# HEAVY RAIL TRACTION DEVELOPMENTS IN NZ

**Allan Neilson, Manager Traction & Electrical Engineering,**
**Kiwirail Network (NZRC)**

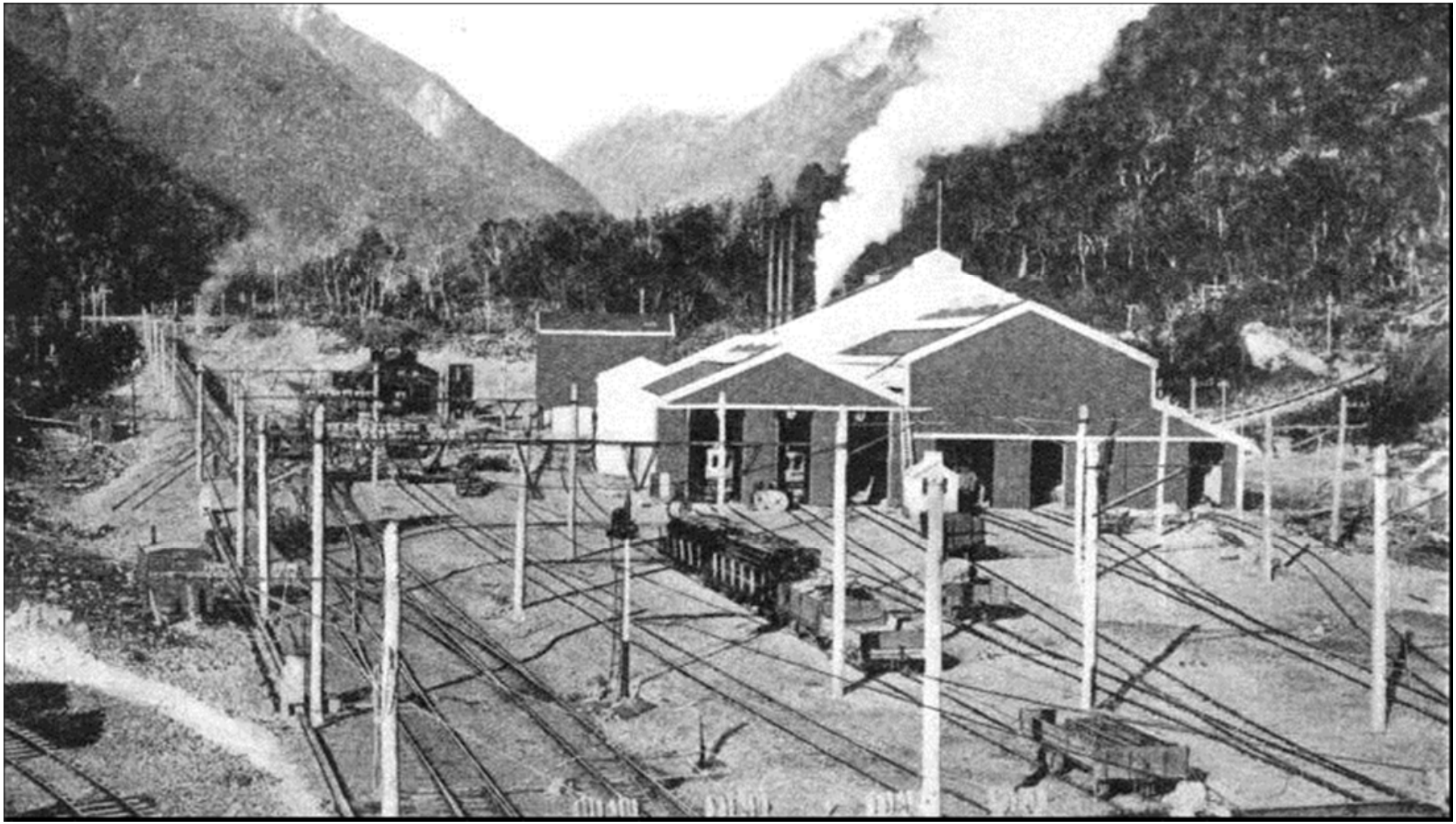
# WELLINGTON ELECTRIFIED AREA POWER SUPPLIES

