

LIGHTING OUR WAY TO THE END OF THE TUNNEL





Pepeha



**Nō Rotorua
ahau**

*I am from
Rotorua*



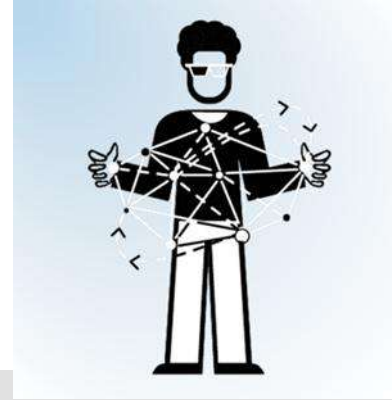
**Ko Otautahi
te kainga
noho**

*Christchurch is
where I live*



**Ko WSP ahau
e mahi ana**

*WSP is my
employer*



**He Pau
Whakahaere
hangarau
ahau**

*My role is a
Technical
Director*



**Ko Jason
ahau**

I am Jason



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Facts and Figures

- 460m long tunnel consisting of 3 lanes (2 NB, 1 SB)
- Provides connectivity between SH1 and the Inner-City Bypass and improving connectivity in the inner Wellington area
- Construction completed and tunnel opened 1978
- Designed as twin tunnels, however only single tunnel constructed

- Refurbishment completed 2012
 - Removed false ceiling
 - New wall lining/panels
 - Jet fans for ventilation
 - New lighting (and emergency lighting) installation
 - Controls and emergency equipment cabinets

