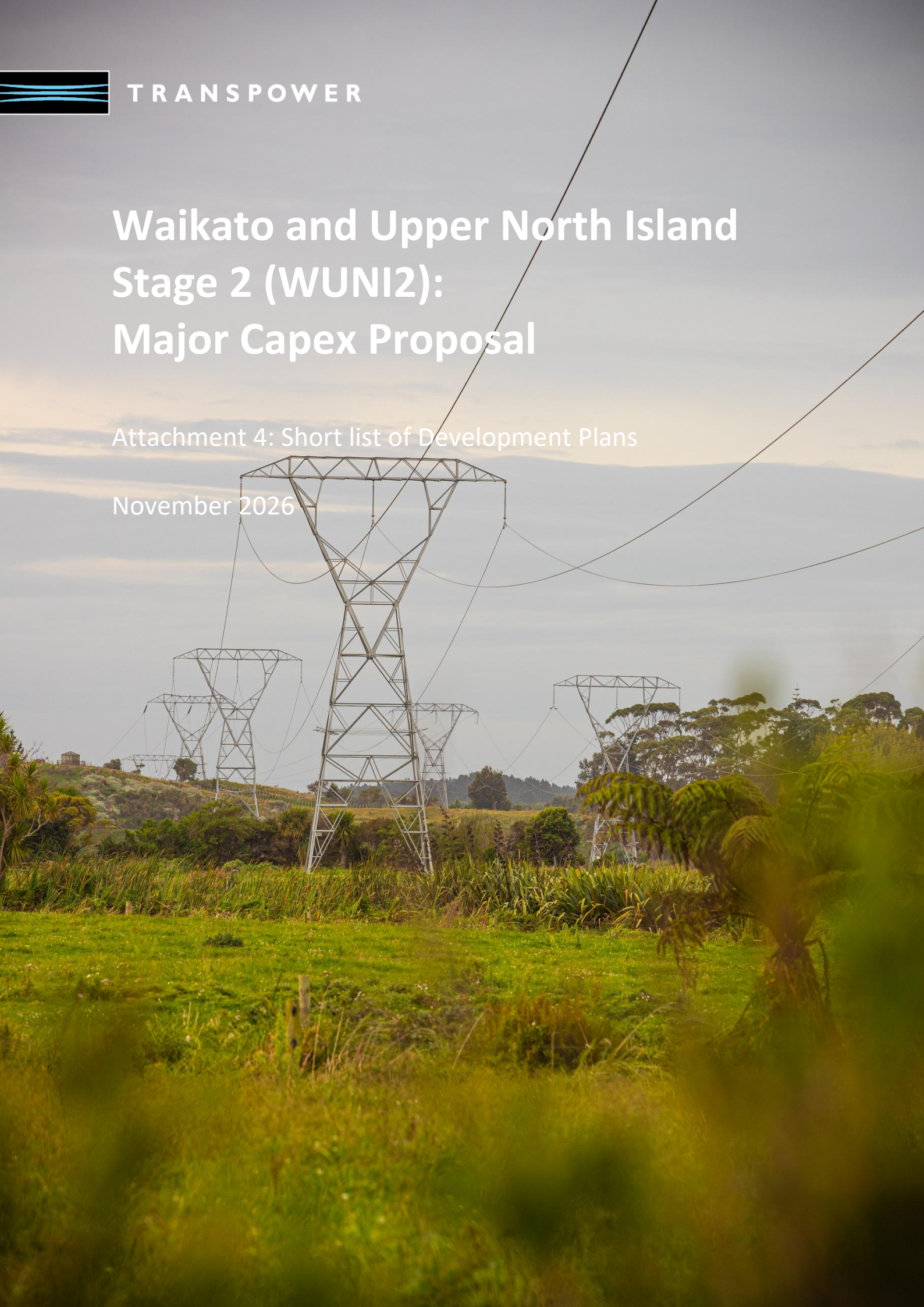
TRANSPOWER

Waikato and Upper North Island Stage 2 (WUNI2): Major Capex Proposal

Attachment 4: Short list of Development Plans

November 2026



Purpose

This Attachment is part of our Waikato and Upper North Island (**WUNI**) Stage 2 Major Capex Proposal (**MCP**). The purpose of this Attachment is to outline our approach to developing options and detail how we derived our final short list of development plans (investment options).

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1 Options assessment

1.1 Background

The WUNI Upgrade major capex project is being implemented in stages to address the WUNI region's evolving need.