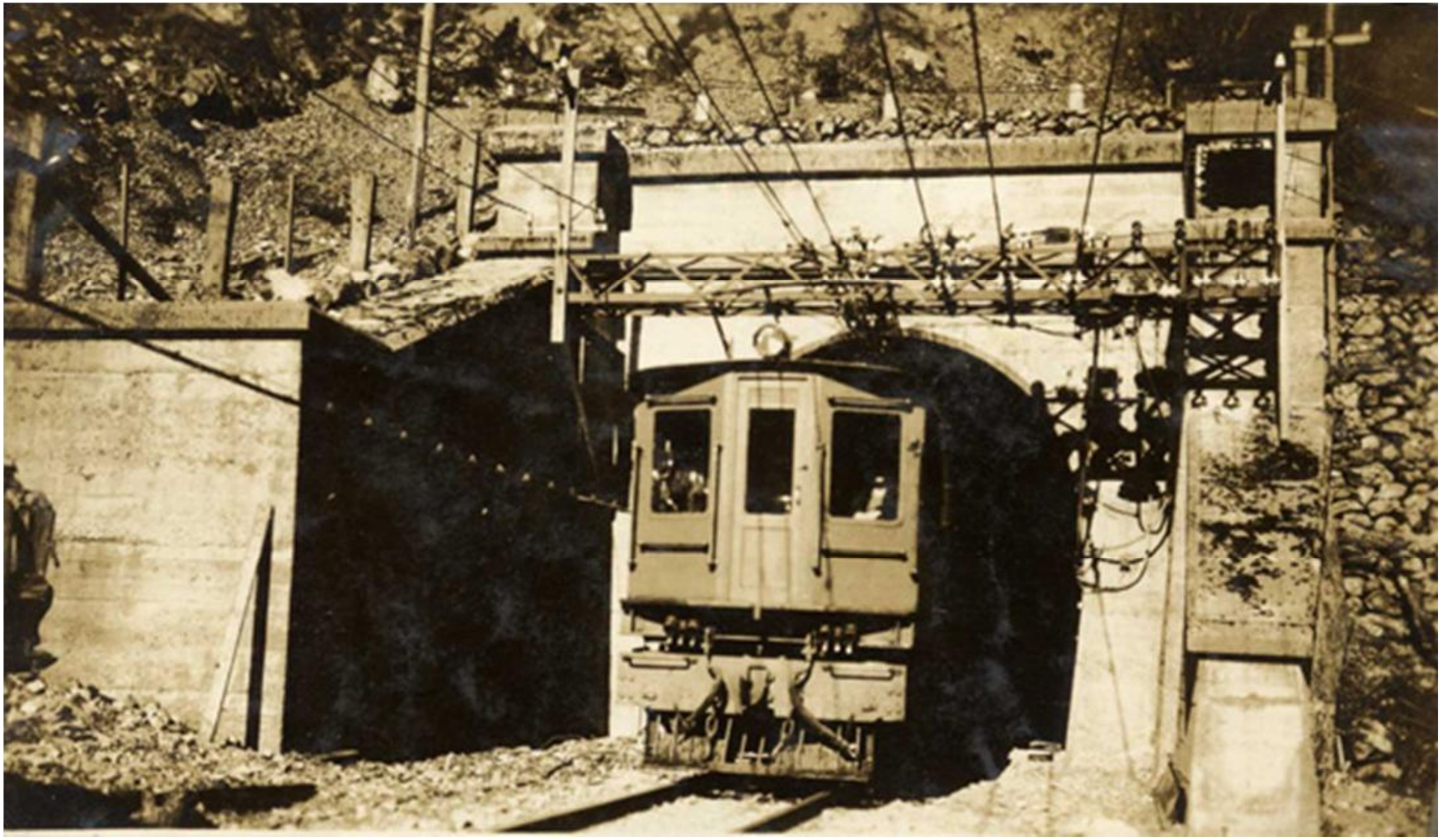
**Craig Tooke**
**Traction Engineer, KBR, Melbourne**

# Where it all started.

Otira Tunnel – opened 1923

- 8.5km long on a 1 in 33 grade
- New 1500v DC system between Otira and Arthurs Pass – approx 13.5 route km's
- Coal fired power station at Otira, then in 1941 replaced by a new mercury arc rectifier sub at Otira Tunnel portal
- 5 Eo class locos – 680hp (1 hour rating) each capable of hauling 175 tons at 18mph on 1 in 33 grade






E°6

# Otira - continued

- Original Eo locos replaced 1968 with 5 new Toshiba locos (1285hp 1 hour rating)
- Increasing coal traffic necessitated diesel operation plus electric bankers in 1990's
- Tunnel ventilation system commissioned in 1997 which allowed full diesel operation and decommissioning of the electrification.