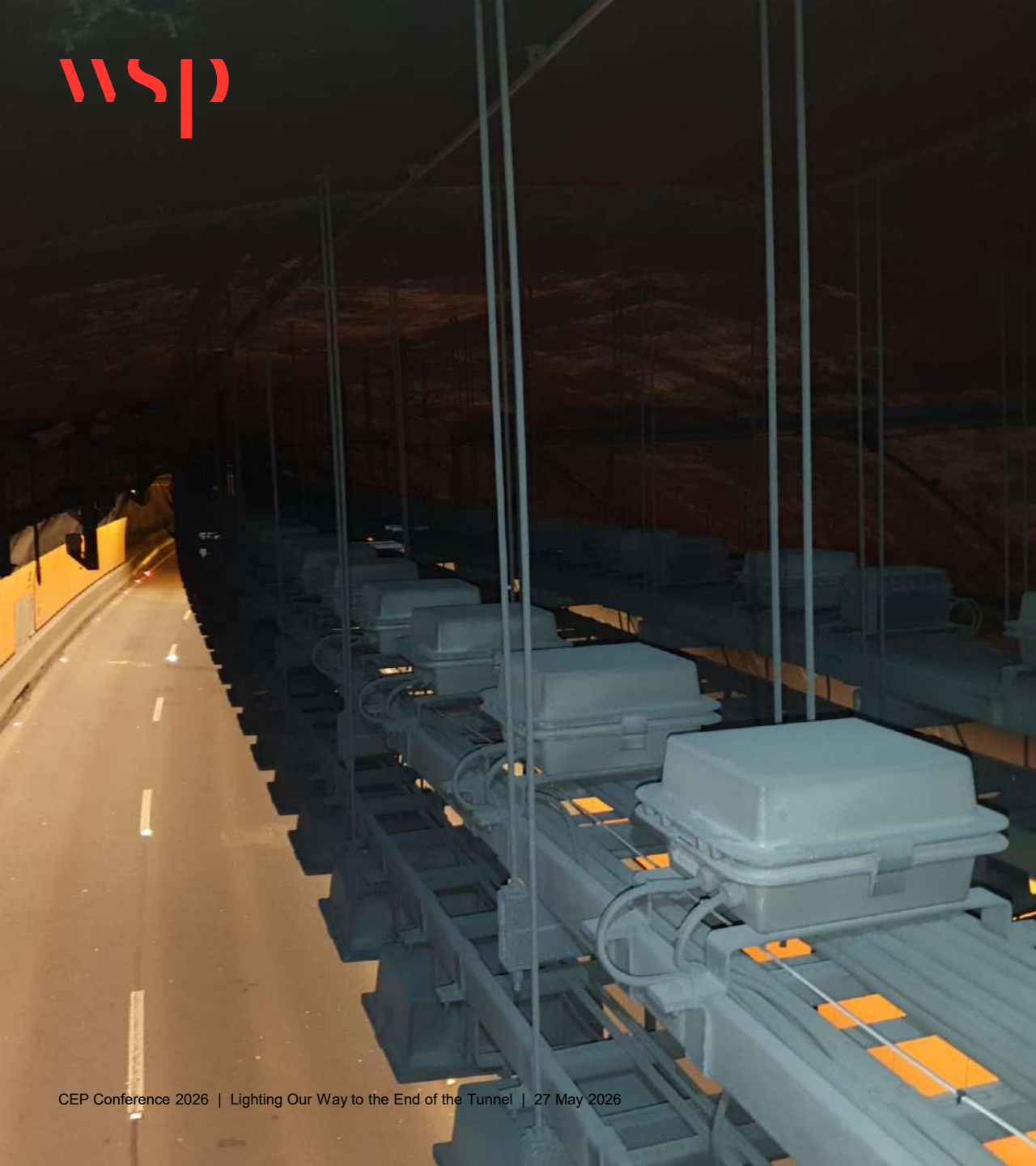


Project Background

Existing Arrangement

- Base lighting (24/7):
 - 1 row of linear fluorescent lighting on each side
 - 307 x 58W luminaires plus ballast losses = total of 19.6kW
- Main (boost) lighting (daytime):
 - 2 rows of HPS luminaires mounted centrally
 - 814 HPS luminaires (600W/400/250/150/70W) = total of 346.2kW
- **Total installed load = 365.8kW**

- Electrical cabling was hard-wired via duplicate circuits (resilience) into junction boxes and then to each luminaire/driver box
- Every 6th linear luminaire connected to UPS for emergency backup.



The Need for Upgrade

Procurement uncertainty

HPS spare parts becoming less available, increasing failures

LED offered benefits

Improved resilience, reliability, efficiency and lifespan

Suitable systems

Lighting control system also to be upgraded with modern, digital system to enable dimming

Design Requirements

Incorporation of latest standards - Road reflectance impacts with new LED arrangement, middle third of tunnel fitted with glare-limiting reflectors