In 2016 we consulted on a long list of components that could address anticipated grid issues in the WUNI region. We subsequently consulted on a short list of development plans for Stage 1 of the WUNI Upgrade major capex project (**Stage 1**), and in 2020 our preferred Stage 1 investments were approved.

We are now proposing investments for Stage 2 of the WUNI Upgrade major capex project (**Stage 2**). We consulted on a short list of Stage 2 development plans in January 2026. This Attachment sets out our final short list of development plans for Stage 2 (investment options) following our consideration of consultation feedback and further information about forecast peak load.

1.2 Long list of investment components

In 2016 we consulted on a long list of components that could help play a potential role in addressing anticipated grid issues in the WUNI region.[1] These components served as building blocks for potential investment options; each development plan would comprise a specific set of these components, commissioned sequentially over the planning period, to address the investment need.

While there are many components that could contribute to meeting the need for both thermal capacity and voltage stability support, some were quite specific technologies. The long list components can be grouped into categories as follows:

- Reactive power devices (e.g., shunt capacitors and reactors, STATCOMs)
- Other transmission assets (e.g., series capacitors, new transmission lines and upgraded existing lines, 400 kV conversions, grid reconfigurations, special protection schemes)
- Non-transmission solutions (e.g., battery storage, demand-side participation).

Stakeholder submissions on our long list consultation led to refinements before applying our short-listing criteria. A full summary of this process, including the criteria used, is available in the Stage 1 MCP.[2]

[1] Transpower, Waikato and Upper North Island Long-List Consultation, July 2016

[2] Our long-list to short-listing process is detailed in WUNI Stage 1 MCP Attachment C - Options and costing report, December 2019

1.3 Short list of investment options and Stage 1 preferred option

Table 1 summarises the components short-listed in 2019 as potential solutions for the transmission challenges in the WUNI region. In Stage 1, the short-listed components were combined into various development plans representing potential investment options. When compiling those development plans, we added components to ensure the prudent peak demand forecast remained below the transmission limits. As components are commissioned, these limits increase, enabling the grid to accommodate growing demand and meet the investment need.

The preferred option for Stage 1, approved by the Commerce Commission in September 2020,[3] included two 150 Mvar STATCOMs at the Hamilton and Ōtāhuhu substations to enhance voltage stability. These works were successfully completed in 2023 and 2025, respectively.[4]

The Stage 1 investments were part of a broader development path, recognising the need for future investments to accommodate continued regional demand growth. Stage 1 funding also included preparatory work for the anticipated Stage 2 investments, ensuring we were prepared to address regional growth when conditions required it. Initial analysis identified series capacitors on the Brownhill–Whakamaru (BHL–WKM) circuits as the most likely Stage 2 investment but recognised that options would need to be reconsidered nearer to the need date.

For further details on Stage 1, please refer our Stage 1 MCP.[5]

[3] Commerce Commission, Decision and reasons on Stage 1 of Transpower's WUNIVM staged major capex project, September 2020

[4] Transpower, Waikato and Upper North Island (WUNI) Upgrades

[5] Transpower, Waikato and Upper North Island Stage 1 Major Capex Proposal, December 2019

2 Stage 2 short-listed components

Table 1 summarises the components short-listed in 2019 as potential solutions for the transmission challenges in the WUNI region.

As part of our Stage 2 investigation, we have reviewed these components and determined that they remain appropriate components from which to build Stage 2 development plans to meet the investment need.[6]

This review reconsidered the (previously long-listed) component of converting parts of the network to 400 kV, which was excluded from the Stage 1 short-listed components due to its significantly higher cost. Consistent with Stage 1, a 400 kV conversion was not included in the Stage 2 short-listed components.

Table 1: Summary of Stage 2 short-listed components

Option	Components
Dynamic reactive devices	Dynamic reactive devices are power system components that can respond to changing power-system conditions. Common examples include Static Synchronous Compensators (STATCOMs), Static Var Compensators (SVCs) and Synchronous Condensers. Although all three technologies can provide dynamic voltage support, their response characteristics and wider contributions to the power system differ. Inverter-based resources, including inverter-based generation and battery energy storage systems, may also provide dynamic reactive power through their power electronic converters. The extent of this capability depends on the converter rating, the available capacity at the prevailing active power operating point, and the plant's control arrangements. Dynamic reactive support is particularly important during and following power system disturbances, when rapid changes in reactive power may be required to support voltage stability and post-disturbance voltage recovery. *Duration of works: 36 months*
Shunt capacitors	Shunt capacitors provide static reactive power support, helping to maintain acceptable voltage levels and reduce the risk of slow voltage collapse. Where appropriate switching schemes are provided, additional capacitor banks may be switched in following a disturbance to support voltage recovery and provide sustained reactive power support as the system settles into its post-disturbance operating condition. *Duration of works: 24 months*

[6] We agreed with the Commerce Commission that long list consultation for Stage 2 is not required.