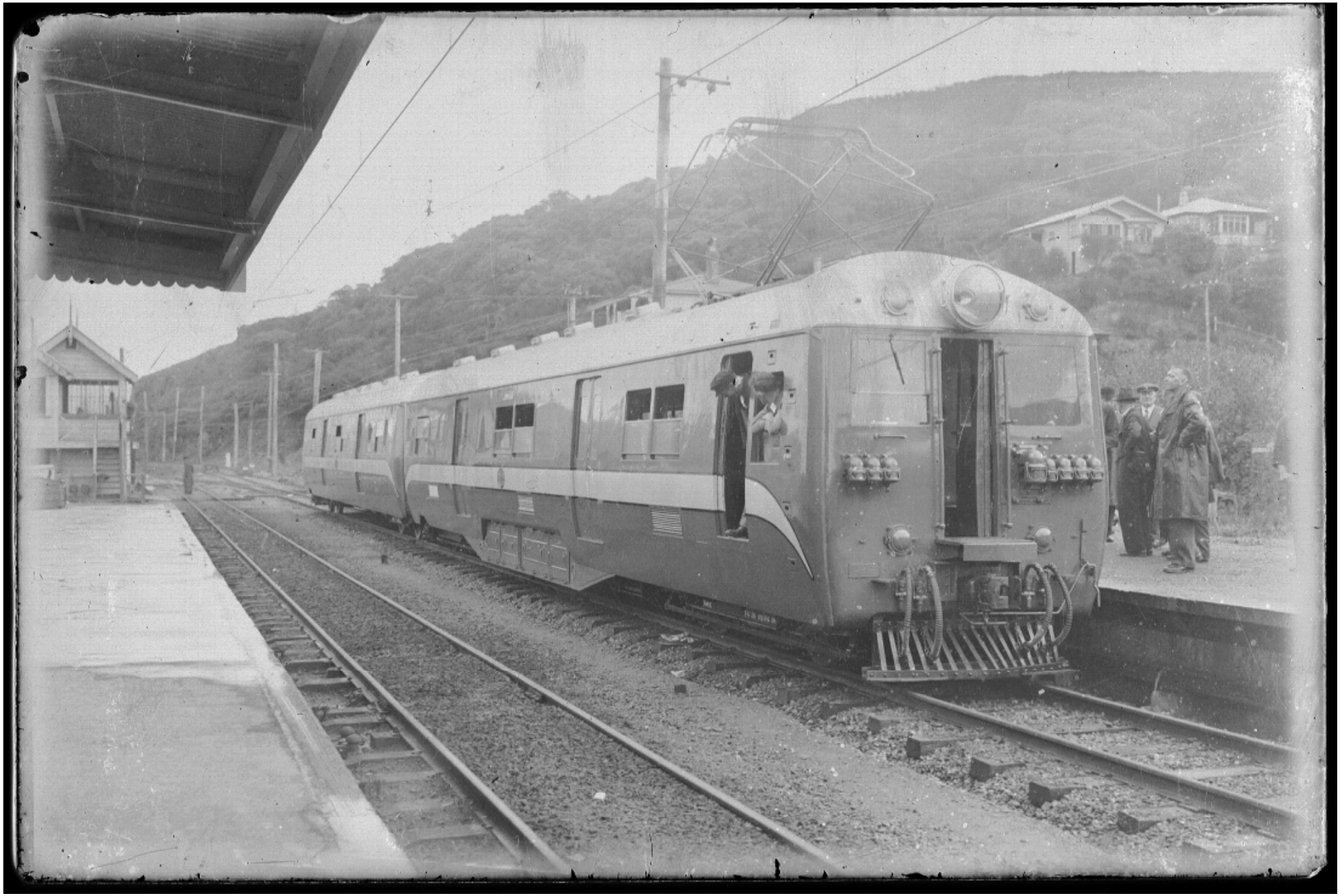
# Christchurch – Lyttelton 1929 -1970

- 1500v DC system linking Christchurch and Lyttelton – distance of 10.5km
- Installed to eliminate smoke problems in Lyttelton tunnel (approx 3.5km long)
- One rotary converter substation at Woolston near middle of system
- 6 Ec class locos – 1188hp 1 hr rating
- System effectively displaced by diesel locos


E7

# Wellington Electrified Area (WEA)

- 1500v DC system – (standard practice for time)
- 1st line to Johnsonville opened 1938 (10.42km)
- Wellington – Paekakariki 1940 (39km)
- Wellington – Upper Hutt completed 1955 (32km)
- Extension Paekakariki to Paraparaumu 1983 (9km)
- Extension Paraparaumu – Waikanae planned for completion Jan 2011 (7km)