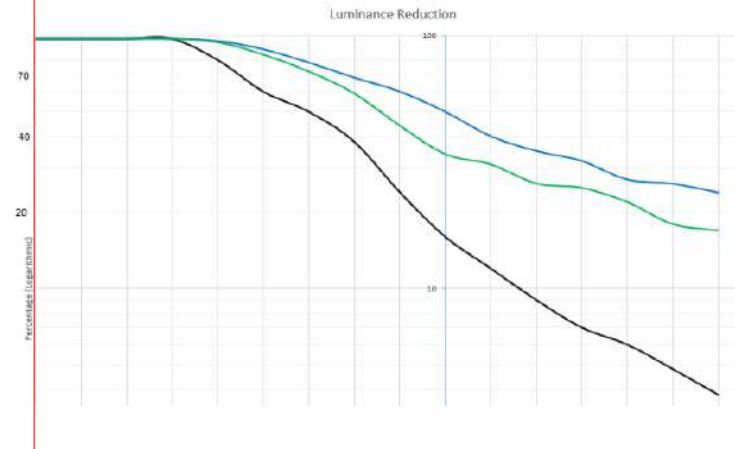
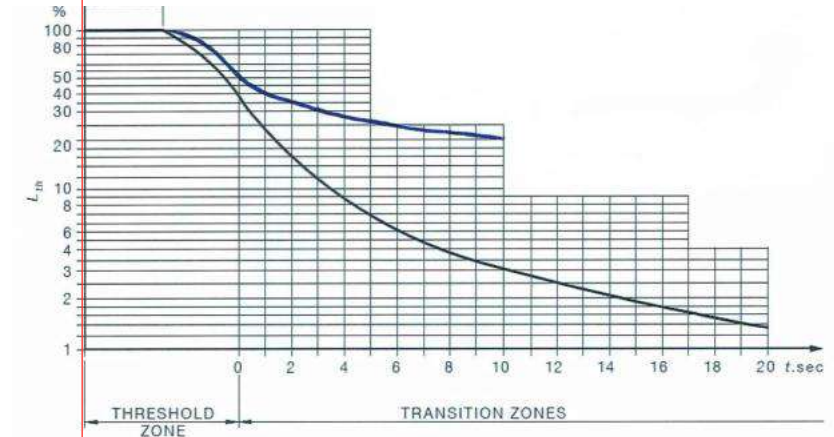
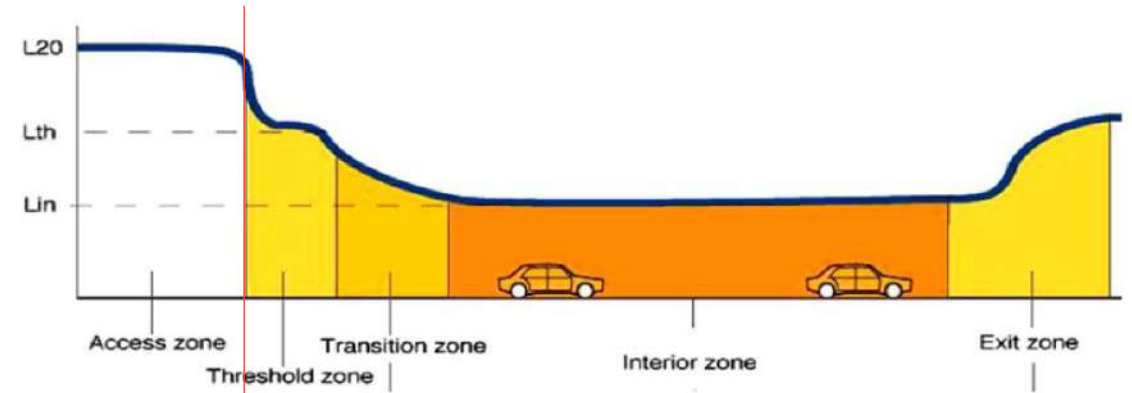
Luminance reduction curve - No interior zone (length of tunnel < 500 metres). Luminance reduction curve softened via dimming.

Spacing (old vs new luminaires) - Light-for-light replacement was desired, but every fifth light fitting was removed to allow the full ~890mm of space for each luminaire (longer than the previous 600mm)

Quality checking - Method to confirm the adequacy of existing luminaire housing was identified early in installation (linear retrofit)

Timing - Timing was constrained as a full tunnel closure was scheduled for June 2024; future projects should commence due diligence at least one year in advance, plus allow additional time for a full testing regime.

Temperature - Luminaires dimmed to 90% of maximum to reduce thermal issues



Luminaire Evaluation

Eight NZ based (8) suppliers provided eleven (11) options

Selected product - Schreder T-Flex lighting selected (200mm longer than existing). LED luminaire inserts designed to fit into existing stainless steel linear fluorescent housings. 58W linear fluorescent > 20W LED with the same output (65% energy savings)

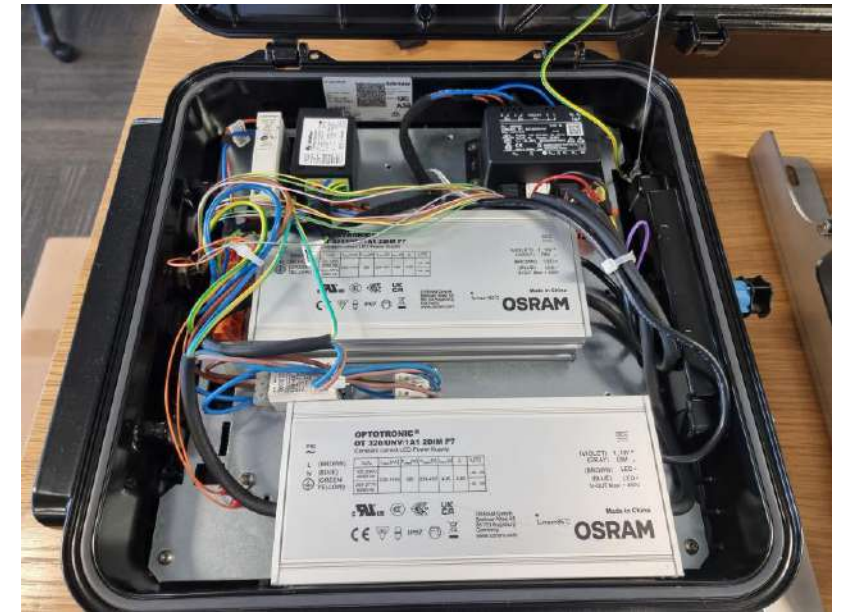
Lamp variety - Existing variety of HSP lamps reduced to three sizes of LED lamps only, dimmable via DALI 2