Option	Components
Series compensation	Series compensation reduces the effective impedance, or electrical length, of a transmission line. Applying series compensation to the 220 kV BHL–WKM circuits would improve the distribution of power flows across the parallel transmission paths supplying the WUNI region. By reducing the impedance of these circuits, a greater share of the transfer would flow through the high-capacity BHL–WKM circuits, reducing the loading on the lower-capacity parallel circuits. The BHL–WKM circuits were built as part of the North Island Grid Upgrade Project and can operate at 400 kV. Series compensation provides a way to make greater use of their existing capacity while they continue to operate at 220 kV. Conversion to 400 kV remains a possible longer-term development. Series compensation on the BHL–WKM circuits could: • improve power-flow distribution across the parallel transmission paths, reducing the loading on lower-capacity circuits and increasing the WUNI load limit • improve static and dynamic voltage stability by reducing the effective electrical length and voltage drop on the BHL–WKM transmission path • reduce transmission losses under high-transfer conditions by improving the distribution of power flows across the available circuits. The appropriate level and location of compensation would need to take account of overall system performance, protection requirements and potential interactions with connected generating plant. *Duration of works: 36 months*
Thermal transmission components	With further demand growth we are approaching the thermal transmission capacity limits for transfer into the region. This can be mitigated by increasing the grid capacity between Whakamaru and Auckland. There are many ways in which the grid could be developed to increase thermal transfer limits in the WUNI region. Such thermal options identified include a new cable between Brownhill and Ōtāhuhu (BHL–OTA), a tee connection of BHL–WKM 1 and 2 circuits into Ohinewai switching station, and bussing OTA–WKM 1 and 2 circuits into Ohinewai and duplexing the southern section between Ohinewai and Whakamaru. *Duration of works: 24-60 months*
Series reactors	Series reactors in a circuit increase the impedance of that circuit. This can be a useful tool for balancing loading across multiple parallel circuits, therefore maximising power transfer. *Duration of works: 36 months*
Non-transmission solutions (NTS)	We are not proposing any NTS for investment deferral in Stage 2. Updated peak demand forecasts have moved the investment need dates out and further economic deferral is constrained by the risk of higher costs and longer lead times if STATCOM procurement is delayed, the condition-driven need to replace the OTA-WKM A and B conductors, and the relatively low cost of the shunt capacitor compared with its capacity benefit.

3 Updated Stage 2 development plans

As with Stage 1, individual short-listed components are not sufficient to provide a complete solution at Stage 2; therefore, multiple components need to be combined to meet the investment need. The development plans presented here combine necessary investments to address voltage stability and thermal capacity constraints through to 2055.

As discussed in Attachment 2, the long-term development plans are still based on the prudent (P90) peak load forecast (Environmental scenario) as presented in the short list consultation[7] but with updated load limits, while the proposed Stage 2 investments – a subset of the preferred development plan – are based on the latest (lower) peak load forecast, which was only finalised earlier this year. Hence the development plans do not fully correspond to the proposed Stage 2 investments. With the updated peak load forecast, the first need date is 2034 instead of 2030.

Following the short list consultation, we removed Options 1 and 4a from further assessment.

Option 1 (series compensation and Ohinewai tee) was removed due to technical issues with the series compensation in combination with the tee connection of the Brownhill–Whakamaru line (creating a three-terminal circuit). This configuration would lead to issues with the required protection setup as well as severely impact the protection systems of the wider grid.

Option 4a (series compensation and duplexing) was introduced as an alternative variant of Option 4 to acknowledge the challenging timeline to deliver the duplexing of the OTA–WKM A and B lines by the original need date (2030). With the need date now pushed out to 2034 and based on further investigation of the deliverability of the duplexing, Option 4a is no longer needed. Option 4b, which was the preferred option in the short list consultation, provides superior optionality, with the series compensation deferred to a potential future stage.

Table 2 summarises the components of the final short-listed development plans and highlights the differences between the options. The naming is kept consistent with the short list consultation. Common investments across all three options are a 100 Mvar shunt capacitor at Pakuranga substation and a ±150 Mvar STATCOM at Henderson substation.

