REPORT

REGIONAL FREIGHT HUB- DESIGN, CONSTRUCTION AND OPERATION

PREPARED FOR KIWIRAIL

October 2020

Stantec

This document has been prepared for the benefit of KiwiRail. No liability is accepted by this company or any employee or sub-consultant of this company with respect to its use by any other person.

This disclaimer shall apply notwithstanding that the report may be made available to Palmerston North City Council and other persons for an application for permission or approval to fulfil a legal requirement.

QUALITY STATEMENT

PROJECT MANAGER	PROJECT TECHNICAL LEAD
Jon Eaton	Karen Bell

PREPARED BY		
Mike Skelton	.....	23/10/2020
CHECKED BY		
Karen Bell	.....	23/10/2020
REVIEWED BY		
Karen Bell	.....	23/10/2020
APPROVED FOR ISSUE BY		
Jon England	.....	23/10/2020

PALMERSTON NORTH
118 Fitzherbert Avenue, Palmerston North 4410
PO Box 13-052, Armagh, Christchurch 8141
TEL +64 6 357 4034, FAX +64 6 356 1164

REVISION SCHEDULE

Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by

Abbreviations

Abbreviation	Term
AAR	American Association of RailRoads[1]
CT	Container Terminal
Freight Hub	Regional Freight Hub
HPT	Horsepower per tonne
KR	KiwiRail Holdings Ltd
KB	Kairanga -Bunnythorpe (usually referenced to the road)
NEIZ	North Eastern Industrial Zone
NIMT	North Island Main Trunk
NoR	Notice of Requirement
OPW	Outline Plan of Works
PNCC	Palmerston North City Council
PSR	Precision Scheduled Railroading
PSI	Preliminary Site Investigation
RMA	The Resource Management Act 1991
SC	Speed Categories for trains from KiwiRail Standards
TEU	Twenty-foot equivalent units
Waka Kotahi	Waka Kotahi NZ Transport Agency

[1] In the context of this report reference is to AAR couplers. Upgrading to these will allow KiwiRail to increase train lengths and capacity

Glossary

Term	Meaning
Arrival/Departure yard	The tracks used by arriving and departing trains, allowing incoming trains to be held off the mainline until classification takes place. Locomotives are removed/added here.
Ballast	The aggregate 'stones' beneath the rail tracks that form the track bed and supports the track. It also helps with drainage.
Classification	Where wagons are sorted by destination into blocks of wagons that can then be combined in the departure yard to form new trains.
Container	A receptacle or enclosure for holding a product used in storage, packaging, and shipping typically these are 10, 20 and 40 feet long. The Standard unit of measure is TEU – 20ft Equivalent
Container Terminal yard	Area where containers are transferred from rail to truck and vice versa and includes container storage, rail tracks and truck parking.
Coupler	Mechanism for connecting rolling stock in a train. Upgrading to AAR coupler will allow increase from 900m to 1500m long trains
Horsepower per tonne	Pulling power of a locomotive
Intermodal Hub	Locomotive, cargo handling equipment, and truck activity
Mainline	The principal artery of a railway network
Maintenance Facilities	Where locomotives, wagons and work equipment are maintained and repaired
Marshalling yard	A train yard where trains are marshalled, generally by shunting as part of breaking down or compiling a train as well as the stabling, light maintenance, inspection, and queuing of trains.
Network Services	The team responsible for the track, structures, signals, power, and other railway infrastructure
North Island Main Trunk Line	The main railway line running between Wellington and Auckland
Ruling Grade:	Maximum grade on a specific rail line segment, between terminals, which governs the power requirements for a defined trailing load (or the trailing load for defined power)
Run-Around Track:	Service track, not used to store wagons or locomotives, which provide a clear, unobstructed route through a yard
Bad Order Road	A rail track within the marshalling yard where defective rolling stock can be placed for repair or held before being taken to the maintenance facility
Thermit Welding	Mobile exothermic process used to weld rails.
Unit train	Train in which all cars carry the same commodity and are shipped from the same origin to the same destination, without being split up or stored enroute.
Zero Harm	An approach to occupational safety with the goal to operate a workplace without exposing an individual to injury through the implementation of safe work systems.
Formation Level Or Subgrade Level	Defined as the top of bulk earth works level onto which buildings, internal road and rail track foundations are built. This has been assumed at 700mm below finished yard level.
Yard Level	The design finish level applicable to all track work within the yard. This also cover nominal floor levels within buildings and vehicular roads.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICIES

1. Introduction

1.1 Report Purpose

KiwiRail has selected a location for its new intermodal Regional Freight Hub (Freight Hub) and is seeking a Notice of Requirement (NoR) to designate the land required for the construction and operation of the Freight Hub.

This report has been prepared to support the NoR to designate the land required for Freight Hub that will be lodged with Palmerston North City Council (PNCC). It provides a summary of the concept design work undertaken to demonstrate construction and operational feasibility of the Freight Hub and to enable an understanding of the effects of construction and operation sufficient to inform the NoR.

The concept design also establishes engineering and design parameters which will be refined (within the envelope established by the designation) at the detailed design stages of the Freight Hub in the future.

1.2 Project Stages

KiwiRail anticipates that the Freight Hub will be fully operational in terms of its full freight capacity in or around 2050. By about 2030, KiwiRail plans to have a significant proportion of its operations at the existing yard at Tremaine Avenue in Palmerston North (Existing Freight Yard) moved to the Site, recognising that some areas within the proposed extent of the designation (Designation Extent) will not be fully developed and operating at full capacity when the Freight Hub initially commences operation.

The current stage has included the following:

- engineering design to a concept design level
- initial Site analysis and investigations
- development of extent of land required for future construction and operation (this NoR).

Future stages are:

- detailed Design
- further Site analysis and investigations
- design of earthworks and trackwork
- engineering design such as building layout, services, and stormwater
- ongoing consultation
- preparing applications for and obtaining regional resource consents
- preparing Outline Plan of Works (OPW)
- tender and award of the construction contract, preparation of management plans to manage the effects during construction and plans required during the operational phase
- construction
- construction of the new perimeter road and other access roads to provide access to the Site
- installation of required mitigation (such as erosion and sediment control)
- earthworks associated with construction of the Freight Hub floor, that is up to Formation Level
- track installation (relocated North Island Main Trunk (NIMT), arrival and departure yard, marshalling yard and sufficient track works to support facilities)
- construction of new KiwiRail facilities (such as Maintenance and Network services and container terminal)
- construction of freight partner facilities (subject to demand)

- opening
- commissioning and operation of parts of the Freight Hub until the Site is fully developed.

1.3 Overview of the Concept Design and key Requirements for its Construction

1.3.1 The Concept Design

The concept design for the Freight Hub is future focused and involves an approximately 177.7ha. The Freight Hub will be connected to the existing NIMT which will be relocated into the Designation Extent, with provision made for future double tracking of the NIMT if required (as currently enabled in the NIMT designation corridor). The Site has been sized to provide for forecasted freight and network operational growth out to approximately 2050.

The analysis of freight operations and future demand undertaken as part of the Master Plan work identified an up to 50% increase in tonnage/business by 2050 with increased container traffic predicted. Train lengths on branch lines, including South bound to Wellington, will remain restricted to 900m with increased capacity being managed by increasing train frequency. Increased traffic between Auckland/Hamilton and Palmerston North is to be accommodated by increasing train lengths by 65% to 1,500m.

Because of this analysis the Concept design needed to address three functions:

- Primary Function - Marshalling of Trains - 76% of rail traffic has been identified as through Traffic whose origin and destination are outside of Palmerston North. The balance 24% is equally split between originating from and destined to Palmerston North.
- Secondary Function – wagon storage, equipment maintenance, network services and yard operations.
- Additional Function - the increasing demand for container and commodity storage, commercial operations with freight forwards and specials traffic such as log handling.

To address these requirements, the concept design provides:

- 8 arrival and departure tracks and 13 mixed length marshalling tracks. Arrival and departure tracks can each accommodate the longest 1500m trains. Additional yard flexibility is provided by having a split ladder configuration in the marshalling yard allowing 900m and 1500m long trains to be built.
- KiwiRail specific operational facilities include:
    - mechanical Maintenance facilities – required for the maintenance of the current fleet of Wagons, Diesel Locomotives, Electric Locomotives, including specialist equipment – wheel lathe
    - network Services Depot including track maintenance
    - wagon and locomotive storage.
- Container terminal. Provides 3 tracks (2 centrally located between the container terminals loading areas and one on the eastern side of the container facility) capable of holding 900m long unit trains. These tracks are configured so that trains can directly arrive and depart. Onsite storage is provided for 200 40ft containers stacked 3 high. Direct loading access, rail to truck and reverse, is also provided to expedite operations.
- Freight partner facilities:
    - Freight Forwarders - Provision is made for 4 large and 6 smaller freight forwarders to co-locate onto the Site. The areas are serviced by a common loading/unloading rail track with road access into the facility.
    - Log yard - This specific facility allows for the transfer of logs from truck to rails with two 450m long tracks allowing for 900m unit trains to be assembled. Unit trains are able to leave directly south (Centre Port) or West (Port of Napier). Onsite storage is provided to hold logs if wagons are able to be turned around – this particularly applies to South Bound trains. The log yard is separated from other commercial facilities because of its appearance.
    - Tank farm for storage of bulk liquids including containment facility.

- In addition, the concept could accommodate an Inland Port being a secure area compliant with export security restrictions.

1.3.2 Roading Changes to Enable the Concept Plan to be Constructed and Operate

Currently the NIMT is on the eastern side of Railway Road meaning that Railway Road cannot be retained in its current location. To allow construction of the yard and connection to the NIMT, Railway Road will be stopped from the Roberts Line intersection through to just south of Maple Street.

To provide for the access to and from the Freight Hub, a new road will be provided that will run along the western perimeter of the Hub, from Roberts Line in the south to Maple Street in the North. This road will also provide alternative public access once Railway Road is stopped.

Three Freight Hub accesses are proposed:

- Southern and principal access to the Freight Hub - the freight forwarding and container areas. This will be located at the upgraded Roberts/ Richardsons Intersection.
- Western access off the perimeter road providing access to the Tank farm, administration facilities and freight forwarding facilities.
- Northern access also off the perimeter road providing access to the Log handling facility, maintenance and service areas, and storage facilities.

In addition, several sections of existing formed roads will need to be closed to form the Freight Hub, these include:

- Cleverly Line, from 400m North east of Roberts line through to Railway Road and then to Sangsters Road including the level crossing. The extent of road to be stopped estimated at 1.1km.
- Te Ngaio Road. – from 180m East of Maple St to Railway road. The extent of road to be stopped is approximately 730m in length.
- Richardson Line – from Roberts Line to Railway road. The extent of road to be stopped is approximately 425m in length.

1.3.3 Grades and Earthworks Required

1.3.3.1 Grades

Safe operational yards are typically flat (or slightly bowl shaped):

- To determine yard levels pullback grades were limited to a value between plus or minus 0.5%.
- To accommodate the rising NIMT level from Palmerston North, the yard levels fell in a range from RL 49m to 51m.

Connections between the Hub and the NIMT occur:

- At either end of the arrival and departure yard and the marshalling yard mid-point of the arrival departure yard where crossovers allow short trains to readily depart (and arrive).
- At the main line turnout for the pull back to the south some 1500m from the yard potentially needed in the long-term future.

At each of these locations the NIMT and connecting tracks (to the Freight Hub) must be at the same level.

For the development of this NoR, a value of RL50m across the Designation Extent has been adopted as it provides sufficient height to pass overland flows through the Site either by piping or constructed open channels. The final level may change +/- 0.5m pending more accurate survey information and detail design.

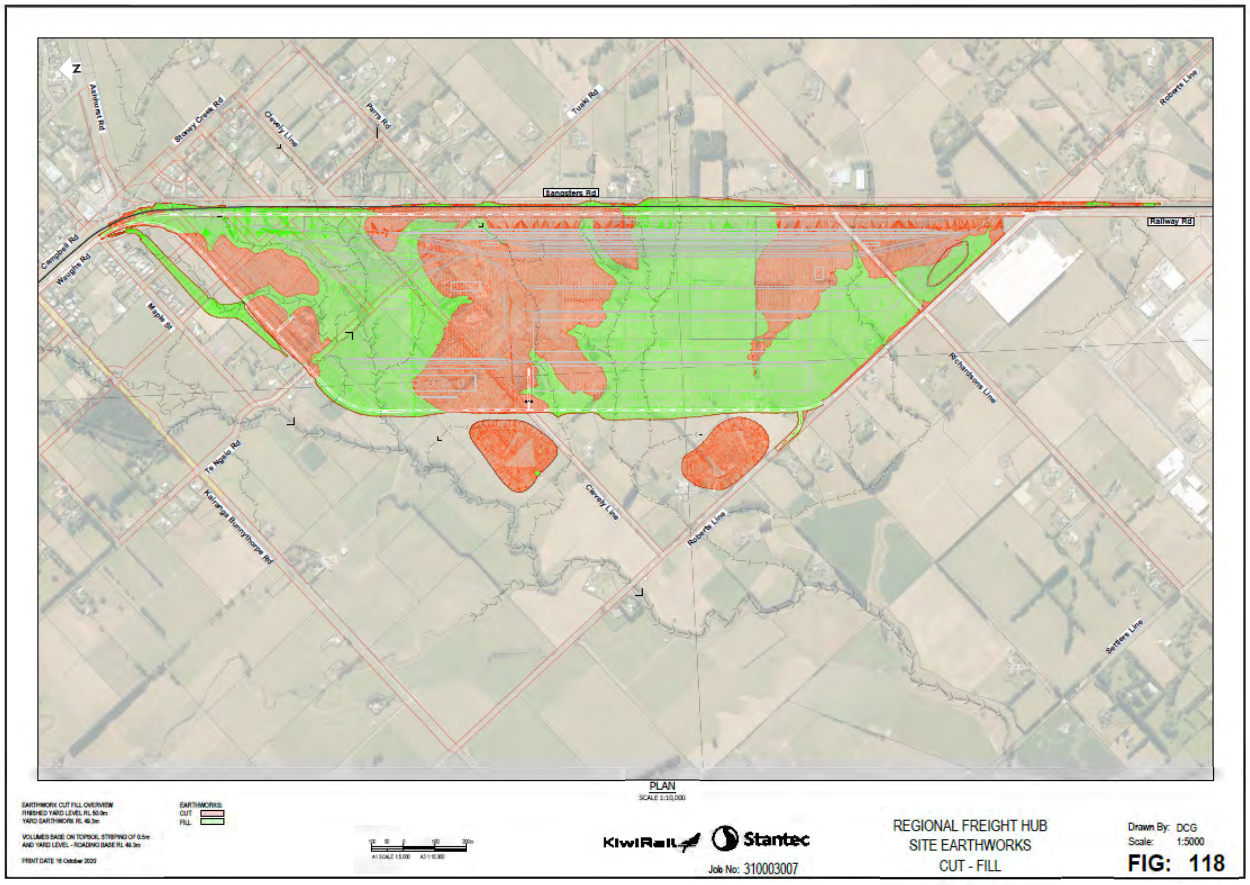
Typically, civil earthworks are designed so that cut to waste volumes are minimised. Due to limiting factors of track grade and stormwater considerations, it is expected that there will be a shortfall in bulk fill quantities with balance achieved for a yard level of RL49m.

Figure 1 below shows areas of bulk earthworks (cut (red) and fill (green)) across the Site for RL50m. At this level, the demand for fill material exceeds the amount of material won from cut, allowing for the estimated 440,000m^3 won from the construction of the two detention ponds. The additional material required to be imported is estimated at 1.5 million m^3.

For feasibility studies the elevation of RL50m has been used. However, the effects of the importation of material can be managed and mitigated through the future design phase.

Figure 1 Indicative Cuts and Fills Depths over the Designation Extent

*Note: A larger version of Figure 1 is attached as Appendix A to this report.



Although the proposed finished yard level is RL50m, the formation level or top of the bulk earthworks level is currently assumed at 700mm below, that is RL49.3m. This lower level has been used to determine bulk earthwork volumes. The balance 700mm is made up of the various foundation elements required for buildings and structures, vehicle accessways around the Site and trackwork. This would include:

- Granular fill – to be used under trackwork, building foundations, roads, and parking areas.
- Ballast – primary structural support material for trackwork.
- Concrete and asphalt - finishing surfaces to building areas, container terminal, roads and carparking areas.

1.3.3.2 Earthworks up to Formation Level (700mm below finished Hub floor level)

The bulk earthworks are likely to be staged west to east from the perimeter road towards Railway Road but earthworks may occur around the Site in different sequences, subject to contractors work planning and overall programme.

Requirements related to erosion and sediment control will need to be in place and implemented at all times. Construction noise is expected to be managed through observing the hours of operation (likely to be Mon- Sat 7am – 7pm).

In order to optimise site access and construction flexibility, the bulk earthworks are expected to proceed in the following sequence:

- Excavate and prepare external detention ponds and plant area as the relevant section is completed.
- Construct northern noise mitigation bund and plant the area.
- Construct the perimeter road formation and perimeter of the Site - approximately 60m wide. This provides room for boundary security fencing and planting. Including installation of box culvert units for stormwater discharge.
- Form the perimeter road and make the road operational once western boundary earthworks including ponds are completed.
- Close Railway Road and move traffic to the perimeter road. This would include the Roberts/Railway Road Intersection upgrade and the priority change where Roberts Line and the perimeter road intersect.
- Form temporary construction site access off Richardsons Road and Railway Road.
- Build new formation on the eastern side of the Site to take the relocated NIMT. This will include cut to fill and installation of sections of box culverts.
- Once settlement requirements are met, construct track. The ballast is to be trucked to the Site from a stockpile in the current yard (Tremaine Ave) or directly from the supplier (expected to be in Otaki).
- Relocate the NIMT to its new location.
- Complete earthworks to eastern boundary, constructing noise mitigation and landscaping in the area formerly occupied by NIMT with priority on the Northern section. Generally, from the southern extent of the formed section of Sangsters Road northward to the substation near Maple Street.
- Continue with cut and fill in body of the Site, utilising Site material in the lower area. Completing box culverts through the middle of the Site, the northern section and forming the open channel.
- Begin stockpiling imported material on the southern section of the Site once sufficient area is available.
- Place imported material to bring the Site up to formation level.

