to be resolved.

6.3.1.2 Distribution Substations

S601 Kumara - Replace Structure with Pad Mounted Substation

Deferred from the previous financial year, this distribution substation replacement work was carried out during the 2014/15 financial year due to design delays.

6.3.1.3 Zone Substations

44028: Whataroa Zone Substation – Replace CB1412 with WVE38x

This project was planned for the 2013/14 financial year. Contractors were advised at late notice by the supplier of the replacement recloser, that they could not deliver the equipment in the time frame as agreed when ordered. With other projects planned to coincide together, a decision was made to use Westpower's spare recloser. The project was completed in the 2013/14 financial year. The recloser arrived in 2014 resulting in costs of $23,438 in the 2014/15 financial year.

6.3.1.4 MV Switchgear

56009: Haupiri STATCOM

Budgets had been allocated to automate a capacitor bank ($50,000) and to relocate the regulators at Haupiri ($40,000) to improve power quality on the Arnold 4 feeder. Further analysis determined that the best option for this issue was to install a STATCOM at Haupiri resulting in unallocated costs of $98,307. The budgets allocated to automating the capacitor bank and relocating the regulators was used for the STATCOM project.

6.3.2 Uncommenced Works

Projects (over $10,000) that were not commenced in the 2014/15 financial year of the AMP are outlined below.

6.3.2.1 Distribution

Berlins 11 kV Line Replacement

The Berlins 11 kV line replacement was delayed while consents were granted. This work was completed in the latter part of the 2015/16 financial year.

Te Kinga Iveagh Bay - Relocate 11 kV Line

A section of line threatened by the Crooked River was to be relocated. A design was carried out however landowner issues prevented the line relocation work commencing.

6.3.2.2 Zone Substations

54022: Install WMS Access at Wahapo Zone Substation $35,000

All possible options were considered to installing access for the mobile substation at Wahapo. Due to the practicality and expected additional costs to complete, it was determined that it was not feasible to commence this project.

6.3.2.3 MV Switchgear

66005: Automate Capacitors at Various Locations $50,000

A budget was allowed to automate capacitors on the Arnold 4 feeder to improve power quality in the Haupiri area. Further analysis determined that the best option for this was to install a STATCOM at Haupiri. The budget allocated for the automating the capacitor bank was used towards the STATCOM.

56009: Relocate Haupiri Regulator $40,000

A budget was allowed to relocate the regulator at Haupiri to improve power quality in the Haupiri area. Further analysis determined that the best option for this was to install a STATCOM at Haupiri. The budget allocated for relocating the regulators was used towards the STATCOM.

6.3.3 Uncompleted Works

Projects that were started and have more than $20,000 remaining in the 2014/15 financial year of the AMP are outlined below.

6.3.3.1 Zone Substations

14010: Rapahoe Substation – Paint Gantry Steelwork and Reinsulate $28,101

A detailed assessment of the gantry and steelwork was completed resulting in less work required than first anticipated. All work was completed at a cost of $4,898 resulting in an under spend of $21,101.

14019: Oil Filter and Dry Out System for Transformers $21,329

Regular oil testing (DGA) helps identify transformers requiring the Trojan filter unit to be installed. All transformers identified were filtered at a costs of $5,670, resulting in an under spend of $21,329.

44010: Battery Replacement Programme $22,590

The budget for 2014/15 was over estimated. All battery banks identified as needing to be replaced were completed at a costs of $21,409, resulting in an under spend of $22,590.

6.3.3.2 MV Switchgear

16003: RMU/Recloser Maintenance $20,012

Due to resource constraints and outage requirements for some equipment, all work able to be completed was completed at a cost of $12,987, resulting in an under spend of $20,012.

16007: Inspection of Earthing of MV Switchgear Equipment $21,678

Due to resource constraints, outage requirements for some equipment and delays in the development of improved testing methods and written approved standards, all work able to be completed was done at a cost of $18,321, resulting in an under spend of $21,678.

46003: Disconnector Replacement $22,425

Some disconnectors are identified as needing to be replaced during the disconnector maintenance programme. All disconnectors identified were replaced at a costs of $12,574, resulting in an under spend of $22,425.

2014-2015	Development		Enhancement		Replacement		IS&T		Faults		Repairs		Total	
	Actual	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual	Budget
Sub-Transmission	0	0	0	0	200	245	440	672	7	25	172	34	819	976
Distribution	8	16	105	100	327	310	1691	1849	264	264	980	53	3375	2592
Reticulation	13	0	0	0	76	79	215	240	55	23	56	21	414	363
Services	48	53	0	0	100	70	46	56	141	89	9	6	344	274
Zone Substations	2	0	35	66	493	406	790	713	6	6	105	76	1431	1267
Distribution Substations	48	47	17	40	56	30	453	492	3	18	13	11	590	638
MV Switchgear	36	81	146	120	19	42	193	236	0	6	66	60	460	545
SCADA/Comms	260	371	169	0	13	0	303	60	48	3	47	0	841	434
Distribution Transformer	252	112	0	75	0	110	103	351	3	46	0	46	358	740
Other	0	0	0	0	0	0	0	105	2	6	0	1	2	112
Total	**666**	**680**	**472**	**401**	**1283**	**1292**	**4235**	**4774**	**529**	**486**	**1448**	**308**	**8633**	**7941**

Table 6.6: Actual vs Budget Performance by Asset Type ($'000)

7.0 ASSET MANAGEMENT PROCESSES, SYSTEMS AND IMPROVEMENT PROGRAMMES

7.1 Introduction

The Asset Management Plan provides a focus for ongoing analysis within Westpower aimed at continuously improving the management of the distribution system. Westpower is constantly striving to find more efficient ways to carry out its daily functions, by reducing costs and improving productivity. The benchmark of best commercial practice is constantly moving, as demonstrated through the industry information disclosure regime, which looks at factors such as price and supply reliability.

A key strategic goal for the business is compliance with ISO 55000, a global specification for good asset management practice. Considerable progress has been made in this area, with Westpower's asset management practices now assessed as being 91% compliant with the standard.

This section provides an overview of the asset management processes and practices employed by Westpower and specific improvement initiatives being undertaken. These are discussed under the following three headings:

1. Asset Management Processes – the business processes, analysis and evaluation techniques needed for lifecycle asset management.
2. Assets and Works Management Data and Information Systems – the information and data support systems used to store and manage the data that are required for effective decision making.
3. Asset Management Improvement Plan – outlines the improvement priorities and action plan for the coming year in relation to compliance with ISO 55000.

7.2 Asset Management Processes

7.2.1 Rationalisation of Responsibilities and Procedures

The structure of ElectroNet's asset management division, reporting to the GM-Assets, continues to develop to meet business needs and legislative change. Responsibilities, reporting lines, work flows and procedures have been implemented for the different activities carried out in the office. These activities include action, planning, monitoring and reporting.

7.2.2 Network Services Operational Support

Westpower uses ElectroNet Services Ltd as its preferred maintenance contractor for all network associated inspection service and testing, faults, fault repair, maintenance replacement and network enhancement. Development projects are handled in the same way, although outside contractors may be sub-contracted in to carry out some of the work. A fully commercial relationship exists between Westpower and its contracting subsidiary ElectroNet Services Ltd, which encourages price efficiency and high productivity through commercial discipline.

Service level agreements are currently in place with ElectroNet Services Ltd for asset management and asset maintenance. Larger enhancement and development projects have contracts prepared on a specific basis.

Westpower encourages suppliers to improve their services and techniques continuously, and, at the same time, negotiates competitive supply and maintenance contracts.

7.2.3 Asset Management Documentation

Westpower has a range of documents relating to asset management. These documents include:

- High level policy and planning documents – how the company will approach the management of its assets e.g. Asset Management Policy as outlined in Section 2.
- Technical standards – for procurement, construction, maintenance and operation of the network assets.
- Network guidelines – provide directions and procedures on the construction, maintenance and operation of network assets and processes.
- Forms, Safety and Engineering Advices required for working on or near the network.

Westpower employs Microsoft Sharepoint software system for management of its documentation and drawings.

7.2.3.1 Specifications, Procedures and Manuals

Westpower is continuing to update its manuals for easier use by contractors which contain the specifications, procedures, levels of competency, network releases and access to sites. The completion of a full suite of manuals and standards suitable for use by contractors is a key strategic goal. A set of network design standards are available to contractors who wish to undertake network extensions and network reconstruction.

The procedures that have been developed are mandatory for contractors who wish to carry out work on Westpower's network. They have been developed to comply with the requirements of the relevant government legislation, industry codes and standards.

7.2.3.2 Controlled Document Process

The documents described above have been developed and approved through a controlled document process. These documents are reviewed at prescribed intervals or more frequently depending on their criticality, or for example when there have been changes in legislation. Any changes to documents are made using the controlled document procedure.

This process ensures that new or modified documents are released to staff or contractors in a controlled manner. Contractors have access to the website www.westpower.co.nz/contractors to obtain the latest copies of the controlled documents e.g. forms, standards, drawings or safety and engineering advices.

7.2.4 Legal Compliance

The specific external environment in which Westpower operates is the electricity industry, within which there are various legislative requirements including Acts, Regulations, Codes and Standards that Westpower must comply with.

The Executive Management team has overall responsibility for ensuring that Westpower complies with all legal and regulatory obligations and reports to directors on a regular basis.

Westpower has a register of all legal requirements which is maintained by the corporate division.

7.2.5 CAPEX Analysis

CAPEX needs to be carefully targeted to ensure that the greatest benefit is reaped from each capital dollar expended.

Westpower has developed a robust evaluation tool using industry best practice CAPEX Stratagio™ software to provide objectivity and robustness around this process. This underlying approach is based upon a DCF analysis but the product has been adapted for Westpower's needs by adding expert decision support tools. The process used has been explained in more detail in Section 4 *Network Development*, along with other methods to determine the optimal CAPEX profile.

7.3 Asset and Works Management Data and Information Systems

Westpower has implemented an Assets and Works Management System (AWMS) which is based on the integration of a number of information and communications systems. This comprehensive system has been developed and improved on over time and is critical to the asset management process, in managing both the day to day operation of the network and the optimisation of Westpower's assets.

These key systems include:

- Maximo®, proprietary asset management software produced by IBM to record and analyse all of Westpower's assets. This provides work orders and financial tracking;
- ArcMap® Geographic Information Systems (GIS), to represent Westpower's assets spatially, with tools available to provide information such as outage data. The GIS is interfaced to the Maximo system;
- Gentrack Velocity® (customer relationship management) software is used to interface to the energy retailers and Electricity Registry, ensuring Westpower is compliant with current legislation. All customer data are collected for mass market and time of use metering;
- RealFlex® SCADA, to allow real time data acquisition, automation and remote control of many of Westpower's outstations; and
- ETAP® Loadflow software to analyse the effect of new connections and load changes on the network.

The first three systems are integrated, with data being exchanged between them and are therefore integral in the asset management works programme including performing the SAIDI, SAIFI and CAIDI calculations (refer Section 3) which are the most widely accepted KPIs for electricity networks.

The RealFlex® SCADA and ETAP® Loadflow systems are integral in managing the operation of the network.

These five systems are described in more detail below.

New software and technologies will continue to be employed where Asset Management engineers are satisfied that they can be cost-effectively and reliably employed to improve service quality and performance.

7.3.1 IBM Maximo®

The AWMS is based on Maximo® which, since its implementation and subsequent upgrades, has provided benefit to Westpower managers, contractors and consumers, in the areas of:

- Collection, consolidation and analysis of essential information on all types of assets;
- Improvement of operations through better information on asset availability, reliability and utilisation;
- Extending the useful life of practically all assets or equipment, and deferring new purchases;
- Unifying processes for wide-ranging asset management functions across multiple sites; and
- Providing work orders and financial tracking.

Day to day asset management activities have been fully integrated into Maximo®, including monthly invoicing and work order reconciliations. Reports have been developed to assist managers in the interpretation of data and for strategic planning.

The system is continually monitored and updated as required. During 2011, for example, Maximo® was upgraded to the latest available specification. The system integrator in partnership with Westpower's AWMS project team, provided a comprehensive solution which met functional, financial and time based targets.

Subsequent improvements to the system include the upgrade of the vegetation management system to fully utilise the capabilities of the AWMS. Rather than respond reactively to vegetation threats to the network as in the past, information relating to vegetation threats are collected in the field using ArcGIS mobile technology which is synchronised to AWMS.

The focus is now on enhancing asset management systems, with the recent or proposed installation of additional software such as:

- CATAN Line Design – CATAN is simple to use and provides an accurate solution to power line design which standardises line design and helps to ensure Westpower is meeting the AS/NZS 7000 design standard for overhead lines.
- Maximo Scheduler – Maximo Scheduler is a planning tool for scheduling maintenance work to help ensure efficient work scheduling. Using Maximo Scheduler, maintenance planners within the operations division can create schedules that contain work orders generated by asset management staff.
- Maximo Heath, Safety and Environment Manager – Maximo H,S & E Manager is a Maximo add on that integrates health, safety and environment processes with work and asset management. This enterprise asset management add on solution provides a central application for reporting all incidents spanning work, personnel, safety, health and environmental areas for both employees and the public.

7.3.2 Geographical Information System (GIS)

Historically, asset data was collected through as-built drawings and recorded on hard copy files. The introduction of the GIS allowed this information to be electronically recorded. Advances in technology have seen electronic data being collected in the field and automatically transferred to the GIS, creating a more accurate and efficient data collection system than was employed in the past.

ESRI's ArcMap® Geographic Information Systems (GIS), is used to represent Westpower's assets spatially, with tools available to provide information such as outage and asset condition data. The GIS is interfaced to the Maximo system.

GIS is the repository for all network spatial data. It contains and manages attribution data relating to transformers, isolators, poles, conductor and cables, which are used to describe the asset and its condition. This data assists with the development of the Preventative Maintenance programme (PM). GIS also provides network connectivity, which is used to evaluate the impact on consumers, or package work on feeders, during outages. This process minimises consumer disruption, reduces costs and facilitates safe working environments.

Confidence in the integrity of the data has grown with the current data collection methods used and high levels of accuracy are now being achieved.

7.3.3 Gentrack Velocity®

The Gentrack Velocity® (customer relationship management) software application is used to manage ICPs and revenue data. It is used to interface to the energy retailers and Electricity Registry, ensuring Westpower is compliant with current legislation. All customer data is collected for mass market and time of use metering.

7.3.4 AWMS – Key Business Processes

A brief description of the key business processes managed through the AWMS are outlined below.

7.3.4.1 Maintenance

Considerable effort is put into PM. The PM schedules are developed with job plans and routes and these are used for the majority of scheduled maintenance work programmes.

The maintenance programme which has been developed over time, is based on an engineering assessment of network assets and manufacturer's recommendations, identifies the frequency of maintenance required and lists the maintenance tasks. The maintenance programme is monitored via the PM report.

All defects (faults and failures) are reported. A failure report which identifies the problem/cause/remedy is applied to all faults and assessed by engineers to identify recurring problems. Additionally contractors are instructed to submit service requests to Westpower identifying any damage or repairs required to the network. Workflow processes direct these to the appropriate asset management department. The development of this comprehensive system for the reporting of defects ensures that future maintenance plans are better informed.

7.3.4.2 Workflows

Workflows are an integral part of the AWMS and provide significant benefits to both Westpower and ElectroNet Services Ltd. Westpower has assumed ownership of Workflow creation and maintenance. Having staff within the organisation with these skills simplifies customisation and ensures that changes are timely.

For example, the workflow used for new connections includes all the key elements of the workflow from the initial request, including notification to the customer and electrician so they are informed, and the acknowledgement from the retailer ensuring that all customers have a retailer contract before they are livened. All new connection requests are maintained on the asset management system, and supporting documentation showing connection points, connection agreements, and livening sheets are attached to these requests.

7.3.4.3 Outage Management

Through regulatory legislation, Westpower is obliged to maintain transparent outage management systems. In-house systems, currently based on the GIS, carry out this function with outage information stored in a geodatabase using Westpower's GIS. The GIS is used to select transformers and consumers affected by an outage, and along with all related information, are then recorded as an entry in the geodatabase.

Westpower has been investigating options for outage management systems for the network. This system will replace the current system and can be utilised for any outages or MEDs, allowing for improved coordination, communication, customer notification etc. for fault response. These systems are being used by other network companies.

7.3.4.4 Condition Assessment

The Condition Assessment Programme enables Westpower to accurately assess the condition of the network. ArcPad, an "out of the box" field data capture application, has provided benefits over customised programming. This has reduced the need for manual data entry into the GIS.

The development of ArcPad to meet the requirements of Westpower's condition assessment has primarily been done in house. The information collected as part of the condition assessment as well as general comments noted during the assessment are useful in assessing the overall security of the network. Advances are being made to utilise ESRI's "Collector" mobile data collection app, allowing the use of an iPad and streamlined data synchronisation to the GIS database.

7.3.4.5 Budgets

This system divides network expenditure into appropriate activities as outlined in Sections 4 *Network Development* and 5 *Lifecycle Management* (namely: Development; Enhancement; Replacement; and I, S &T; Faults; and Repairs) as well as asset type and location. Detailed reports including capital and operating expenditure may be generated at any time and used for comparison to the budget.