[7] Transpower, Waikato and upper North Island (WUNI) stage 2 project short-list consultation

Table 2: Components in each final short-listed development plan (main differences between development plans highlighted in bold)

Option	2030-33 (Stage 2)[8]	2034+ (anticipated future stages)
Option 2: Series compensation and Brownhill–Ōtāhuhu cable	• ±150 Mvar STATCOM at HEN • **Series compensation on BHL–WKM circuits** • **Brownhill 220 kV Bus** • **220 kV Brownhill–Ōtāhuhu cable** • Shunt capacitor at various locations	• Shunt capacitors at various locations • Series reactors on HTU–WKM
Option 3: Ōtāhuhu–Whakamaru duplexing and STATCOM	• ±150 Mvar STATCOM at HEN • **Connect OTA–WKM A&B at Ohinewai and duplex the OHW–WKM section** • Shunt capacitor at various locations	• **±150 Mvar STATCOM** • Shunt capacitors at various locations • Series reactors on OHW-OTA 3&4
Option 4b: Ōtāhuhu–Whakamaru duplexing and series compensation	• ±150 Mvar STATCOM at HEN • **Connect OTA–WKM A&B at Ohinewai and duplex the OHW–WKM section** • Shunt capacitor at various locations	• **Series compensation on BHL–WKM circuits** • Shunt capacitors at various locations

[8] Acronyms: Henderson (HEN), Brownhill Road (BHL), Whakamaru (WKM), Ōtāhuhu (OTA), Ohinewai (OHW), Pakuranga (PAK), Hautapu (HTU).

4 Stage 2 investment options

As outlined in section 3, we refined the short-listed development plans based on feedback received in the short list consultation and further internal investigation. The following sections provide a detailed overview of the final short-listed development plans (investment options) and their respective development paths over the analysis period.

Our short-listed development plans include a range of options that explore different investment paths to meet the investment need over the near and medium term. These options include making better use of existing assets, such as duplexing the Ōtāhuhu–Whakamaru A and B lines south of Ohinewai, constructing new transmission assets, providing static and dynamic reactive support through technologies such as shunt capacitor banks and STATCOMs, and using series compensation to improve power flow distribution, voltage stability and transfer capability.

Based on the shortlisting criteria in the Stage 1 MCP,[9] we believe that these investment options are appropriate in number and include an appropriate diversity of technologies, having regard to the estimated expenditure and investment need.

The following subsections provide a detailed breakdown of each investment option and its development path.

4.1 Option 2 – Series compensation and Brownhill–Ōtāhuhu cable

Option 2 involves upgrades to the transmission network by constructing a new 220 kV underground cable between Brownhill Road and Ōtāhuhu, along with series compensation on the Brownhill–Whakamaru circuits. This investment, which also requires the establishment of a new 220 kV bus at Brownhill Road, increases the thermal transfer capacity into the upper North Island, enhances voltage stability and maximises the use of existing overhead transmission routes to meet the investment need.

The initial investments focus on voltage stability, with shunt capacitors installed at key substations in the Auckland region to increase static limits. A STATCOM at Henderson further lifts the voltage stability limits. Further shunt capacitor and series reactor installations in later years provide ongoing voltage support and re-balance power flows as demand continues to grow.

Table 3 outlines the components of Option 2 and their commissioning dates (based on the peak load forecast as per the short list consultation), while Figure 1 highlights the main new Stage 2 components in a single line diagram.

[9] See footnote 2.

Table 3: Option 2 – Series compensation and Brownhill–Ōtāhuhu cable investment path (based on short list consultation peak load forecast)

Year	Component	Description
2030	100 Mvar shunt capacitor at PAK	Shunt capacitors are required to raise the static limit.
2031	±150 Mvar STATCOM at HEN	To address voltage stability issues in the WUNI region, both under- and over-voltage. This technology is chosen particularly as it addresses the over-voltage need more effectively.
2032	100 Mvar shunt capacitor at HEN 2x75 Mvar shunt capacitors at OHW	Shunt capacitors are required to raise the static limit.
2033	Series compensation on BHL–WKM circuits at Hangawera Road (2x26.15 Ohm) Brownhill 220 kV Bus and 220 kV Brownhill–Ōtāhuhu cable	Reduces the electrical distance between the central North Island generators and the upper North Island and improves system stability. Series capacitors improve power flow distribution, voltage stability and transfer capability. Bussing at Brownhill Road and a new cable between Brownhill and Ōtāhuhu (BHL–OTA) will increase thermal transfer limits into the upper North Island.
2036	100 Mvar shunt capacitor 100 Mvar shunt capacitor 100 Mvar shunt capacitor 100 Mvar shunt capacitor	Shunt capacitors at four locations in the Auckland region are required to raise the static limit.
2046	100 Mvar shunt capacitor 100 Mvar shunt capacitor	Shunt capacitors at a location in Waikato are required to raise the static limit.
2052	100 Mvar shunt capacitor 100 Mvar shunt capacitor 100 Mvar shunt capacitor 2x3 Ohm series reactors on HTU–WKM 1&2 circuits	Shunt capacitors in Auckland and Waikato are required to raise the static limit. Series reactors are used to redirect power flow away from heavily loaded circuits.