D2411
CYCLOPS


KDH
4RB1


AXI


EM 1505
EM 1505
Tyne & Wear Metro


FT4103
FT4103
metlink


7
KiwiRail
45
DE045

# NIMT 25kV AC system

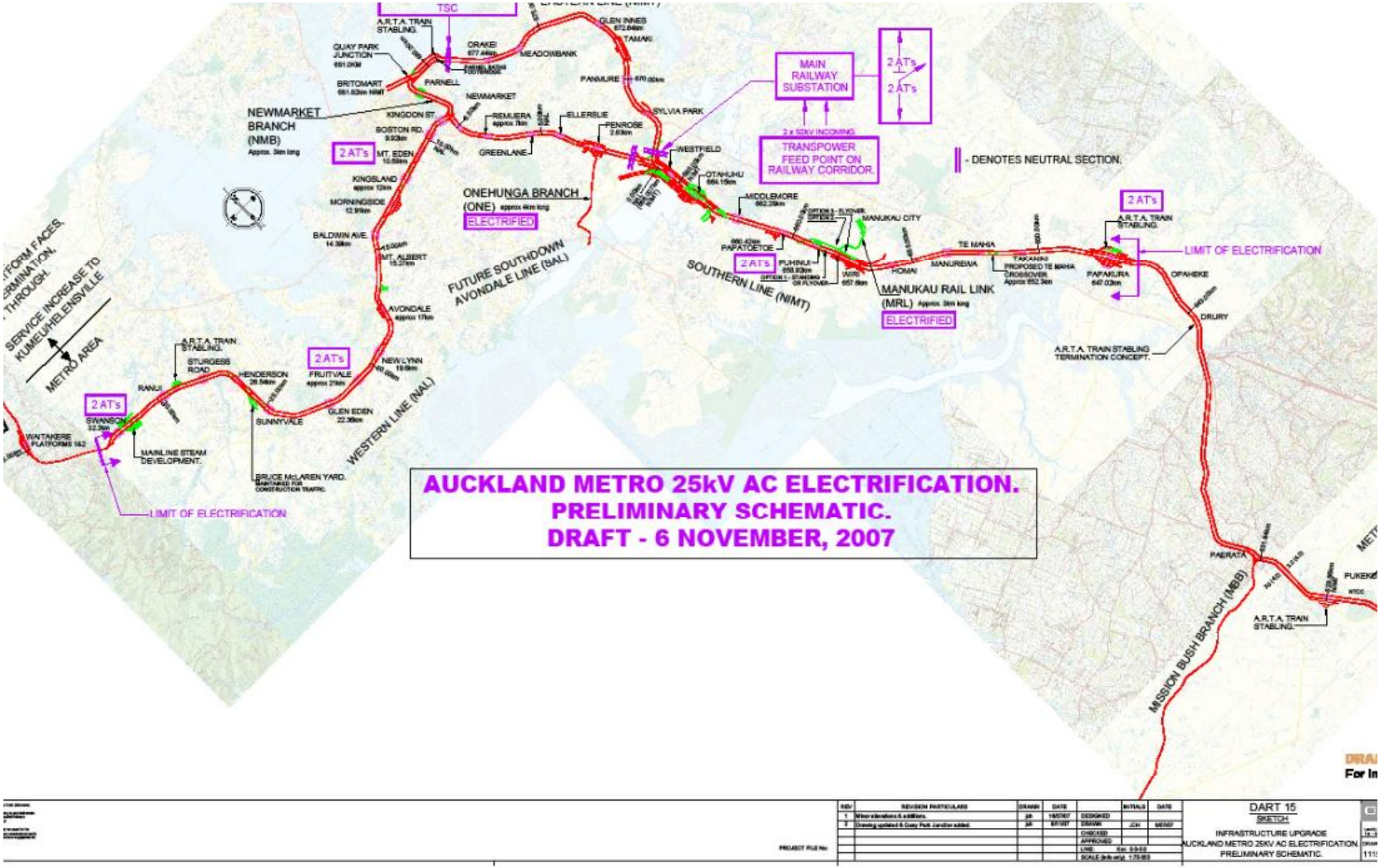
- Completed 1988
- 405 route km's between Palmerston North and Hamilton over mainly hilly terrain
- 4 feeder substations directly connected to 220kV grid
- 22 (now 18?) 30 class locos 3KW (4021hp) continuous rating