7.3.4.6 Asset Register/Inventory

Maximo is the primary repository for all asset and works management information and data. It provides the Westpower asset management group with the ability to track equipment, associated costs , the history and failures of assets.

7.3.4.7 Work Order Management and Service Requests.

Work orders and estimated costs of work are raised in the AWMS and put against assets. Cost information from completed jobs enters Maximo via an electronic invoicing process, derived directly from ElectroNet's Job Costing system.

7.3.5 RealFlex® SCADA

The SCADA and communications networks system are essential to Westpower and assist in real time operational and performance management of the Westpower network. SCADA provides for remote control and monitoring of telemetered field devices such as circuit breakers, substation equipment, and an overview of the HV network connectivity. In the event of a fault, these systems allow safe isolation of the defective plant and also fast restoration of supply to as many consumers as possible.

7.3.6 ETAP® Loadflow software

This software is used to analyse the effect of new connections and load changes on the network.

ETAP Loadflow software performs power flow analysis and voltage drop calculations with accurate and reliable results. Built-in features include automatic equipment evaluation, alerts and warnings summary, load flow result analyzer, and intelligent graphics. Proposed upgrades over the planning period include GIS integration.

7.3.7 Strategic Management

The key systems described above contribute to the strategic management of the assets. The various elements of Maximo® and GIS have provided Westpower with accurate and timely information to support the decision making process. This includes both planning for maintenance and capital projects. Once details are entered into Maximo, financial forecasts can then be extracted from the database for AMP and disclosure purposes.

Reports have been structured for managers at various levels of the organisation to assist them in effectively managing their respective departments. Improved planning, maintenance and reporting are contributing to a well performing network along with improved security of supply for consumers.

7.4 Asset Management System Improvement Process

7.4.1 Introduction to ISO 55000

Over the last two years, Westpower has been re-evaluating its asset management systems for conformance with the BSI Standards Publication, BS ISO 55000:2014, Asset Management.

ISO 55000 provides an overview of asset management and asset management systems and provides the context for ISO 55001 and ISO 55002.

It has identified common practices that can be applied to the broadest range of assets, in the broadest range of organisations, across the broadest range of cultures.

ISO 55000, ISO 55001 and ISO 55002 relate to a management system for asset management, which is referred to as an "asset management system" throughout the three standards. ISO 55001 specifies requirements for an asset management system.

The adoption of ISO 55000 enables Westpower to achieve its objectives through the effective and efficient management of its assets. The application of an asset management system provides assurance that those objectives can be achieved consistently and sustainably over time.

Many processes are in place and it is planned for full implementation to occur throughout 2016.

7.4.2 Improvement Plan

Westpower plans to improve its realisation of value from their asset base by adopting ISO 55000 practices as a key performance indicator in the overall business Strategic Plan.

As part of this process, the Board has signed off on the Asset Management Policy which provides the governance framework for all asset management activities. This ensures strategic alignment between Westpower's business goals and management of the asset.

Over the next year, Westpower plans to complete full implementation of the ISO 55000 asset management practices. The key targets for the coming year include:

- A formal and documented review of the performance of the previous AMP;
- Implementation of the formally documented asset management system;
- An internal audit to ISO 55000 by the end of the period; and
- Preparation for certification of compliance with ISO 55000.

7.4.3 Action Plans

- Concentrate on implementation of the processes defined in its overarching asset management system documentation. At the end of the period, Westpower must complete a full review of the AMP to enhance its continual improvement programme.
- Complete a full internal audit to ISO 55000, using a competent auditor, prior to end of March 2017.
- Continue the development of a formal risk management system which provides input to the asset strategy process.
- Implement a methodology for ranking/rating asset management initiatives to assist in the optimisation, and documentation of the optimisation process.
- Implement a program of process/procedure discussion and review. Ensure that discussions cover individual's roles and responsibilities and that records are kept.
- Ensure that staff are aware of why key asset management activities are necessary and the consequences of not performing the activity as required.
- Develop a long term skill development plan to ensure that key skills are available to Westpower into the longer term.
- Ensure that wide spread training is provided to all participants in asset management in the use of Maximo and SharePoint and their capabilities.
- Develop an on-going process for monitoring the legal, regulatory, statutory and other asset management requirements and reacting to changes that are of sufficient importance to the asset management system.

7.4.4 Monitoring Progress

Implementation of ISO 55000 is a major undertaking for a company the size of Westpower and it is achieving progress using internal resources. These resources are limited in the time available for ISO 55000 so progress has been slower than originally planned. However, steady progress is being made.

Westpower maintains a schedule of the full breakdown of requirements for ISO 55000 and monitors this on a regular basis to ensure continual improvement.

The chart below (Figure 7.1) is a summary of that schedule and indicates (91%) that most processes are in place. What remains, is the full implementation of the processes defined and the full engagement of all staff and contractors.

No	Clause
4.1	Understanding the organization and its context
4.2	Understanding the needs and expectations of stakeholders
4.3	Determining the scope of the asset management system
4.4	Asset management system
5.1	Leadership and commitment
5.2	Policy
5.3	Organizational roles, responsibilities and authorities
6.1	Actions to address risks and opportunities for the asset management system
6.2.1	Asset management objectives
6.2.2	Planning to achieve asset management objectives
7.1	Resources
7.2	Competence
7.3	Awareness
7.4	Communication
7.5	Information requirements
7.6.1	Documented information general
7.6.2	Creating and updating documented information
7.6.3	Control of documented information
8.1	Operational planning and control
8.2	Management of change
8.3	Outsourcing
9.1	Monitoring, measurement, analysis and evaluation
9.2	Internal audit
9.3	Management review
10.1	Nonconformity and corrective action
10.2	Preventive action
10.3	Continual improvement

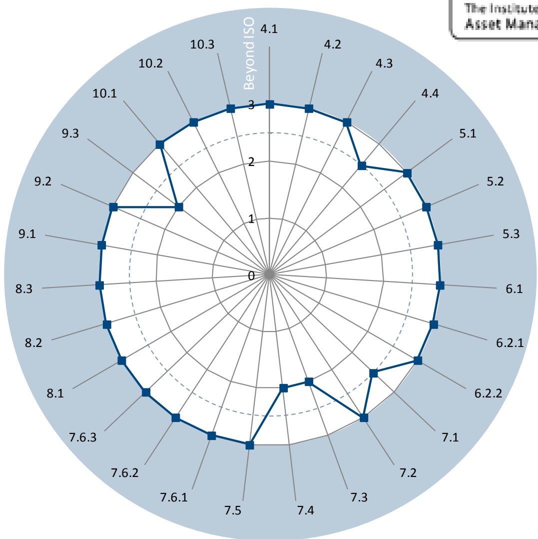

Figure 7.1: ISO 55000 Assessment Summary

8.0 RISK MANAGEMENT PLAN

Westpower has a Risk Management Plan (RMP) in place as part of its overall business planning strategy. This includes business impact analysis and business continuity planning.

In addition, Westpower is actively involved in the West Coast Engineering Lifelines Group which looks at ways of managing the infrastructure risks involved with major disasters and ensuring that plans are in place to deal with most of the likely scenarios.

A general overview of the risk management process is included below to demonstrate the robust and professional approach taken to this important aspect of planning.

The RMP is a living document that is regularly updated.

8.1 Risk Management Planning Framework

A detailed risk assessment was conducted which:

- Defined specific risks;
- Assessed the potential impact of each risk on a five-point scale from 180 [Low] to 500 [Critical];
- Assigned management responsibility to each risk;
- Identified current control measures for all risks with a potential impact of 300 [High] or above and rated the effectiveness of the controls; and
- Documented the results.

The methodology adopted by Westpower, and currently in use, is consistent with the joint Australian and New Zealand Standard AS/NZS ISO 31000:2009. It is a simple and effective method, but remains subjective. The validity of the risk control assessments is reviewed at two yearly intervals, particularly where the risk is critical to the business.

8.2 Risk Planning Methodology

The Risk Management team in conjunction with Westpower's management have considered the impact of 60 risks presented in a framework under 13 categories.

Figure 8.1 charts the methodology used by Westpower. The 10 stages of this process are described below.

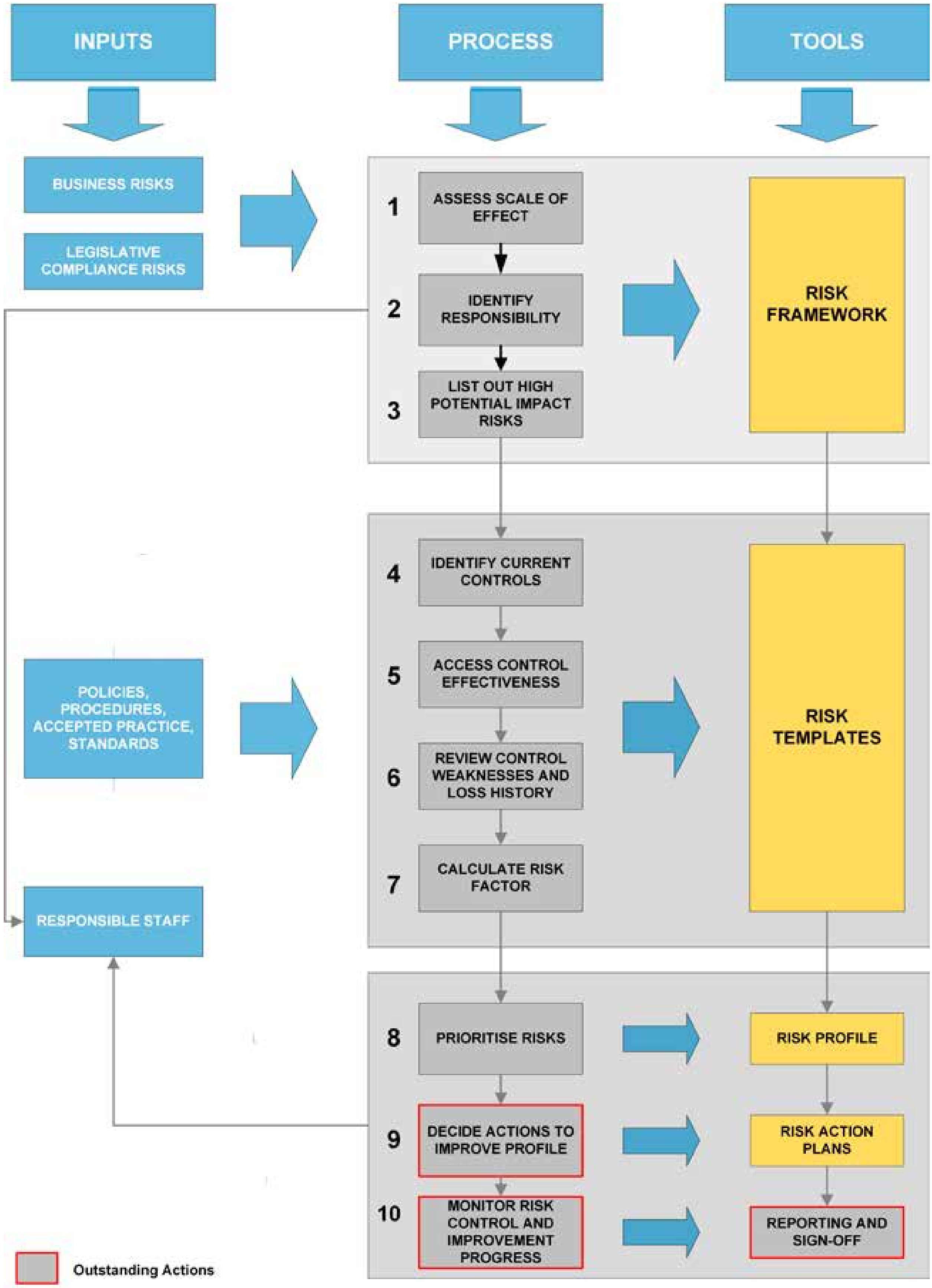

Figure 8.1: Westpower Risk Planning Methodology

Stage 1. Assess Scale of Effect

Risk is measured in terms of scale of effect, which is a combination of consequence and likelihood. The assessment of the potential scale of effect is based on the following table developed in consultation with senior Westpower management.

Table 8.1: Scale of Effect

Scale of Effect	Unbudgeted Cost, Unforecast Revenue Loss or Loss of Value		Multiplier
	From	To	
Low	$0	$500,000	180
Moderate	$500,001	$1,000,000	200
High	$1.000,001	$5,000,000	300
Severe	$5,000,001	$10,000,000	400
Critical	Greater Than $10,000,001		500

Stage 2. Identify Responsibility

A responsible person is identified for each of the risks given a consequence rating. This person is regarded as being in the best position to rate the effectiveness of the current control methods.

Stage 3. Identify High Consequence Risks

It is important to separate out the significant, high-impact risks for further attention from those with lesser impacts.

Stage 4. Identify Current Controls

Each high impact risk is discussed in detail and a description of the current control methods provided. These results are captured in risk templates.

Stage 5. Assess Control Effectiveness

The effectiveness of the current control methods is assessed using the following rating scale.

Table 8.2: Control Effectiveness

Assessment	Effectiveness of Controls	Effectiveness of Preparations	Multiplier
Unacceptable	Few, if any, control points covered	No plan in place	0.8
Adequate	One or two key control points covered	One or two likely key scenarios covered	0.5
Reasonably Good	Majority of key contol points covered	Majority of likely key scenarious covered	0.33
Good	All control points covered	All likely key scenarious covered	0.25
Very Good	Enhanced controls introduced for key control points	All likely scenarios covered	0.2
Excellent	Enhanced control points introduced for all control points	All likely plus less likely scenarios covered	0.15

Stage 6. Review Control Weakness and Loss History

An assessment of the weaknesses associated with the current control measures is undertaken. Suggestions for improvements are put forward by managers and a brief review of the recent loss history for the particular risk is noted.

Stage 7. Calculate Risk Factor

The risk factor value can be calculated using the following formula:

Scale of Effect X Control Effectiveness = Risk Factor

Stage 8. Prioritise Risks

By using the risk assessment formula shown above, the top risks for Westpower can be prioritised based upon the risk factor. The risks are shown in order in Table 8.3.

Table 8.3: Risk Priority

Controllable and Contingency Risks	Risk Factor	Rank
Emergency Response Procedures [Company Property][Contingency]	132	1
Contractors, Sub-contractors and Service Providers	100	2
Unauthorised Access to Company Property	100	3
Health and Safety Culture	100	4
Safety by Design	100	5
Fatigue	100	6
Fitness for Work & Competency	100	7

Stage 9. Action Plan Development

Any risk with a risk factor of 100 or above must be matched by a corresponding action plan. There are seven risks identified in this category.

The action plans are developed with input from key staff. These are reviewed at regular intervals.

Stage 10. Monitor Risk Control and Improvement Processes

Westpower reviews the effectiveness of its action plans and improvement progress through regular monitoring.

8.3 Failure Mode and Effects: Criticality Analysis

Asset failure is managed using the failure mode and effects criticality analysis process. This forms part of the "desired practice" for an optimised renewal strategy.

Having identified the failure modes, risk costs and treatment options for key assets, appropriate risk treatment options are included in the AMP. This process and the typical failure modes, effects and treatments are summarised in Figures 8.2 and 8.3.