This work is expected to take close to three and half years.

1.4 Regional Freight Hub Operation

In order to meet safety requirements, provision is made for the Freight Hub to be lit to provide for staff working safely 24 hours a day, 7 days a week, if required.

In addition, the Freight Hub includes large and adaptable shared amenities and administration spaces. Provision will need to be made during the detailed design process for specific management requirements in relation to the management of waste and any other KiwiRail Environmental Practices.

As there will be a significant area of impervious surface, provision is made for onsite stormwater collection, treatment, and detention before being discharged. Provision is also made for reuse of stormwater where appropriate.

Internal roads are included in the concept design to ensure that goods and personnel can move around and to the Site safely, this includes minimising the internal road/rail crossing points. Site access points from the external roading network will also be controlled to manage both security and safety.

The Freight Hub must sit immediately adjacent to the NIMT to allow track access to and from the yard for mainline trains, shunts and other train movements as is required as part of a functioning Freight Hub.

1.5 Related Projects

PNCC and Waka Kotahi have been developing the Palmerston North Integrated Transport Initiative (PNITI) for some time. There are aspects of this work that could impact upon the Freight Hub and alter the assumptions outlined above.

The absence of confirmed and funded upgrades to the wider regional road network from PNCC or Waka Kotahi has meant that the Freight Hub has proposed solutions that will allow the Freight Hub to move forward in the planning process but such solutions will not preclude connections to the wider transport network once those have been confirmed.

Long lead times before the Freight Hub becomes operational provide the opportunity for Waka Kotahi to develop its preferred ring road routes and identify any new connections. Collaboration with PNCC could see improved transport outcomes in the area by changing how the perimeter road connects to Roberts Line and Kairanga Bunnythorpe Road, as required.

Further details are covered in the Integrated Transport Assessment (Technical Report I).

2. Technical Considerations

Several technical parameters, constraints, risks and assumptions have influenced the development of the concept design in terms of the location of the specific components and layout.

2.1 Technical Parameters

Parameters are the design requirements needed to meet KiwiRail's operational standards. Table 1 contains the key parameters that have driven the concept design.

Table 1 KiwiRail's Operational Standards

Element	Basis/Reference
Site	
Elevation	Vertical elevation of the Site is constrained by the NIMT; ruling vertical grades to access the Site; and by physical constraints such as bridge level to the north of Bunnythorpe
Track Alignment and Geometry	
Design Speed	• SC4 – 40km/h - Arrival/Departure Tracks • SC4 – 30km/h - Marshalling Yard, Back Shunts, Leads • SC5 – 25km/h - All other locations
Maximum vertical grade	• Mainline to Arrival/Departure Yard - 1:200 (0.5%) • Leads between yards - 1:200 (0.5%) • Yard Track – 0% level
Track Configuration (turnouts, spacing etc)	• 4.0m minimum Track spacing between pairs • 7.0m minimum Track spacing with 3m maintenance road • 1:12 for mainline and to arrival and Departure Yard. 40km/h • 1:9 for terminal leads. 30km/h • 1:7.5 for other area. 25km/h
Curve Radius	• 140m minimum for uncoupling rolling stock • 150m minimum otherwise
Trains	
Locomotive	• Provide for current diesel and electric locomotive • Newer, more efficient and higher Horsepower
Rolling stock	• Provide for current Rolling stock • New Rolling stock with AAR couplers, heavier axle loads and carrying capacity
Train length	• Provide for up to 1500m long trains between Palmerston North and Auckland
Track structure	
Marshalling yard and all other Hub tracks	• Standard KiwiRail track section for yards and terminals • Standard concrete sleeper • Welded track including turnouts

Element	Basis/Reference
	• Exposed rail to be used in all parts of the Freight Hub
Operational and safety requirements	
Lighting standards	EN 12464-2. Specified in KiwiRail's 2016 Traction and Electrical Standard Rail Yard Lighting

2.2 Physical Constraints

The existing physical environment coupled with the engineering challenges of linking to a live rail line as well as the need to legally stop the connection provided by Railway Road produce a range of physical constraints for the Freight Hub that require and/or drive engineering solutions. Key physical constraints that have influenced this concept design are summarised in the following sections.

2.2.1 Natural Topography and Rail Gradients

The existing NIMT generally rises away from Palmerston North toward Bunnythorpe. However, the track is not evenly graded and contains rolling features colloquially known as "the Bunnythorpe dips", with low points where the NIMT drops to cross two watercourses in the section. The following Table 2 provides Track Elevation levels to illustrate the uneven grade.

Table 2 Level Changes on NIMT

Track Kilometrage[2]	Location Description	Level (m)	Variance from Proposed Hub Level (m)
141.500	South end of the Site – approximately Roberts Line	51.5	1.5m Higher
141.900	Local high section. Mid way between Roberts and Richardsons Line	53	3m Higher
142.650	First dip. Location of large culvert under yard	45.6	4.6m Lower
143.100	Local high section. 200m South of Tutaki/ Sangster Intersection	53.5	3.5m Higher
143.950	Local low second dip. 150m north of Clevely LX	48.4	1.6m Lower
144.200	Tie-in point to NIMT	50	None

For similar reasons, the Site contours vary, with high ground located between water courses and flood plans. Generally, landforms fall away from the NIMT in a south westerly direction.

To meet KiwiRail's maximum gradients in relation to connection to the NIMT, a flat Hub and other constraints, the Freight Hub level has been set at RL50m for the purposes of the NoR.

The final elevation selected is subject to further survey and design inputs but is not expected to vary significantly.

The final Site level will be achieved by cutting the high points and filling the low points across the Site, with up to 5-6m of fill[3] expected in some locations. Site earthworks are not balanced, and imported fill will be required to build up to sub grade level.

[2] Track kilometrage is the distance from the start of the NIMT – Wellington is kilometer zero

[3] Actual depth of fill will be greater than height difference due to topsoil strip and removal of any identified unsuitable material

2.2.2 Material Sourcing

- Earthworks - Close to 55% of material is expected to be won onsite. The balance estimated at 1.55 million m^3 will need to be imported. This material will vary from surplus cut (e.g. over burden from quarry operations or from other suitable consented source identified by the contractor) or existing granular sources (quarry or river), where higher quality fill is required for the design. The likely method of getting this material to the Site will be road cart using truck and trailers if sourced locally. The number of truck units available provide a constraint to this. Competition for material particularly granular material from other Projects such as Te Ahu a Turanga (replacement road to the closed SH3 Manawatu Gorge) and Otaki to Levin may also be a constraining factor and influence future design. Alternatively, material sourced from further afield can be transported by rail.
- Ballast - Initial site demand for the construction of the first tracks on the Site will be by road truck. Once Railway Road is closed, the perimeter road constructed and NIMT moved, a siding could be constructed to allow delivery of ballast from Otaki by ballast train.
- Rail - The initial requirements could be met by trucking in rail in 25m lengths. As the yard develops longer, 75m length could be supplied by rail reducing road transport requirements as well as the number of Site "Thermit" welds required[4].
- Box culvert units - A large number of concrete box culverts are required for the Freight Hub. Production has been assumed at 1 unit per day. Manufacture at multiple sites (around New Zealand) could reduce the supply timeframe with KiwiRail able to move units by rail. A temporary siding which is able to receive and unload wagons within the Site would be required.

2.2.3 Flooding and Stormwater

The Site is located to the east of the Mangaone Stream and is part of the wider Mangaone catchment. Catchments in the order of 1200Ha drain through the Site at three main locations:

- Northern section - Contributing upstream catchment some 623Ha via a flat wide and poorly drained area. Surface water is channelled through multiple culverts under the NIMT and Railway Road eventually discharging under a single culvert at Te Ngaio Road and into the Mangaone. The flood plain area occupies some 23Ha of the Site.
- Central section - Contributing upstream catchment is close to 596Ha and discharges at the low point in the current NIMT under the NIMT and through the Site. The flood plain within the Site is some 10Ha. The channel outlet is under Roberts Line and eventually to the Mangaone downstream of the Site.
- Southern Section - Servicing a small 20 Ha catchment. It drains away from the Freight Hub Site to the west, around the Roberts Line / Richardson Line intersection, to then turn to drain to the northwest and eventually to the Mangaone Stream below 815 Roberts Line.

To manage stormwater through the Site the following treatments are proposed at this time prior to detailed design when the culvert sizes will be informed through required modelling.

- Northern End - Twin box culverts under the NIMT and yard connections. Final dimensions will need to be confirmed during detailed design. The culverts are intended to discharge to an open planted channel that runs parallel to the log yard entry track before transitioning to box culverts under an access road and other facilities. The culverts will discharge to another open planted channel section before crossing under the new perimeter road in box culverts to discharge to the Mangaone Stream in the same location as at present.
- Central channel - This channel under Sangsters Road and under the Freight Hub site will be culverted for the whole length some 650m using twin box culverts. Final dimensions will need to be confirmed during detailed design. There is no opportunity to utilise open channel sections here as it crosses almost perpendicular to all yard tracks, under the container and freight forwarding facilities. The western discharge point will be at same downstream location of the Hub site as at present.

The creation of the Site will remove area (capacity) from the flood plain. The Site will also have reduced surface permeability associated with new buildings and the large area of hardstand and roading that will be constructed. This will result in increased runoff from the Site and potentially downstream flooding impacts.

[4] the yard trackwork will be fully welded. This will reduce help reduce rail joint noise.

These effects are proposed to be managed with two stormwater attenuation wetland ponds located between the perimeter road and the Mangaone stream. The area of land required for two larger ponds is approximately 6Ha and 7Ha although the actual footprint of the ponds is smaller. A third smaller pond is to be located along the southern (Roberts Line) boundary.

From a stormwater perspective, the following engineering constraints have been considered:

- The Freight Hub level needs to be sufficiently high to provide a discharge gradient for stormwater.
- The ponds need to be located downstream of the Freight Hub and before the Mangaone Stream.
- The ponds need to be located outside of the flood plain.

Details of the proposed flood and stormwater management approach and site treatment are contained in the Stormwater and Flooding Assessment (Technical Report G).

2.2.4 Geological Considerations

To date, civil works have assumed that a significant portion of the cut material is suitable for reuse. The Preliminary Geotechnical Assessment Report has identified several risks that will need to be addressed these are ranked as follows:

- Liquefaction / lateral spread and soft ground (high risk) - The focus is on areas of the Site within flood plain and surface water channel areas where the depth of low quality fine silty material could be high. Generally, these areas are un-weathered Holocene alluvium, containing recent alluvial gravels sand, silt, mud, and clay with peat.
- Earthworks (high risk) - Compaction criteria, quantities and zones will require definition. The cut area comprises old, elevated river terraces containing weathered material, poor to moderately sorted gravel with loess, sand, and silt.
- Slope stability - This will be particularly relevant to the stormwater detention ponds. If permeability requirements cannot be met lining may be an option. Batter slope for the larger fills will need careful consideration.

As of yet, a detailed site investigation has not been undertaken. Provision has been made within an indicative programme to allow a comprehensive investigation over the completed Site as part of future stages.

This work will inform the:

- Extent / volume of site material that can be reused.
- Expected bearing capacity that can be expected or developed at the formation level for design the Freight Hub element foundations.
- Requirements around preloading of ground to minimise settlement.

Refer to the Preliminary Geotechnical Assessment Report (Technical Report B) for further and more specific details.

2.2.5 Ecology

The watercourses have been assessed by Boffa Miskell and as outlined in the Assessment of Ecological Values (Technical Report F) no sensitive aquatic habitats or other ecological values were identified. Mitigation for stream loss will need to be considered through the detailed design process along with the provision for fish passage.

2.3 Roads and Connectivity

The need to provide for the rail connection from the existing NIMT to the Freight Hub has meant that Railway Road between Roberts Line in the south to Maple Street in the north will be stopped and the land will become part of the Freight Hub.

This means that all road connections to that section of Railway Road will be stopped and for those properties not part of the Freight Hub, new access connections will need to be provided. The roads / road connections affected from the south to the north are:

1. Roberts Line / Railway Road intersection - It will not be possible to travel north along Railway Road or east along Roberts Line.
2. Richardsons Line / Railway Road intersection - The existing Railway Road will become part of the Site and this section of Richardson Road will become part of the Freight Hub.
3. The private level crossing opposite Richardsons Line will be closed and a new accessway for the two properties (422 and 422A Railway Road) that use the level crossing will be provided along the unformed section of Sangsters Road south to Roberts Line. There will be no through route created along Sangsters Road for vehicles.
4. Te Ngaio Road / Railway Road intersection - The existing Railway Road will become part of the Site and most of Te Ngaio Road from Railway Road to Maple Street will become part of the Site.
5. Clevely Line West / Railway Road intersection - The existing Railway Road will become part of the Site and most of Clevely Line West will become part of the Site.
6. Clevely Line East / Railway Road intersection - The existing Railway Road will become part of the Site and the level crossing will be closed.
7. The private level crossing to 282 Railway Road will be closed.

KiwiRail has included a perimeter road to link from Roberts Line to south of Maple Street to provide connectivity and access into the Freight Hub, as well as to provide alternative access to Bunnythorpe once the section of Railway Road is stopped.

The Te Araroa Trail[5] will still be able to follow the Sangsters Road alignment.

2.4 Utilities and Key Infrastructure

2.4.1 PNCC Bore and Water Supply

The location and extent of the Freight Hub has been changed through the concept design process to avoid PNCC's existing water bore which is located at the south eastern end of the Freight Hub, adjacent to the Roberts Line / Railway Road intersection. The Designation Extent extends into part of the land that PNCC owns for the water bore. The section will be crossed by the main access track from the NIMT to all rail served facilities other than the arrival and departure yard. This area has also allowed for clearance from track to security fencing.

It is anticipated that KiwiRail will require a supply of potable water provisionally estimated at 50m^3 / day.

The Freight Hub operation will have other water demands including wash down. It is expected that the onsite stormwater collect system will provide sufficient capacity for these functions. In addition, onsite fire capacity must allow for a minimum of 120 minutes storage plus normal days operation for fire cells less than 800m^2 in area. For larger areas and activities with high fire loads the specific fire hazard rating makes fire engineering assessment necessary.

If fire capacity is to be provided from the PNCC water supply then a DN300mm main (estimated size) will be required to meet design flows.

2.4.2 Gas

The First Gas high pressure gas transmission pipeline to Hastings is provided by way of an easement running west to east across the Site (crosses into the Site 400m north of Roberts / Richardsons Intersection and offsite immediately North of Railway Road / Richardsons Road intersection).

The gas main will need to be relocated in advance of cut to fill earthworks in the southern section of the Site.

It is anticipated that the Freight Hub will require a gas service.

[5] Te Araroa Trail is a walking/tramping route, stretching circa 3,000 kilometres along the length of the NZ from Cape Reinga to Bluff. It is made up of a mixture of older tracks and walkways, new tracks, and link sections alongside roads.

2.4.3 Sewer

The PNCC wastewater rising main sewer that services Bunnythorpe runs from the Pumping station on Kairanga -Bunnythorpe Road then along Te Ngaio Road and Railway Road. At the southern end of the Site the system changes to a gravity main.

A new potential route along Te Ngaio Road, the perimeter road, Roberts Line and then continuing south along Railway Road to connect to the gravity system has been identified.

Initial work estimates that two onsite pump stations will be required to service the Site and connected to the rising main. The current and recently replaced main may need to be resized (currently 100mm) to accommodate future discharges from the Site. The increased capacity will occur after the first Freight Hub connection point and extended through to the discharge point into the DN475 gravity sewer near El Prado Drive.

2.4.4 Power and Transmission Lines

Access to electricity will be a key service requirement and work will need to be undertaken in conjunction with supply authorities to ensure that there is enough supply for the Site's requirements and operation.

Once supply points are known, local reticulation across the Designation Extent will need to be removed. This will occur on the following roads:

- Railway Road
- Te Ngaio Road (approximately 200m south of Maple) to Railway Road
- Clevely (from Railway to 400m south of Roberts Line).

Transmission lines currently cross the northern corner of the Designation Extent. The two circuits cross the NIMT on lattice towers before being split to two HV pole lines as they cross Marple St. These lines eventually join Kairanga – Bunnythorpe Road (100m South of Te Ngaio Road) running down each side of the road. The Freight Hub is not expected to impact on this infrastructure.

2.5 Risk

As the design is developed to a greater level of detail than the concept plan, several risks that have been identified are expected to be addressed through further design work.

2.5.1 Ground Conditions

As noted, there have been no site investigations to confirm the underlying conditions. A comprehensive ground investigation will need to occur as part of the next stage.

2.5.2 Flood Risks

While there is a risk of flooding at the Site, it is anticipated that it is possible to minimise the potential for increasing the flood risk on other adjacent sites and to ensure that the Freight Hub itself would not be subject to flooding over time.