North Island Main Trunk (electrified)
North Island Main Trunk (non electrified)
Other Railways
Main Roads
Auckland
Papakura
Pukekohe
Huntly
Ngaruawahia
Hamilton
Tauranga
Te Awamutu
Te Kuiti
Gisborne
Taumarunui
New Plymouth
Raurimu
National Park
Mauinganui o te ao (Last Spike)
Ohakune
Waiouru
Napier
Taihape
Hastings
Wanganui
Hunterville
Marton
Feilding
Palmerston North
Levin
Otaki
Paraparaumu
Porirua
Wellington
0
75
150


30134
KiwiRail
30134
EF30134

# Auckland 25kV AC System

- All lines Papakura – Swanson inclusive
- Under construction – due for completion by end 2013
- 2 feeder substations directly connected to 220kV power transmission grid
- EMU procurement in early stages.
- All main lines double track
- Bi – directional signals operation on double lines




| REV | REVISION PARTICULARS | DRAWN | DATE | | INITIALS | DATE |
|---|---|---|---|---|---|---|
| 1 | Minor alterations & additions. | pjt | 16/07/07 | DESIGNED | | |
| 2 | Drawing updated & Quay Park Junction added. | pjt | 6/11/07 | DRAWN | JCH | 06/07 |
| | | | | CHECKED | | |
| | | | | APPROVED | | |
| | | | | LINE | Km 0.0-0.0 | |
| | | | | SCALE (fully orig) | 1:75 @ 0 | |

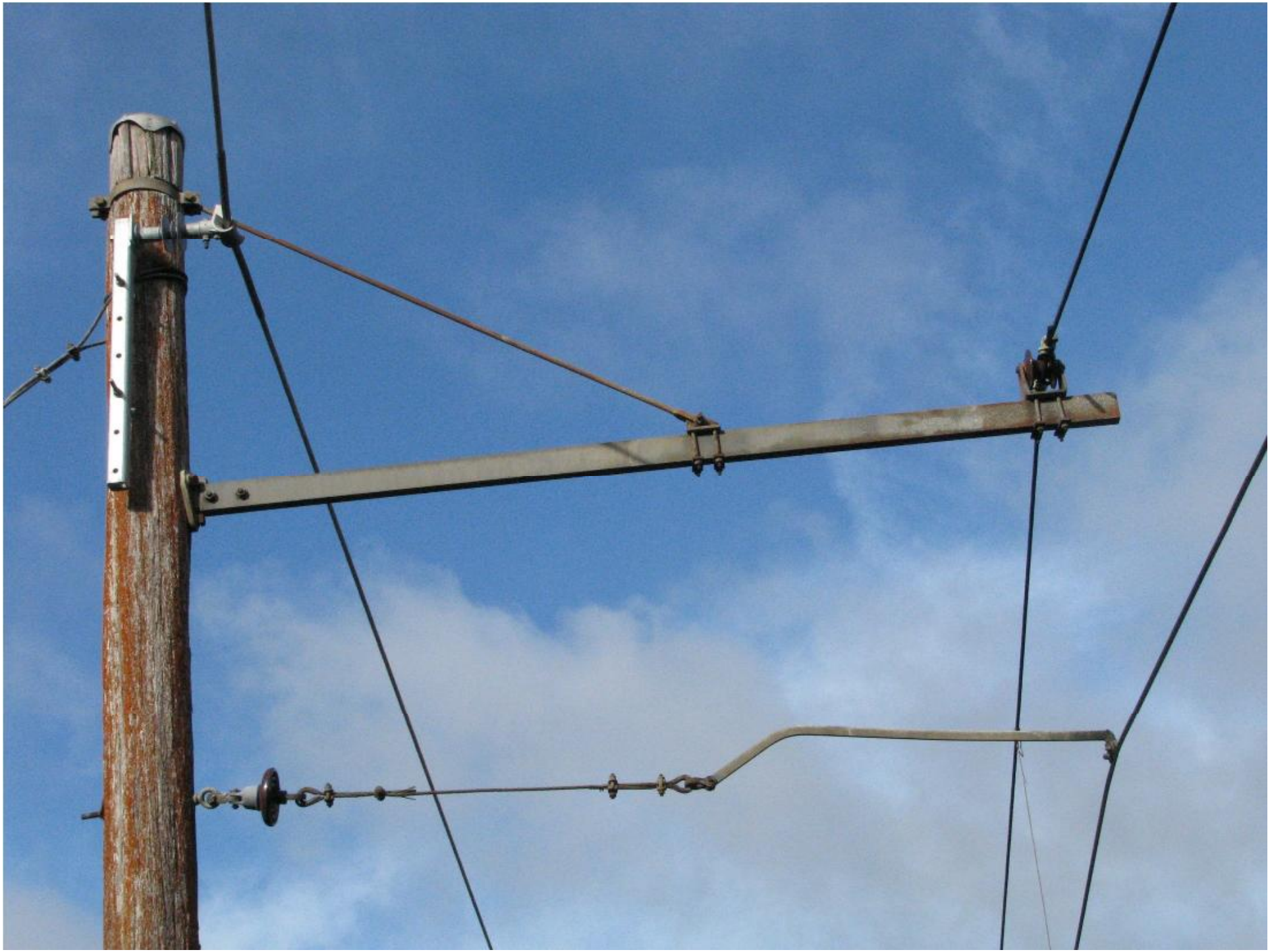
DART 15
SKETCH
INFRASTRUCTURE UPGRADE
AUCKLAND METRO 25KV AC ELECTRIFICATION
PRELIMINARY SCHEMATIC.