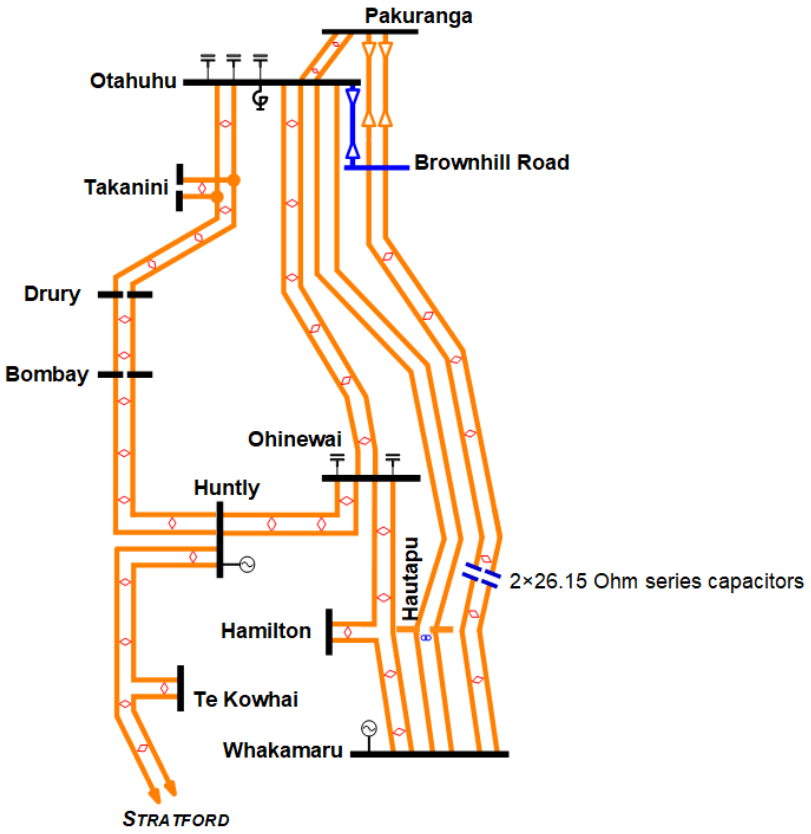


Figure 1: Single line diagram of Option 2 (new components shown in blue)

4.2 Option 3 – Ōtāhuhu–Whakamaru duplexing and STATCOM

Option 3 meets the investment need by enhancing the capacity of a key transmission corridor. This approach involves connecting the circuits of the Ōtāhuhu–Whakamaru A and B lines at Ohinewai switching station and duplexing the section south of Ohinewai, doubling the capacity of these lines. This significantly improves power transfer capability in the WUNI region.

The initial investments focus on voltage stability, with shunt capacitors installed at Pakuranga in the Auckland region to increase static limits. A STATCOM at Henderson substation further lifts the voltage stability limits. Additional shunt capacitors will be installed later. Series reactors on the Ohinewai–Ōtāhuhu circuits are installed to re-balance power flows and prevent overloads. An additional STATCOM in the Auckland region will be required in the late 2040s.

Table 4 outlines the components of Option 3, including their commissioning dates (based on the peak load forecast as per the short list consultation), while Figure 2 highlights the main new Stage 2 components in a single line diagram.