It is recognised that more detailed modelling work and information will be required in the next stage to refine the concept parameters and for robust detailed design to occur and the required regional consents obtained.

2.5.3 Dimensional and Topographical Data

The survey information available and used at this concept design stage is considered appropriate for the Freight Hub for establishing the Designation Extent. It is recognised that more detailed survey work and information will be required for robust detailed design to occur.

In addition, the Freight Hub team was advised by PNCC in 2019 that Moturiki, is the source for the ASML and that PNCC's old lidar data is in Moturiki vertical datum 1953 and it is 0.26m different from Vertical Datum 2016. New data has been released by PNCC but has not been used for the work to date.

These issues were identified during preliminary assessment works. The above issues can be addressed by undertaking site specific Lidar and control surveys. A decision was made to delay this work and include as part of the detail design.

2.5.4 Bunding for Specific Activities

For safe management of bulk fluids' provision has been made for containment bunding around the bulk liquid storage.

There are also smaller fuel facilities around the Site that will require appropriate levels of containment/spillage control. These will be identified and detailed during detail design process.

3. Freight Hub Description

The Regional Freight Hub is a new intermodal facility on the NIMT that processes services operating on the NIMT to and from the south (Wellington and the South Island and to destinations in Hawkes Bay) and north (to destinations such as Auckland, Hamilton and Tauranga, Wanganui and Taranaki via branch lines). The concept design needs to meet KiwiRail's operating requirements for its networks and respond to planned changes to the network. By using the infrastructure installed in the Hub, KiwiRail will undertake the assembly and disassembly and checking of trains in a systematic, safe, and expeditious manner in order to make the use of rail to move freight more attractive.

3.1 The Freight Hub Site

KiwiRail has developed a master plan for intermodal freight hubs. The master plan has been applied to the Site, but it has been adjusted as required to address the local environment and related constraints.

The Site is sufficient in size to accommodate the operational aspects identified in the master plan and includes, roading access and areas that are needed to manage the environmental effects of the Site. These are primarily related to the management of stormwater discharged from the Site but also required for noise mitigation and planting for visual mitigation.

The key parameters of the Site are set out in Table 3 below.

Table 3 Freight Hub Site Statistics

Element	Basis/Reference
Operational Footprint	The Freight Hub operational footprint is **130 Ha** This is determined by the elements included in the concept design amended to recognise the specific constraints of the Site.
Freight Hub Operational length	The Site's length is **2850m** determined by the need to provide for 1,500m long trains in the future.
Freight Hub Operational width	The Site's width is **630m** determined by the layout of the tracks, access roads and key elements from the Concept design.
Stormwater management area	**13.5 Ha** Area required to manage Stormwater generated from the Site. Land is required for the construction of two stormwater attenuation ponds downstream of the Site.
New Roading	**11.8 Ha** land is required for the formation of a new perimeter Road (along the western and northern boundaries) and related intersection works to Roberts Line. The perimeter road to provide access to the Freight Hub and alternative access once Railway Road is closed.
Sangsters Road	**1.8 Ha** Area of Sangsters Road required for earthworks related to the installation of drainage structures (culverts) and the formation of new accesses.
Existing Road	The total area of legal road currently vested in PNCC (excluding Sangsters Road) designated is approximately 15.8Ha. This includes 3.4Ha unnamed unformed roads in the northern end of the Designation Extent.
Noise and visual mitigation	Approximately **19.5Ha** of land that will be utilised for noise and visual mitigation including the current NIMT corridor and land to the north between the new road and Maple street.
Total Project Area	**177.7Ha**.

3.2 Key Elements

The key elements managed by KiwiRail are:

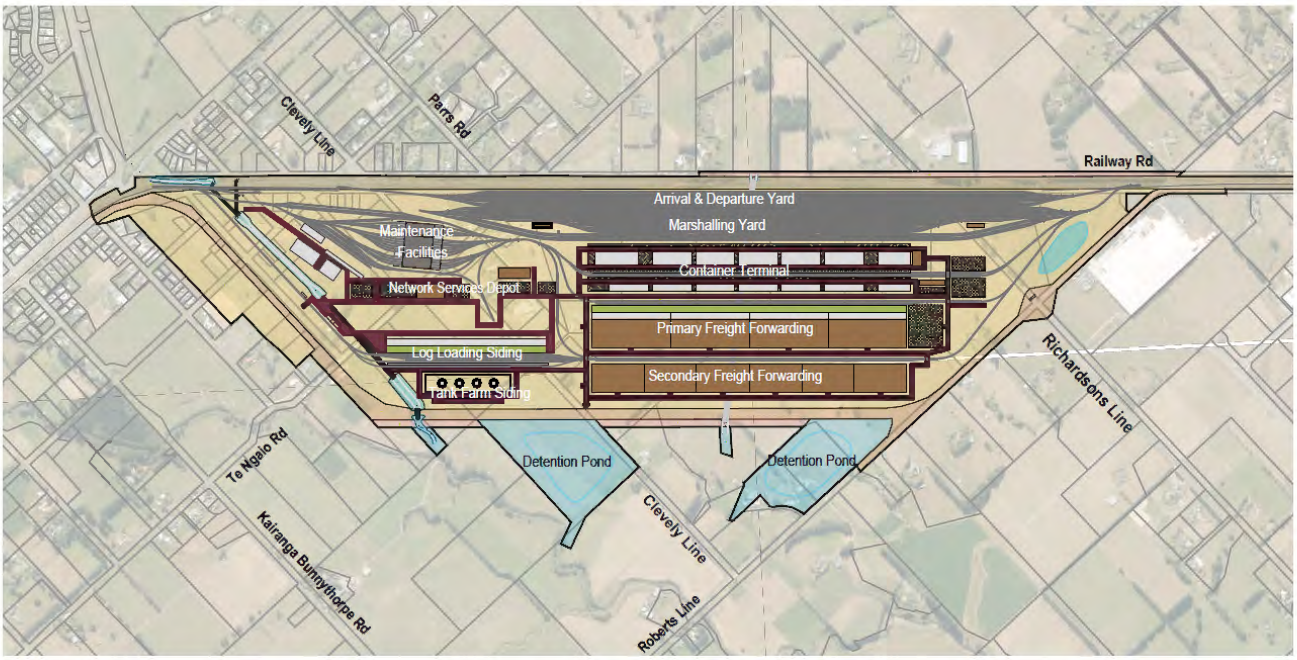
- Arrival and Departure Yard – with an 8-track configuration to provide the ability to stage a long train on any track. The yard will have some / all of the tracks provided with overhead electrification.
- Marshalling Yard – with 12 tracks configuration to provide the ability to build 900m and 1,500m long trains. In addition, the yard has 2 "bad order" roads (tracks to hold broken or damaged wagons for repair) which are 300m long and a run round track to allow movement from one end of the yard to the other.
- Container Terminal – with four tracks providing easy access for direct arrival and departure of unit trains. The configuration with two hardstand islands where containers are removed from or loaded on to wagons and where containers are stored in stacks (up to three high), and the ability to connect to power for refrigerated units.
- Maintenance facilities – where wagons, locomotives (diesel and electric) and Rail related equipment is maintained and repaired with 15 tracks and a maintenance yard that includes 4 equipment storage tracks, a triangle to turn locomotives, maintenance tracks for containers and side-curtain wagons, as well as locomotive fuelling and sand loading facilities.
- Wagon and locomotive storage.
- Network Services Depot – where the regional teams responsible for the maintenance and repair of the track, structures, signals, power, and other railway infrastructure store materials and operate from.
- Freight Operations Facility – where KiwiRail staff who operate the Freight Hub will be based.

In addition, KiwiRail's commercial partners will have direct access to Rail Service for the following:

- Freight Forwarding Private Sidings over approx. 17ha with buildings that are expected to be up to 3 storeys high, with access to a common loading and unloading track so they can be serviced directly from rail.
- Tank Siding that can be serviced directly from rail.
- Log Loading Siding that can be serviced directly by two 450-metre-long tracks.

The Site has potential for the provision for an Inland port facility to be incorporated in the design.

Figure 2 Freight Hub Concept Design with key Elements Identified



The concept design anticipates the following elements will also be included in the Freight Hub:

- Run around tracks to service different parts of the Site with a limited number of level crossings where the tracks intersect with internal roads.
- Equipment wash stations – including for wagons and locomotives and equipment.
- Building services including office space, staff facilities and parking.
- Separate outdoor training area for fire training, confined space, fall protection.
- Materials storage areas (Sleepers, Rail lengths, Ballast stockpiles, Cables, Traction/Signals poles) and parking for heavy trucks, forklifts, and other heavy equipment.
- Internal parking areas.
- Weigh bridges e.g. for log trucks.
- Stacking of containers by fixed and mobile cranes.
- Fueling on the Marshalling Yard and Arrival/Departure Tracks with fuel stored onsite (underground tanks) piped to the tracks. LPG will also be stored onsite. Air will also be supplied to the Arrival/Departure tracks.
- Spill containment will be required in relation to some activities such as use of drip trays and concrete surfaces to contain, collect, and treat spills.
- Tracks on ballast with sleepers made of concrete and provision for maintenance roads between pairs of tracks in all yards.
- Overhead lighting in all yards with the possibility of providing underside lighting on tracks.
- Security to include fencing, CCTV, lighting, remote gates.
- Areas for noise mitigation and landscape planting.

3.3 Internal Roading Design

The following matters will be considered at detailed design with the objective of reducing the number of internal level crossing points and will also look to avoid multiple track crossings.

Table 4 Roading Design Parameters

Parameter	Basis/Reference
Zero Harm	An approach to occupational safety with the goal to operate a workplace without exposing an individual to injury through the implementation of safe work systems.
NZTA / KiwiRail's Level Crossing Risk Assessment Guidance (5 July 2017)[6]	Any new crossing must be designed with a Low or Medium-Low Level Crossing Safety Score risk.

To optimise equipment and personnel movements, safe operations and to promote efficiencies in management and operations within the various working groups, the concept design provides:

- Vehicular access from the opposite side of the terminal from the mainline.
- A perimeter road along three sides of the Freight Hub (not including the mainline side).
- The concept provides for multiple connections from the perimeter road (one each on the northern, western, and southern boundaries) to the local road network each with security gates at multiple terminal access locations to control access.

[6] https://www.kiwirail.co.nz/assets/Uploads/documents/673ec0236e/LevelCrossingRiskAssessmentGuide.pdf

- Grouping of services / facilities such as offices, and staff amenities (lunchroom, toilets, showers, lockers), staff and visitor parking and equipment and materials storage.

3.4 Lighting Design

A provisional lighting design has been completed. The relevant parameters used in the lighting design are set out in Table 5 below:

Table 5 Lighting Design Parameters

Parameter	Basis/Reference
KiwiRail's specified standard EN 12464-2	KiwiRail's operational requirements for outdoor activities.
Performance standards from Rule R12A.4.1 in the PNCC district plan for lighting in relation to boundaries	• Exterior lighting must be designed and installed to ensure compliance with AS/NZ Standard 4282:2019 - Control of the obtrusive effects of outdoor lighting. • Any artificial lighting must be shielded from the approach and take-off paths to and from the Palmerston North Airport.

This preliminary design work was completed prior to the decision to relocate the NIMT from its current alignment and into the Freight Hub, a westward shift of approximately 20m. This shift does not impact upon the detail of the lighting layout as poles will move laterally a similar amount increasing the distance of the pole (and light source) from the rail boundary and as a result from adjoining residential properties east of Sangsters Road.

The proposed design uses a combination of pole sizes to effectively light the Site as follows:

- Typically for open track areas 22m poles with single or double heads;
- Around lower structures and onto roadways carpark areas typically 7.3m residential height poles with single or double heads and 900mm outreach arms; and
- Larger structures and buildings typically building mounted poles at 12m.

Specific detail is provided in the Lighting Design Report appended as Appendix B to this report.

3.5 Buildings and Outdoor Storage

The following outlines some of the parameters that apply to the Site and its design:

- The Freight Hub is outside the Airport Zone Precincts but falls within the Horizontal Surface protection area for the airport (horizontal surface is at 90 metres AMSL[7]) identified in the District Plan.
- All buildings and structures are expected to be able to comply with R13.4.7.1 (Airport Protection Surface). That rule requires that no structure, building, tree, or other object shall impinge within the surface. Using the assumed Freight Hub level of RL50m (notwithstanding issues identified in section 2.5.3) the highest structure is the lighting towers which will be at RL72m, comfortably below the surface restriction.
- Approximately 50% of the Site falls within the NEIZ. It is noted that under Rule 12A.4.1 the maximum height of buildings is limited to 9m. All buildings and most fixed structures, apart from lighting poles, are expected to be no more than 9m.
- To reduce heavy metal contaminants entering the stormwater system, the Stormwater and Flooding Assessment (Technical Report G) recommends the selection of building materials to limit the generation of contaminants such as zinc.

[7] Height above Mean Sea Level set using Moturiki for the vertical datum

3.6 Safety, Security and Environmental Management

- Security will include fencing, CCTV lighting and security gates.
- Overhead lighting will be provided in all yards.
- Designated safe working zones will be identified in all yards and areas of conflict of people with moving equipment will be identified and managed appropriately.
- Spill containment – concrete surfaces to contain, collect, and treat spills and fuelling locations in the Marshalling Yard and Arrival / Departure Tracks, and approaches to Maintenance work bays.

3.7 Landscaping /Amenity Planting

- As shown in the landscape plan in Appendix C to the AEE, the Site is expected to be planted extensively in non-operational areas.
- Security fencing must conform to the KiwiRail's requirements and for the most part is unlikely to be visible.
- Species selection is expected to include River Plain, River Terrace and wetland species.

Ideally development of landscape planting early in the construction sequence will allow establishment of planting so that the screening effect can be achieved earlier. The large site and locations of significant planted areas near or outside the Operational Hub area makes early planting easier as long as earthworks are completed.

4. Construction Description

4.1 Outline of Construction

A key milestone in relation to the construction of the Site is the completion of the bulk earthworks – that is up to formation level. This will end the pre-implementation work and allow construction of track work, hardstand areas for container, freight partner facilities, maintenance buildings and internal roading as identified in Stage 1. Refer to Table 7 Interim Indicative Demand and Staging Timeline

Stages 2 and finally stage 3 will complete the construction of Freight Hub facilities. Completion of foundations construction (the last 700mm) can proceed as demand and the construction timetable determines.

The estimated total volume of bulk earthworks required is detailed in the following Table 6. Quantities are rounded to the nearest 10,000m^3.

Table 6 Estimated Bulk Earthwork Volumes Considering a Hub Elevation of EL50m

Item	Quantity (m^3)	Comments
Topsoil strip	780,000	Strip to stockpile for use in noise bunds and landscape planting areas. Topsoil depth assumed at 0.5m across site could be deeper in low lying areas.
Total Fill required	2,830,000	The calculated volume of Fill required after topsoil strip to build yard up to formation level. This quantity reduced by the amount of material won onsite (cut to fill) to define the shortfall in material (imported fill)
Cut to Fill	840,000	Estimated volume from within the Hub Footprint- Lowering high ground to RL49.3m.
Cut to Fill	440,00	Estimated volume of material excavated to form the two external stormwater detention ponds.
Imported Fill	1,550,000	Material requirements could vary from clay through to granular material and will be determined from result of the geotechnical testing and onsite soil parameters.

Although initial estimates show that close to 55% of material could be available onsite, fill sources for the imported fill operation need to be identified and plans for the movement of fill to the Site confirmed. In the detailed design phase KiwiRail will consider options for reducing earthwork volumes and offsite material handling. There is potential for the quantity of earthworks to be reduced through site level reduction (with and without NIMT integration works), benching within the Site and through onsite material reuse, with a positive analysis of Site soil conditions. Final Site levels will also need to consider drainage from and through the Site.

Based on 15m^3 capacity (truck and trailer), imported material will require an estimated 145,000[8] trips over a 2 -year period allowing for winter breaks of 3 months. Surplus strip material will be backloaded.

Realigning the NIMT will provide room for future double tracking of the NIMT and increasing the separation to adjoining properties as well as providing more space for noise mitigation and landscape planting.

Regrading to match the Freight Hub longitudinal profile will allow improved operational flexibility - mid yard cross over connections and have a positive impact by eliminating operational noise associated with the "Bunnythorpe Dips".

4.1.1 Site Preparation – Pre-Implementation

Regional resource consent applications will be made prior to commencement of bulk earthworks. It is expected that environmental controls, erosion and sediment controls and the piping of overland flow paths and stream diversions will need to be installed and audited to ensure full compliance with consent conditions. This includes extension or alteration of culverts that currently run under the NIMT and Railway Road and closure of the level crossings through the Freight Hub and provision of alternative accesses.

[8] The number of trips calculated from the total imported fill divided by the truck capacity 15m^3 with a bulking factor of 1.4

The size of the Site will mean that dust will need to be managed carefully. Expected methods of control are water and / or polymer soil stabilisers for bare surfaces. A water spray system could use upwards of 100,000 litres per day, necessitating a secure onsite water supply or connection to the PNCC system. The use of rolled and compacted granular surface at the subgrade top of bulk earthworks level will reduce dust nuisance.

Constructing the detention ponds early is critical to successful Site environmental control, and once built and operational allows for the construction of the perimeter road including the new PNCC sewer rising main.

Northern noise mitigation and landscape planting is to follow, with planting continuing to the detention ponds and along the western Boundary of the Site.

Once the perimeter road is operational, Railway Road can be stopped and the Designation Extent clear with unrestricted access to the NIMT and eastern boundary.

In order to construct noise mitigation (and complete landscape planting) on the eastern boundary and in particular along the formed port of Sangsters Road and northwards, a formation to take the relocated NIMT is a high priority in the construction sequence.