# Wellington Electrified Area (WEA) Overhead

- 1100 new steel poles installed to date
- New overhead McKays to Waikanae (duplicated track) and other selected areas
- All new and full replacement work made balanced weight tension
- Addition of positive feeder wires on all lines

# WEA Positive feeder wires

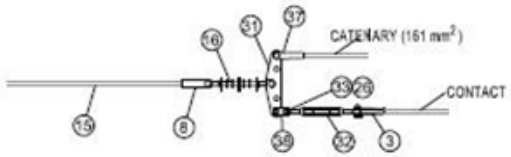
- Additional feeder wire run on overhead for each main line for additional voltage and current support
- Doubled wire in a few critical locations
- Special Aluminium alloy wire 307mm2
- Helps mitigate sag of catenary and contact wire due to heat and high current draw where fixed tension overhead installed.








65




ET71001/1 - BALANCE PLATE ARRANGEMENT FOR 161 mm² CATENARY.

1. ON ALL DATA SHEETS AND CROSS-SECTIONS EACH ASSEMBLY TO THIS DRAWING SHALL BE DENOTED BY A SEPARATE REFERENCE NUMBER

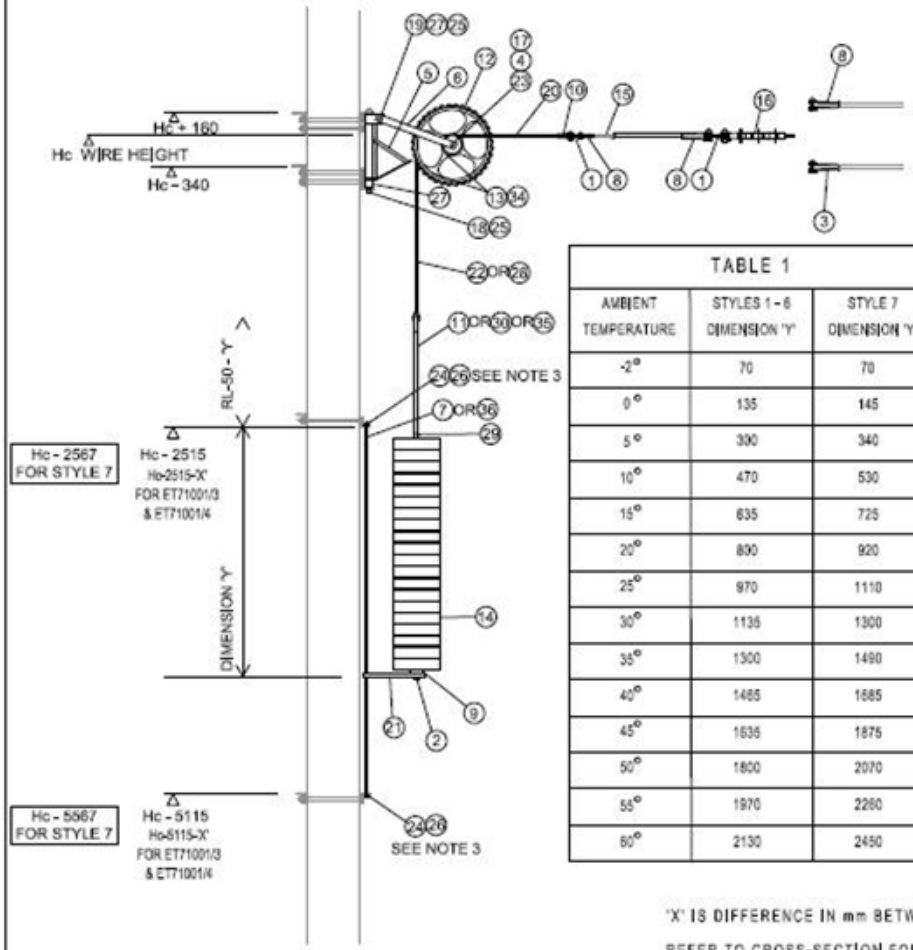
2. ALL DIMENSIONS ARE IN MILLIMETRES

3. M16 NUTS ( ITEM 26 ) TO BE PRESSED INSIDE OF WEIGHT GUIDE TUBE ( ITEM 7 )

4. WEIGHT TENSION ASSEMBLY TO BE SET UP WITH A RATIO OF WIRE TURNS ON THE LARGE AND SMALL DRUMS OF 1.75 : 1.5 THEN 'Y' ADJUSTED FOR AMBIENT TEMPERATURE ( SEE TABLE 1 )

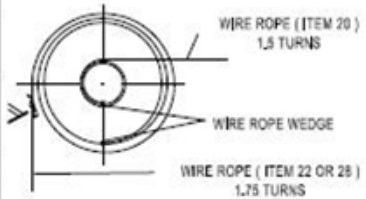
5. WIRE ROPE TO BE ROUND STRAND EQUAL LAY 6 x 19S ( 9/9/1 ) STEEL WIRE ROPE, GALVANISED, 8mm DIA. WITH MINIMUM BREAKING LOAD OF 35kN. CUT ENDS ARE TO BE TREATED TO PREVENT STRANDS FROM SPREADING