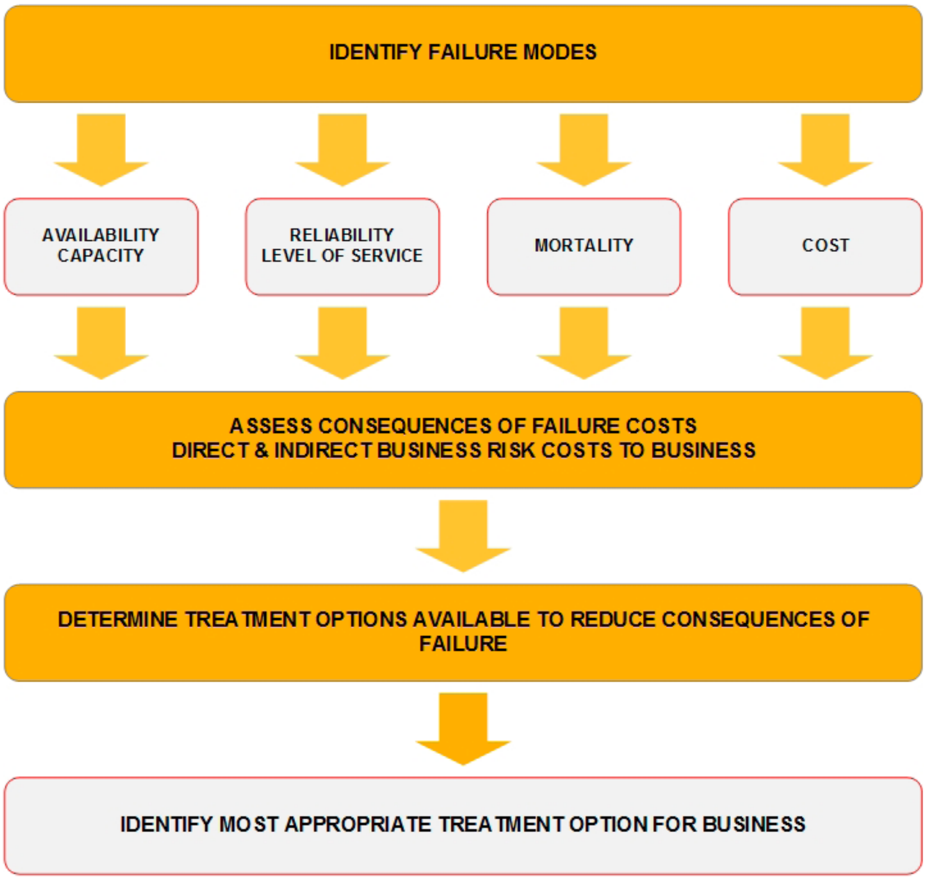

Figure 8.2: Failure Modes Analysis Process

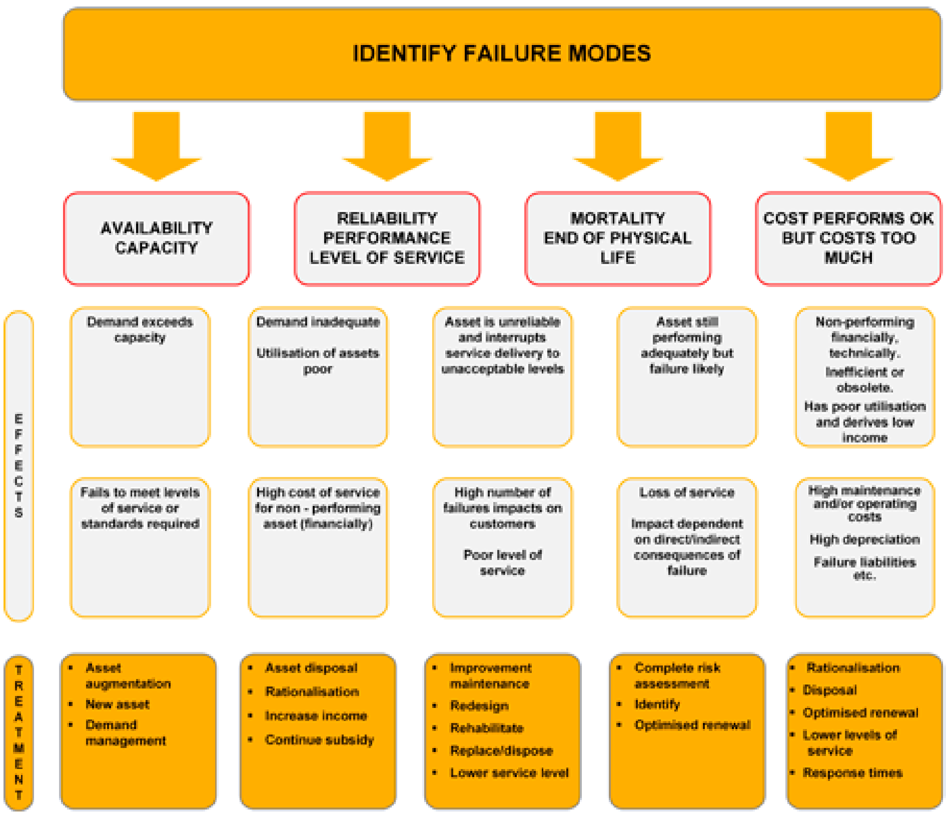

Figure 8.3: Typical Failure Modes, Effects and Treatments

8.4 Safety

Safety is always a prime driver in any risk management strategy and Westpower takes this seriously. A key function of Westpower's Health and Safety committee is to ensure safety matters are properly addressed. This committee is comprised of staff from all areas of the business.

In addition, Westpower's contractor, ElectroNet Services Ltd, has been audited by the Accident Compensation Corporation (ACC) and has received a tertiary level grading for its safety processes and systems, the highest grading available.

Safety is kept to the fore through regular refresher courses and staff training and competency programmes designed to enhance the awareness of safety issues throughout all aspects of the workplace.

Westpower maintains an active hazard identification programme which includes registers for specific types of hazard. At zone substations, hazard identification notice boards are used to inform all personnel coming on to site of identified hazards. Personnel are required to add any new hazards, that they identify, to the list.

New equipment is always checked for safety and specific operational procedures developed where necessary. All manufacturers are required to supply material safety data sheets (MSDS) for substances used in the workplace, and these are kept in a readily available register.

8.5 Environmental

Oil spills are the most likely form of environmental damage to occur as a result of Westpower's activities. This risk has been specifically identified for further attention and has been reported at Board level.

To mitigate this risk, Westpower has installed bunding at all major substations where there are oil containment vessels with a capacity of more than 1,500 litres. All zone substations are now compliant.

Spill response kits are supplied to all major sites and staff are trained in their use to mitigate the impact of any potential spill.

8.6 Key Risks Identified

Key risks for Westpower are similar for most lines businesses and are mainly due to climatic and seismic factors.

Westpower has identified the following five major risks to its ability to supply electricity:

- Earthquakes
- Storms (including high winds)
- Lightning
- Flooding
- Ripple injection system failure.

8.6.1 Earthquake

The likelihood of a major earthquake on the West Coast due to slippage on the Alpine Fault within the next 50 years is considered to be relatively high. There is very little that can be done to minimise the risk to overhead lines and cables in the event of an earthquake, but it is also relatively straightforward to straighten poles and restring conductors, as long as access and materials are available.

A Seismic Withstand report was prepared for most zone substations in the 2003/04 year to identify any seismic strengthening measures that can be taken to mitigate the impact of a major earthquake. Recommended strengthening measures identified in this report were assessed and actioned where necessary.

In addition, Westpower closely co-operates with other ELBs and uses similar industry standard equipment to ensure that a ready supply of spares will be available if required.

8.6.2 Storm Damage

Westpower faces this risk regularly, with several major storms experienced in any one year. Damage is caused by poles being blown over and/or trees or other large objects being blown into the overhead lines.

Westpower mitigates this risk by maintaining a regular pole inspection programme to check that poles are adequately rated and in good condition. Any poles that are found to be substandard are replaced quickly.

A wide range of spares are kept by Westpower's contractor, including poles, conductors, fittings and transformers to ensure that storm damage can be readily dealt with. The level of spares held for various types of equipment has been developed through experience over a number of years, and a regular reporting and reordering programme is maintained to ensure that minimum quantities are maintained.

In addition, regional depots are maintained at Reefton, Hokitika and Harihari so that a rapid response can be provided throughout Westpower's area.

8.6.3 Lightning

The West Coast is renowned as a significant lightning-prone region of New Zealand, both in terms of strike density and intensity.

As Westpower has had to live with this phenomenon over many years, it has developed design practices to minimise the damage caused by lightning strikes. These include the fitting of modern surge diverters on all distribution substations, something not common in many parts of the country.

For zone substations, station class (line discharge level 3) arrestors are fitted on the terminals of all major power transformers, and overhead shield wires are fitted on incoming overhead circuits.

A substantial quantity of spares are held for transformers as lightning is a common cause of damage for this plant and severe lightning events can sometimes last for several days.

8.6.4 Flooding

This risk mainly affects ground-mounted assets such as pad mount distribution transformers and RMUs.

Where possible, the location of this equipment is chosen so that it is at least 300 mm above maximum recorded flood levels, although this is not always feasible in areas such as the CBD of Greymouth.

In the event of a major flood, operational plans are in place to make sure that power is isolated from plant prior to flooding reaching levels where it could cause an electrical fault and possible hazards to workers and the public. This is in addition to the normal protection systems used to isolate equipment in the event of a fault.

8.6.5 Ripple Injection System Failure

The ripple injection system is an integral part of Westpower's control system for managing demand on the network and providing tariff switching signals for retailers. A failure of the ripple system could result in unmanageable peaks being applied to the system, eventually resulting in brown-outs or, under extreme circumstances, black-outs.

Over recent years, Westpower has diversified its base of ripple injection plants and now has units installed at Hokitika, Greymouth, Dobson and Reefton. These are synchronised so that if one unit should fail, coverage is provided from the remaining units. In addition, each unit can be operated locally in an emergency.

8.7 General Mitigation Measures

A number of general strategies and plans, as listed below, are in place to mitigate the risks identified to Westpower's network and operational capability.

- Regular inspection, service and testing is carried out to check the operational capability of all equipment. This includes checking of vegetation in close proximity to overhead lines and active vegetation management.
- Distribution automation has been progressively expanded throughout the network over recent years and this has allowed additional plant to be regularly monitored to give indications of an early failure.
- Westpower has network design and construction standards as well as a materials approval system to ensure that only quality materials are used and that a high standard of workmanship is maintained. This ensures that the integrity of the network is protected.
- Regular staff training is implemented in system operation and the issue of permits so that access to the network is always carried out in a safe manner.
- Contingency plans and emergency procedures are in place. Included within these plans are the following:
    - Coordinated Incident Management System;
    - Regional emergency load shedding plan;
    - Electrical industry emergency contact list; and
    - Zone substations - emergency operating order templates. A number of engineering measures have been taken to mitigate risk including:
        - A healthy complement of spares is maintained so that most eventualities can be covered without resorting to external support;
        - A seismic strengthening programme has been completed.
        - A fully mobile 33/11 kV substation, WMS, has been built to provide coverage for single-transformer zone substations. Sufficient spare power transformers are available to cover long-term faults; and
        - Spare circuit breakers and controllers have been purchased to cover expected failure rates.

8.8 West Coast Engineering Lifelines Group

The Engineering Lifelines Group (ELG) consists of the four local authorities and all lifeline utility operators on the West Coast including Westpower. The ELG is involved in readiness and reduction activities following on from identified outcomes in the Lifelines Reports published in 2005, as well as participating in regional Civil Defence Emergency Management (CDEM) exercises.

The Civil Defence Emergency Management Act 2002 requires individual Lifeline Utilities to establish planning and operational relationships with CDEM Groups. Westpower supports the local CDEM Group by exchanging information about their risk management processes and their readiness and response arrangements. Compliance with the above Act is based upon four "Rs"; Reduction, Readiness, Response and Recovery.

As part of the 2005 Lifelines Report, a selection of critical facilities within the Westpower operating area were surveyed to assess their vulnerability to damage from a number of predetermined natural hazards, e.g. wind storms and severe earthquakes.

The full report contains a detailed summary of findings together with completed vulnerability charts that quantify risk and importance in a systematic way. These charts are based upon the system originally employed for the Wellington and Christchurch engineering lifeline studies. The quantification level is sufficient to enable relative risk to be assessed to assist a process of mitigating areas of risk in a progressive manner from highest risk/vulnerability/importance to lowest.

The following main substations and switchyards were surveyed as part of the exercise:

- Greymouth substation
- Dobson substation
- Arnold power station switchyard
- Rapahoe substation
- Kumara power station switchyard
- Hokitika substation
- Franz Josef substation
- Fox substation.

In addition to the above, a selection of less important substations was surveyed to gain an assessment of the overall network. These included substations/switchyards at Badger Lane, Harihari, Mawhera Quay, Ross, Wahapo Power Station, Waitaha and Wilson Lane.

The Westpower network is controlled from the Networking Operating Centre in the offices at their depot on Tainui Street, Greymouth. The Networking Operating Centre is an essential part of Westpower's lifeline readiness and is designed for maximum resilience in the event of a major disaster. The control room and associated facilities have been brought up to the requirements of the latest loadings and materials standards.

8.9 Transmission Lines

The major transmission lines feeding into the Westpower section of the West Coast CDEM area are:

- Inangahua-Blackwater A — 110 kV single-circuit on poles
- Dobson-Blackwater A — 110 kV single-circuit on poles
- Inangahua-Reefton A — 110 kV single-circuit on poles
- Dobson-TEE-A — 110 kV single-circuit on poles
- Arahura (Hokitika)-Otira A — 66 kV double-circuit on poles
- Arahura (Hokitika)-Dobson A — 66 kV single-circuit on poles (between Dobson and Greymouth)

The major transmission lines that Westpower own are:

- Greymouth-Kumara — 66 kV single-circuit on poles — 25 km
- Kumara-Kawaka — 66 kV double-circuit on poles — 11 km
- Hokitika-Harihari — 66 kV single-circuit on poles — 64 km
- Two-Mile-Hokitika — 66 kV single-circuit on poles — 8 km

Westpower's transmission/distribution lines cover several routes over widely varying terrain from coastal plains to relatively unstable and rugged hill country. Some redundancy is built into portions of the system whereby an outage on any one particular line, depending upon time of day/time of year, may not affect supply to other areas of the network.

Most poles supporting transmission and distribution lines are well founded to prevent collapse under high winds/ice conditions, and therefore are only moderately vulnerable to earthquake-induced slope instability.

8.10 Communications

Westpower is able to use a number of independent means of communication to control its network, namely:

- Two-way radio
- Landline telephone network
- Cellular phone network (in some areas).

Each system is essentially independent of each other and therefore there is significant redundancy in the event of disruption.

8.11 Disaster Recovery

Westpower has adopted procedures and policies which define processes and assign responsibilities for the conduct of emergency response teams and departments in the event of a disaster.

These procedures and policies include: the Coordinated Incident Management System (CIMS); Departmental Business Continuity Plans (DBCP); and the Load Shedding Plan as discussed in Section 8.7.

8.11.1 Emergency Management Team

The CIMS prescribe the appropriate processes and assigns the responsibilities for the conduct of the Emergency Management Team (EMT) in the event of a disaster of such proportions that requires coordinated command and control.

This applies to all elements of ElectroNet when performing duties assigned by the EMT. The structure of the EMT may alter subject to the nature of the disaster, resources available and the tactical situation.

The EMT is categorised as follows;

Command & Control – Includes definition of roles and responsibilities, operating control and overall command once a disaster is declared.

Planning – When a disaster has been declared, EMT operations will be conducted in three phases.

Admin and Logistics – Defines the location of the EMT base of operations, including all communications and materials available, and a list of priority services. Also included is a list of personnel available and their contacts.

8.11.2 Business Continuity Plans

The BCPs are defined by each department and enable the re-establishment of normal processes and procedures following a major disruptive event which results in either the loss of business premises, resources or people.

Each department has a continuity plan in place that can be used to prevent the interruption of critical business functions in the event of a major interruption.

The departments include stores, financial, asset management, electricians and lines. Figure 8.4 provides an overview of the BCP structure.

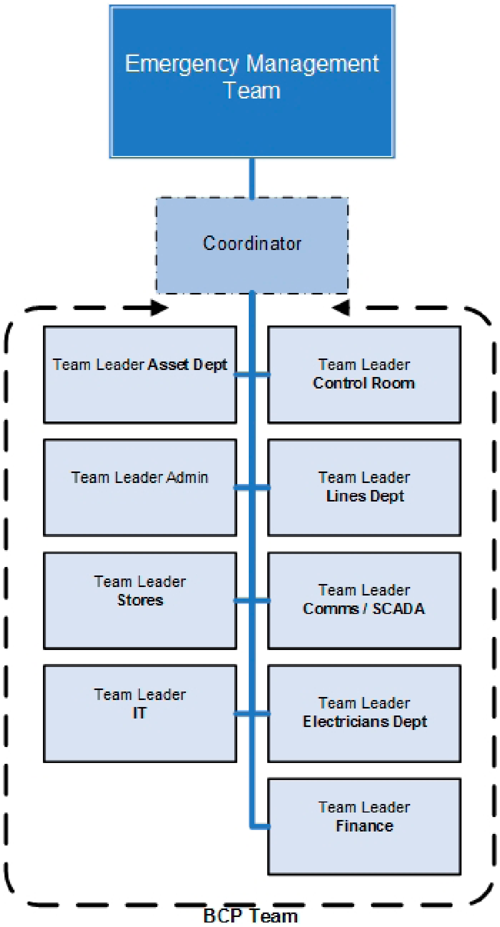

Figure 8.4: BCP Organisation Structure

The objectives of the BCPs are as follows:

- To define and prioritise the critical functions of the department;
- To analyse the emergency risks to the department;
- To detail the agreed response to an emergency; and
- To identify key contacts during an emergency.