Stream channels will still flow through the Site, until these can be culverted silt control measures will need to be in place within the working area.

4.1.2 Freight Hub – Floor

The intention is to complete the bulk earthworks over the Site before construction of the Freight Hub begins.

The site stormwater collection system will need to be in place and functioning sufficiently to capture onsite rainfall which is to either be stored for reuse during construction (sprayed as dust suppressant) or discharged to the detention ponds. Systems shall comply with current best practice and KiwiRail standards at a minimum.

Track construction will comply with KiwiRail standard details[9].

All undertrack structures shall be designed for 250 tonne axle loadings. Due to the span, the box culvert units shall be designed as if it were a 'bridge'.

Ducts and cables shall be located clear of the formation and drains. The design shall conform to KiwiRail's requirements.

4.1.3 Freight Hub - Above Ground Development

It is anticipated that the Freight Hub would be developed over time. An indicative analysis of interim demand and potential staging has been provided below in Table 7. The staging assumes that initial rail operations will commence in or around 2030 and the Freight Hub will be fully developed by 2050. The scenarios for implementation are based on assumptions that predate the impact of Covid 19 on New Zealand's economy. In that respect they can be considered optimistic scenarios.

[9] KiwiRail drainage & formation Details reference document CE100862

Table 7 Interim Indicative Demand and Staging Timeline

Functional Areas	Stage 1 2030 Full Demobilization from Tremaine Ave	Stage 2 2040	Stage 3 2050 Full Implementation	Area m²
Arrival/Departure Yard	2 Tracks (1500m trains); no pull backs required	4 Tracks (1500m trains); south (PN) pull back should be considered	8 tracks	83,100
Marshalling Yard	12 Tracks	15 Tracks	15 tracks	106,500
Wagon Storage Yard	1 track 900m long 50% - of capacity. marshalling tracks can be used to cover storage shortfall if required	2 tracks (100%)	2 tracks	14,400
Container Terminal	Full development. Refrigerated containers included. 3 Pad Tracks. Office, Truck and Car Parking.	Full development. Refrigerated containers included. 3 Pad Tracks. Office, Truck and Car Parking.	Full development with 8000 TEUs pa / 180 refrigerated	176,000
Maintenance Facilities:				
Wagons, Locomotives	Main maintenance Building + 50% supporting buildings(storage)	Full implementation	Full implementation	130,000
Network work Equipment	75% supporting buildings and shed areas	100% supporting buildings and shed areas	100%	43,000
Network Services Maintenance Depot and Terminal Operations	100% (see appendices for details)	100%	Depot and terminal building	2,700
Freight Forwarding Sidings- Prime Facilities	2 Warehouses (50% of full capacity) plus 50% of track required to service area	3 Warehouses (75% of full capacity) plus 100% of trackwork required to service area	4 Warehouses	90,000
Freight Forwarding Sidings: Secondary Facilities	2 Warehouses (33% of full capacity) plus Trackwork	4 Warehouses (66% of full capacity)	6 Warehouses	60,000
Log Loadings	1 track 450m long (50% of planned max capacity)	2 tracks each 450m (100%) includes northern connection to main	2 tracks	51,600
Tanks	0 Tanks	2 Tanks (accordingly to needs)	4 tanks Diameter 20m 5m tall	87,500

4.2 Indicative Construction Programme

Consideration has been given to a construction programme that commences at lodgement of the NoR through to the initial establishment of the Freight Hub operation. Indicative timeframes identified are set out below.

- **Start of construction onsite 3.5 years**.
  Principal elements within this period are:
  - regional Consents - 1 year
  - comprehensive Site geotechnical assessment, testing, and technical specs – 20 weeks
  - detail design – 40 weeks
  - secure funding for stage 1 – 26 weeks
  - engage Contractor – 15 weeks
  - preparation and approve various plans- Environmental, CTMP– 16 weeks
  - order and manufacture of Box culverts (estimated 950 Units) -95 weeks.
- Bulk earthworks to subgrade level - 3 years minimum. Principal Elements in this period area:
  - stripping of Topsoil and Unsuitable material - 36 weeks
  - excavation and preparation of the detention ponds - 24 weeks
  - cut to fill - 45 weeks
  - place Imported fill - 75 weeks
  - construction of perimeter road - 12.5 weeks
  - build new NIMT track in the Freight Hub site - 11 weeks
  - placing of box culverts - 48 weeks
  - construction of noise bunds and planting - 7 weeks.
- Freight Hub Construction (to Complete Stage 1, 2030) estimated 3 years. Principal elements in this period area:
  - construction of rail track work for yard – 3 years
  - major freight forwarder building - 12 months
  - secondary freight forwarder - 8 months
  - container Terminal – 18 months
  - parking and roading – 18 months
  - other structures – 8 months.

The indicative steps above shows that to commission the yard in or around 2030 construction of facilities will need to occur on multiple fronts.

5. Operation

5.1 Freight Movement on the Rail Network

5.1.1 Current Train Services

In 2018 there were 11, 757 freight trains travelling to / from / through Palmerston North. There were more movements to the north than to the south as shown in Table 8 below.

Table 8 Freight Train Movements North and South of Palmerston North

Direction of Movement	Total Freight Train Movements 2018
North (through Bunnythorpe)	5969
South (to Napier and to Wellington)	5788

The average daily start is 45.2 however in 2018, 95% of the weekly traffic ran Monday to Friday. Table 9 contains the daily summary of train starts by day of the week with an estimated daily peak factor included.

Table 9 Daily Summary of Train Starts by Day of the Week in 2018

		Sunday	Monday	Tuesday	Weds	Thursday	Friday	Saturday	Total
Five-day average	78	5	67	81	81	81	79	17	411
Peak factor			0.86	1.04	1.04	1.04	1.02		

In 2018, 13 % of freight moved through the Existing Freight Yard originated in Palmerston North and 12% was destined for Palmerston North. The largest commodity by net weight leaving was logs and the largest coming to Palmerston North was Freight Forwarding. By weight, the largest volume of commodities was transported on through trains (75%).

The largest volumes are hauled between October and December for through traffic and commodities destined for Palmerston North. The largest volume of commodities (primarily logs) departing Palmerston North are between March and June.

Palmerston North's rail freight service, due to its central location on the NIMT and distribution function, is impacted jointly by national freight growth, as well as growth in the Manawatu region.

5.1.2 Freight Growth

For planning purposes, a 30-year horizon has been adopted for this project. This is based on a 10-year site development stage with relocation of services from the Existing Freight Yard on Tremaine Avenue at the end of that period (2030), and 20 years of operation with development of the Site in two operational stages reaching full development at 2050. As such, demand forecast is out to the year 2050, which is appropriate for a project of this scale.

Nationally, the freight task in terms of tonnage was forecasted pre Covid-19 to increase by 45 per cent out to 2052 / 2053. Future commodity estimates were used to estimate the size of the various facilities within the Freight Hub. It is considered that this growth may be optimistic in the short term.

5.1.3 Changes to Freight Services

To accommodate the predicted freight growth, KiwiRail plans to operate 1,500m long trains along the NIMT between Palmerston North and Auckland. The service from Palmerston North south to Wellington as well as branch line services, will continue to operate trains of up to 900 metres in length.

New wagons based on changes proposed by KiwiRail will have larger carrying capacity Loadings per wagon are not expected to change much in the short to medium term because of the relatively light density of the commodities being hauled.

As such, there will not be much opportunity to absorb increased weight with this new equipment. The additional business will generate more train traffic for the shorter 900 metres trains.

Improved systems coupling between wagons / locomotives have been proposed. The Freight Hub will roughly double the trailing load of future trains, longer trains of 1,500 metres (65% increase in length) on the northern portion of the NIMT will be able to absorb some of the increased box and container traffic running Northbound and Southbound between Palmerston North and Hamilton/Auckland.

Further, there is the potential for reinstatement of the Stratford-Okahukura Line (SOL) to service Fonterra's existing dairy plant in Whareroa. Should this occur, there would be a reduction in traffic into Palmerston North by approximately 570 trips a year.

It is considered that based on forecasts for Palmerston North, even though there will be a 28% increase in tonnage / business through the Site from 2017 / 18 to 2052 / 53 (excluding logs), there will be a 9% net reduction in the number of trains at Palmerston North. This is based on 2018 train traffic data associated with running longer trains north of Palmerston North, and if reinstatement of the SOL occurs.

5.2 Freight Hub Operation

The Freight Hub is expected to operate seven days a week. The Freight Hub operations, equipment maintenance, and network services facilities will continue to operate 24/7 to ensure that they can meet programmed requirements and respond to unplanned events across the network.

Freight forwarding facilities will be expanded based on forecasted regional growth and increased demand for rail freight services, with changes away from reliance on roads to move freight longer distances. It is expected that Freight Forwarding facilities and the Container Terminal will be operating 7 days per week, with service to the rail connected Freight Forwarders provided by a common service track for daily inbound and outbound traffic. The Container Terminal will be able to arrive and depart unit trains directly from the terminal. Similarly, the Log Loading facility will also be able to arrive and depart unit trains directly from off their loading tracks.

Access to KiwiRail's operations will be restricted for security and safety reasons. It is anticipated that noise and other operational effects that impact outside the designation boundary will be managed as required by the conditions of the designation and any relevant regional consents.

5.3 Access Roads

In order to develop the Freight Hub and have safe connection to and from the NIMT it is necessary to close Railway Road. As a result, a new road needs to be constructed to provide access to the Freight Hub, which will also provide alternative public access.

Railway Road is a heavily used link for commuters accessing the eastern suburbs of Palmerston North. Furthermore, it provides a transport link to Fielding and to Ashhurst and the Gorge from the airport and the NEIZ avoiding city routes.

KiwiRail considered a number of options for this route and early consultation documents showed a non-specific connection from the north western corner of the Site out to Kairanga – Bunnythorpe Road. This option could tie into a future Western by-pass of Bunnythorpe making the Feilding commuter trip more direct. However, given the lack of detail of this future route at the time of preparing this NoR, there is insufficient certainty about the ability to connect into this by-pass.

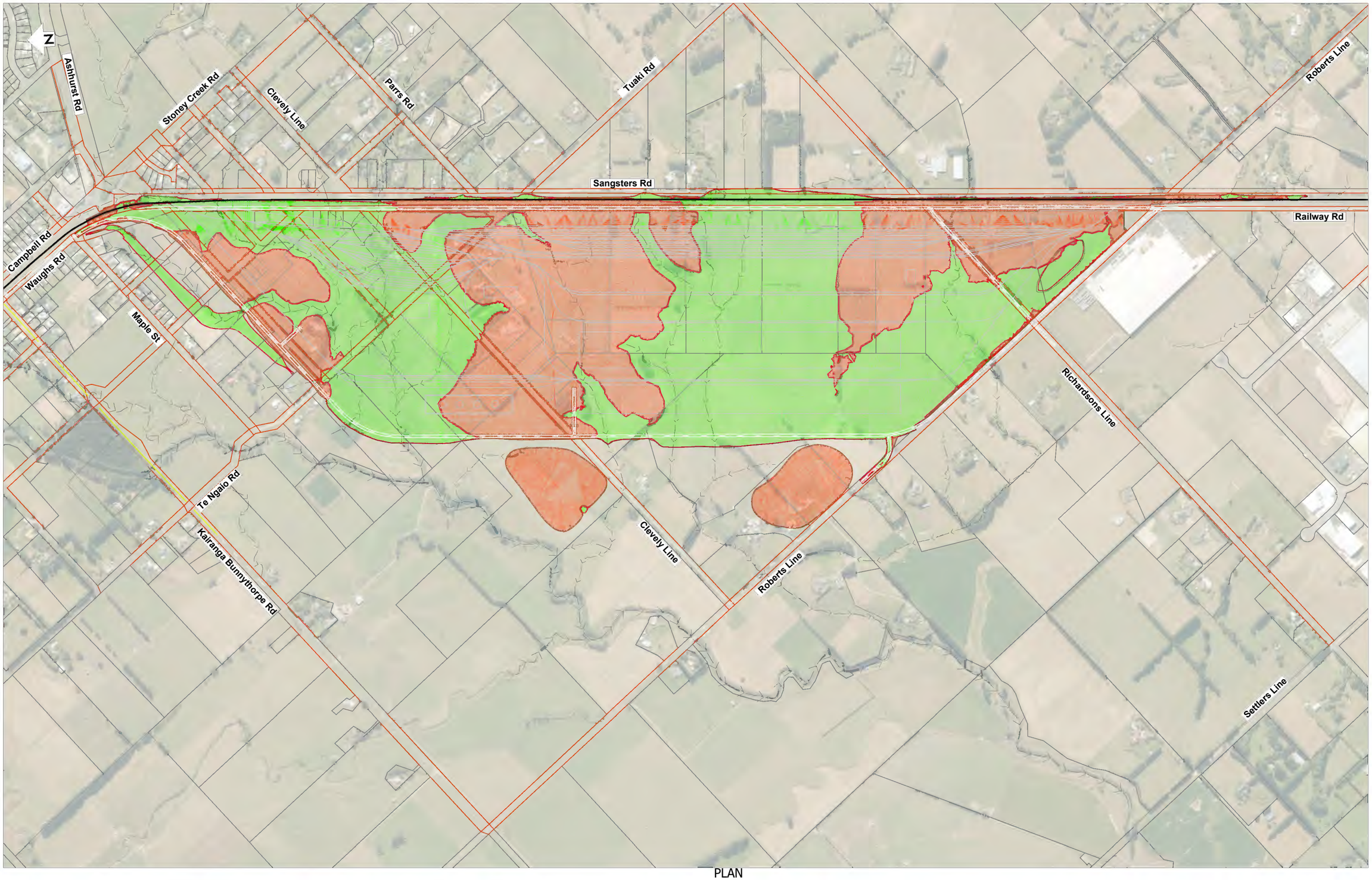
A second option considered was to use Roberts Line, although this made access to two of the proposed hub's entry points problematic without further roading connections from the existing road network being provided.

Both of these options also used Kairanga – Bunnythorpe Road to connect to Bunnythorpe. The section of Kairanga – Bunnythorpe Road from Te Ngaio Road to Bunnythorpe contains two narrow and weight restricted Bridges (Mangaone and Jack's Creek). There is currently no specific programme to replace or upgrade these structures so KiwiRail determined that that route, at least at this current time, could not be used until upgrades were completed.

As a result, KiwiRail considered that the perimeter road option around the western side of the Freight Hub would provide the most efficient and effective roading connection at this time. That connection does not preclude connections to future upgrades to the wider regional network.

Appendices

Appendix A Site Earthworks- Cuts and Fill



PLAN
SCALE 1:10,000

EARTHWORK CUT FILL OVERVIEW
FINISHED YARD LEVEL RL 50.0m
YARD EARTHWORK RL 49.3m

VOLUMES BASE ON TOPSOIL STRIPING OF 0.5m
AND YARD LEVEL - ROADING BASE RL 49.3m

PRINT DATE 16 October 2020

EARTHWORKS:
CUT
FILL

100 50 0 100 200m
A1 SCALE 1:5,000 A3 1:10,000

KiwiRail Stantec

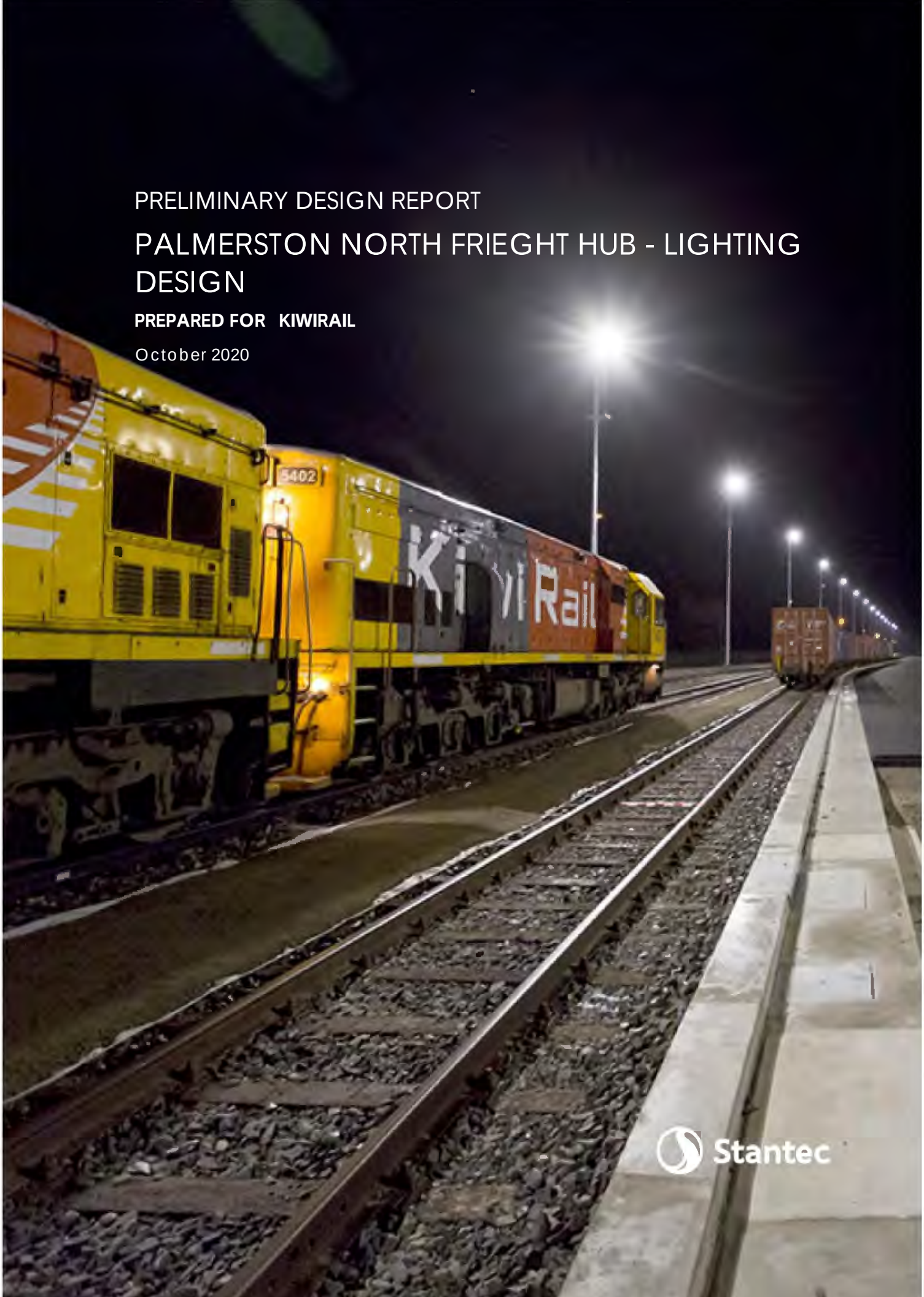
Job No: 310003007

REGIONAL FREIGHT HUB
SITE EARTHWORKS
CUT - FILL

Drawn By: DCG
Scale: 1:5000

FIG: 118

Appendix B Lighting Design Report



PRELIMINARY DESIGN REPORT

PALMERSTON NORTH FRIEGHT HUB - LIGHTING DESIGN

PREPARED FOR KIWIRAIL

October 2020

This document has been prepared for the benefit of KiwiRail. No liability is accepted by this company or any employee or sub-consultant of this company with respect to its use by any other person.