6. ALL MOVING JOINTS AND WIRE ROPE SHALL BE COATED WITH ALVANIA GREASE R2 OR EQUIVALENT AFTER ASSEMBLING




| TABLE 1 | | |
|---|---|---|
| AMBIENT TEMPERATURE | STYLES 1 - 6 DIMENSION 'Y' | STYLE 7 DIMENSION 'Y' |
| -2° | 70 | 70 |
| 0° | 135 | 145 |
| 5° | 300 | 340 |
| 10° | 470 | 530 |
| 15° | 635 | 725 |
| 20° | 800 | 920 |
| 25° | 970 | 1110 |
| 30° | 1135 | 1300 |
| 35° | 1300 | 1490 |
| 40° | 1465 | 1685 |
| 45° | 1635 | 1875 |
| 50° | 1800 | 2070 |
| 55° | 1970 | 2260 |
| 60° | 2130 | 2450 |

## WEIGHT TENSION WHEEL SET-UP PROCEDURE




1. INSTALL UNLOADED WHEEL ON RATCHET AS SHOWN ABOVE

2. OBSERVE AMBIENT TEMPERATURE AND CORRESPONDING DIMENSION 'Y' ( SEE TABLE 1 )

3. ROTATE UNLOADED WHEEL UNTIL EYE IN WIRE ROPE IS AT DIMENSION RL-50 - 'Y' (RL=WEIGHT ROD LENGTH )

4. HANG WEIGHTS

5. CUT IN TAIL WIRE ( ITEM 15 ) BETWEEN WIRE ROPE AND TERMINATION INSULATOR

6. WHEEL RATCHET SHOULD NOW BE RELEASED

7. RE-CHECK DIMENSION 'Y' ( PERMISSIBLE TOLERANCE 50)

8. ADJUST TAIL WIRE IF REQUIRED

'X' IS DIFFERENCE IN mm BETWEEN CATENARY AND CONTACT ANCHOR HEIGHTS.

REFER TO CROSS-SECTION FOR THE FIGURE.

SUPPORT BRACKETS & GUY ARE NOT SUPPLIED WITH THIS DRAWING.

STYLES 1 TO 6, WHEEL SETUP FOR MAXIMUM HALF TENSION LENGTH OF 650M WITH TEMPERATURE RANGE OF -2C TO 60C. MINIMUM TERMINATION HEIGHT 5.20M FOR THIS CONFIGURATION.

STYLE 7, WHEEL SETUP FOR MAXIMUM HALF TENSION LENGTH OF 750M WITH TEMPERATURE RANGE OF -2C TO 60C. MINIMUM TERMINATION HEIGHT 5.70M FOR THIS CONFIGURATION.