APPENDIX A: GLOSSARY OF TERMS AND ABBREVIATIONS

Abbreviation	Term
A	Ampere
AAAC	All Aluminium Alloy Conductor
AAC	All Aluminium Conductor
ABC	Aerial Bundle Cable
AC	Alternating Current
ACC	Accident Compensation Corporation
ACOT	Avoided Cost of Transmission
ACSR	Aluminium Conductor Steel Reinforced
ADMD	After Diversity Maximum Demand
AMP	Asset Management Plan
AMS	Asset Management System
AWMS	Asset Works Management System
CAPEX	Capital Expenditure
CB	Circuit Breaker
CBD	Central Business District
CBM	Condition Based Maintenance Programme
CDEM	Civil Defence Emergency Management
CIGRE	International Council for Large Electric Systems
DBCP	Departmental Business Continuity Plans
DC	Direct Current
DCF	Discounted Cash Flow
DDO	Dominion Drop Out Fuse
DGA	Dissolved Gas Analysis
DOC	Department of Conservation
DRC	Depreciated Replacement Cost
EDIDD 2012	Electricity Distribution Information Disclosure Determination 2012
EEA	Electricity Engineers Association
ELB	Electricity Lines Business

EMT	Emergency Management Team
EPDM	Ethylene Propylene Diene Monomer.
ERP	Emergency Response Plan
EPR	Earth Potential Rise
GDP	Gross Domestic Product
GFN	Ground Fault Neutraliser
GIP	Grid Injection Point
GIS	Geographic Information System
GXP	Grid Exit Point
HV	High Voltage
HVDC	High Voltage Direct Current
ICP	Installation Control Point
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IPCC	Intergovernmental Panel on Climate Change
KPI	Key Performance Indicators
kV	Kilo Volt
kVA	Kilo Volt Ampere
kW	Kilo Watt
kWh	Kilo Watt per hour
LDC	Line Drop Compensation
LCB	Line Circuit Breaker
LV	Low Voltage
MBIE	Ministry Of Business, Innovation and Employment
MDI	Maximum Demand Indicator
MED	Major Event Day
MSDS	Material Safety Data Sheets
MVA	Mega Volt Ampere
NER	Neutral Earthing Resistor
NPV	Net Present Value
ODRC	Optimised Depreciated Replacement Cost

ODV	Optimised Deprival Value
OLTC	On Load Tap Changer
OPEX	Operating Expenditure
PDC	Polarisation De-polarisation Current Analysis
PILCSWA	Paper Insulated Lead Covered Steel Wire Armoured cable
PLC	Programmable Logic Controllers
PSMS	Public Safety Management System
RCPD	Regional Coincident Peak Demand
ROI	Return on Investment -
RMP	Risk Management Plan
RTU	Remote Terminal Unit
RMU	Ring Main Unit
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SCADA	Supervisory Control and Data Acquisition
SCI	Statement Corporate Intent
SOP	Standard Operating Procedure
TCP/IP	Transmission Control Protocol and Internet Protocol
V	Voltage
WCEPT	West Coast Electric Power Trust
WCGUP	West Coast Grid Upgrade Project
WMS	Westland Mobile Substation
XLPE	Cross linked Polyethylene

APPENDIX B: ACTIVITY GROUP DEFINITIONS – AMP AND INFORMATION DISCLOSURE

GAAP[1]	AMP	Information Disclosure (see Definitions Appendix 1)
Operational Expenditure	Inspection, Service & Test	Routine and Corrective Maintenance and Inspection
		Vegetation Management
	Faults	Service Interruption and Emergencies
	Repairs	Asset Replacement and Renewal (Opex)
Capital Expenditure	Replacement	Asset Replacement and Renewal (Capex)
		Relocate
	Enhancement Development	System Growth
		Reliability, Safety and Environment - Quality of Supply - Legislative and Regulatory - Other
		Customer Connections

INFORMATION DISCLOSURE DETERMINATION 2012 - DEFINITIONS

NETWORK OPERATIONAL EXPENDITURE

- **Service Interruptions & Emergencies**

  Operational expenditure where the primary driver is an unplanned instantaneous event or incident that impairs the normal operation of network assets. This relates to reactive work (either temporary or permanent) undertaken in the immediate or short term in response to an unplanned event. Includes back up assistance required to restore supply, repair leaks or make safe. It also includes operational support such as mobile generation used during the outage or emergency response. It also includes any necessary response to events arising in the transmission system.

  It does not include expenditure on activities performed proactively to mitigate the impact such an event would have should it occur. Planned follow up activities resulting from an event which are unable to be permanently repaired in the short term are to be included under routine and corrective maintenance and inspection.

- **Vegetation Management**

  Operational expenditure where the primary driver is the need to physically fell, remove trim vegetation (including root management) that is in the proximity or overhead lines or cables. It includes:

1. GAAP Generally Accepted Accounting Practice

- Inspection of affected lines and cables where the inspection is substantially or wholly directed to vegetation management. Includes pre-trim inspections as well as inspections of vegetation cut for the primary purpose of ensuring the work has been undertaken in an appropriate manner.
- Liaison with landowners including the issue of trim/cut notices and follow up calls on notices.
- The felling or trimming of vegetation to meet externally imposed requirements or internal policy including operations support such as any mobile generation used during the activ ity.

The following activities and related costs are excluded from this category:

- General inspection costs of assets subject to vegetation where this is not substantially directed to vegetation management (included in routine and corrective maintenance and inspection).
- Costs of assessing and reviewing the vegetation management policy (included in network support).
- Data collection relating to vegetation (included in network support)
- The cost of managing a vegetation management contact except as stated above (includ ed network support).
- Emergency work (included in service interruption and emergencies)

- **Routine and Corrective Maintenance and Inspection**

  Operational expenditure where the primary driver is the activities specified in planned or programmed inspection, testing and maintenance work schedule and includes:

  - Fault rectification work that is undertaken at a time or date subsequent to any initial fault response and restoration activities.
  - Routine inspection
  - Functional and intrusive testing of assets, plant and equipment including critical spares and equipment
  - Helicopter, vehicle and foot patrols including negotiation of landowner access
  - Asset surveys
  - Environmental response
  - Painting of network assets
  - Outdoor and indoor maintenance of substations including weed and vegetation clearance, lawn mowing and fencing.
  - Maintenance of access tracks, including associated security structure and weed and vegetation clearance
  - Customer driven maintenance
  - Notices issued.

- **Asset Replacement and Renewal (Opex Repairs)**

  Operational Expenditure where the primary driver is the need to maintained network asset integrity so as to maintain current security and/or quality of supply standards.

NETWORK CAPITAL EXPENDITURE

- **Customer Connection**

  Capital expenditure on assets where the primary driver is the establishment of a new customer connection point or alterations to an existing customer connection point.

- **System Growth**

  Capital expenditure on assets where the primary driver is a change in the demand or generation on a part of network which results in a requirement for either additional capacity to meet this demand or additional investment to maintain current security and/or quality of supply standards due to the increased demand. This category includes expenditure on assets associated with SCADA and telecommunications.

- **Asset Replacement and Renewal (Capex)**

  Expenditure on assets where the primary driver is the need to maintained network asset integrity so as to maintain current security and/or quality of supply standards and includes expenditure to replace or renew assets incurred as a result of:

  - the progressive physical deterioration of the condition of network assets or their immediate surrounds;
  - the obsolescence of network assets;
  - preventative replacement programmes consistent with asset life-cycle management policies; or
  - the need to ensure the ongoing security of the network assets

- **Asset Relocations**

  Capital expenditure on assets where the primary driver is the need to relocate assets due to third party requests such as for the purpose of allowing road widening or similar needs. This category includes expenditure on assets relating to the undergrounding of previously above ground assets at the request of a third party.

- **Reliability, Safety and Environment**

  1 Quality of Supply

  Capital expenditure on assets where the primary driver is the need to meet improved security and/or quality of supply standards. The may include expenditure to:

  - Reduce the overall interruption/fault rate of the network
  - Reduce the average time that consumers are affect by planned and/or unplanned interruptions; or
  - Reduce the average number of consumers affected by planned and/or unplanned interruptions.

  2 Legislative and Regulatory

  Capital expenditure on assets where the primary driver is a new regulatory or legal requirement that results in the creation of or modification to the network assets.

  3 Other Reliability, Safety and Environment

  Capital expenditure on assets where the primary driver is to improve network reliability or safety or to mitigate the environmental impacts of the network, but is not included in either the quality of supply or legislative and regulatory categories above. For example this category may include expenditure on assets where the primary driver is to ensure staff safety or meet the company's environmental policies.

APPENDIX C: Network Reliability by Zone Substation and Feeder

The table below shows the reliability levels for each of Westpower's 19 Zone Substations.

Substation	Load (MW)	Sub-Trans Security	# HV Feeds	Feeders	Restoration Time (Hrs)	Backup	Comments
Reefton 33 kV	7.181	n-1	2	CB3012	<0.5	CB3072 at Sub	There are two transformers fed from Inangahua and Atarau through two separate 110 kV circuits. There is no problem with the backup.
				CB3072	<0.5	CB3012 at Sub	
Reefton 11 kV	3.385	n-1	2	CB4	< 0.5	CB5 at Sub	
				CB5	< 0.5	CB4 at Sub	
						BWR CB1 to Reefton town	
Globe 11 kV	1.738	n	1	CB2	<1		Accepted by Customer. Backup is available just for 11 kV.
				CB3	<1		
				CB4	<1		
						Mobile Sub for all feeders	
Globe 6.6 kV	4.000	n	1	CB39		No Backup	The 6.6 kV feeder only supplies the Globe Ball Mill and there is no backup, which is accepted by Customer.
Ngahere	1.942	n	1	CB1	<1	DOB CB1	There is a backup feed from Reefton for a 33 kV feeder fault. Backup is available for the Blackball feed from Dobson or Arnold. The CB3 feeder can be fed from Blackwater. Repair times are short. A backup transformer is available.
						ALD CB3	
				CB3	<1	BWR CB2	
						Mobile Sub for both feeders	
Rapahoe	1.749	n	1	CB1	<1	CB3 at Sub	There is no backup for a 33 kV feeder fault. Backup is available via a bypass switch for 33 kV and 11 kV circuit breaker faults. Dobson and/or Greymouth are able to supply the domestic 11 kV load, and minimal industrial load, e.g. mine pumps. A backup transformer is available.
				CB3	<1	DOB CB1	
						GYM CB13	
					<1	Mobile Sub for both feeders	

Substation	Load (MW)	Sub-Trans Security	# HV Feeds	Feeders	Restoration Time (Hrs)	Backup	Comments
Dobson 33 kV	8.154	n - 1	2	CB1322	< 0.5	CB1362 at Sub	This is the major 33 kV supply point for the Grey Valley and is supplied direct from the Trans Power network. The radial 33 kV feeders can be bypassed at the substation for circuit breaker faults but there are no alternate feed for the feeders themselves. Repair times are short. CB1382 is not provided with a bypass, as Arnold Power Station provides an alternate source on the 11 kV network. The mobile substation can be used as a backup for CB1342 and T1.
				CB1342	< 0.5	Mobile Sub	
				CB1362	< 0.5	CB1322 at Sub	
				CB1382	< 0.5	33kV Tie to Arnold	
						CB3072 Reefton	
Dobson 11 kV	3.065	n	1	CB1	<0.5	RAP CB3	This substation is fed directly from the Transpower Dobson 33 kV bus, and so is not subject to Westpower Subtransmission Line Faults. The 33/11 kV transformer also acts as a spare, which can be transported to Ngahere, Rapahoe, Hokitika, Wahapo or Franz Josef if required. Several 11 kV ties exist for the feeders out of this substation and repair times are short.
						ALD CB3	
						NGH CB1	
				CB3	<0.5	GYM CB13	
						Mobile Sub for both feeders	
Blackwater	1.443	n	1	CB1	<1	RFN CB5	The 33 kV feeder backup is available from Reefton or Dobson.
				CB2	<1	NGH CB3	
						Mobile Sub for both feeders	
Arnold	3.236	n	1	CB3	< 0.5	DOB CB1	The backup for a 33 kV feeder fault is the local generating station tied in through the 11 kV network. Backup is available for the Stillwater feed from Dobson, and for the Moana feed from Kumara. Partial back feed to Dobson or Turiwhate is possible. Repair times are short. A backup transformer is available.
				CB4	< 0.5	KUM CB2	
					< 0.5	Mobile Sub	
Greymouth	13.850	n-1	2	CB7	< 0.5	CB12 & CB9	This is Westpower's largest Point of Supply that feeds the Greymouth Central Business District (CBD). There are several radial 11 kV feeders that are intermeshed at several points providing a significant amount of diversity. The Cobden Feeder has an alternative supply from the Dobson Sub via RMU58 on the North side of the Grey River. The 11 kV cable network in the CBD is highly intermeshed with a "double-ring" construction. All substations have two, and many three, 11 kV cable feeds.
				CB13	< 0.5	CB6	
						DOB CB3	
				CB6	< 0.5	CB13	
						CB11	
						KUM CB1	
				CB12	< 0.5	CB9	
						CB6	
				CB11	< 0.5	CB6	
						CB12	
				CB9	< 0.5	CB7	
						CB12	

Substation	Load (MW)	Sub-Trans Security	# HV Feeds	Feeders	Restoration Time (Hrs)	Backup	Comments
Kumara	1.518	n	1	CB1	< 1	GYM CB6	This supply is fed directly from the Kumara 11 kV bus, which is in turn supplied by a very reliable Transpower 66 kV bus. Both 11 kV feeders can be back fed from Greymouth, Arnold or Hokitika Substations. A spare transformer is available from Greymouth Substation.
				CB2	< 1	ALD CB4	
						HKK CB10	
Hokitika	14.508	n-1	2	CB10	< 0.5	CB4	This substation feeds Hokitika and all of South Westland down to Paringa. In addition, it supplies three feeders to the Westland Dairy. Hokitika can be supplied on reduced load from Wahapo and Amethyst Power Stations, depending on availability, should the 66 kV feed be interrupted.
				CB4	< 0.5	CB10	
						CB12	
				CB12	< 0.5	CB4	
				CB5	< 0.5	CB9	
						CB11	
				CB9	< 0.5	CB5	
						CB11	
				CB11	< 0.5	CB5	
						CB9	
Ross	0.493	n	1	CB1	< 0.5	CB3 at Sub	The 33 kV substation feed can be from Hokitika, Amethyst or Wahapo, depending on Power Station availability. Domestic load on CB1 and CB3 can be fed from Hokitika CB10. Both feeders have a short repair time.
				CB3	< 0.5	HKK CB10	
						CB1 at Sub	
Waitaha	0.310	n	1	CB1	< 5	No Backup	The 33 kV substation feed can be from Hokitika, Amethyst or Wahapo, depending on Power Station availability. This is a very small and isolated substation and no backup is possible for the 11 kV feeders. A spare transformer is available.
						Mobile Sub	
Harihari	0.820	n	1	CB1	< 0.5	CB3 at Sub	The 33 kV substation feed can be from Hokitika, Amethyst or Wahapo, depending on Power Station availability. This is a small and isolated substation and no backup is possible for the 11 kV feeders apart from a bypass for the 11 kV circuit breakers. A spare transformer is available.
				CB3	< 0.5	CB1 at Sub	
						Mobile Sub	
Whataroa	0.801	n	1	CB1	< 5	No Backup	The 33 kV substation feed can be from Hokitika, Amethyst or Wahapo, depending on Power Station availability. The mobile substation can backup the 11kV feeder. A spare transformer is available as well.
						Mobile Sub	
Wahapo	3.057	n	1	CB1	< 5	No Backup	The 11 kV substation bus can be fed from Hokitika, Amethyst or Wahapo, depending on Power Station availability. This is an isolated substation and no backup is possible for the 11 kV. A spare transformer is available from Dobson. This substation also connects Wahapo Power Station into Westpower's sub-transmission network.
						Mobile Sub	

Substation	Load (MW)	Sub-Trans Security	# HV Feeds	Feeders	Restoration Time (Hrs)	Backup	Comments
Franz Josef	1.984	n	1	CB1	< 1.5	CB3 at Sub	This substation is fed from Hokitika, Amethyst or Wahapo, depending on Power Station availability, and feeds the Franz Josef area. There are two sections of Hendrix covered conductor in this circuit, which have significant repair times. There is no feasible subtransmission backup. The mobile substation can backup both 11kV feeders.
				CB3	< 1.5	CB1 at Sub	
						Mobile Sub	
Fox Glacier	1.005	n	1	CB1	< 5	No Backup	Similar to Franz Josef substation, this substation is fed from Hokitika, Amethyst or Wahapo, depending on Power Station availability, and feeds the Fox area. There is no feasible subtransmission backup. The mobile substation can backup the 11kV feeder. The substation was constructed in 2003 to supply the Fox Glacier area and south to Paringa.
						Mobile Sub	

APPENDIX D: EDB Information Disclosure Requirements

Company Name	Westpower
AMP Planning Period	1 April 2016 – 31 March 2026

SCHEDULE 11a: REPORT ON FORECAST CAPITAL EXPENDITURE

This schedule requires a breakdown of forecast expenditure on assets for the current disclosure year and a 10 year planning period. The forecasts should be consistent with the supporting information set out in the AMP. The forecast is to be expressed in both constant price and nominal dollar terms. Also required is a forecast of the value of commissioned assets (i.e., the value of RAB additions)

EDBs must provide explanatory comment on the difference between constant price and nominal dollar forecasts of expenditure on assets in Schedule 14a (Mandatory Explanatory Notes).