This disclaimer shall apply notwithstanding that the report may be made available to other persons for an application for permission or approval to fulfil a legal requirement.

QUALITY STATEMENT

PROJECT MANAGER	PROJECT TECHNICAL LEAD
Jon England	Karen Bell

PREPARED BY		
Ian Campbell	.....	22/10/2020
CHECKED BY		
Karen Bell	.....	22/10/2020
REVIEWED BY		
John Fulton	.....	22/10/2020
APPROVED FOR ISSUE BY		
Jon England	.....	22/10/2020

DUNEDIN
Level 3 John Wickliffe House, 265 Princes Street, Dunedin 9016
PO Box 13-052, Armagh, Christchurch 8141
TEL +64 3 477 0885, FAX +64 3 477 0616

REVISION SCHEDULE

Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by
A	28/07/2020	FINAL	IC			
B	22/09/2020	FINAL - LAYOUT CHANGES	IC			

KiwiRail

Palmerston North Frieght Hub - Lighting Design

CONTENTS

APPENDICES

1. Background

In conjunction with the proposed Regional Freight Hub (Freight Hub)north of Palmerston North, new lighting is required for the internal access roads, car parks and outdoor operational areas. The outdoor operational areas include the maintenance facilities, network services depot, log loading siding, tank siding, rail marshalling yard, container terminal and freight forwarding private sidings.

2. Scope

This report specifies the performance and light technical parameters (LTPs) of the lighting design required to achieve compliance with specific KiwiRail requirements, as well as relevant AS/NZS standards.

Power supply requirements associated with the proposed lighting is excluded from this design report.

3. Applicable Lighting Levels

The standards applicable are:

AS/NZS 1158.3.1: Part 3.1: Pedestrian area (Category P) lighting - Performance and design requirements

AS/NZS 4282: Control of the obtrusive effects of outdoor lighting

E-ST-EL-0131: Traction and Electrical Standard

As requested by KiwiRail, the lighting for the internal access roads and car parks has been designed in accordance with the relevant parts of AS/NZS 1158.3.1 and the outdoor operational areas have been designed in accordance with E-ST-EL-0131. Spill light isolux lines have been provided (on the layout drawings) as guidance against the requirements of AS/NZS 4282.

3.1 Basis of Design – Internal Access Roads

Based on the selection criteria from Table 2.1 of AS/NZS 1158.3.1, the lighting subcategory PR5 was applied to the internal access roads. Refer highlighted portions of the table below.

Table 2.1 from AS/NZS 1158.3.1:

TABLE 2.1

LIGHTING SUBCATEGORIES FOR ROAD RESERVES IN LOCAL AREAS

1	2	3	4	5	6
Type of road or pathway		Selection criteria[a,b]			Applicable lighting subcategory[c,d]
General description	Basic operating characteristics	Pedestrian/ cycle activity	Fear of crime	Need to enhance amenity	
Collector roads or non-arterial roads which collect and distribute traffic in an area, as well as serving abutting properties	Mixed vehicle and pedestrian traffic	N/A	High	N/A	PR1
		High	Medium	High	PR2
		Medium	Low	Medium	PR3[f] or PR4[f]
		Low	Low	Low	PR5
Local roads or streets used primarily for access to abutting properties, including residential, commercial and industrial precincts		N/A	High	N/A	PR1
		High	Medium	High	PR2
		Medium	Low	Medium	PR3[f] or PR4[f]
		Low	Low	Low	PR5
		N/A	N/A	N/A	PR6[e]
Common area, forecourts of cluster housing		N/A	High	N/A	PR1
		High	Medium	High	PR2
		Medium	Low	Medium	PR3[f] or PR4[f]
		Low	Low	Low	PR5

The lighting of the internal roads was designed to achieve the PR5 requirements from Table 3.3 of AS/NZS 1158.3.1. Refer highlighted portions of the table below:

TABLE 3.3

VALUES OF LIGHT TECHNICAL PARAMETERS FOR ROADS IN LOCAL AREAS

1	2	3	4
Lighting subcategory	Light technical parameters (LTP)		
	Average horizontal illuminance[a,b] ($\bar{E}_h$) lx	Point horizontal illuminance[a,b] (E_{Ph}) lx	Illuminance (horizontal) uniformity[c] Cat. P (U_{E2})
PR1	7	2	8
PR2	3.5	0.7	8
PR3[g]	1.75	0.3	8
PR4[d,e]	1.3	0.22	8
PR5[d,e]	0.85	0.14	10
PR6[d]	0.7	0.07	10

3.2 Basis of Design - Car Parks

Based on the selection criteria from Table 2.5 of AS/NZS 1158.3.1, the lighting subcategory PC3 was applied to the internal car parks. Refer highlighted portions of the table below.

Table 2.5 from AS/NZS 1158.3.1:

TABLE 2.5

LIGHTING SUBCATEGORIES FOR OUTDOOR CAR PARKS (INCLUDING ROOF-TOP CAR PARKS)

1	2	3	4
Type of area	Selection criteria[a,c]		
	Night time vehicle and/or pedestrian movements	Fear of crime	Applicable lighting subcategory[b]
Parking spaces, aisles and circulation roadways	High	High	PC1
	Medium	Medium	PC2
	Low	Low	PC3
Designated parking spaces specifically intended for people with disabilities	N/A	N/A	PCD
For any designated areas for pedestrians to cross	N/A	N/A	PCX

The lighting of the internal car parks was designed to achieve the PC3 requirements from Table 3.7 of AS/NZS 1158.3.1. Refer highlighted portions of the table below:

TABLE 3.7

VALUES OF LIGHT TECHNICAL PARAMETERS FOR OUTDOOR CAR PARKS (INCLUDING ROOF-TOP CAR PARKS)

1	2	3	4	5
Lighting subcategory	Light technical parameters (LTP)			
	Average horizontal illuminance[a,b] $(\bar{E}_h)$ lx	Point horizontal illuminance[a,b] (E_{Ph}) lx	Illuminance (horizontal) uniformity[c] Cat. P (U_{E2})	Point vertical illuminance[a,b] (E_{Pv}) lx
PC1	14	3	8	3
PC2	7	1.5	8	1
PC3	3.5	0.7	8	—
PCD[d]	—	≥14 and ≥ $(\bar{E}_h)$ [d]	—	—
PCX[e]	21	5	8	—

3.3 Basis of Design - Outdoor Operational Areas

The lighting of the outdoor operational areas was designed to achieve the applicable requirements from Table 6.1 of E-ST-EL-0131. Refer highlighted portions of the table below:

Table 6.1 Lighting levels and quality

Type of area	E_m	U_o	GR_L	R_a	U_d
Railway Marshalling Yards - Anywhere shunting operations are carried out	≥ 10 lux	≤ 0.40	≤ 50	≥ 20	≥ 1/5
Freight Track, short duration operations - The portion of a rail siding where loading and unloading does not occur. Rail movements are infrequent.	≥ 10 lux	≤ 0.25	≤ 50	≥ 20	≥ 1/8
Freight Track, continuous operations - The portion of a rail freight yard where loading and unloading does not occur. Rail movements are frequent. Road traffic and pedestrians are likely to be present.	≥ 20 lux	≤ 0.40	≤ 50	≥ 20	≥ 1/5
Railway Yards Handing Areas - Anywhere that wagons are being loaded with cranes or forklifts. This includes most of the main freight sidings and the Interisland Line terminal areas where wagons are loaded/unloaded	≥ 30 lux	≤ 0.40	≤ 50	≥ 20	≥ 1/5

3.4 Basis of Design - Obtrusive Lighting

1 Lux spill light isolux contour lines have been provided (on the layout drawings) to identify any residential properties that may be adversely affected by the Freight Hub lighting.

The applicable levels of maximum obtrusive light (spill light) is based on what particular environment zone the residential properties are within. Zone A2 was selected based on low district brightness associated with sparsely inhabited rural / semi-rural areas. Refer highlighted portions of table below.

Table 3.1 from AS/NZS 4282 - Environmental Zones:

TABLE 3.1
ENVIRONMENTAL ZONES

Zones	Description	Examples
A0	Intrinsically dark	UNESCO Starlight Reserve. IDA Dark Sky Parks. Major optical observatories No road lighting -unless specifically required by the road controlling authority
A1	Dark	Relatively uninhabited rural areas No road lighting - unless specifically required by the road controlling authority
A2	Low district brightness	Sparsely inhabited rural and semi-rural areas
A3	Medium district brightness	Suburban areas in towns and cities
A4	High district brightness	Town and city centres and other commercial areas Residential areas abutting commercial areas
TV	High district brightness	Vicinity of major sports stadium during TV broadcasts

Spill Light:
The maximum level of spill light (vertical illuminance - Lux) for Zone A2 is provided in the following table:

TABLE 3.2
MAXIMUM VALUES OF LIGHT TECHNICAL PARAMETERS

Zones	Vertical illuminance levels (E_v) lx		Threshold increment (TI)		Sky glow
	Non-curfew	Curfew	%	Default adaptation level (L_{ad})	Upward light ratio
A0	See Note 1	0	N/A	N/A	0
A1	2	0.1	N/A	N/A	0
A2	5	1	20%	0.2	0.01
A3	10	2	20%	1	0.02
A4	25	5	20%	5	0.03
TV	See Table 3.4	N/A	20%	10	0.08

4. Design Modelling Results

In accordance with AS/NZS 1158.3.1 and E-ST-EL-0131, illuminance and uniformity calculations were carried out for the internal access roads, car parks and outdoor operational areas.

Spill light or glare calculations were not carried out for any particular residential buildings, however 1 Lux isolux contour lines were provided (on the layout drawings) to help identify any residential properties that may be adversely affected by the Freight Hub lighting. Detailed calculations may be required in the future if deemed necessary.

All calculations were completed using the lighting software program AGi32, version 2.31, supplied by Lighting Analysts, Inc.

The photometric files (used in the illuminance and luminance calculations) were provided by the luminaire supplier ENERGYLIGHT Ltd.

4.1 Luminaire and Mounting Parameters

Refer to Appendix A for details of the new luminaires and Appendix B for details of the new lighting poles. The new lighting poles shall be located where shown on the layout drawings.

The design results were achieved using a maintenance factor of 0.8, and the following luminaire and mounting parameters:

Type A

Luminaire: AEC Italo 1 (STAN0 4000K 350mA 3M) 27W (3320 lm) LED.

Mounting: 7.3m mounting height with 0° tilt on new ground planted tapered octagonal steel lighting pole complete with 0.9m curved outreach arm.

Type B

Luminaire: AEC Italo 1 (STAN0 4000K 525mA 4M) 51W (6020 lm) LED.

Mounting: 7.3m mounting height with 5° tilt on new ground planted tapered octagonal steel lighting pole complete with 0.9m curved outreach arm.

Type C

Luminaire: AEC Italo 1 (S05 4000K 350mA 2M) 27W (3400 lm) LED.

Mounting: 7.3m mounting height with 0° tilt on new ground planted tapered octagonal steel lighting pole complete with 0.9m curved outreach arm.

Type D

Luminaire: AEC Italo 1 (S05 4000K 350mA 2M) 27W (3400 lm) LED (2 off).

Mounting: 7.3m mounting height with 0° tilt on new ground planted tapered octagonal steel lighting pole complete with double 0.9m curved outreach arms.

Type E

Luminaire: AEC Italo 1 (S05 4000K 350mA 3M) 39W (4970 lm) LED.

Mounting: 7.3m mounting height with 0° tilt on new ground planted tapered octagonal steel lighting pole complete with 0.9m curved outreach arm.

Type F

Luminaire: AEC Italo 1 (S05 4000K 350mA 3M) 39W (4970 lm) LED (2 off).

Mounting: 7.3m mounting height with 0° tilt on new ground planted tapered octagonal steel lighting pole complete with double 0.9m curved outreach arms.

Type G

Luminaire: EWO R4 (Gen 3 EP09 Left / Right Optic 4000K 1800mA) 1523W (182874 lm) LED Floodlight.

Mounting: 22.078m mounting height with 5^0 tilt on new 22.4m (nominal) flange based tapered octagonal steel flood lighting pole complete with 0.6m horizontal cross arm. Luminaire mounted to front face of cross arm using proprietary over-frame bracket.

Type H

Luminaire: EWO R4 (Gen 3 EP09 Left / Right Optic 4000K 1800mA) 1523W (182874 lm) LED Floodlight (2 per pole).

Mounting: 22.078m mounting height with 5^0 tilt on new 22.4m (nominal) flange based tapered octagonal steel flood lighting pole complete with 0.6m horizontal cross arm. Each luminaire mounted to front face of cross arm, using proprietary over-frame brackets, to form opposing (180°) aiming directions.

Type J

Luminaire: EWO R4 (Gen 3 EP09 Left / Right Optic 4000K 1800mA) 1523W (182874 lm) LED Floodlight.

Mounting: 22.078m mounting height with 10^0 tilt on new 22.4m (nominal) flange based tapered octagonal steel flood lighting pole complete with 0.6m horizontal cross arm. Luminaire mounted to front face of cross arm using proprietary over-frame bracket.

Type K

Luminaire: EWO R4 (Gen 3 EP09 Left / Right Optic 4000K 1800mA) 1523W (182874 lm) LED Floodlight (2 per pole).

Mounting: 078m mounting height with 10^0 tilt on new 22.4m (nominal) flange based tapered octagonal steel flood lighting pole complete with 0.6m horizontal cross arm. Each luminaire mounted to front face of cross arm, using proprietary over-frame brackets, to form opposing (180°) aiming directions.

Type L

Luminaire: EWO R4 (Gen 3 EP09 Left / Right Optic 4000K 1800mA) 1523W (182874 lm) LED Floodlight.

Mounting: 12m mounting height with 20^0 tilt secured to front face of building using propriety stirrup bracket.

4.2 Maintenance Factor - Italo Luminaires

A design maintenance factor (MF) is used in the calculations to account for the combined light losses resulting from depreciation in the LED's lumen output and accumulation of dirt on the luminaire.

The MF is calculated as the product of the following depreciation factors:

(a) *Luminaire Maintenance Factor (LMF):* The factor selected from table B.1 of BS 5489-1 which considers the environmental zone, mounting height and cleaning interval. An environmental zone of E3/E4 was selected (corresponding to moderate/high ambient luminance areas), the mounting heights are not more than 6m and a maximum luminaire cleaning interval of 72 months (6 years or 25,200 hours operation) was selected resulting in an LMF of 0.84.

Table B.1 Luminaire maintenance factors

Environ-mental zone	Mounting height	Maintenance factor					
		Cleaning frequency 12 months	Cleaning frequency 24 months	Cleaning frequency 36 months	Cleaning frequency 48 months	Cleaning frequency 60 months	Cleaning frequency 72 months
E1/E2	≤6 m	0.96	0.96	0.95	0.94	0.93	0.92
E1/E2	>6 m	0.96	0.96	0.95	0.94	0.93	0.92
E3/E4	≤6 m	0.94	0.92	0.90	0.88	0.86	0.84
E3/E4	>6 m	0.96	0.96	0.95	0.94	0.93	0.92

(b) *Light Source Lumen Depreciation Factor (LLD):* The amount of light (lumen output) available at the end of a nominated operating period, as a proportion of the initial lumen output (when the LED was new), expressed as a decimal fraction. An LLD of 0.98 was provided by the LED supplier.

(c) Luminaire *Survival Factor (LSF): This is the expected amount of failures after 85,000 hours of operation (including electronic components, drivers, lenses, premature failures or mechanical failure). An LSF of 0.99 was provided by the LED supplier.*

Table B.1 of BS 5489-1 and the manufacturer supplied data has provided in an LMF of 0.92, an LLD of 0.92 and an LSF of 0.99.