Table 4: Option 3 – Duplexing and STATCOM investment path (based on short list consultation peak load forecast)

Year	Component	Description
2030	100 Mvar shunt capacitor at PAK	Shunt capacitors are required to raise the static limit.
2031	±150 Mvar STATCOM at HEN	To address voltage stability issues in the Auckland region, both under- and over-voltage. This technology is chosen particularly as it addresses the over-voltage need more effectively.
2032	100 Mvar shunt capacitor at HEN 2x75 Mvar shunt capacitors at OHW	Shunt capacitors are required to raise the static limit.
2033	Duplex OTA–WKM A&B circuits and connect at Ohinewai	Duplexing the Ōtāhuhu–Whakamaru A&B lines south of Ohinewai and connecting these lines to Ohinewai will increase the thermal capacity into the upper North Island.
2035	100 Mvar shunt capacitor	Shunt capacitors are required to raise the static limit.
2036	100 Mvar shunt capacitor 100 Mvar shunt capacitor 100 Mvar shunt capacitor 100 Mvar shunt capacitor	Shunt capacitors at four locations in the Auckland region are required to raise the static limit.
2038	100 Mvar shunt capacitor 100 Mvar shunt capacitor	Shunt capacitors at a location in Waikato are required to raise the static limit.
2047	100 Mvar shunt capacitor	Shunt capacitors in the Auckland region are required to raise the static limit.
2049	±150 Mvar STATCOM (Auckland region)	To address voltage stability issues in the Auckland region, both under- and over-voltage.
2050	100 Mvar shunt capacitor 100 Mvar shunt capacitor 2x3 Ohm series reactors on OHW–OTA 3&4 circuits	Shunt capacitors are required to raise the static limit. Series reactors are used to limit the current flow on transmission lines to redirect power flow away from heavily loaded circuits.

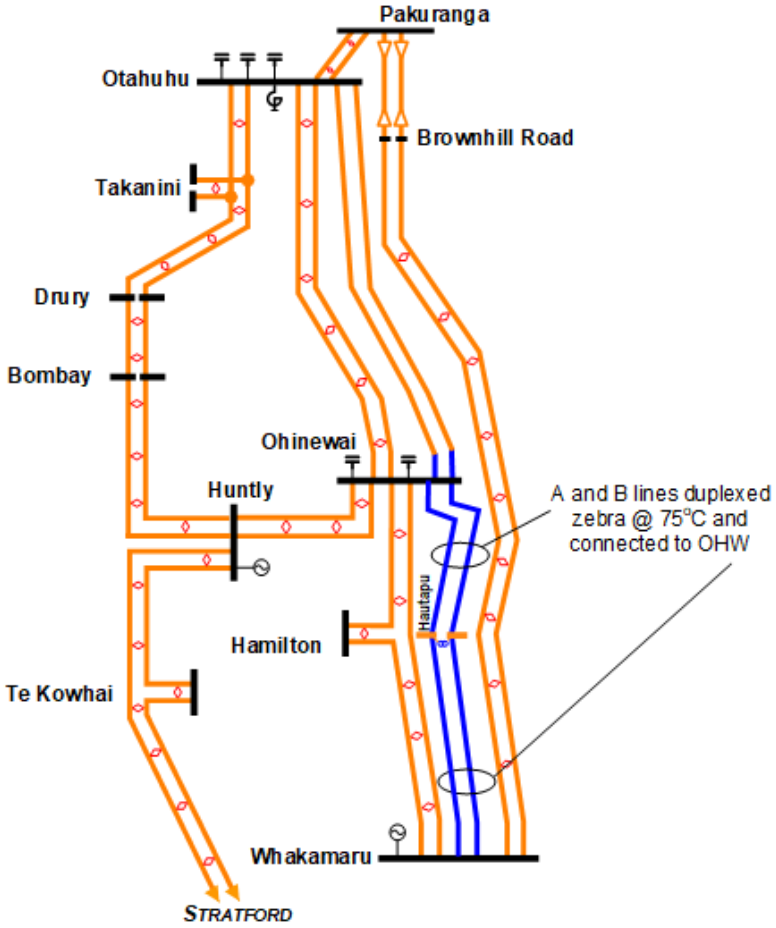


Figure 2: Single line diagram of Option 3 (new components shown in blue)

4.3 Option 4b – Ōtāhuhu–Whakamaru duplexing and series compensation

Similar to Option 3, Option 4b meets the investment need by enhancing the capacity of a key transmission corridor. This approach involves connecting the circuits of the Ōtāhuhu–Whakamaru A and B lines at Ohinewai switching station and duplexing the section south of Ohinewai, doubling the capacity of these lines. This significantly improves power transfer capability in the WUNI region.

The initial investments focus on voltage stability, with shunt capacitors installed at key locations in the Auckland region to increase static limits. A STATCOM at Henderson substation further lifts the voltage stability limits. Further shunt capacitors will be installed later. Only in the late 2040s do the differences relative to Option 3 emerge, by installing series compensation on the Brownhill–Whakamaru circuits, instead of another STATCOM, shunt capacitors and series reactors as in Option 3.