This information is not part of audited disclosure information.

sch ref			Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5	CY+6	CY+7	CY+8	CY+9	CY+10
8		for year ended	31 Mar 16	31 Mar 17	31 Mar 18	31 Mar 19	31 Mar 20	31 Mar 21	31 Mar 22	31 Mar 23	31 Mar 24	31 Mar 25	31 Mar 26
9	**11a(i): Expenditure on Assets Forecast**		**$000 (in nominal dollars)**										
10		Consumer connection	98	98	100	102	104	106	108	110	113	115	117
11		System growth	216	227	315	236	2,116	246	251	256	261	266	271
12		Asset replacement and renewal	1,846	1,548	1,233	1,329	661	1,836	1,626	937	999	1,080	1,783
13		Asset relocations											
14		Reliability, safety and environment:											
15		Quality of supply	660	1,309	1,121	753	567	448	407	416	395	432	220
16		Legislative and regulatory											
17		Other reliability, safety and environment	248	323	222	383	159	97	83	84	86	158	90
18		**Total reliability, safety and environment**	908	1,632	1,343	1,136	726	546	490	500	481	591	310
19		**Expenditure on network assets**	3,068	3,505	2,992	2,803	3,607	2,733	2,475	1,803	1,854	2,051	2,481
20		Expenditure on non-network assets											
21		**Expenditure on assets**	3,068	3,505	2,992	2,803	3,607	2,733	2,475	1,803	1,854	2,051	2,481
22													
23	*plus*	Cost of financing											
24	*less*	Value of capital contributions											
25	*plus*	Value of vested assets											
26													
27		**Capital expenditure forecast**	3,068	3,505	2,992	2,803	3,607	2,733	2,475	1,803	1,854	2,051	2,481
28													
29		Assets commissioned	3,068	3,505	2,992	2,803	3,607	2,733	2,475	1,803	1,854	2,051	2,481
30			*Current Year CY*	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*	*CY+6*	*CY+7*	*CY+8*	*CY+9*	*CY+10*
31		for year ended	31 Mar 16	31 Mar 17	31 Mar 18	31 Mar 19	31 Mar 20	31 Mar 21	31 Mar 22	31 Mar 23	31 Mar 24	31 Mar 25	31 Mar 26
32			**$000 (in constant prices)**										
33		Consumer connection	98	98	98	98	98	98	98	98	98	98	98
34		System growth	216	227	309	227	1,994	227	227	227	227	227	227
35		Asset replacement and renewal	1,846	1,548	1,209	1,278	623	1,696	1,472	832	870	922	1,492
36		Asset relocations	-	-	-	-	-	-					
37		Reliability, safety and environment:											
38		Quality of supply	660	1,309	1,099	724	534	414	369	369	344	369	184
39		Legislative and regulatory	-	-	-	-	-	-					
40		Other reliability, safety and environment	248	323	218	368	150	90	75	75	75	135	75
41		**Total reliability, safety and environment**	908	1,632	1,317	1,092	684	504	444	444	419	504	259
42		**Expenditure on network assets**	3,068	3,505	2,933	2,695	3,399	2,525	2,241	1,601	1,614	1,751	2,076
43		Expenditure on non-network assets	-	-	-	-	-	-					
44		**Expenditure on assets**	3,068	3,505	2,933	2,695	3,399	2,525	2,241	1,601	1,614	1,751	2,076
45													
46	**Subcomponents of expenditure on assets (where known)**												
47		Energy efficiency and demand side management, reduction of energy losses											
48		Overhead to underground conversion											
49		Research and development											

Company Name	Westpower
AMP Planning Period	1 April 2016 – 31 March 2026

SCHEDULE 11a: REPORT ON FORECAST CAPITAL EXPENDITURE

This schedule requires a breakdown of forecast expenditure on assets for the current disclosure year and a 10 year planning period. The forecasts should be consistent with the supporting information set out in the AMP. The forecast is to be expressed in both constant price and nominal dollar terms. Also required is a forecast of the value of commissioned assets (i.e., the value of RAB additions)

EDBs must provide explanatory comment on the difference between constant price and nominal dollar forecasts of expenditure on assets in Schedule 14a (Mandatory Explanatory Notes).

This information is not part of audited disclosure information.

sch ref			Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5	CY+6	CY+7	CY+8	CY+9	CY+10
50													
51			*Current Year CY*	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*	*CY+6*	*CY+7*	*CY+8*	*CY+9*	*CY+10*
52		for year ended	**31 Mar 16**	**31 Mar 17**	**31 Mar 18**	**31 Mar 19**	**31 Mar 20**	**31 Mar 21**	**31 Mar 22**	**31 Mar 23**	**31 Mar 24**	**31 Mar 25**	**31 Mar 26**
53	**Difference between nominal and constant price forecasts**		**$000**										
54	Consumer connection		-	-	2	4	6	8	10	12	15	17	19
55	System growth		-	-	6	9	122	19	24	29	34	39	44
56	Asset replacement and renewal		-	-	24	52	38	140	153	105	129	158	291
57	Asset relocations		-	-	-	-	-	-	-	-	-	-	-
58	Reliability, safety and environment:												
59	Quality of supply		-	-	22	29	33	34	38	47	51	63	36
60	Legislative and regulatory		-	-	-	-	-	-	-	-	-	-	-
61	Other reliability, safety and environment		-	-	4	15	9	7	8	9	11	23	15
62	**Total reliability, safety and environment**		-	-	26	44	42	42	46	56	62	87	51
63	**Expenditure on network assets**		-	-	59	109	208	208	233	202	240	301	405
64	Expenditure on non-network assets		-	-	-	-	-	-	-	-	-	-	-
65	**Expenditure on assets**		-	-	59	109	208	208	233	202	240	301	405
66													

sch ref			Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5
67			*Current Year CY*	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*
		for year ended	**31 Mar 16**	**31 Mar 17**	**31 Mar 18**	**31 Mar 19**	**31 Mar 20**	**31 Mar 21**
68	**11a(ii): Consumer Connection**							
69	*Consumer types defined by EDB**		**$000 (in constant prices)**					
70	Cat1 Domestic		48	48	48	48	48	48
71	Cat1 Non-domestic (< 15kVa)		33	33	33	33	33	33
72	Cat2 Non-domestic (> 15kVa)		17	17	17	17	17	17
73								
74				-	-	-	-	-
75	**include additional rows if needed*							
76	**Consumer connection expenditure**		98	98	98	98	98	98
77	*less* Capital contributions funding consumer connection							
78	**Consumer connection less capital contributions**		98	98	98	98	98	98
79	**11a(iii): System Growth**							
80	Subtransmission							
81	Zone substations			-	82	-	1,767	-
82	Distribution and LV lines							
83	Distribution and LV cables							
84	Distribution substations and transformers		216	227	227	227	227	227
85	Distribution switchgear							
86	Other network assets							
87	**System growth expenditure**		216	227	309	227	1,994	227
88	*less* Capital contributions funding system growth							
89	**System growth less capital contributions**		216	227	309	227	1,994	227
90								

Company Name	Westpower
AMP Planning Period	1 April 2016 – 31 March 2026

SCHEDULE 11a: REPORT ON FORECAST CAPITAL EXPENDITURE

This schedule requires a breakdown of forecast expenditure on assets for the current disclosure year and a 10 year planning period. The forecasts should be consistent with the supporting information set out in the AMP. The forecast is to be expressed in both constant price and nominal dollar terms. Also required is a forecast of the value of commissioned assets (i.e., the value of RAB additions)

EDBs must provide explanatory comment on the difference between constant price and nominal dollar forecasts of expenditure on assets in Schedule 14a (Mandatory Explanatory Notes).

This information is not part of audited disclosure information.

sch ref			Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5
92		for year ended	31 Mar 16	31 Mar 17	31 Mar 18	31 Mar 19	31 Mar 20	31 Mar 21
93	**11a(iv): Asset Replacement and Renewal**		**$000 (in constant prices)**					
94	Subtransmission		468	569	318	89	82	120
95	Zone substations		749	390	324	630	36	1,121
96	Distribution and LV lines		377	365	370	369	320	307
97	Distribution and LV cables							
98	Distribution substations and transformers		30	30	-	-	-	-
99	Distribution switchgear		117	81	95	87	86	49
100	Other network assets		105	114	102	103	99	99
101	**Asset replacement and renewal expenditure**		1,846	1,548	1,209	1,278	623	1,696
102	*less* Capital contributions funding asset replacement and renewal							
103	**Asset replacement and renewal less capital contributions**		1,846	1,548	1,209	1,278	623	1,696
104								

			Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5
106		for year ended	31 Mar 16	31 Mar 17	31 Mar 18	31 Mar 19	31 Mar 20	31 Mar 21
107	**11a(v):Asset Relocations**							
108	*Project or programme**		**$000 (in constant prices)**					
109								
110								
111								
112								
113								
114	**include additional rows if needed*							
115	All other project or programmes - asset relocations							
116	**Asset relocations expenditure**		-	-	-	-	-	-
117	*less* Capital contributions funding asset relocations							
118	**Asset relocations less capital contributions**		-	-	-	-	-	-
119								

			Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5
121		for year ended	31 Mar 16	31 Mar 17	31 Mar 18	31 Mar 19	31 Mar 20	31 Mar 21
122	**11a(vi):Quality of Supply**							
123	*Project or programme**		**$000 (in constant prices)**					
124	Advanced Distribution Management System		50	990	680	200	150	
125	Communication network refurbishment programme		15	80	110	110	110	110
126								
127								
128								
129	**include additional rows if needed*							
130	All other projects or programmes - quality of supply		595	239	309	414	274	304
131	**Quality of supply expenditure**		660	1,309	1,099	724	534	414
132	*less* Capital contributions funding quality of supply							
133	**Quality of supply less capital contributions**		660	1,309	1,099	724	534	414
134								

Company Name	Westpower
AMP Planning Period	1 April 2016 – 31 March 2026

SCHEDULE 11a: REPORT ON FORECAST CAPITAL EXPENDITURE

This schedule requires a breakdown of forecast expenditure on assets for the current disclosure year and a 10 year planning period. The forecasts should be consistent with the supporting information set out in the AMP. The forecast is to be expressed in both constant price and nominal dollar terms. Also required is a forecast of the value of commissioned assets (i.e., the value of RAB additions)

EDBs must provide explanatory comment on the difference between constant price and nominal dollar forecasts of expenditure on assets in Schedule 14a (Mandatory Explanatory Notes).

This information is not part of audited disclosure information.

sch ref			Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5
136		for year ended	31 Mar 16	31 Mar 17	31 Mar 18	31 Mar 19	31 Mar 20	31 Mar 21
137	**11a(vii): Legislative and Regulatory**							
138	*Project or programme**		$000 (in constant prices)					
139								
140								
141								
142								
143								
144	**include additional rows if needed*							
145	All other projects or programmes - legislative and regulatory							
146	**Legislative and regulatory expenditure**		-	-	-	-	-	-
147	*less* Capital contributions funding legislative and regulatory							
148	**Legislative and regulatory less capital contributions**		-	-	-	-	-	-
149								
150			Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5
		for year ended	31 Mar 16	31 Mar 17	31 Mar 18	31 Mar 19	31 Mar 20	31 Mar 21
151	**11a(viii): Other Reliability, Safety and Environment**							
152	*Project or programme**		$000 (in constant prices)					
153								
154								
155								
156								
157								
158	**include additional rows if needed*							
159	All other projects or programmes - other reliability, safety and environment		248	323	218	368	150	90
160	**Other reliability, safety and environment expenditure**		248	323	218	368	150	90
161	*less* Capital contributions funding other reliability, safety and environment							
162	**Other reliability, safety and environment less capital contributions**		248	323	218	368	150	90

Company Name: **Westpower**
AMP Planning Period: **1 April 2016 – 31 March 2026**

SCHEDULE 11a: REPORT ON FORECAST CAPITAL EXPENDITURE

This schedule requires a breakdown of forecast expenditure on assets for the current disclosure year and a 10 year planning period. The forecasts should be consistent with the supporting information set out in the AMP. The forecast is to be expressed in both constant price and nominal dollar terms. Also required is a forecast of the value of commissioned assets (i.e., the value of RAB additions)
EDBs must provide explanatory comment on the difference between constant price and nominal dollar forecasts of expenditure on assets in Schedule 14a (Mandatory Explanatory Notes).
This information is not part of audited disclosure information.

sch ref			Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5
163								
164			*Current Year CY*	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*
165		for year ended	**31 Mar 16**	**31 Mar 17**	**31 Mar 18**	**31 Mar 19**	**31 Mar 20**	**31 Mar 21**
166	**11a(ix): Non-Network Assets**							
167	**Routine expenditure**							
168	*Project or programme**		**$000 (in constant prices)**					
169								
170								
171								
172								
173								
174	**include additional rows if needed*							
175	All other projects or programmes - routine expenditure							
176	**Routine expenditure**		-	-	-	-	-	-
177	**Atypical expenditure**							
178	*Project or programme**							
179								
180								
181								
182								
183								
184	**include additional rows if needed*							
185	All other projects or programmes - atypical expenditure							
186	**Atypical expenditure**		-	-	-	-	-	-
187								
188	**Expenditure on non-network assets**		-	-	-	-	-	-

The following inflation factors have been applied in calculating the nominal expenditure forecasts on Schedule 11a and 11b

- Network Operational Expenditure 2%
- Non Network Operational Expenditure 1-2%
- Network Capital Expenditure 2%

These inflation factors take in to account the forecast movement in prices for key inputs including labour, materials and plants costs.

Company Name	**Westpower**
AMP Planning Period	**1 April 2016 – 31 March 2026**

SCHEDULE 11b: REPORT ON FORECAST OPERATIONAL EXPENDITURE

This schedule requires a breakdown of forecast operational expenditure for the disclosure year and a 10 year planning period. The forecasts should be consistent with the supporting information set out in the AMP. The forecast is to be expressed in both constant price and nominal dollar terms.
EDBs must provide explanatory comment on the difference between constant price and nominal dollar operational expenditure forecasts in Schedule 14a (Mandatory Explanatory Notes).
This information is not part of audited disclosure information.

sch ref		Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5	CY+6	CY+7	CY+8	CY+9	CY+10
8	for year ended	**31 Mar 16**	**31 Mar 17**	**31 Mar 18**	**31 Mar 19**	**31 Mar 20**	**31 Mar 21**	**31 Mar 22**	**31 Mar 23**	**31 Mar 24**	**31 Mar 25**	**31 Mar 26**
9	**Operational Expenditure Forecast**	**$000 (in nominal dollars)**										
10	Service interruptions and emergencies	496	496	506	516	527	537	548	559	570	581	593
11	Vegetation management	550	600	612	624	637	649	662	676	689	703	717
12	Routine and corrective maintenance and inspection	3,586	3,214	3,219	3,219	3,269	3,313	3,365	3,438	3,514	3,604	3,723
13	Asset replacement and renewal	427	309	308	302	292	319	304	321	316	322	374
14	**Network Opex**	5,059	4,619	4,646	4,661	4,724	4,819	4,879	4,994	5,089	5,210	5,408
15	System operations and network support	2,456	2,284	2,281	2,308	2,330	2,358	2,387	2,416	2,445	2,474	2,504
16	Business support	1,633	1,733	1,710	1,727	1,744	1,762	1,800	1,840	1,880	1,921	1,964
17	**Non-network opex**	4,089	4,017	3,991	4,035	4,075	4,120	4,187	4,256	4,325	4,396	4,468
18	**Operational expenditure**	9,148	8,636	8,636	8,696	8,799	8,939	9,067	9,249	9,414	9,606	9,876

sch ref		Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5	CY+6	CY+7	CY+8	CY+9	CY+10
20	for year ended	**31 Mar 16**	**31 Mar 17**	**31 Mar 18**	**31 Mar 19**	**31 Mar 20**	**31 Mar 21**	**31 Mar 22**	**31 Mar 23**	**31 Mar 24**	**31 Mar 25**	**31 Mar 26**
21		**$000 (in constant prices)**										
22	Service interruptions and emergencies	496	496	496	496	496	496	496	496	496	496	496
23	Vegetation management	550	600	600	600	600	600	600	600	600	600	600
24	Routine and corrective maintenance and inspection	3,586	3,214	3,156	3,094	3,081	3,060	3,048	3,053	3,059	3,076	3,116
25	Asset replacement and renewal	427	309	302	290	275	295	275	285	275	275	313
26	**Network Opex**	5,059	4,619	4,555	4,480	4,452	4,452	4,419	4,435	4,430	4,447	4,525
27	System operations and network support	2,456	2,284	2,254	2,254	2,249	2,249	2,249	2,249	2,249	2,249	2,249
28	Business support	1,633	1,733	1,693	1,693	1,693	1,693	1,693	1,693	1,693	1,693	1,693
29	**Non-network opex**	4,089	4,017	3,947	3,947	3,942	3,942	3,942	3,942	3,942	3,942	3,942
30	**Operational expenditure**	9,148	8,636	8,501	8,427	8,393	8,393	8,361	8,376	8,372	8,388	8,466
31	**Subcomponents of operational expenditure (where known)**											
32–33	Energy efficiency and demand side management, reduction of energy losses											
34	Direct billing*											
35	Research and Development											
36	Insurance	200	200	200	200	200	200	200	200	200	200	200
37	** Direct billing expenditure by suppliers that direct bill the majority of their consumers*											

sch ref		Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5	CY+6	CY+7	CY+8	CY+9	CY+10
40	for year ended	**31 Mar 16**	**31 Mar 17**	**31 Mar 18**	**31 Mar 19**	**31 Mar 20**	**31 Mar 21**	**31 Mar 22**	**31 Mar 23**	**31 Mar 24**	**31 Mar 25**	**31 Mar 26**
41	**Difference between nominal and real forecasts**	**$000**										
42	Service interruptions and emergencies	-	-	10	20	30	41	52	63	74	85	97
43	Vegetation management	-	-	12	24	37	49	62	76	89	103	117
44	Routine and corrective maintenance and inspection	-	-	63	125	189	252	317	385	455	528	608
45	Asset replacement and renewal	-	-	6	12	17	24	29	36	41	47	61
46	**Network Opex**	-	-	91	181	272	367	460	559	659	763	883
47	System operations and network support	-	-	27	54	82	110	138	167	196	226	256
48	Business support	-	-	17	34	51	69	107	147	187	228	271
49	**Non-network opex**	-	-	44	88	133	179	246	314	383	454	526
50	**Operational expenditure**	-	-	135	269	406	546	706	873	1,042	1,218	1,409