MF = LMF x LLD x LSF

MF = 0.84 x 0.98 x 0.99

MF = 0.815

A design maintenance factor of 0.8 was applied to the calculations.

It is important to note that the design results are based on a maintenance interval (luminaire cleaning cycle) of 6 years. At the end of 6 years the lighting should still comply with the road lighting standards (AS/NZS 1158) but the luminaires will require cleaning before the performance of the lighting installation degrades below the requirements of the standards. If the luminaires are not routinely cleaned the gradual accumulation of dirt will eventually compromise the optical performance of the installation.

4.3 Maintenance Factor - EWO R4 LED Flood Lights

A design maintenance factor (MF) is used in the calculations to account for the combined light losses resulting from depreciation in the LED's lumen output and accumulation of dirt on the luminaire.

The MF is calculated as the product of the following depreciation factors:

(d) Luminaire Maintenance Factor (LMF): The amount of light (lumen output) available at the end of a nominated period (cleaning interval) where the output has fallen due to the accumulation of dirt. An LMF of 0.92 was provided by the LED supplier based on an 8 year cleaning cycle, glass visor and PMMA lens.

(e) Light Source Lumen Depreciation Factor (LLD): The amount of light (lumen output) available at the end of a nominated operating period as a proportion of the initial lumen output (when the LED was new). An LLD of 0.99 was provided by the LED supplier based on 85,000 hours of operation and an ambient temperature of 25°C.

(f) Luminaire Survival Factor (LSF): This is the expected amount of failures after 85,000 hours of operation (including electronic components, drivers, lenses, premature failures or mechanical failure). An LSF of 1.0 was provided by the LED supplier based on no reported failures.

MF = LMF x LLD x LSF

MF = 0.92 x 0.99 x 1.0

MF = 0.91

A conservative design maintenance factor of 0.8 was applied to the calculations.

It is important to note that the design results are based on a maintenance interval (luminaire cleaning cycle) of 8 years. At the end of 8 years the lighting should still achieve the maintained average illuminance but the luminaires will require cleaning before the output of the lighting installation falls below current design levels. If the luminaires are not routinely cleaned the gradual accumulation of dirt will eventually compromise the optical performance of the installation.

4.4 Illuminance Design Results – Internal Access Roads and Car Parks

An illuminance based design was carried out to determine the average horizontal illuminance (E_h), point horizontal illuminance (E_{Ph}) and horizontal uniformity (U_{E2}) using the lighting software program AGi32, version 2.31, supplied by Lighting Analysts, Inc.

The applicable design areas are the internal roads and parking spaces.

Design area boundaries and calculation points were established in accordance with AS/NZS 1158.2. Refer to the design results below:

Illuminance Calculation Summary Table - AS/NZS 1158.3.1:2020						
Label	CalcType	Units	Avg	Min	Max/Avg	Description
Access Roads	Illuminance	Lux	2.2	0.14	9.6	Cat PR5 - 0.85 Lux (Avg), 0.14 Lux (Min) and Uniformity (Max/Avg) of 10 (Max)
Container Terminal Car Park 1	Illuminance	Lux	3.8	0.8	3.1	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Container Terminal Car Park 2	Illuminance	Lux	4.8	0.8	3.3	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Container Terminal Car Park 3	Illuminance	Lux	3.8	0.9	4.0	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Freight Forwarding Car Park	Illuminance	Lux	4.6	0.8	4.9	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Network Services Car Park 1	Illuminance	Lux	3.9	0.9	3.1	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Network Services Car Park 2	Illuminance	Lux	3.6	0.9	3.5	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Network Services Car Park 3	Illuminance	Lux	3.5	0.7	3.4	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Network Services Car Park 4	Illuminance	Lux	5.3	0.9	3.4	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Network Services Car Park 5	Illuminance	Lux	4.6	0.8	3.8	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)

4.5 Illuminance Design Results - Outdoor Operational Areas

An illuminance based design was carried out to determine the average horizontal illuminance (Em), illuminance uniformity (Uo) and illuminance diversity (Ud) using the lighting software program AGi32, version 2.31, supplied by Lighting Analysts, Inc.

The applicable design areas include the network services depot, log loading siding, tank siding, rail marshalling yard (including maintenance facilities and general areas), container terminal and freight forwarding private sidings.

Design area boundaries and calculation grid points were established in accordance with E-ST-EL-0131. Refer to the design results below:

Illuminance Calculation Summary Table - KiwiRail Traction and Electrical Standard E-ST-EL-0131						
Label	CalcType	Units	Avg	Uo (Min/Avg)	Ud (Min/Max)	Design Requirements
Container Terminal Handling Area	Illuminance	Lux	39.4	0.4	0.2	Table 6.1 - Avg >= 30 Lux, Uo >= 0.4 and Ud >= 0.2
Freight Forwarding Area 1	Illuminance	Lux	35.5	0.4	0.3	Table 6.1 - Avg >= 30 Lux, Uo >= 0.4 and Ud >= 0.2
Freight Forwarding Area 2	Illuminance	Lux	32.3	0.4	0.3	Table 6.1 - Avg >= 30 Lux, Uo >= 0.4 and Ud >= 0.2
Log Loading Area and Tank Siding	Illuminance	Lux	37.1	0.4	0.2	Table 6.1 - Avg >= 30 Lux, Uo >= 0.4 and Ud >= 0.2
Network Services Handling Areas	Illuminance	Lux	37.5	0.4	0.3	Table 6.1 - Avg >= 30 Lux, Uo >= 0.4 and Ud >= 0.2
Railway Marshalling Areas	Illuminance	Lux	31.5	0.4	0.2	Table 6.1 - Avg >= 20 Lux, Uo >= 0.4 and Ud >= 0.2

4.6 Spill Light

According to AS/NZS 4282:2019, the Freight Hub is within zone A2 where the vertical illumination on the walls of residential buildings containing windows is not permitted to exceed 1 Lux. No specific design to check individual properties has been completed, however the 1 Lux horizontal isolux contour line (originating from the Freight Hub) has been plotted on the layout drawings to provide a visual guide.

During detailed design specific spill light and glare calculations can be completed for individual residential properties if deemed necessary.

5. Flood Lighting Poles

All new internal access road / car parking poles shall be Spunlite Subdivisional (or equal) hot dip galvanised tapered octagonal steel ground planted poles complete with curved outreach arms.

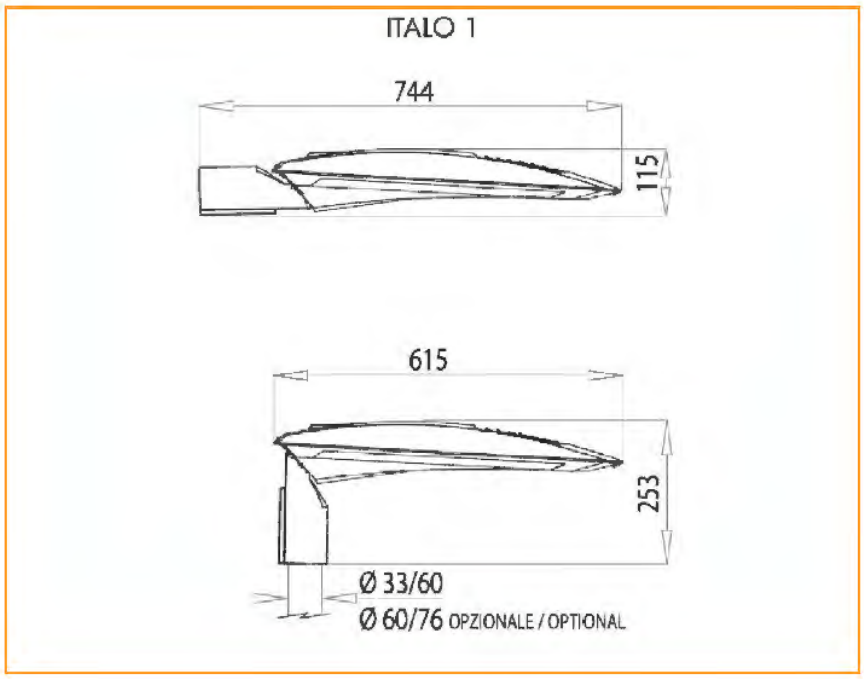
The new outdoor operational area poles shall be Spunlite (or equal) 22.4m flange based general purpose flood lighting poles complete with 0.6m long cross arms.

Refer to Appendix B for typical lighting pole details.

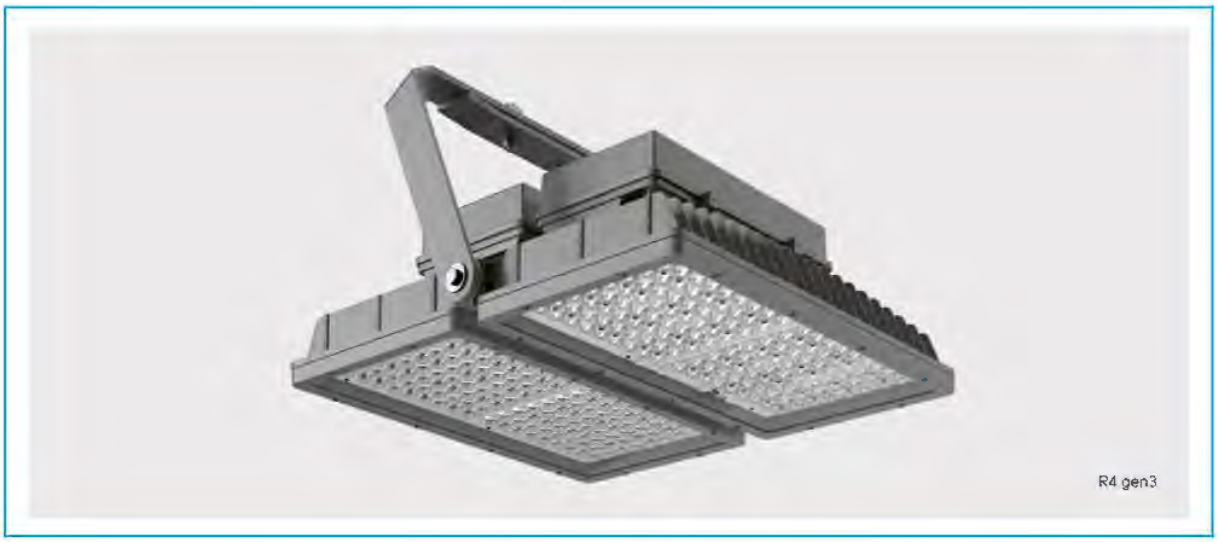
Appendices

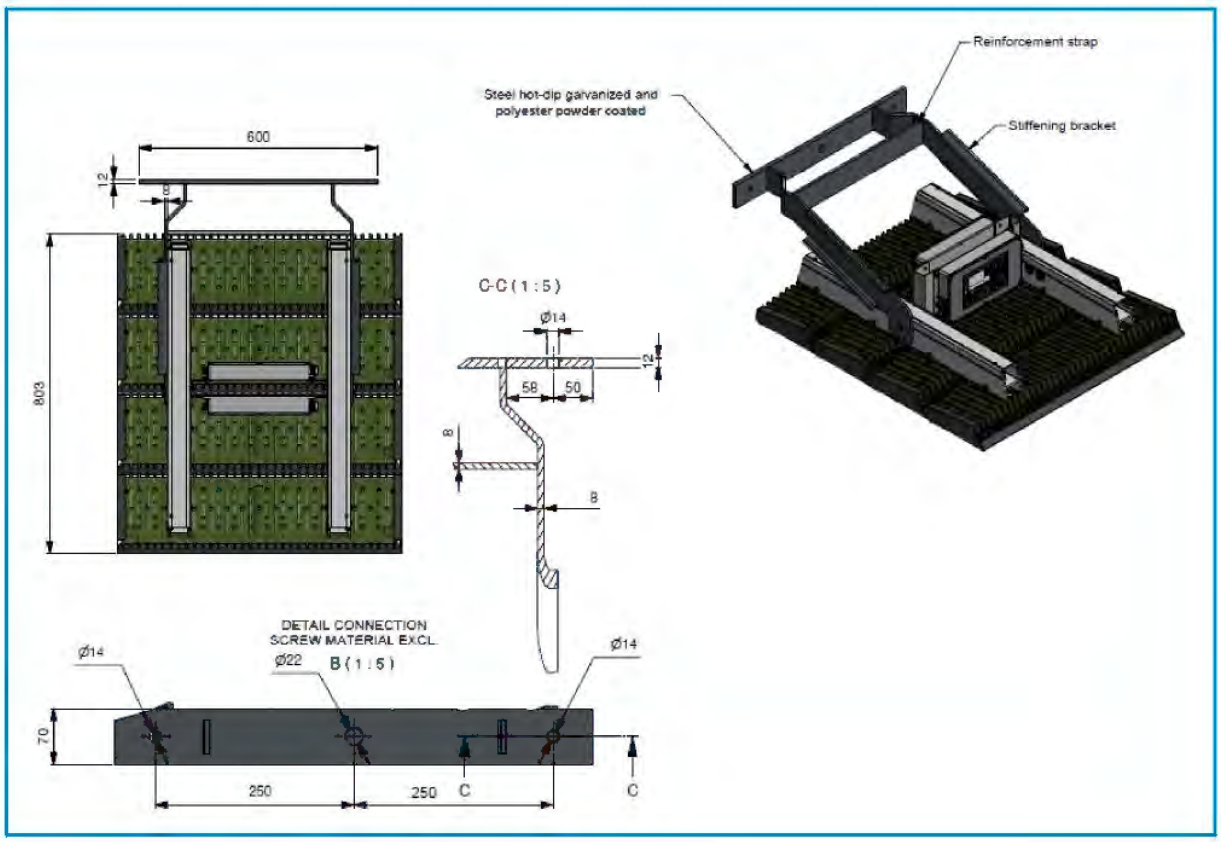
Appendix A LED Floodlight Luminaire Details