Cabling - Existing cabling removed and new plug and protective cap installed on each luminaire. New cabling run through entire tunnel length for controls

Warranty - WTA required a 10-year warranty on new products, accepted by the manufacturer (10-year warranty for new luminaires, 5-year warranty only for new inserts for retrofit)

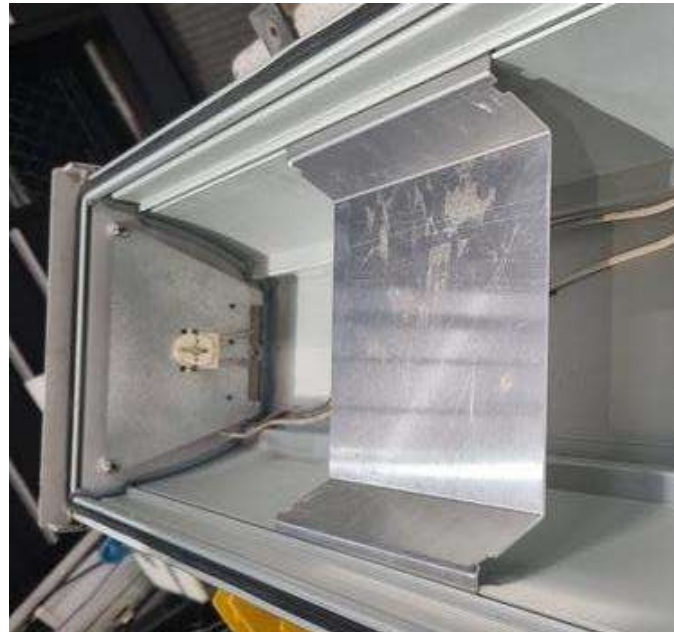
Design risk - All parties (engineering designers, maintenance contractor, asset owner) shared risk to streamline retrofitting costs

Power quality assessment – Harmonic impacts reviewed – minimal due to short length of tunnel. EFLI checked to ensure protection devices would trip under fault.