Company Name		Westpower
AMP Planning Period		1 April 2016 – 31 March 2026

SCHEDULE 12a: REPORT ON ASSET CONDITION

This schedule requires a breakdown of asset condition by asset class as at the start of the forecast year. The data accuracy assessment relates to the percentage values disclosed in the asset condition columns. Also required is a forecast of the percentage of units to be replaced in the next 5 years. All information should be consistent with the information provided in the AMP and the expenditure on assets forecast in Schedule 11a. All units relating to cable and line assets, that are expressed in km, refer to circuit lengths.

sch ref	Voltage	Asset category	Asset class	Units	Grade 1	Grade 2	Grade 3	Grade 4	Grade unknown	Data accuracy (1–4)	% of asset forecast to be replaced in next 5 years
7					Asset condition at start of planning period (percentage of units by grade)						
10	All	Overhead Line	Concrete poles / steel structure	No.	0.02%	0.87%	10.51%	87.66%	0.94%	3	
11	All	Overhead Line	Wood poles	No.	2.06%	15.44%	28.82%	50.21%	3.48%	3	
12	All	Overhead Line	Other pole types	No.						N/A	
13	HV	Subtransmission Line	Subtransmission OH up to 66kV conductor	km			27.95%	43.35%	28.70%	3	
14	HV	Subtransmission Line	Subtransmission OH 110kV+ conductor	km			100.00%			4	
15	HV	Subtransmission Cable	Subtransmission UG up to 66kV (XLPE)	km				100.00%		4	
16	HV	Subtransmission Cable	Subtransmission UG up to 66kV (Oil pressurised)	km						[Select one]	
17	HV	Subtransmission Cable	Subtransmission UG up to 66kV (Gas pressurised)	km						[Select one]	
18	HV	Subtransmission Cable	Subtransmission UG up to 66kV (PILC)	km						[Select one]	
19	HV	Subtransmission Cable	Subtransmission UG 110kV+ (XLPE)	km						[Select one]	
20	HV	Subtransmission Cable	Subtransmission UG 110kV+ (Oil pressurised)	km						[Select one]	
21	HV	Subtransmission Cable	Subtransmission UG 110kV+ (Gas Pressurised)	km						[Select one]	
22	HV	Subtransmission Cable	Subtransmission UG 110kV+ (PILC)	km						[Select one]	
23	HV	Subtransmission Cable	Subtransmission submarine cable	km						[Select one]	
24	HV	Zone substation Buildings	Zone substations up to 66kV	No.	-	-	80.00%	20.00%	-	4	
25	HV	Zone substation Buildings	Zone substations 110kV+	No.	-	-	-	100.00%	-	4	
26	HV	Zone substation switchgear	22/33kV CB (Indoor)	No.	-	-	-	100.00%	-	4	
27	HV	Zone substation switchgear	22/33kV CB (Outdoor)	No.	-	-	100.00%	-	-	4	
28	HV	Zone substation switchgear	33kV Switch (Ground Mounted)	No.	-	-	-	-	-	4	
29	HV	Zone substation switchgear	33kV Switch (Pole Mounted)	No.	-	-	100.00%	-	-	4	
30	HV	Zone substation switchgear	33kV RMU	No.	-	-	-	-	-	4	
31	HV	Zone substation switchgear	50/66/110kV CB (Indoor)	No.	-	-	-	-	-	4	
32	HV	Zone substation switchgear	50/66/110kV CB (Outdoor)	No.	-	-	85.00%	15.00%	-	4	
33	HV	Zone substation switchgear	3.3/6.6/11/22kV CB (ground mounted)	No.	-	-	90.00%	10.00%	-	4	
34	HV	Zone substation switchgear	3.3/6.6/11/22kV CB (pole mounted)	No.	-	20.00%	50.00%	30.00%	-	4	20.00%
36					Asset condition at start of planning period (percentage of units by grade)						
38	Voltage	Asset category	Asset class	Units	Grade 1	Grade 2	Grade 3	Grade 4	Grade unknown	Data accuracy (1–4)	% of asset forecast to be replaced in next 5 years
39	HV	Zone Substation Transformer	Zone Substation Transformers	No.	-	-	80.00%	20.00%	-	4	
40	HV	Distribution Line	Distribution OH Open Wire Conductor	km	-	3.00%	7.94%	35.95%	53.12%	3	
41	HV	Distribution Line	Distribution OH Aerial Cable Conductor	km	-	-	-	100.00%	-	4	
42	HV	Distribution Line	SWER conductor	km	-	-	-	-	-	N/A	
43	HV	Distribution Cable	Distribution UG XLPE or PVC	km	-	0.98%	24.19%	19.02%	55.81%	3	
44	HV	Distribution Cable	Distribution UG PILC	km	-	2.84%	87.78%	1.20%	8.19%	3	
45	HV	Distribution Cable	Distribution Submarine Cable	km	-	-	-	-	-	N/A	
46	HV	Distribution switchgear	3.3/6.6/11/22kV CB (pole mounted) - reclosers and sectionalisers	No.						[Select one]	
47	HV	Distribution switchgear	3.3/6.6/11/22kV CB (Indoor)	No.						[Select one]	
48	HV	Distribution switchgear	3.3/6.6/11/22kV Switches and fuses (pole mounted)	No.						[Select one]	
49	HV	Distribution switchgear	3.3/6.6/11/22kV Switch (ground mounted) - except RMU	No.						[Select one]	
50	HV	Distribution switchgear	3.3/6.6/11/22kV RMU	No.						[Select one]	
51	HV	Distribution Transformer	Pole Mounted Transformer	No.	1.14%	10.52%	11.96%	22.77%	53.61%	1	
52	HV	Distribution Transformer	Ground Mounted Transformer	No.	3.64%	13.82%	56.74%	14.90%	10.90%	2	
53	HV	Distribution Transformer	Voltage regulators	No.						[Select one]	
54	HV	Distribution Substations	Ground Mounted Substation Housing	No.						[Select one]	
55	LV	LV Line	LV OH Conductor	km	-	2.36%	14.37%	34.50%	48.77%	3	
56	LV	LV Cable	LV UG Cable	km	-	0.06%	47.13%	14.76%	38.05%	3	
57	LV	LV Streetlighting	LV OH/UG Streetlight circuit	km					100.00%	4	
58	LV	Connections	OH/UG consumer service connections	No.		5.78%	47.34%	40.62%	6.26%	2	
59	All	Protection	Protection relays (electromechanical, solid state and numeric)	No.						[Select one]	
60	All	SCADA and communications	SCADA and communications equipment operating as a single system	Lot						[Select one]	
61	All	Capacitor Banks	Capacitors including controls	No.	-	-	100.00%	-	-	4	
62	All	Load Control	Centralised plant	Lot	-	-	100.00%	-	-	4	
63	All	Load Control	Relays	No.						[Select one]	
64	All	Civils	Cable Tunnels	km						[Select one]	

Company Name	**Westpower**
AMP Planning Period	**1 April 2016 – 31 March 2026**

SCHEDULE 12b: REPORT ON FORECAST CAPACITY

This schedule requires a breakdown of current and forecast capacity and utilisation for each zone substation and current distribution transformer capacity. The data provided should be consistent with the information provided in the AMP. Information provided in this table should relate to the operation of the network in its normal steady state configuration.

sch ref

7 **12b(i): System Growth - Zone Substations**

sch ref	*Existing Zone Substations*	Current Peak Load (MVA)	Installed Firm Capacity (MVA)	Security of Supply Classification (type)	Transfer Capacity (MVA)	Utilisation of Installed Firm Capacity %	Installed Firm Capacity +5 years (MVA)	Utilisation of Installed Firm Capacity + 5yrs %	Installed Firm Capacity Constraint +5 years (cause)	Explanation
9	Arnold	3	6	N	1	52%	6	54%	No constraint within +5 years	
10	Blackwater	1	5	N-1 switched	1	29%	5	30%	No constraint within +5 years	
11	Dobson	3	5	N-1 switched	3	61%	5	64%	No constraint within +5 years	
12	Fox Glacier	1	5	N	-	20%	5	22%	No constraint within +5 years	
13	Franz Josef	2	5	N	-	40%	5	44%	No constraint within +5 years	
14	Globe	6	10	N	-	57%	10	7%	No constraint within +5 years	
15	Greymouth	14	15	N-1	2	92%	15	102%	Transformer	
16	Harihari	1	1	N	-	82%	1	90%	No constraint within +5 years	
17	Hokitika	15	20	N-1	0	73%	20	86%	No constraint within +5 years	
18	Kumara	10	10	N	1	95%	10	96%	No constraint within +5 years	
19	Ngahere	2	5	N-1 switched	2	39%	5	41%	No constraint within +5 years	
20	Otira	1	3	N	-	25%	3	26%	No constraint within +5 years	
21	Rapahoe	2	5	N-1 switched	2	35%	5	45%	No constraint within +5 years	
22	Reefton	11	30	N-1	1	35%	30	20%	No constraint within +5 years	
23	Ross	0	1	N-1 switched	0	49%	1	52%	No constraint within +5 years	
24	Wahapo	3	5	N	-	61%	5	61%	No constraint within +5 years	
25	Waitaha	0	1	N	-	31%	1	34%	No constraint within +5 years	
26	Whataroa	1	1	N	-	80%	1	88%	No constraint within +5 years	

29 [1] *Extend forecast capacity table as necessary to disclose all capacity by each zone substation*

Company Name	**Westpower**
AMP Planning Period	**1 April 2016 – 31 March 2026**

SCHEDULE 12C: REPORT ON FORECAST NETWORK DEMAND

This schedule requires a forecast of new connections (by consumer type), peak demand and energy volumes for the disclosure year and a 5 year planning period. The forecasts should be consistent with the supporting information set out in the AMP as well as the assumptions used in developing the expenditure forecasts in Schedule 11a and Schedule 11b and the capacity and utilisation forecasts in Schedule 12b.

sch ref								
7	**12c(i): Consumer Connections**							
8	*Number of ICPs connected in year by consumer type*				**Number of connections**			
9			*Current Year CY*	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*
10		for year ended	**31 Mar 16**	**31 Mar 17**	**31 Mar 18**	**31 Mar 19**	**31 Mar 20**	**31 Mar 21**
11	*Consumer types defined by EDB**							
12	CAT 1 DOMESTIC		10,664	10,717	10,771	10,825	10,879	10,933
13	CAT 1 NON-DOMESTIC		1,873	1,882	1,892	1,901	1,911	1,920
14	CAT 2 NON-DOMESTIC		854	858	863	867	871	876
	CAT 3 NON-DOMESTIC		15	15	15	15	15	15
15	CAT 4 NON-DOMESTIC		3	3	3	3	3	3
16	CAT 5 NON-DOMESTIC		1	1	1	1	1	1
17	**Connections total**		13,410	13,477	13,544	13,612	13,680	13,749
18	**include additional rows if needed*							
19	**Distributed generation**							
20	Number of connections		10	10	11	11	11	11
21	Capacity of distributed generation installed in year (MVA)		28	28	30	30	30	30
22	**12c(ii) System Demand**							
23			*Current Year CY*	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*
24	**Maximum coincident system demand (MW)**	for year ended	**31 Mar 16**	**31 Mar 17**	**31 Mar 18**	**31 Mar 19**	**31 Mar 20**	**31 Mar 21**
25	GXP demand		24	22	22	23	24	24
26	*plus* Distributed generation output at HV and above		24	24	25	25	25	25
27	**Maximum coincident system demand**		48	46	48	48	49	50
28	*less* Net transfers to (from) other EDBs at HV and above							
29	**Demand on system for supply to consumers' connection points**		48	46	48	48	49	50
30	**Electricity volumes carried (GWh)**							
31	Electricity supplied from GXPs		179	166	158	163	168	174
32	*less* Electricity exports to GXPs		41	44	44	42	41	40
33	*plus* Electricity supplied from distributed generation		147	147	156	156	156	156
34	*less* Net electricity supplied to (from) other EDBs		-	-	-	-	-	-
35	**Electricity entering system for supply to ICPs**		284	269	270	277	283	290
36	*less* Total energy delivered to ICPs		266	255	257	263	269	276
37	**Losses**		18	13	14	14	14	15
38								
39	**Load factor**		68%	67%	65%	65%	66%	66%
40	**Loss ratio**		6.2%	5.0%	5.0%	5.0%	5.0%	5.0%

Company Name	**Westpower**
AMP Planning Period	**1 April 2016 – 31 March 2026**
Network / Sub-network Name	

SCHEDULE 12d: REPORT FORECAST INTERRUPTIONS AND DURATION

This schedule requires a forecast of SAIFI and SAIDI for disclosure and a 5 year planning period. The forecasts should be consistent with the supporting information set out in the AMP as well as the assumed impact of planned and unplanned SAIFI and SAIDI on the expenditures forecast provided in Schedule 11a and Schedule 11b.

sch ref		*Current Year CY*	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*
9	for year ended	**31 Mar 16**	**31 Mar 17**	**31 Mar 18**	**31 Mar 19**	**31 Mar 20**	**31 Mar 21**
10	**SAIDI**						
11	Class B (planned interruptions on the network)	49.0	49.0	49.0	49.0	49.0	49.0
12	Class C (unplanned interruptions on the network)	128.0	128.0	128.0	128.0	128.0	128.0
13	**SAIFI**						
14	Class B (planned interruptions on the network)	0.22	0.22	0.22	0.22	0.22	0.22
15	Class C (unplanned interruptions on the network)	2.11	2.11	2.11	2.11	2.11	2.11

APPENDIX E: Westpowers AMMAT Report

Question No.	Function	Question	Maturity Level 3	Why	Who	Record/documented Information	Evidence—Summary	Score
3	Asset management policy	To what extent has an asset management policy been documented, authorised and communicated?	The asset management policy is authorised by top management, is widely and effectively communicated to all relevant employees and stakeholders, and used to make these persons aware of their asset related obligations.	Widely used AM practice standards require an organisation to document, authorise and communicate its asset management policy (eg, as required in PAS 55 para 4.2 i). A key pre-requisite of any robust policy is that the organisation's top management must be seen to endorse and fully support it. Also vital to the effective implementation of the policy, is to tell the appropriate people of its content and their obligations under it. Where an organisation outsources some of its asset-related activities, then these people and their organisations must equally be made aware of the policy's content. Also, there may be other stakeholders, such as regulatory authorities and shareholders who should be made aware of it.	Top management. The management team that has overall responsibility for asset management.	The organisation's asset management policy, its organisational strategic plan, documents indicating how the asset management policy was based upon the needs of the organisation and evidence of communication.	There is an asset management policy that is approved by directors and widely avilable in the Asset Management Plan (AMP)	3
10	Asset management strategy	What has the organisation done to ensure that its asset management strategy is consistent with other appropriate organisational policies and strategies, and the needs of stakeholders?	All linkages are in place and evidence is available to demonstrate that, where appropriate, the organisation's asset management strategy is consistent with its other organisational policies and strategies. The organisation has also identified and considered the requirements of relevant stakeholders.	In setting an organisation's asset management strategy, it is important that it is consistent with any other policies and strategies that the organisation has and has taken into account the requirements of relevant stakeholders. This question examines to what extent the asset management strategy is consistent with other organisational policies and strategies (eg, as required by PAS 55 para 4.3.1 b) and has taken account of stakeholder requirements as required by PAS 55 para 4.3.1 c). Generally, this will take into account the same polices, strategies and stakeholder requirements as covered in drafting the asset management policy but at a greater level of detail.	Top management. The organisation's strategic planning team. The management team that has overall responsibility for asset management.	The organisation's asset management strategy document and other related organisational policies and strategies. Other than the organisation's strategic plan, these could include those relating to health and safety, environmental, etc. Results of stakeholder consultation.	There is an AM strategy document directly linked with the asset management policy	3