In the short list consultation, the need dates for duplexing and series compensation were determined to be 2030 and 2033, respectively. With a higher initial transmission limit used in this MCP (as outlined in Attachment 2), the need date for duplexing shifts to 2033, while series compensation can be pushed out to 2049 with some additional shunt capacitors considered earlier

in the development plan. This later need date for the duplexing, which moves out even further by applying the updated peak load forecast, removes the need for the alternative Option 4a. Option 4b now allows sufficient time to deliver the duplexing in line with the system need date and the condition assessment of the existing conductors.

Table 5 outlines the components of Option 4b, including their commissioning dates (based on the peak load forecast as per the short list consultation), while Figure 3 highlights the main new Stage 2 components in a single line diagram.

Table 5: Option 4b – Duplexing and series compensation investment path (based on short list consultation peak load forecast)

Year	Component	Description
2030	100 Mvar shunt capacitor at PAK	Shunt capacitors are required to raise the static limit.
2031	±150 Mvar STATCOM at HEN	To address voltage stability issues in the Auckland region, both under- and over-voltage. This technology is chosen particularly as it addresses the over-voltage need more effectively.
2032	100 Mvar shunt capacitor at HEN 2x75 Mvar shunt capacitors at OHW	Shunt capacitors are required to raise the static limit.
2033	Duplex OTA–WKM A&B circuits and connect at Ohinewai	Duplexing the Ōtāhuhu–Whakamaru A&B lines south of Ohinewai and connecting these lines to Ohinewai will increase the thermal capacity into the upper North Island.
2035	100 Mvar shunt capacitor	Shunt capacitors are required to raise the static limit.
2036	100 Mvar shunt capacitor 100 Mvar shunt capacitor 100 Mvar shunt capacitor 100 Mvar shunt capacitor	Shunt capacitors at four locations in the Auckland region are required to raise the static limit.
2038	100 Mvar shunt capacitor 100 Mvar shunt capacitor	Shunt capacitors at a location in Waikato are required to raise the static limit.
2047	100 Mvar shunt capacitor	Shunt capacitors in the Auckland region are required to raise the static limit.
2049	Series compensation on BHL–WKM circuits at Hangawera Road (2x16.93 Ohm)	Reduces the electrical distance between the central North Island generators and the upper North Island and improves system stability. Series capacitors improve power flow distribution, voltage stability and transfer capability.

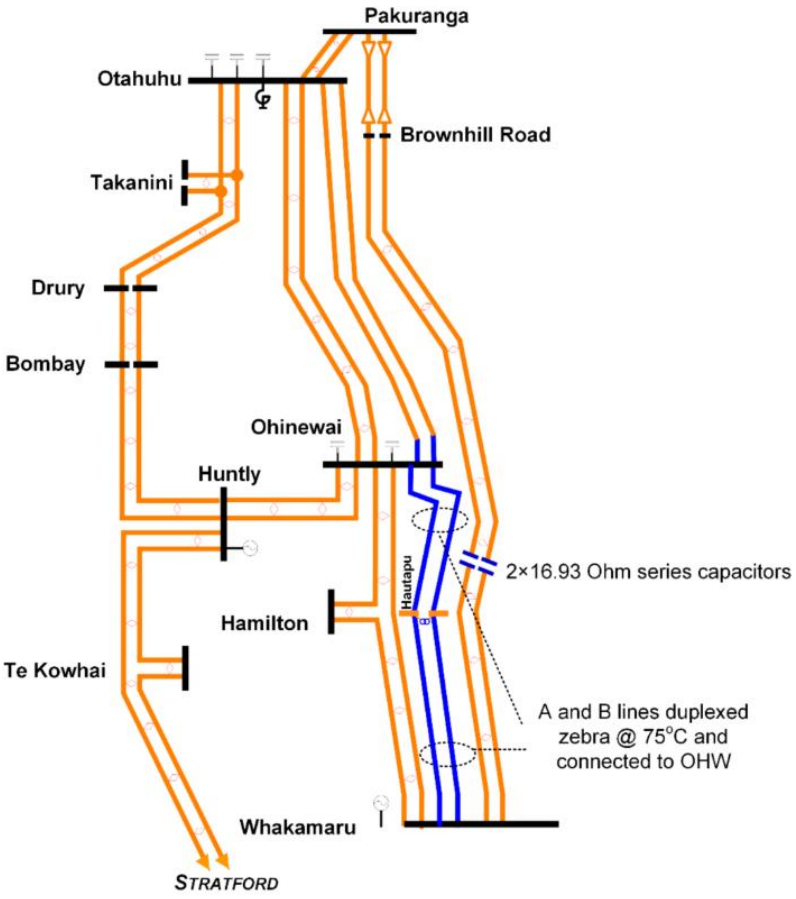


Figure 3: Single line diagram of Option 4b (new components shown in blue)