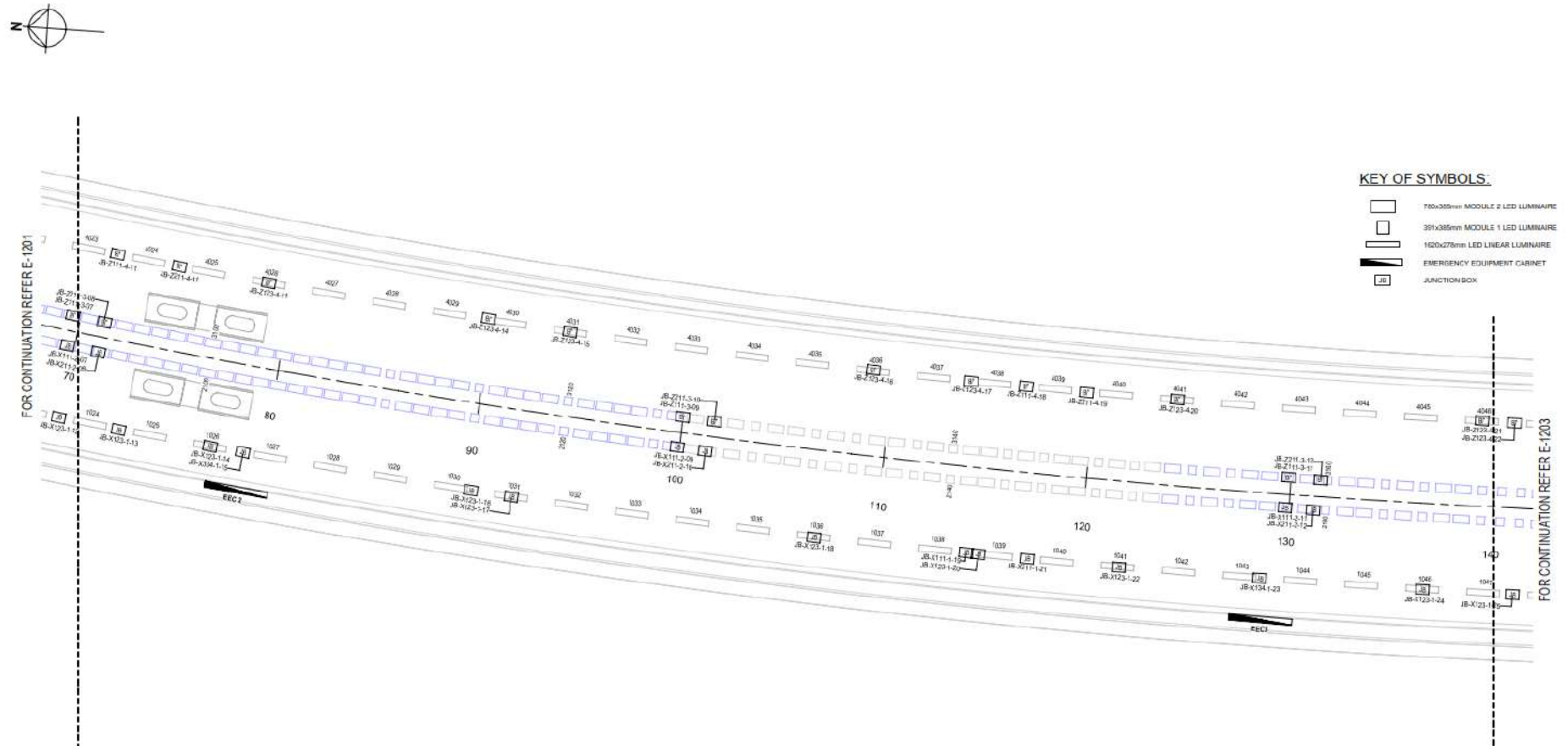
Luminaire Retrofit

- Removal of 5ft (58W) fluorescent tube and gear tray
- Fabrication of new gear tray insert with new LED array
 - 20W - capable of running at 40W
- Driver mounted on back of new gear tray at end adjacent to cable termination (gland connection using existing wiring)
- Challenges terminating existing fire rated cabling into new terminal block
- Front glass and seals checked and replaced if necessary
- Epoxy encapsulated LED chips used to mitigate against corrosion due to potential ingress into luminaire (moisture/gases/dust)



Finalised Design

- Base lighting – 307 retrofitted luminaires at 30W = 9.2kW
- Main (boost) lighting – rationalized 782 new LED luminaires
444W / 300W / 222W = 276.2kW
- Rationalised luminaire sizes
- Total installed capacity – 285.378kW (Savings of 80.4kW = 22%).



Installation

Methodology / Process:

- Removal of existing HPS luminaires and fitment of plug connector onto cabling (with blanking cap)
- Reuse mounting brackets and fabricate additional for remote control gear on upper tray / ladder
- New luminaires pre-programmed before install using wireless wand to suit dimming requirements for each zone and luminaire grouping (A/B/C/D/E)
- Use of elevated working platforms (truck mounted or scissor lift)
- Mounting of new drivers then connected cabling via plug/socket
- Fly lead (plug and socket) between driver and luminaire
- Dali controls cabling connected between driver boxes to aggregation points
- Completed over period of approximately 2 weeks (night closures)
- Celebratory picnic/pizza on final night of install.