A.1 AEC Italo 1 Luminaire



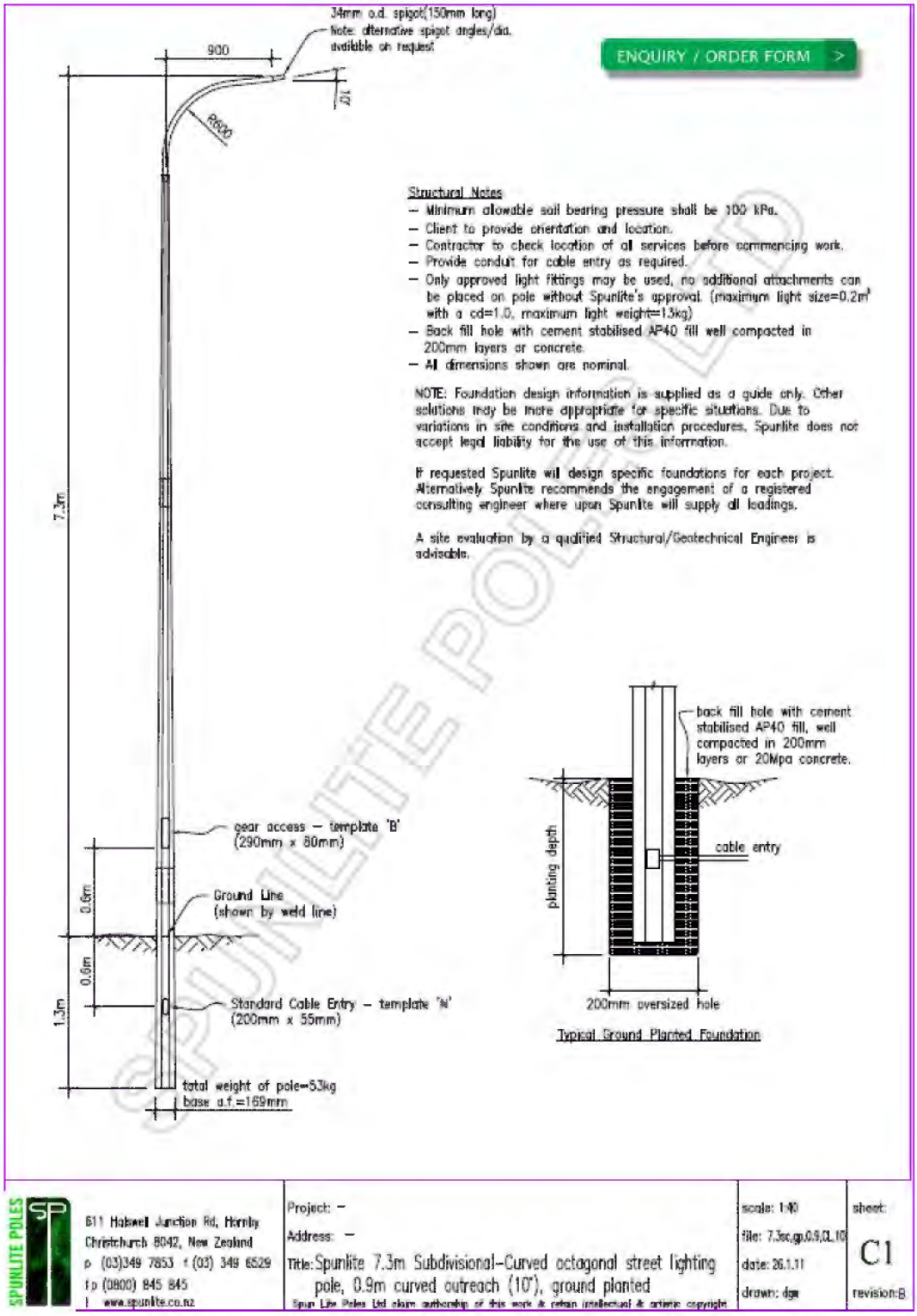
A.2 EWO R4 LED Floodlight



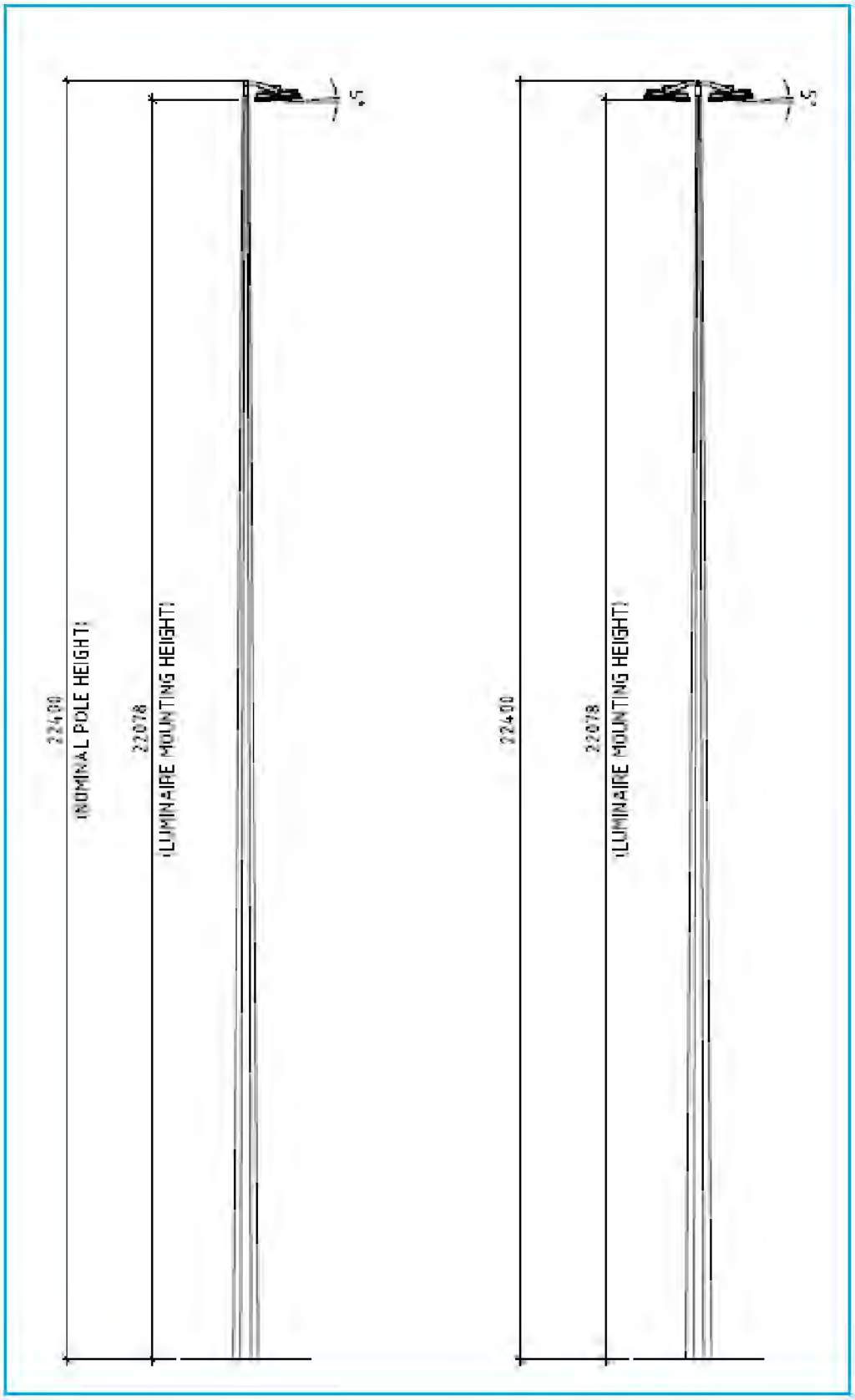


Appendix B Lighting Pole Details

B.1 Spunlite 7.3m Subdivisional Lighting Pole



B.2 Spunlite 22.4m Flange Based Flood Lighting Pole



LUMINAIRE AND POLE LIST

TYPE	LED LUMINAIRE DESCRIPTION	POLE / MOUNTING DESCRIPTION	MOUNTING HEIGHT	OUTREACH ARM / BRACKET MOUNTING DETAILS	TILT ANGLE	LUMINAIRE QTY
A	AEC ITALO 1 (STAN0 4000K 350mA 3M) 27W LED	SPUNLITE SUBDIVISIONAL GP LIGHTING POLE C/W SINGLE ARM	7.3m	0.9M SINGLE CURVED OUTREACH ARM	0	123
B	AEC ITALO 1 (STAN0 4000K 525mA 4M) 51W LED	SPUNLITE SUBDIVISIONAL GP LIGHTING POLE C/W SINGLE ARM	7.3m	0.9M SINGLE CURVED OUTREACH ARM	5	3
C	AEC ITALO 1 (S05 4000K 350mA 2M) 27W LED	SPUNLITE SUBDIVISIONAL GP LIGHTING POLE C/W SINGLE ARM	7.3m	0.9M SINGLE CURVED OUTREACH ARM	0	27
D	AEC ITALO 1 (S05 4000K 350mA 2M) 27W LED (2 PER POLE)	SPUNLITE SUBDIVISIONAL GP LIGHTING POLE C/W DOUBLE ARMS	7.3m	0.9M DOUBLE CURVED OUTREACH ARMS	0	4
E	AEC ITALO 1 (S05 4000K 350mA 3M) 39W LED	SPUNLITE SUBDIVISIONAL GP LIGHTING POLE C/W SINGLE ARM	7.3m	0.9M SINGLE CURVED OUTREACH ARM	0	16
F	AEC ITALO 1 (S05 4000K 350mA 3M) 39W LED (2 PER POLE)	SPUNLITE SUBDIVISIONAL GP LIGHTING POLE C/W DOUBLE ARMS	7.3m	0.9M DOUBLE CURVED OUTREACH ARMS	0	4
G	EWO R4 (GEN 3 EP09 LR OPTIC 4000K 1800mA) 1523W	SPUNLITE 22.4m FLB FLOOD LIGHTING POLE C/W 0.6m CROSS ARM	22.078m	PROPRIETARY OVER-FRAME BRACKET MOUNTED TO POLE CROSS ARM (VERTICAL FACE)	5	24
H	EWO R4 (GEN 3 EP09 LR OPTIC 4000K 1800mA) 1523W (2 PER POLE)	SPUNLITE 22.4m FLB FLOOD LIGHTING POLE C/W 0.6m CROSS ARM	22.078m	PROPRIETARY OVER-FRAME BRACKET MOUNTED TO POLE CROSS ARM (VERTICAL FACE)	5	82
J	EWO R4 (GEN 3 EP09 LR OPTIC 4000K 1800mA) 1523W	SPUNLITE 22.4m FLB FLOOD LIGHTING POLE C/W 0.6m CROSS ARM	22.078m	PROPRIETARY OVER-FRAME BRACKET MOUNTED TO POLE CROSS ARM (VERTICAL FACE)	10	25
K	EWO R4 (GEN 3 EP09 LR OPTIC 4000K 1800mA) 1523W (2 PER POLE)	SPUNLITE 22.4m FLB FLOOD LIGHTING POLE C/W 0.6m CROSS ARM	22.078m	PROPRIETARY OVER-FRAME BRACKET MOUNTED TO POLE CROSS ARM (VERTICAL FACE)	10	26
L	EWO R4 (GEN 3 EP09 LR OPTIC 4000K 1800mA) 1523W	BUILDING MOUNTED	12m	PROPRIETARY STIRRUP BRACKET MOUNTED TO BUILDING (VERTICAL FACE)	20	28

LEGEND

A — NEW LED LUMINAIRE MOUNTED ON NEW GROUND PLANTED LIGHTING POLE (LETTER DENOTES PARTICULAR LUMINAIRE TYPE AND MOUNTING PARAMETERS AS PER THE LUMINAIRE AND POLE LIST)

D D — NEW LED LUMINAIRES (2 OFF) MOUNTED ON NEW GROUND PLANTED LIGHTING POLE (LETTER DENOTES PARTICULAR LUMINAIRE TYPE AND MOUNTING PARAMETERS AS PER THE LUMINAIRE AND POLE LIST)

G — NEW LED FLOODLIGHT MOUNTED ON NEW FLANGE BASED LIGHTING POLE (LETTER DENOTES PARTICULAR LUMINAIRE TYPE AND MOUNTING PARAMETERS AS PER THE LUMINAIRE AND POLE LIST)

H H — NEW LED FLOODLIGHTS (2 OFF) MOUNTED ON NEW FLANGE BASED LIGHTING POLE (LETTER DENOTES PARTICULAR LUMINAIRE TYPE AND MOUNTING PARAMETERS AS PER THE LUMINAIRE AND POLE LIST)

PROPOSED LIGHTING ISOLUX CONTOUR LINES

SPILL LIGHTING ISOLUX CONTOUR LINES (1 LUX AT MF = 1.0) (REFER SPILL LIGHT NOTES)

CALCULATION RESULTS - ACCESS ROADS AND CAR PARKS - ILLUMINANCE LEVELS AND UNIFORMITIES

Illuminance Calculation Summary Table - AS/NZS 1158.3.1:2020

Label	CalcType	Units	Avg	Min	Max/Avg	Description
Access Roads	Illuminance	Lux	2.2	0.14	9.6	Cat PR5 - 0.85 Lux (Avg), 0.14 Lux (Min) and Uniformity (Max/Avg) of 10 (Max)
Container Terminal Car Park 1	Illuminance	Lux	3.8	0.8	3.1	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Container Terminal Car Park 2	Illuminance	Lux	4.8	0.8	3.3	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Container Terminal Car Park 3	Illuminance	Lux	3.8	0.9	4.0	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Freight Forwarding Car Park	Illuminance	Lux	4.6	0.8	4.9	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Network Services Car Park 1	Illuminance	Lux	3.9	0.9	3.1	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Network Services Car Park 2	Illuminance	Lux	3.6	0.9	3.5	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Network Services Car Park 3	Illuminance	Lux	3.5	0.7	3.4	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Network Services Car Park 4	Illuminance	Lux	5.3	0.9	3.4	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Network Services Car Park 5	Illuminance	Lux	4.6	0.8	3.8	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)

CALCULATION RESULTS - OUTDOOR OPERATIONAL AREAS - ILLUMINANCE LEVELS AND UNIFORMITIES

Illuminance Calculation Summary Table - KiwiRail Traction and Electrical Standard E-ST-EL-0131

Label	CalcType	Units	Avg	Uo (Min/Avg)	Ud (Min/Max)	Design Requirements
Container Terminal Handling Area	Illuminance	Lux	39.4	0.4	0.2	Table 6.1 - Avg >= 30 Lux, Uo >= 0.4 and Ud >= 0.2
Freight Forwarding Area 1	Illuminance	Lux	35.5	0.4	0.3	Table 6.1 - Avg >= 30 Lux, Uo >= 0.4 and Ud >= 0.2
Freight Forwarding Area 2	Illuminance	Lux	32.3	0.4	0.3	Table 6.1 - Avg >= 30 Lux, Uo >= 0.4 and Ud >= 0.2
Log Loading Area and Tank Siding	Illuminance	Lux	37.1	0.4	0.2	Table 6.1 - Avg >= 30 Lux, Uo >= 0.4 and Ud >= 0.2
Network Services Handling Areas	Illuminance	Lux	37.5	0.4	0.3	Table 6.1 - Avg >= 30 Lux, Uo >= 0.4 and Ud >= 0.2
Railway Marshalling Areas	Illuminance	Lux	31.5	0.4	0.2	Table 6.1 - Avg >= 20 Lux, Uo >= 0.4 and Ud >= 0.2

NOTES

1. THE ACCESS ROAD LIGHTING HAS BEEN DESIGNED TO COMPLY WITH THE SUBCATEGORY PR5 REQUIREMENTS OF AS/NZS 1158.3.1:2020 (PEDESTRIAN AREA (CATEGORY P) LIGHTING - PERFORMANCE AND DESIGN REQUIREMENTS), AND THE CAR PARK LIGHTING HAS BEEN DESIGNED TO COMPLY WITH THE SUBCATEGORY PC3 REQUIREMENTS OF AS/NZS 1158.3.1:2020. REFER TO THE CALCULATION RESULTS SUMMARY TABLE. THE CALCULATIONS WERE COMPLETED WITHOUT ANY CONTRIBUTION FROM THE OUTDOOR WORK AREA LED FLOODLIGHTING.
2. THE OUTDOOR OPERATIONAL AREAS (FREIGHT MARSHALLING YARDS, RAIL MOVEMENTS AND FREIGHT HANDLING AREAS) ARE DESIGNED TO COMPLY WITH THE RELEVANT LIGHTING REQUIREMENTS FROM TABLE 6.1 OF THE KIWIRAIL TRACTION AND ELECTRICAL STANDARD E-ST-EL-0131.
3. THE ACCESS ROAD AND CAR PARK LUMINAIRES SHALL BE AEC ITALO LEDs WITH MODULES AND WATTAGES AS SPECIFIED IN THE LUMINAIRE AND POLE LIST. THE QUALITY OF MANUFACTURE AND OPTICAL PERFORMANCE OF ANY ALTERNATIVE LUMINAIRES SHALL MATCH OR EXCEED THAT OF THE ITALO (INCLUDING THE CURRENT DESIGN ILLUMINANCE LEVELS) AND SUPPORTING CALCULATIONS SHALL BE REQUIRED TO BE SUBMITTED ALONG WITH ANY ALTERNATIVE LUMINAIRES OFFERED.
4. THE LED FLOODLIGHTS SHALL BE EWO R4 GENERATION 3 LED FLOODLIGHTS (OR EQUAL), SUPPLIED BY ENERGYLIGHT LTD, WITH OPTICS AND WATTAGES AS SPECIFIED IN THE LUMINAIRE AND POLE LIST. THE QUALITY OF MANUFACTURE AND OPTICAL PERFORMANCE OF ANY ALTERNATIVE LED FLOODLIGHTS SHALL MATCH OR EXCEED THAT OF THE EWO R4 (INCLUDING THE CURRENT DESIGN ILLUMINANCE LEVELS) AND SUPPORTING CALCULATIONS SHALL BE REQUIRED TO BE SUBMITTED ALONG WITH ANY ALTERNATIVE LUMINAIRES OFFERED.
5. WHEN INSTALLED ALL NEW LUMINAIRES SHALL HAVE THE MOUNTING HEIGHTS AND TILT ANGLES AS SPECIFIED IN THE LUMINAIRE AND POLE LIST. THE NEW FLOODLIGHTING LUMINAIRES SHALL BE ATTACHED TO THE FRONT FACE OF THE LIGHTING POLE CROSS ARMS (1.2m LONG - SUPPLIED WITH THE LIGHTING POLES) IN ACCORDANCE WITH THE LED MANUFACTURES INSTRUCTIONS USING PROPRIETARY EWO R4 STANDARD STIRRUP BRACKETS (SUPPLIED WITH THE NEW LUMINAIRES). ALL LUMINAIRES SHALL BE AIMED IN ACCORDANCE WITH THE ORIENTATIONS DEPICTED ON THE LAYOUT DRAWINGS.
6. A LIGHTING CONTROL SYSTEM SHALL BE SPECIFIED DURING DETAILED DESIGN, HOWEVER THE ACCESS ROAD AND CAR PARK LIGHTING SHALL BE CONTROLLED INDEPENDENTLY FROM THE OUTDOOR WORK AREA FLOODLIGHTS. THE OUTDOOR FLOODLIGHTS SHALL BE MANUALLY CONTROLLED FROM WITHIN EACH SPECIFIC WORK AREA. LOW LEVEL SECURITY LIGHTING SHALL BE PROVIDED FROM SELECTED ACCESS ROAD LIGHTS THAT WILL OPERATE DURING THE HOURS OF DARKNESS WHEN OPERATIONS HAVE STOPPED.
7. THE COMPLETE LIGHTING UPGRADE REQUIRES NEW LED LUMINAIRES TO BE MOUNTED ONTO NEW LIGHTING POLES.
8. ALL MATERIALS (INCLUDING LUMINAIRES, POLES, CROSS ARMS, BRACKETS AND MOUNTING HARDWARE) SHALL COMPLY WITH THE DURABILITY REQUIREMENTS OF KIWIRAIL.
9. THIS DRAWING ONLY DEPICTS THE LUMINAIRES AND MOUNTING REQUIREMENTS ASSOCIATED WITH THE LIGHTING DESIGN. ANY WORK ASSOCIATED WITH PROVIDING POWER SUPPLY INFRASTRUCTURE (TO SUPPLY THE NEW LUMINAIRES) IS OUTSIDE THE SCOPE OF THIS DESIGN.
10. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY POWER SUPPLY DESIGN AND INSTALLATION (REQUIRED TO PROVIDE POWER AND CONTROLS TO THE NEW LIGHTING) AND SHALL PAY ANY ASSOCIATED LOCAL ELECTRICITY NETWORK FEES. THE CONTRACTOR SHALL COMPLY WITH THE ELECTRICITY (SAFETY) REGULATIONS, AS/NZS 3000 (NZ WIRING RULES) AND ANY SPECIFIC KIWIRAIL RULES AND PROCEDURES AS APPLICABLE.
11. EACH NEW STEEL LIGHTING POLE SHALL BE EARTHED / BONDED TO THE FREIGHT HUB ELECTRICAL EARTHING SYSTEM IN ACCORDANCE WITH KIWIRAIL REQUIREMENTS.