Question No.	Function	Question	Maturity Level 3	Why	Who	Record/documented Information	Evidence—Summary	Score
11	Asset management strategy	In what way does the organisation's asset management strategy take account of the lifecycle of the assets, asset types and asset systems over which the organisation has stewardship?	The asset management strategy takes account of the lifecycle of all of its assets, asset types and asset systems.	Good asset stewardship is the hallmark of an organisation compliant with widely used AM standards. A key component of this is the need to take account of the lifecycle of the assets, asset types and asset systems. (For example, this requirement is recognised in 4.3.1 d) of PAS 55). This question explores what an organisation has done to take lifecycle into account in its asset management strategy.	Top management. People in the organisation with expert knowledge of the assets, asset types, asset systems and their associated life-cycles. The management team that has overall responsibility for asset management. Those responsible for developing and adopting methods and processes used in asset management	The organisation's documented asset management strategy and supporting working documents.	The asset management strategy takes account of the lifecycle of all of its assets, asset types and asset systems.	3
26	Asset management plan(s)	How does the organisation establish and document its asset management plan(s) across the life cycle activities of its assets and asset systems?	Asset management plan(s) are established, documented, implemented and maintained for asset systems and critical assets to achieve the asset management strategy and asset management objectives across all life cycle phases.	The asset management strategy need to be translated into practical plan(s) so that all parties know how the objectives will be achieved. The development of plan(s) will need to identify the specific tasks and activities required to optimize costs, risks and performance of the assets and/or asset system(s), when they are to be carried out and the resources required.	The management team with overall responsibility for the asset management system. Operations, maintenance and engineering managers.	The organisation's asset management plan(s).	The Asset Management Plan is established, documented, implemented and maintained for asset systems and critical assets to achieve the asset management strategy and asset management objectives across all life cycle phases.	3

Question No.	Function	Question	Maturity Level 3	Why	Who	Record/documented Information	Evidence—Summary	Score
27	Asset management plan(s)	How has the organisation communicated its plan(s) to all relevant parties to a level of detail appropriate to the receiver's role in their delivery?	The plan(s) are communicated to all relevant employees, stakeholders and contracted service providers to a level of detail appropriate to their participation or business interests in the delivery of the plan(s) and there is confirmation that they are being used effectively.	Plans will be ineffective unless they are communicated to all those, including contracted suppliers and those who undertake enabling function(s). The plan(s) need to be communicated in a way that is relevant to those who need to use them.	The management team with overall responsibility for the asset management system. Delivery functions and suppliers.	Distribution lists for plan(s). Documents derived from plan(s) which detail the receivers role in plan delivery. Evidence of communication.	The 2016 AMP is available on the company's website and is approved by the directors	3
29	Asset management plan(s)	How are designated responsibilities for delivery of asset plan actions documented?	Asset management plan(s) consistently document responsibilities for the delivery actions and there is adequate detail to enable delivery of actions. Designated responsibility and authority for achievement of asset plan actions is appropriate.	The implementation of asset management plan(s) relies on (1) actions being clearly identified, (2) an owner allocated and (3) that owner having sufficient delegated responsibility and authority to carry out the work required. It also requires alignment of actions across the organisation. This question explores how well the plan(s) set out responsibility for delivery of asset plan actions.	The management team with overall responsibility for the asset management system. Operations, maintenance and engineering managers. If appropriate, the performance management team.	The organisation's asset management plan(s). Documentation defining roles and responsibilities of individuals and organisational departments.	Designated responsibilities are identified in the AMP and further detailed in the individual Position Descriptions	3

Question No.	Function	Question	Maturity Level 3	Why	Who	Record/documented Information	Evidence—Summary	Score
31	Asset management plan(s)	What has the organisation done to ensure that appropriate arrangements are made available for the efficient and cost effective implementation of the plan(s)? (Note this is about resources and enabling support)	The organisation's arrangements fully cover all the requirements for the efficient and cost effective implementation of asset management plan(s) and realistically address the resources and timescales required, and any changes needed to functional policies, standards, processes and the asset management information system.	It is essential that the plan(s) are realistic and can be implemented, which requires appropriate resources to be available and enabling mechanisms in place. This question explores how well this is achieved. The plan(s) not only need to consider the resources directly required and timescales, but also the enabling activities, including for example, training requirements, supply chain capability and procurement timescales.	The management team with overall responsibility for the asset management system. Operations, maintenance and engineering managers. If appropriate, the performance management team. If appropriate, the performance management team. Where appropriate the procurement team and service providers working on the organisation's asset-related activities.	The organisation's asset management plan(s). Documented processes and procedures for the delivery of the asset management plan.	Westpower own 100% of its subsidiary company Electronet Services Limited (ENS). ENS is empowered to resource for all of Westpower's requirements plus other commercial activities as it sees fit	3
33	Contingency planning	What plan(s) and procedure(s) does the organisation have for identifying and responding to incidents and emergency situations and ensuring continuity of critical asset management activities?	Appropriate emergency plan(s) and procedure(s) are in place to respond to credible incidents and manage continuity of critical asset management activities consistent with policies and asset management objectives. Training and external agency alignment is in place.	Widely used AM practice standards require that an organisation has plan(s) to identify and respond to emergency situations. Emergency plan(s) should outline the actions to be taken to respond to specified emergency situations and ensure continuity of critical asset management activities including the communication to, and involvement of, external agencies. This question assesses if, and how well, these plan(s) triggered, implemented and resolved in the event of an incident. The plan(s) should be appropriate to the level of risk as determined by the organisation's risk assessment methodology. It is also a requirement that relevant personnel are competent and trained.	The manager with responsibility for developing emergency plan(s). The organisation's risk assessment team. People with designated duties within the plan(s) and procedure(s) for dealing with incidents and emergency situations.	The organisation's plan(s) and procedure(s) for dealing with emergencies. The organisation's risk assessments and risk registers.	Westpower has a well document Emergency Response Plan which has been used with great effect during recent emergency events.	3

Question No.	Function	Question	Maturity Level 3	Why	Who	Record/documented Information	Evidence—Summary	Score
37	Structure, authority and responsibilities	What has the organisation done to appoint member(s) of its management team to be responsible for ensuring that the organisation's assets deliver the requirements of the asset management strategy, objectives and plan(s)?	The appointed person or persons have full responsibility for ensuring that the organisation's assets deliver the requirements of the asset management strategy, objectives and plan(s). They have been given the necessary authority to achieve this.	In order to ensure that the organisation's assets and asset systems deliver the requirements of the asset management policy, strategy and objectives responsibilities need to be allocated to appropriate people who have the necessary authority to fulfil their responsibilities. (This question, relates to the organisation's assets eg, para b), s 4.4.1 of PAS 55, making it therefore distinct from the requirement contained in para a), s 4.4.1 of PAS 55).	Top management. People with management responsibility for the delivery of asset management policy, strategy, objectives and plan(s). People working on asset-related activities.	Evidence that managers with responsibility for the delivery of asset management policy, strategy, objectives and plan(s) have been appointed and have assumed their responsibilities. Evidence may include the organisation's documents relating to its asset management system, organisational charts, job descriptions of post-holders, annual targets/objectives and personal development plan(s) of post-holders as appropriate.	Westpower's Asset Management Group are specifically charged with theses responsibilities as set out in the AMP	3
40	Structure, authority and responsibilities	What evidence can the organisation's top management provide to demonstrate that sufficient resources are available for asset management?	An effective process exists for determining the resources needed for asset management and sufficient resources are available. It can be demonstrated that resources are matched to asset management requirements.	Optimal asset management requires top management to ensure sufficient resources are available. In this context the term 'resources' includes manpower, materials, funding and service provider support.	Top management. The management team that has overall responsibility for asset management. Risk management team. The organisation's managers involved in day-to-day supervision of asset-related activities, such as frontline managers, engineers, foremen and chargehands as appropriate.	Evidence demonstrating that asset management plan(s) and/or the process(es) for asset management plan implementation consider the provision of adequate resources in both the short and long term. Resources include funding, materials, equipment, services provided by third parties and personnel (internal and service providers) with appropriate skills competencies and knowledge.	Westpower has a team of 14 personnel dedicated at asset management. This is constantly reviewed by the General Manager, Assets and Engineering Services.	3

Question No.	Function	Question	Maturity Level 3	Why	Who	Record/documented Information	Evidence—Summary	Score
42	Structure, authority and responsibilities	To what degree does the organisation's top management communicate the importance of meeting its asset management requirements?	Top management communicates the importance of meeting its asset management requirements to all relevant parts of the organisation.	Widely used AM practice standards require an organisation to communicate the importance of meeting its asset management requirements such that personnel fully understand, take ownership of, and are fully engaged in the delivery of the asset management requirements (eg, PAS 55 s 4.4.1 g).	Top management. The management team that has overall responsibility for asset management. People involved in the delivery of the asset management requirements.	Evidence of such activities as road shows, written bulletins, workshops, team talks and management walkabouts would assist an organisation to demonstrate it is meeting this requirement of PAS 55.	The General Manager, Assets and Engineering Services heads the asset management group and attends monthly director's meetings	3
45	Outsourcing of asset management activities	Where the organisation has outsourced some of its asset management activities, how has it ensured that appropriate controls are in place to ensure the compliant delivery of its organisational strategic plan, and its asset management policy and strategy?	Evidence exists to demonstrate that outsourced activities are appropriately controlled to provide for the compliant delivery of the organisational strategic plan, asset management policy and strategy, and that these controls are integrated into the asset management system	Where an organisation chooses to outsource some of its asset management activities, the organisation must ensure that these outsourced process(es) are under appropriate control to ensure that all the requirements of widely used AM standards (eg, PAS 55) are in place, and the asset management policy, strategy objectives and plan(s) are delivered. This includes ensuring capabilities and resources across a time span aligned to life cycle management. The organisation must put arrangements in place to control the outsourced activities, whether it be to external providers or to other in-house departments. This question explores what the organisation does in this regard.	Top management. The management team that has overall responsibility for asset management. The manager(s) responsible for the monitoring and management of the outsourced activities. People involved with the procurement of outsourced activities. The people within the organisations that are performing the outsourced activities. The people impacted by the outsourced activity.	The organisation's arrangements that detail the compliance required of the outsourced activities. For example, this this could form part of a contract or service level agreement between the organisation and the suppliers of its outsourced activities. Evidence that the organisation has demonstrated to itself that it has assurance of compliance of outsourced activities.	Technically, Westpower has outsourced its asset management to Electronet Services limited but the Asset Management Group is housed within the Westpower's offices and is headed by Westpower's General Manager, Assets and Engineering Services, so the operation is effectively "in house"	3

Question No.	Function	Question	Maturity Level 3	Why	Who	Record/documented Information	Evidence—Summary	Score
48	Training, awareness and competence	How does the organisation develop plan(s) for the human resources required to undertake asset management activities - including the development and delivery of asset management strategy, process(es), objectives and plan(s)?	The organisation can demonstrate that plan(s) are in place and effective in matching competencies and capabilities to the asset management system including the plan for both internal and contracted activities. Plans are reviewed integral to asset management system process(es).	There is a need for an organisation to demonstrate that it has considered what resources are required to develop and implement its asset management system. There is also a need for the organisation to demonstrate that it has assessed what development plan(s) are required to provide its human resources with the skills and competencies to develop and implement its asset management systems. The timescales over which the plan(s) are relevant should be commensurate with the planning horizons within the asset management strategy considers e.g. if the asset management strategy considers 5, 10 and 15 year time scales then the human resources development plan(s) should align with these. Resources include both 'in house' and external resources who undertake asset management activities.	Senior management responsible for agreement of plan(s). Managers responsible for developing asset management strategy and plan(s). Managers with responsibility for development and recruitment of staff (including HR functions). Staff responsible for training. Procurement officers. Contracted service providers.	Evidence of analysis of future work load plan(s) in terms of human resources. Document(s) containing analysis of the organisation's own direct resources and contractors resource capability over suitable timescales. Evidence, such as minutes of meetings, that suitable management forums are monitoring human resource development plan(s). Training plan(s), personal development plan(s), contract and service level agreements.	Westpower has a team of 14 personnel dedicated at asset management. This is constantly reviewed by the General Manager, Assets and Engineering Services.	3

Question No.	Function	Question	Maturity Level 3	Why	Who	Record/documented Information	Evidence—Summary	Score
49	Training, awareness and competence	How does the organisation identify competency requirements and then plan, provide and record the training necessary to achieve the competencies?	Competency requirements are in place and aligned with asset management plan(s). Plans are in place and effective in providing the training necessary to achieve the competencies. A structured means of recording the competencies achieved is in place.	Widely used AM standards require that organisations to undertake a systematic identification of the asset management awareness and competencies required at each level and function within the organisation. Once identified the training required to provide the necessary competencies should be planned for delivery in a timely and systematic way. Any training provided must be recorded and maintained in a suitable format. Where an organisation has contracted service providers in place then it should have a means to demonstrate that this requirement is being met for their employees. (eg, PAS 55 refers to frameworks suitable for identifying competency requirements).	Senior management responsible for agreement of plan(s). Managers responsible for developing asset management strategy and plan(s). Managers with responsibility for development and recruitment of staff (including HR functions). Staff responsible for training. Procurement officers. Contracted service providers.	Evidence of an established and applied competency requirements assessment process and plan(s) in place to deliver the required training. Evidence that the training programme is part of a wider, co-ordinated asset management activities training and competency programme. Evidence that training activities are recorded and that records are readily available (for both direct and contracted service provider staff) e.g. via organisation wide information system or local records database.	Competency requirements are identified in the individual Position Descriptions within the Asset Management Group. Regular training is completed throughout the year and the training records are held in the company's file system called The Vault.	3

Question No.	Function	Question	Maturity Level 3	Why	Who	Record/documented Information	Evidence—Summary	Score
50	Training, awareness and competence	How does the organization ensure that persons under its direct control undertaking asset management related activities have an appropriate level of competence in terms of education, training or experience?	Competency requirements are identified and assessed for all persons carrying out asset management related activities - internal and contracted. Requirements are reviewed and staff reassessed at appropriate intervals aligned to asset management requirements.	A critical success factor for the effective development and implementation of an asset management system is the competence of persons undertaking these activities. organisations should have effective means in place for ensuring the competence of employees to carry out their designated asset management function(s). Where an organisation has contracted service providers undertaking elements of its asset management system then the organisation shall assure itself that the outsourced service provider also has suitable arrangements in place to manage the competencies of its employees. The organisation should ensure that the individual and corporate competencies it requires are in place and actively monitor, develop and maintain an appropriate balance of these competencies.	Managers, supervisors, persons responsible for developing training programmes. Staff responsible for procurement and service agreements. HR staff and those responsible for recruitment.	Evidence of a competency assessment framework that aligns with established frameworks such as the asset management Competencies Requirements Framework (Version 2.0); National Occupational Standards for Management and Leadership; UK Standard for Professional Engineering Competence, Engineering Council, 2005.	All personnel undertaking asset management duties undergo formal annual reviews to ensure they are competent and remain competent to carried out their assigned responsibilities	3
53	Communication, participation and consultation	How does the organisation ensure that pertinent asset management information is effectively communicated to and from employees and other stakeholders, including contracted service providers?	Two way communication is in place between all relevant parties, ensuring that information is effectively communicated to match the requirements of asset management strategy, plan(s) and process(es). Pertinent asset information requirements are regularly reviewed.	Widely used AM practice standards require that pertinent asset management information is effectively communicated to and from employees and other stakeholders including contracted service providers. Pertinent information refers to information required in order to effectively and efficiently comply with and deliver asset management strategy, plan(s) and objectives. This will include for example the communication of the asset management policy, asset performance information, and planning information as appropriate to contractors.	Top management and senior management	Asset management policy statement prominently displayed on notice boards, intranet and internet; use of organisation's website for displaying asset performance data; evidence of formal briefings to employees, stakeholders and contracted service providers; evidence of inclusion of asset management issues in team meetings and contracted service provider contract meetings; newsletters, etc.	The Asset Management Group is physically located on the same site as the company's contracting company that carry out the majority of the asset management work. Communication occurs on a daily basis	3

Question No.	Function	Question	Maturity Level 3	Why	Who	Record/documented Information	Evidence—Summary	Score
59	Asset Management System documentation	What documentation has the organisation established to describe the main elements of its asset management system and interactions between them?	The organisation has established documentation that comprehensively describes all the main elements of its asset management system and the interactions between them. The documentation is kept up to date.	Widely used AM practice standards require an organisation maintain up to date documentation that ensures that its asset management systems (ie, the systems the organisation has in place to meet the standards) can be understood, communicated and operated. (eg, s 4.5 of PAS 55 requires the maintenance of up to date documentation of the asset management system requirements specified throughout s 4 of PAS 55).	The management team that has overall responsibility for asset management. Managers engaged in asset management activities.	The documented information describing the main elements of the asset management system (process(es)) and their interaction.	Westpower operates several asset management systems. The GIS is updated on a daily basis by the GIS manager; the Asset and Works Management System, Maximo, provides a comprehensive solution which meets functional, financial and time based targets and the Vault contained records of accidents incidents as well as staff records for competency and training	3