Outcome = 24.2T CO₂e

Installed capacity

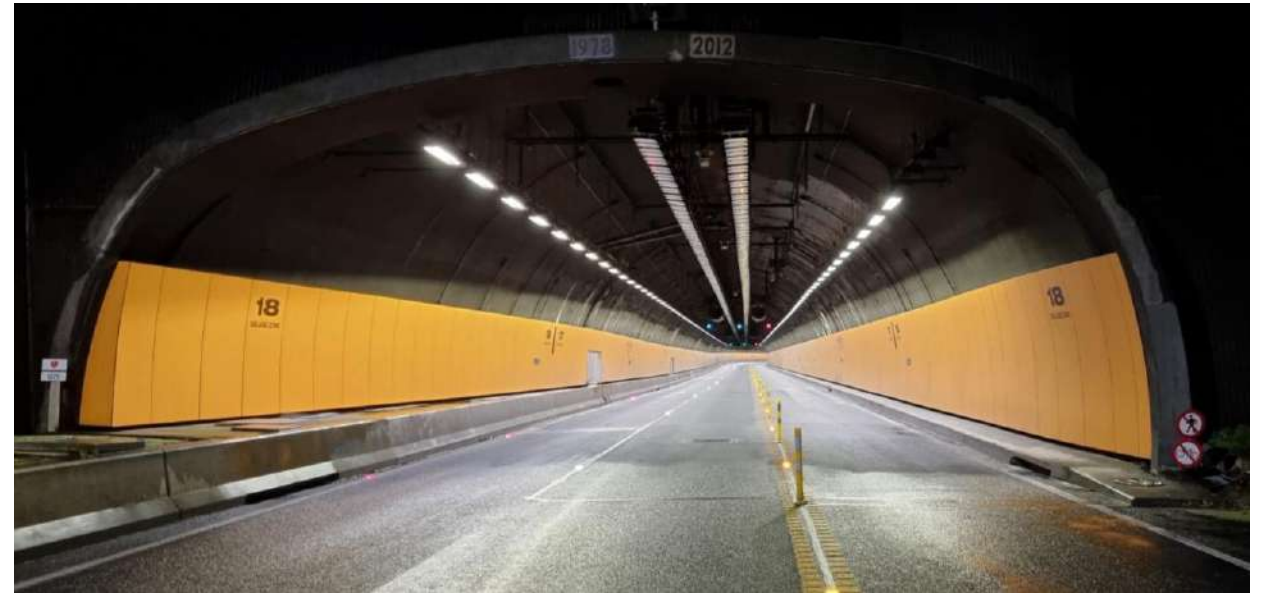
- Base lighting (24/7)
 - 307 linear fluorescent luminaires at 58W plus losses = 19.6kW
 - 307 retrofitted luminaires at 30W = 9.2kW
- Main (boost) lighting (daytime – 5 modes to suit external ambient levels)
 - 814 HPS luminaires (600W/400/250/150/70W) = 346.2kW
 - 782 new LED luminaires (444/300/222W) = 276.2kW
- Total installed capacity 365.8 reduced to 285.4kW (Savings of 80.3kW = 22%).

Operational savings

Due to preset dimming levels (~70-90%) and run hours per annum, operational savings of 43% achieved (original target of 30%-40%), Note 24/7 luminaires dimmed to 20W = 6.4kW (65% savings)

User feedback

Positive feedback about the look and “brighter” lighting – improved CRI and visual acuity due to colour temperature of LED vs HPS.