4.4 Modelled Project

A related consideration is the modelled project involving the planned reconductoring works on the OTA–WKM A and B lines. These lines will need condition-based reconductoring (i.e., replacing the conductors due to corrosion) soon. The next stage of this work in south Auckland (labelled as stage 2 in Figure 4) is planned for 2028 and is the subject of a separate investment proposal to the Commission.[10] That proposal was approved in July 2026.[11]

Our latest condition assessment indicates that the southern section of the OTA–WKM A and B lines (between Ohinewai and Whakamaru) will require further inspections and potential repairs from 2030 (particularly the OHW–HTU section of the B line) and reconductoring from 2034 through to 2040, see Figure 4. Note that the stages 3 and 4 are labelled in different order for the A and B line, given their current condition rating. However, both A and B lines will be reconductored simultaneously in each section for delivery efficiency.

Under Options 3 and 4b, the reconductoring of the OHW–HTU and HTU–WKM sections – and its associated costs – could be avoided, as these options include duplexing the lines to increase capacity ahead of the condition-based replacement need. To avoid regular reinspection and defect repair in

10 Ōtāhuhu–Whakamaru A and B Lines Reconductoring Project | Transpower
11 Ōtāhuhu – Whakamaru A and B line reconductoring project | Commerce Commission

the later years, and for delivery and cost efficiencies, our preference is to complete the reconductoring (duplexing) of the entire section between Ohinewai and Whakamaru by 2035.

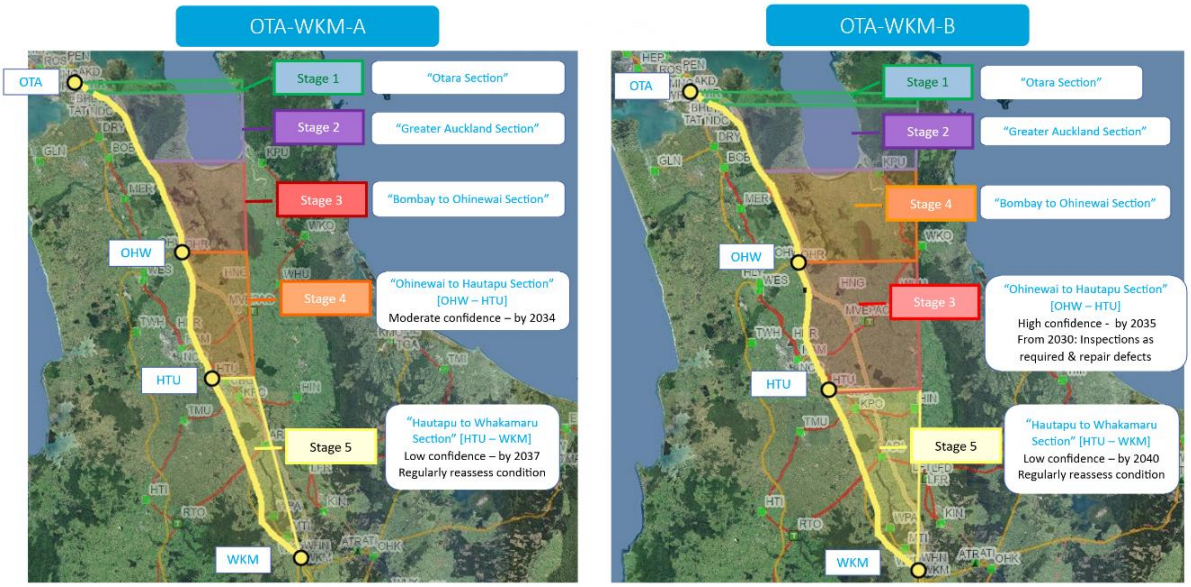


Figure 4: OTA–WKM A and B lines reconductoring schedule

This future reconductoring work and its costs, or the potential avoidance of the work and the associated costs, has been included within the cost-benefit analysis for each investment option as a modelled project, see Attachment 5.

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