Question No.	Function	Question	Maturity Level 3	Why	Who	Record/documented Information	Evidence—Summary	Score
62	Information management	What has the organisation done to determine what its asset management information system(s) should contain in order to support its asset management system?	The organisation has determined what its asset information system should contain in order to support its asset management system. The requirements relate to the whole life cycle and cover information originating from both internal and external sources.	Effective asset management requires appropriate information to be available. Widely used AM standards therefore require the organisation to identify the asset management information it requires in order to support its asset management system. Some of the information required may be held by suppliers. The maintenance and development of asset management information systems is a poorly understood specialist activity that is akin to IT management but different from IT management. This group of questions provides some indications as to whether the capability is available and applied. Note: To be effective, an asset information management system requires the mobilisation of technology, people and process(es) that create, secure, make available and destroy the information required to support the asset management system.	The organisation's strategic planning team. The management team that has overall responsibility for asset management. Information management team. Operations, maintenance and engineering managers	Details of the process the organisation has employed to determine what its asset information system should contain in order to support its asset management system. Evidence that this has been effectively implemented.	Westpower asset management system contains all physical information related to the asset in its GIS and all work planning and history in its AMWS Maximo. Digital storage is unlimited so all historical records are held indefinitely	3
63	Information management	How does the organisation maintain its asset management information system(s) and ensure that the data held within it (them) is of the requisite quality and accuracy and is consistent?	The organisation has effective controls in place that ensure the data held is of the requisite quality and accuracy and is consistent. The controls are regularly reviewed and improved where necessary.	The response to the questions is progressive. A higher scale cannot be awarded without achieving the requirements of the lower scale. This question explores how the organisation ensures that information management meets widely used AM practice requirements (eg, s 4.4.6 (a), (c) and (d) of PAS 55).	The management team that has overall responsibility for asset management. Users of the organisational information systems.	The asset management information system, together with the policies, procedure(s), improvement initiatives and audits regarding information controls.	Information from Maximo is made available to the GIS manager on a daily basis to ensure the GIS is constantly updated. Maximo tracks all works orders from conception to completion and provides exception reports on all work outside the specified timelines set by the Asset Management Group	3

Question No.	Function	Question	Maturity Level 3	Why	Who	Record/documented Information	Evidence—Summary	Score
64	Information management	How has the organisation's ensured its asset management information system is relevant to its needs?	The organisation's asset management information system aligns with its asset management requirements. Users can confirm that it is relevant to their needs.	Widely used AM standards need not be prescriptive about the form of the asset management information system, but simply require that the asset management information system is appropriate to the organisations needs, can be effectively used and can supply information which is consistent and of the requisite quality and accuracy.	The organisation's strategic planning team. The management team that has overall responsibility for asset management. Information management team. Users of the organisational information systems.	The documented process the organisation employs to ensure its asset management information system aligns with its asset management requirements. Minutes of information systems review meetings involving users.	The GIS and Works Maximo systems were populated in house to a very high level. The GIS contains information about every piece of asset and Maximo records all actions relating to asset work.	3

Question No.	Function	Question	Maturity Level 3	Why	Who	Record/documented Information	Evidence—Summary	Score
69	Risk management process(es)	How has the organisation documented process(es) and/or procedure(s) for the identification and assessment of asset and asset management related risks throughout the asset life cycle?	Identification and assessment of asset related risk across the asset lifecycle is fully documented. The organisation can demonstrate that appropriate documented mechanisms are integrated across life cycle phases and are being consistently applied.	Risk management is an important foundation for proactive asset management. Its overall purpose is to understand the cause, effect and likelihood of adverse events occurring, to optimally manage such risks to an acceptable level, and to provide an audit trail for the management of risks. Widely used standards require the organisation to have process(es) and/or procedure(s) in place that set out how the organisation identifies and assesses asset and asset management related risks. The risks have to be considered across the four phases of the asset lifecycle (eg, para 4.3.3 of PAS 55).	The top management team in conjunction with the organisation's senior risk management representatives. There may also be input from the organisation's Safety, Health and Environment team. Staff who carry out risk identification and assessment.	The organisation's risk management framework and/or evidence of specific process(es) and/or procedure(s) that deal with risk control mechanisms. Evidence that the process(es) and/or procedure(s) are implemented across the business and maintained. Evidence of agendas and minutes from risk management meetings. Evidence of feedback in to process(es) and/or procedure(s) as a result of incident investigation(s). Risk registers and assessments.	The risk assessment process for the asset life cycle is documented in the company's AMP	3
79	Use and maintenance of asset risk information	How does the organisation ensure that the results of risk assessments provide input into the identification of adequate resources and training and competency needs?	Outputs from risk assessments are consistently and systematically used as inputs to develop resources, training and competency requirements. Examples and evidence is available.	Widely used AM standards require that the output from risk assessments are considered and that adequate resource (including staff) and training is identified to match the requirements. It is a further requirement that the effects of the control measures are considered, as there may be implications in resources and training required to achieve other objectives.	Staff responsible for risk assessment and those responsible for developing and approving resource and training plan(s). There may also be input from the organisation's Safety, Health and Environment team.	The organisations risk management framework. The organisation's resourcing plan(s) and training and competency plan(s). The organisation should be able to demonstrate appropriate linkages between the content of resource plan(s) and training and competency plan(s) to the risk assessments and risk control measures that have been developed.	The risk assessment process is used to prioritise work in the AMP and this leads to all resourcing requirements	3

Question No.	Function	Question	Maturity Level 3	Why	Who	Record/documented Information	Evidence—Summary	Score
82	Legal and other requirements	What procedure does the organisation have to identify and provide access to its legal, regulatory, statutory and other asset management requirements, and how is requirements incorporated into the asset management system?	Evidence exists to demonstrate that the organisation's legal, regulatory, statutory and other asset management requirements are identified and kept up to date. Systematic mechanisms for identifying relevant legal and statutory requirements.	In order for an organisation to comply with its legal, regulatory, statutory and other asset management requirements, the organisation first needs to ensure that it knows what they are (eg, PAS 55 specifies this in s 4.4.8). It is necessary to have systematic and auditable mechanisms in place to identify new and changing requirements. Widely used AM standards also require that requirements are incorporated into the asset management system (e.g. procedure(s) and process(es))	Top management. The organisations regulatory team. The organisation's legal team or advisors. The management team with overall responsibility for the asset management system. The organisation's health and safety team or advisors. The organisation's policy making team.	The organisational processes and procedures for ensuring information of this type is identified, made accessible to those requiring the information and is incorporated into asset management strategy and objectives	Management provide directors, on a regular basis, written assurance the company complies with all legal and regulatory requirements. A register of all requirements is maintained by the company corporate division	3
88	Life Cycle Activities	How does the organisation establish implement and maintain process(es) for the implementation of its asset management plan(s) and control of activities across the creation, acquisition or enhancement of assets. This includes design, modification, procurement, construction and commissioning activities?	Effective process(es) and procedure(s) are in place to manage and control the implementation of asset management plan(s) during activities related to asset creation including design, modification, procurement, construction and commissioning.	Life cycle activities are about the implementation of asset management plan(s) i.e. they are the "doing" phase. They need to be done effectively and well in order for asset management to have any practical meaning. As a consequence, widely used standards (eg, PAS 55 s 4.5.1) require organisations to have in place appropriate process(es) and procedure(s) for the implementation of asset management plan(s) and control of lifecycle activities. This question explores those aspects relevant to asset creation.	Asset managers, design staff, construction staff and project managers from other impacted areas of the business, e.g. Procurement	Documented process(es) and procedure(s) which are relevant to demonstrating the effective management and control of life cycle activities during asset creation, acquisition, enhancement including design, modification, procurement, construction and commissioning.	All life cycle activities of the company's assets are provided in the annual AMP which is approved by company directors. Activities throughout the year are reported monthly to the Board so top management can monitor progress against the AMP	3

Question No.	Function	Question	Maturity Level 3	Why	Who	Record/documented Information	Evidence—Summary	Score
91	Life Cycle Activities	How does the organisation ensure that process(es) and/or procedure(s) for the implementation of asset management plan(s) and control of activities during maintenance (and inspection) of assets are sufficient to ensure activities are carried out under specified conditions, are consistent with asset management strategy and control cost, risk and performance?	The organisation has in place process(es) and procedure(s) to manage and control the implementation of asset management plan(s) during this life cycle phase. They include a process, which is itself regularly reviewed to ensure it is effective, for confirming the process(es)/ procedure(s) are effective and if necessary carrying out modifications.	Having documented process(es) which ensure the asset management plan(s) are implemented in accordance with any specified conditions, in a manner consistent with the asset management policy, strategy and objectives and in such a way that cost, risk and asset system performance are appropriately controlled is critical. They are an essential part of turning intention into action (eg, as required by PAS 55 s 4.5.1).	Asset managers, operations managers, maintenance managers and project managers from other impacted areas of the business	Documented procedure for review. Documented procedure for audit of process delivery. Records of previous audits, improvement actions and documented confirmation that actions have been carried out.	Constant communication between the asset management group and the contractor before, during and after the works program ensure the work is completed to the plans and procedures specifies in the AMP	3

Question No.	Function	Question	Maturity Level 3	Why	Who	Record/documented Information	Evidence—Summary	Score
95	Performance and condition monitoring	How does the organisation measure the performance and condition of its assets?	Consistent asset performance monitoring linked to asset management objectives is in place and universally used including reactive and proactive measures. Data quality management and review process are appropriate. Evidence of leading indicators and analysis.	Widely used AM standards require that organisations establish implement and maintain procedure(s) to monitor and measure the performance and/or condition of assets and asset systems. They further set out requirements in some detail for reactive and proactive monitoring, and leading/lagging performance indicators together with the monitoring or results to provide input to corrective actions and continual improvement. There is an expectation that performance and condition monitoring will provide input to improving asset management strategy, objectives and plan(s).	A broad cross-section of the people involved in the organisation's asset-related activities from data input to decision-makers, i.e. an end-to end assessment. This should include contactors and other relevant third parties as appropriate.	Functional policy and/or strategy documents for performance or condition monitoring and measurement. The organisation's performance monitoring frameworks, balanced scorecards etc. Evidence of the reviews of any appropriate performance indicators and the action lists resulting from these reviews. Reports and trend analysis using performance and condition information. Evidence of the use of performance and condition information shaping improvements and supporting asset management strategy, objectives and plan(s).	Asset inspection is a dedicated function within the contracting company. Targets are set and performance monitor with KPI reported to directs on a monthly basis	3

Question No.	Function	Question	Maturity Level 3	Why	Who	Record/documented Information	Evidence—Summary	Score
99	Investigation of asset-related failures, incidents and non-conformities	How does the organisation ensure responsibility and the authority for the handling, investigation and mitigation of asset-related failures, incidents and emergency situations and non conformances is clear, unambiguous, understood and communicated?	The organisation have defined the appropriate responsibilities and authorities and evidence is available to show that these are applied across the business and kept up to date.	Widely used AM standards require that the organisation establishes implements and maintains process(es) for the handling and investigation of failures incidents and non-conformities for assets and sets down a number of expectations. Specifically this question examines the requirement to define clearly responsibilities and authorities for these activities, and communicate these unambiguously to relevant people including external stakeholders if appropriate.	The organisation's safety and environment management team. The team with overall responsibility for the management of the assets. People who have appointed roles within the asset-related investigation procedure, from those who carry out the investigations to senior management who review the recommendations. Operational controllers responsible for managing the asset base under fault conditions and maintaining services to customers. Contractors and other third parties as appropriate.	Process(es) and procedure(s) for the handling, investigation and mitigation of asset-related failures, incidents and emergency situations and non conformances. Documentation of assigned responsibilities and authority to employees. Job Descriptions, Audit reports. Common communication systems i.e. all Job Descriptions on Internet etc.	Westpower maintains a dedicated process to the investigation of asset related failures, incident and nonconformities as detailed in their documentation for Public Safety.	3

Question No.	Function	Question	Maturity Level 3	Why	Who	Record/documented Information	Evidence—Summary	Score
105	Audit	What has the organisation done to establish procedure(s) for the audit of its asset management system (process(es))?	The organisation can demonstrate that its audit procedure(s) cover all the appropriate asset-related activities and the associated reporting of audit results. Audits are to an appropriate level of detail and consistently managed.	This question seeks to explore what the organisation has done to comply with the standard practice AM audit requirements (eg, the associated requirements of PAS 55 s 4.6.4 and its linkages to s 4.7).	The management team responsible for its asset management procedure(s). The team with overall responsibility for the management of the assets. Audit teams, together with key staff responsible for asset management. For example, Asset Management Director, Engineering Director. People with responsibility for carrying out risk assessments	The organisation's asset-related audit procedure(s). The organisation's methodology(s) by which it determined the scope and frequency of the audits and the criteria by which it identified the appropriate audit personnel. Audit schedules, reports etc. Evidence of the procedure(s) by which the audit results are presented, together with any subsequent communications. The risk assessment schedule or risk registers.	Westpower has not completed a formal and documented process of audit on its asset management systems. However, all the asset management systems have been upgraded over the passed three years and a full study of requirements was specified at the time the upgrades were specified. A full audit process is under development	2

Question No.	Function	Question	Maturity Level 3	Why	Who	Record/documented Information	Evidence—Summary	Score
109	Corrective & Preventative action	How does the organisation instigate appropriate corrective and/or preventive actions to eliminate or prevent the causes of identified poor performance and non conformance?	Mechanisms are consistently in place and effective for the systematic instigation of preventive and corrective actions to address root causes of non compliance or incidents identified by investigations, compliance evaluation or audit.	Having investigated asset related failures, incidents and non-conformances, and taken action to mitigate their consequences, an organisation is required to implement preventative and corrective actions to address root causes. Incident and failure investigations are only useful if appropriate actions are taken as a result to assess changes to a businesses risk profile and ensure that appropriate arrangements are in place should a recurrence of the incident happen. Widely used AM standards also require that necessary changes arising from preventive or corrective action are made to the asset management system.	The management team responsible for its asset management procedure(s). The team with overall responsibility for the management of the assets. Audit and incident investigation teams. Staff responsible for planning and managing corrective and preventive actions.	Analysis records, meeting notes and minutes, modification records. Asset management plan(s), investigation reports, audit reports, improvement programmes and projects. Recorded changes to asset management procedure(s) and process(es). Condition and performance reviews. Maintenance reviews	All incidents of poor performance and nonconformance undergo investigation as per defined processes. Where necessary, corrective actions are recommended and entered into the Maximo Works System which monitors work progress through to completion. All corrective actions are reviewed after 12 months to ensure effectiveness	3
113	Continual Improvement	How does the organisation achieve continual improvement in the optimal combination of costs, asset related risks and the performance and condition of assets and asset systems across the whole life cycle?	There is evidence to show that continuous improvement process(es) which include consideration of cost risk, performance and condition for assets managed across the whole life cycle are being systematically applied.	Widely used AM standards have requirements to establish, implement and maintain process(es)/procedure(s) for identifying, assessing, prioritising and implementing actions to achieve continual improvement. Specifically there is a requirement to demonstrate continual improvement in optimisation of cost risk and performance/condition of assets across the life cycle. This question explores an organisation's capabilities in this area—looking for systematic improvement mechanisms rather that reviews and audit (which are separately examined).	The top management of the organisation. The manager/team responsible for managing the organisation's asset management system, including its continual improvement. Managers responsible for policy development and implementation.	Records showing systematic exploration of improvement. Evidence of new techniques being explored and implemented. Changes in procedure(s) and process(es) reflecting improved use of optimisation tools/techniques and available information. Evidence of working parties and research.	The AMP is completely reviewed on an annual basis with all asset related risks reassessed	3

Question No.	Function	Question	Maturity Level 3	Why	Who	Record/documented Information	Evidence—Summary	Score
115	Continual Improvement	How does the organisation seek and acquire knowledge about new asset management related technology and practices, and evaluate their potential benefit to the organisation?	The organisation actively engages internally and externally with other asset management practitioners, professional bodies and relevant conferences. Actively investigates and evaluates new practices and evolves its asset management activities using appropriate developments.	One important aspect of continual improvement is where an organisation looks beyond its existing boundaries and knowledge base to look at what 'new things are on the market'. These new things can include equipment, process(es), tools, etc. An organisation which does this (eg, by the PAS 55 s 4.6 standards) will be able to demonstrate that it continually seeks to expand its knowledge of all things affecting its asset management approach and capabilities. The organisation will be able to demonstrate that it identifies any such opportunities to improve, evaluates them for suitability to its own organisation and implements them as appropriate. This question explores an organisation's approach to this activity.	The top management of the organisation. The manager/team responsible for managing the organisation's asset management system, including its continual improvement. People who monitor the various items that require monitoring for 'change'. People that implement changes to the organisation's policy, strategy, etc. People within an organisation with responsibility for investigating, evaluating, recommending and implementing new tools and techniques, etc.	Research and development projects and records, benchmarking and participation knowledge exchange professional forums. Evidence of correspondence relating to knowledge acquisition. Examples of change implementation and evaluation of new tools, and techniques linked to asset management strategy and objectives.	Westpower is very active within the national bodies of like companies (the ENA and EEA) and maintains a wide library of international magazines	3