## REFERENCE No. ET71001/'N'

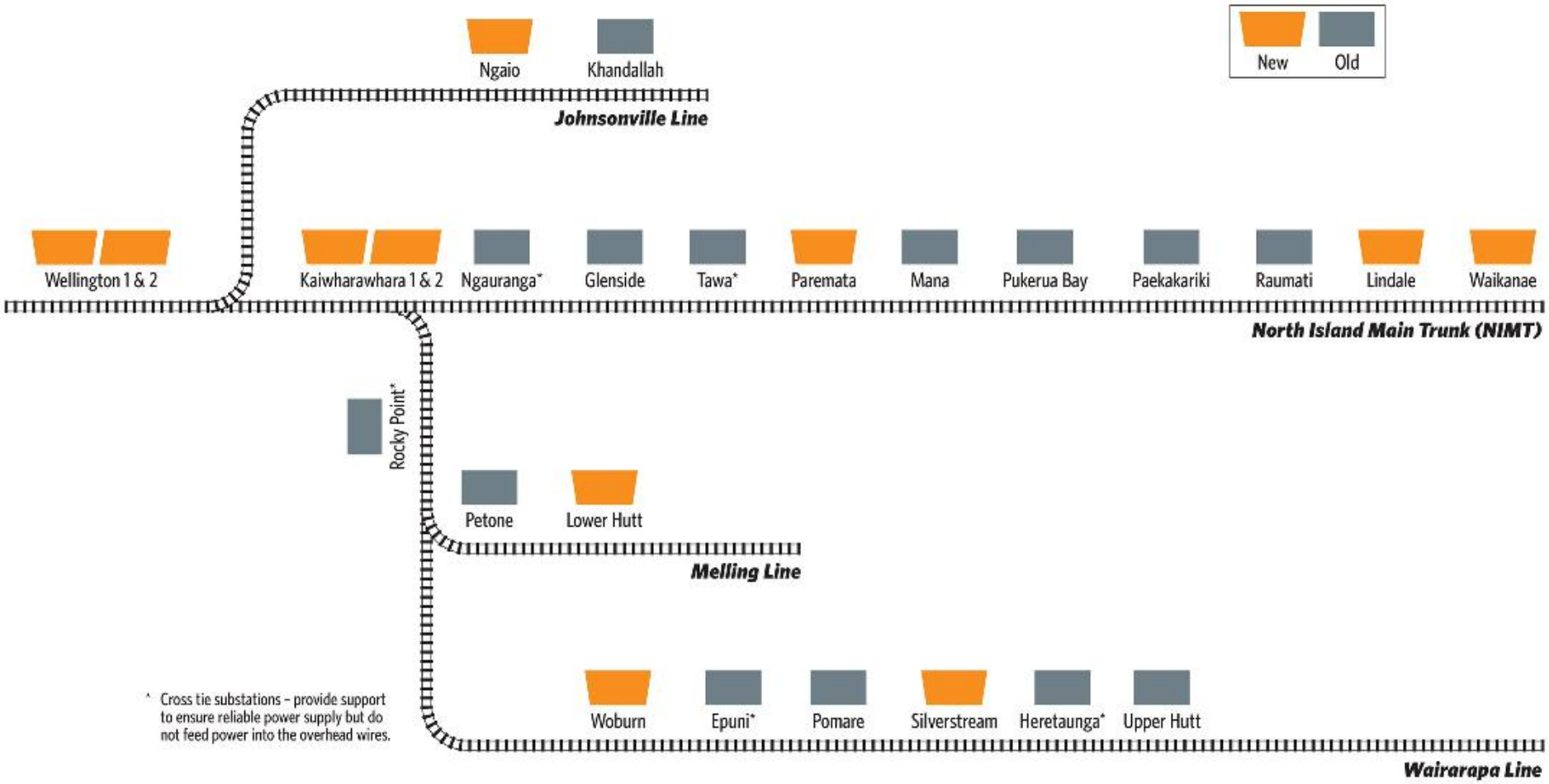
MINIMUM TERMINATION HEIGHT FOR STYLES 1 TO 6 = 5200mm.

MINIMUM TERMINATION HEIGHT FOR STYLE 7 = 5700mm.

# WEA Power requirements

- 1500v DC systems need a lot more substations compared to 25kV AC
- 1500v DC in Auckland would have required about 22 feeder substations compared to 2 feeder substations for 25kV
- 8 new DC substations being provided for existing network and additional 2 for extension to Waikanae.
- New SCADA control system for substations

# Wellington Region 1500v DC Traction Substations




National Train Control Centre
Traction Control
Wellington

# WEA Substations

## See Wellington Power Upgrade by Craig Tooke.