Next Steps / Future Projects

Tunnel Lighting (and System) Upgrades:

- SH1 Johnstone’s Hill Tunnel (North Auckland)
- SH1 Victoria Park Tunnel (Auckland)
- SH74 Lyttelton Tunnel (Christchurch)

New Tunnels:

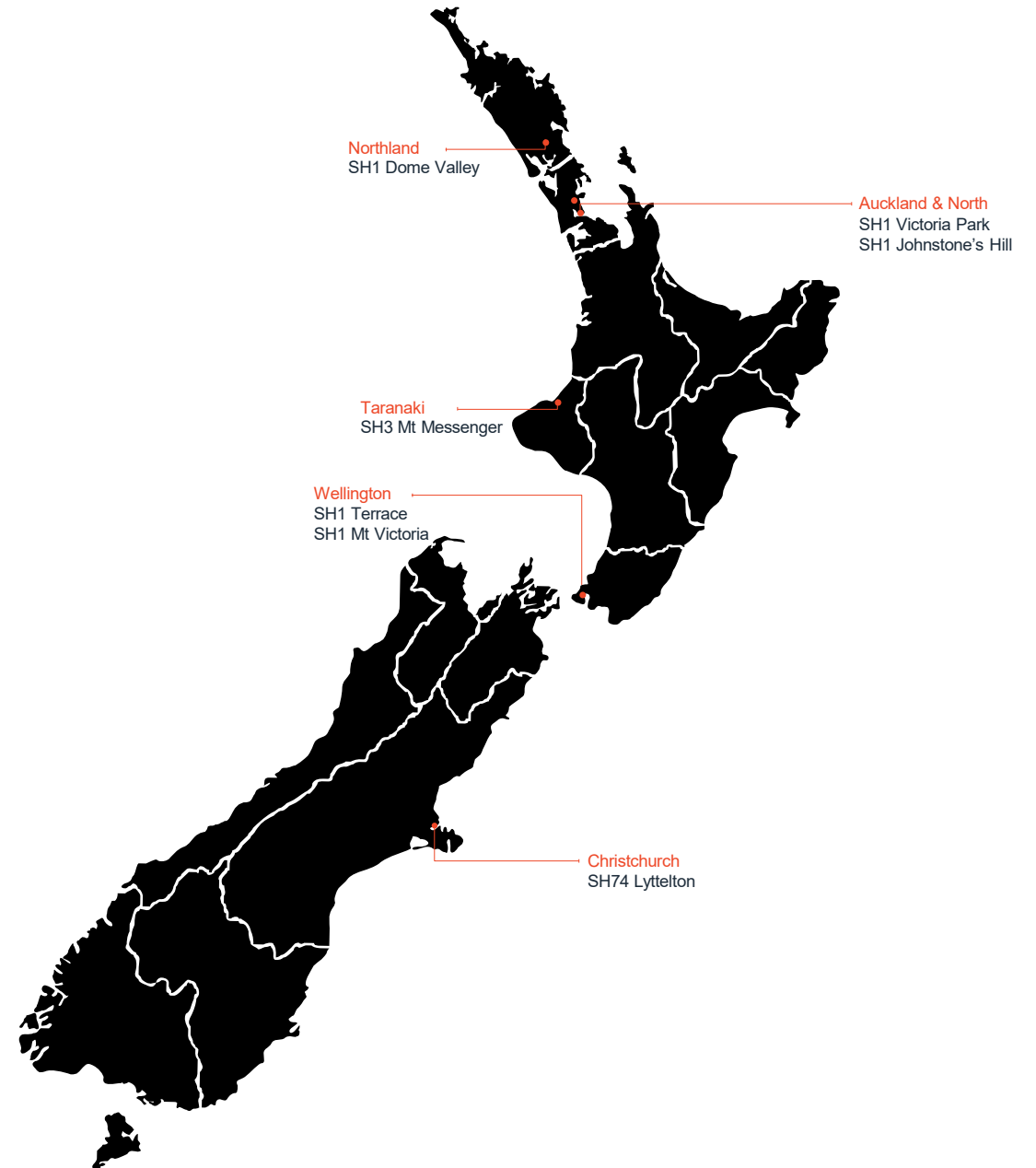
SH3 Mt Messenger Tunnel (North Taranaki), under construction

SH1 Dome Valley Tunnels (North of Warkworth) – specimen design for PPP – Appointment Pending

SH1 Wgn city to Airport – Early concept for tunnel duplication (Terrace and Mt Victoria)

Industry Standard:

Draft “Tunnel Lighting Design & Procurement Standard” development underway with NZTA, to complement M30 – Road Lighting.





Thank you Nga mihi

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