SPILL LIGHT NOTES

1. ACCORDING TO AS/NZS 4282:2019 (CONTROL OF THE OBTRUSIVE EFFECTS OF OUTDOOR LIGHTING) THE FREIGHT HUB IS WITHIN ZONE A2 (SPARSELY INHABITED RURAL / SEMI-RURAL AREAS WITH LOW DISTRICT BRIGHTNESS) WHERE THE VERTICAL ILLUMINATION (ON THE FRONT FACES OF RESIDENTIAL BUILDINGS CONTAINING WINDOWS) IS NOT PERMITTED TO EXCEED 1 LUX. TO ASSIST IN DETERMINING THE LIKELY AMOUNT OF SPILL LIGHT, ORIGINATING FROM THE FREIGHT HUB, THE 1 LUX HORIZONTAL ISOLUX CONTOUR LINES HAVE BEEN PLOTTED ON THE LAYOUT DRAWINGS.
2. IF DEEMED NECESSARY A FULL OBTRUSIVE LIGHTING STUDY CAN BE COMPLETED, DURING DETAILED DESIGN, TO ASSESS THE MAXIMUM LEVELS OF SPILL LIGHT AND GLARE AT SPECIFIED RESIDENTIAL BUILDINGS.

REFERENCE DRAWINGS

FIG: 68 LIGHTING LAYOUT SHEET 1 OF 8
FIG: 69 LIGHTING LAYOUT SHEET 2 OF 8
FIG: 70 LIGHTING LAYOUT SHEET 3 OF 8
FIG: 71 LIGHTING LAYOUT SHEET 4 OF 8
FIG: 72 LIGHTING LAYOUT SHEET 5 OF 8
FIG: 73 LIGHTING LAYOUT SHEET 6 OF 8
FIG: 74 LIGHTING LAYOUT SHEET 7 OF 8
FIG: 75 LIGHTING LAYOUT SHEET 8 OF 8
FIG: 76 LIGHTING POLE AND LUMINAIRE MOUNTING DETAILS

KiwiRail — Backbone of integrated transport networks

Stantec

Job No: 310003007

KIWIRAIL HUB
SITE 3-G2 LIGHTING
INFORMATION SHEET

Drawn By: IAN CAMPBELL
Scale:

FIG: 67

9/22/2020 11:13 AM

N

144300 144200 144100 144000 143900 143800 143700

LINE

A P001 A P002 A P003 A P004 A P005 A P006 A P007 A P008 A P009 A P010 A P011 A P012 A P013 A P014 A P015 A P016 A P017 A P018

G P326 G P332 G P333 G P334

H P327A H P327B H P328A H P328B H P329A H P329B H P330A H P330B H P331A H P331B H P335A

L P336 L P340

C P201 C P202 C P203 C P204 C P205 C P206 C P207 C P208 C P209 C P210

310003007-FIG-69

310003007-FIG-72

JOIN

JOIN

LINE

NOTE: REFER TO FIG: 67 FOR LIGHTING LEGEND, NOTES AND EQUIPMENT SCHEDULE

PLAN
SCALE 1:1,000

10 0 10 20 30 40 50m
A1 SCALE 1:1,000 A3 1:2,000

KiwiRail
Backbone of integrated transport networks

Stantec

Job No: 310003007

KIWIRAIL HUB
SITE 3-G2 LIGHTING LAYOUT
SHEET 1 OF 8

Drawn By: IAN CAMPBELL
Scale: 1:1000

FIG: 68

C:\pwworkdir\ap_projects\010\d0117\046\310003007-FIG-68-SITE 3-G2 Lighting Layout.dwg

9/22/2020 11:25 AM

N

LINE

143600 143500 143400 143300 143200 143100 143000 142900

J P301 J P302 J P303 J P304 J P305 J P306 J P307 J P308 J P309 J P310

H P338A H P338B

310003007-FIG-68

L P337 L P239 L P341

H P342A H P343A H P344A H P345A H P346A H P347A H P348A H P349A H P350A H P351A

H P342B H P343B H P344B H P345B H P346B H P347B H P348B H P349B H P350B H P351B

A P032 A P033 A P034 A P035

A P031

G P376 H P377A H P378A

H P377B H P378B

A P027

K P380A K P381A K P382A K P383A

K P380B K P381B K P382B K P383B

A P030

A P011 A P012

P207 P210

C P211 C P212 C P213

E P215 E P214 E P216 E P218 E P219 E P217

JOIN

A P018 A P019 A P020

A P025 A P026 A P028 A P029

A P024 A P023 P021 A P027 A P047 A P048 A P049

JOIN

310003007-FIG-73

G P385 G P386 G P387 G P388

LINE

NOTE: REFER TO FIG: 67 FOR LIGHTING LEGEND, NOTES AND EQUIPMENT SCHEDULE

PLAN
SCALE 1:1,000

10 0 10 20 30 40 50m
A1 SCALE 1:1,000 A3 1:2,000

KiwiRail
Backbone of integrated transport networks

Stantec

Job No: 310003007

KIWIRAIL HUB
SITE 3-G2 LIGHTING LAYOUT
SHEET 2 OF 8

Drawn By: IAN CAMPBELL
Scale: 1:1000

FIG: 69

C:\pwwork\dir\ap_projects01\d0117048\31000300?-FIG-69-SITE 3-G2 Lighting Layout.dwg

9/22/2020 12:51 PM

N

LINE

1423000 1422900 1422800 1422700 1422600 1422500 1422400 1422300 1422200

J P310 J P311 J P312 J P313 J P314 J P315 J P316 J P317 J P318 J P319 J P320

H P351A H P352A H P353A H P354A H P355A H P356A H P357A H P358A H P359A H P360A H P361A

H P351B H P352B H P353B H P354B H P355B H P356B H P357B H P358B H P359B H P360B H P361B

P035 A P036 A P037 A P038 A P039 A P040 A P041 A P042 A P043 A P044 A P045 A P046

K P384A K P385A K P386A K P387A K P388A K P389A K P390A K P391A K P392A

K P384B K P385B K P386B K P387B K P388B K P389B K P390B K P391B K P392B

G P393 G P394

C P234 C P237 C P240 C P220 C P221 C P245

A P050 A P051 A P052 A P053 A P054 A P055 A P056 A P057 A P058 A P059 A P060

G P408

JOIN

JOIN G P399 G P400 G P401 G P402 G P403 G P404 G P405 G P406 G P407

LINE

E P222 E P223 E P224

P225 P226A P226B P227

310003007-FIG-69

310003007-FIG-71

310003007-FIG-74

NOTE: REFER TO FIG: 67 FOR LIGHTING LEGEND, NOTES AND EQUIPMENT SCHEDULE

PLAN
SCALE 1:1,000

10 0 10 20 30 40 50m
A1 SCALE 1:1,000 A3 1:2,000

KiwiRail
Backbone of integrated transport networks

Stantec

Job No: 310003007

KIWIRAIL HUB
SITE 3-G2 LIGHTING LAYOUT
SHEET 3 OF 8

Drawn By: IAN CAMPBELL
Scale: 1:1000

FIG: 70

C:\Data\Export - Import\310003007-FIG-70-SITE 3-G2 Lighting Layout.dwg

9/22/2020 12:52 PM

N

LINE

142100 142000 141900 141800 141700 141600 141500 141400

J P321 J P322 J P323 J P324 J P325

310003007-FIG-70

H P365A G P367

H P364A

H P363A H P365B

H P362A

H P364B

H P363B

H P362B

C P234 C P235 C P236

C P237 C P238 C P239

A P046

G P394

H P366A

C P240 C P241 C P242

D P243A D P244A

H P366B

D P243B D P244B

C P245 C P246 C P247

JOIN

A P060 JOIN A P061

310003007-FIG-75

LINE

NOTE: REFER TO FIG: 67 FOR LIGHTING LEGEND, NOTES AND EQUIPMENT SCHEDULE

PLAN
SCALE 1:1,000

10 0 10 20 30 40 50m
A1 SCALE 1:1,000 A3 1:2,000

KiwiRail Backbone of integrated transport networks

Stantec

Job No: 310003007

KIWIRAIL HUB
SITE 3-G2 LIGHTING LAYOUT
SHEET 4 OF 8

Drawn By: IAN CAMPBELL
Scale: 1,1000

FIG: 71

C:\Data\Export - Import\310003007-FIG-71-SITE 3-G2 Lighting Layout.dwg

9/22/2020 12:54 PM

JOIN

310003007-FIG-68

LINE

LINE

310003007-FIG-73

JOIN

A P013 A P014 A P015 A P016 A P017 A P01

A P062 A P063 A P064 A P065 A P066

A P074 A P075 A P076

H P369A H P370A

G P368 H P369B H P370B

A P031

NOTE: REFER TO FIG: 67 FOR LIGHTING LEGEND, NOTES AND EQUIPMENT SCHEDULE

N

PLAN
SCALE 1:1,000

10 0 10 20 30 40 50m
A1 SCALE 1:1,000 A3 1:2,000

KiwiRail
Backbone of integrated transport networks

Stantec

Job No: 310003007

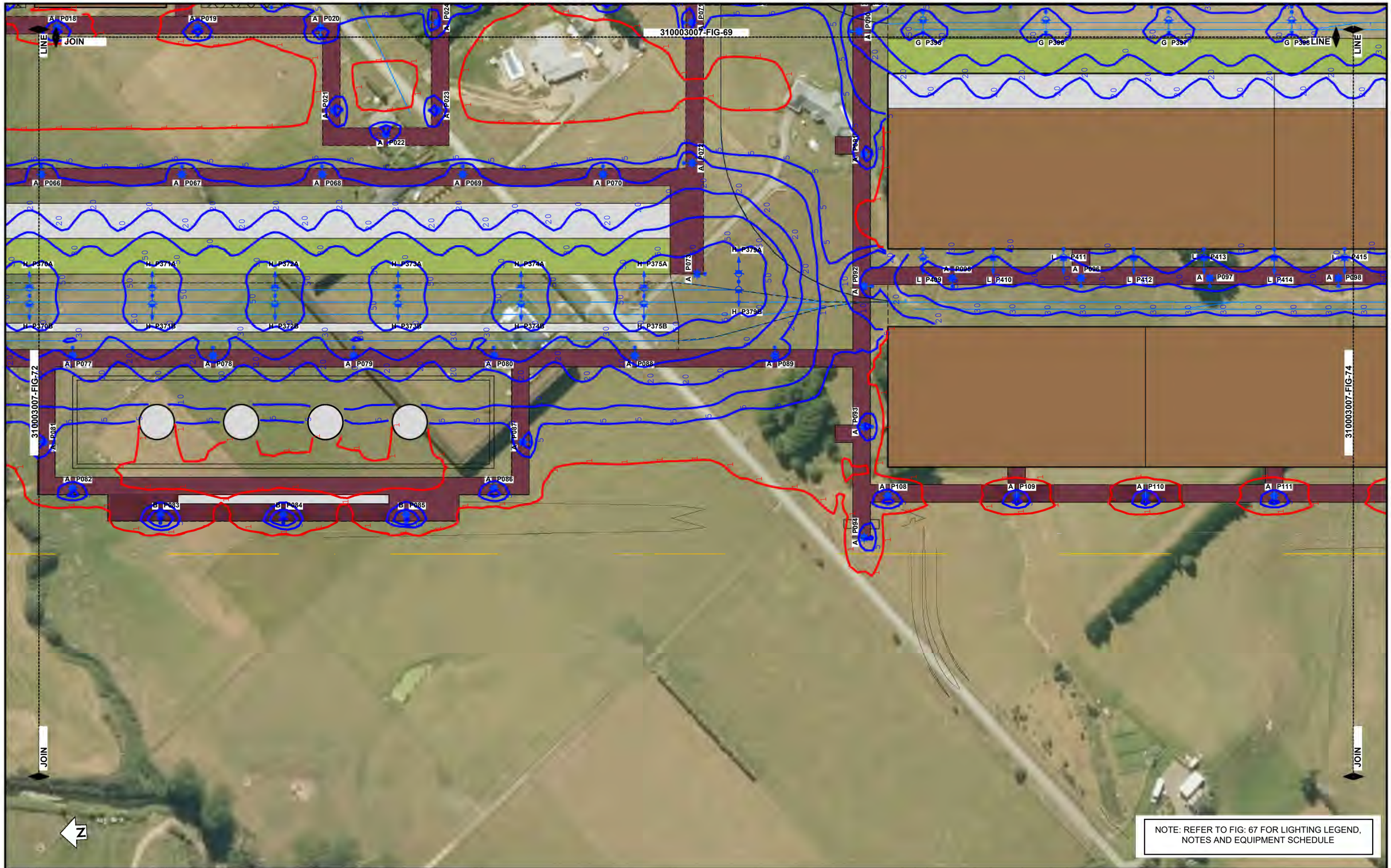
KIWIRAIL HUB
SITE 3-G2 LIGHTING LAYOUT
SHEET 5 OF 8

Drawn By: IAN CAMPBELL
Scale: 1:1000

FIG: 72

C:\Data\Export - Import\310003007-FIG-72-SITE 3-G2 Lighting Layout.dwg

9/22/2020 12:55 PM



PLAN
SCALE 1:1,000

10 0 10 20 30 40 50m
A1 SCALE 1:1,000 A3 1:2,000

KiwiRail
Backbone of integrated transport networks

Stantec

Job No: 310003007

KIWIRAIL HUB
SITE 3-G2 LIGHTING LAYOUT
SHEET 6 OF 8

Drawn By: IAN CAMPBELL
Scale: 1:1000

FIG: 73

C:\Data\Export - Import\310003007-FIG-73-SITE 3-G2 Lighting Layout.dwg

9/22/2020 12:57 PM

310003007-FIG-70

310003007-FIG-73

310003007-FIG-75

NOTE: REFER TO FIG: 67 FOR LIGHTING LEGEND, NOTES AND EQUIPMENT SCHEDULE

PLAN
SCALE 1:1,000

10 0 10 20 30 40 50m
A1 SCALE 1:1,000 A3 1:2,000

KiwiRail Backbone of integrated transport networks

Stantec

Job No: 310003007

KIWIRAIL HUB
SITE 3-G2 LIGHTING LAYOUT
SHEET 7 OF 8

Drawn By: IAN CAMPBELL
Scale: 1:1000

FIG: 74

C:\Data\Export - Import\310003007-FIG-74-SITE 3-G2 Lighting Layout.dwg

9/22/2020 12:58 PM

PLAN
SCALE 1:1,000

10 0 10 20 30 40 50m
A1 SCALE 1:1,000 A3 1:2,000

KiwiRail
Backbone of integrated transport networks

Stantec

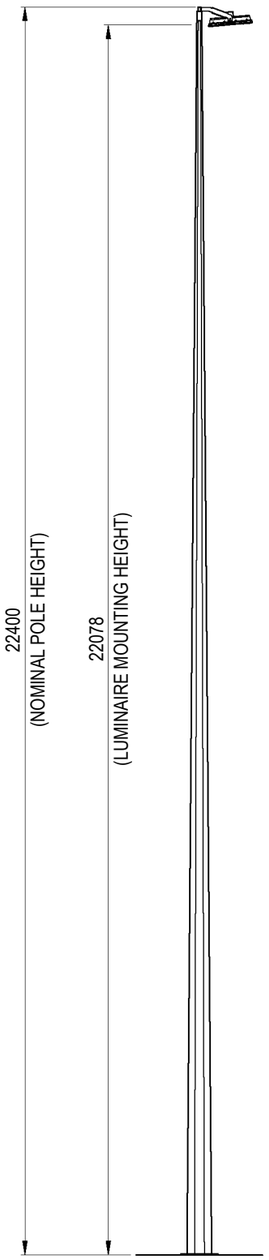
Job No: 310003007

KIWIRAIL HUB
SITE 3-G2 LIGHTING LAYOUT
SHEET 8 OF 8

Drawn By: IAN CAMPBELL
Scale: 1:1000

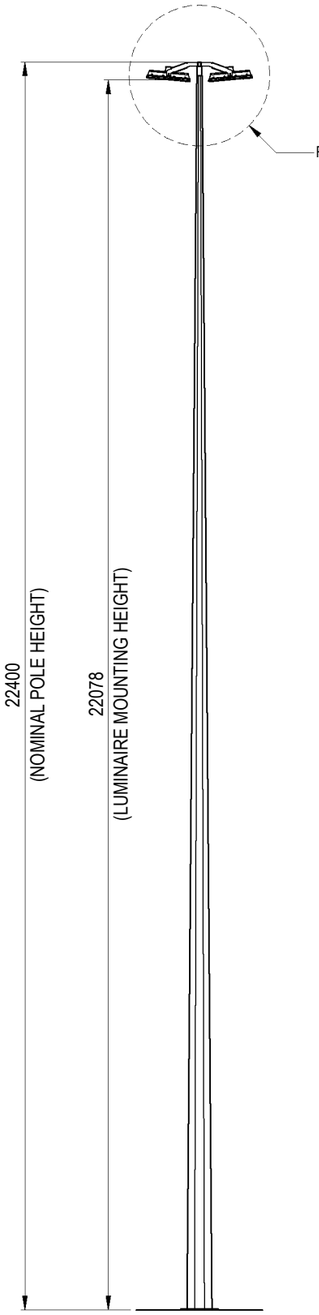
FIG: 75

C:\Data\Export - Import\310003007-FIG-75-SITE 3-G2 Lighting Layout.dwg



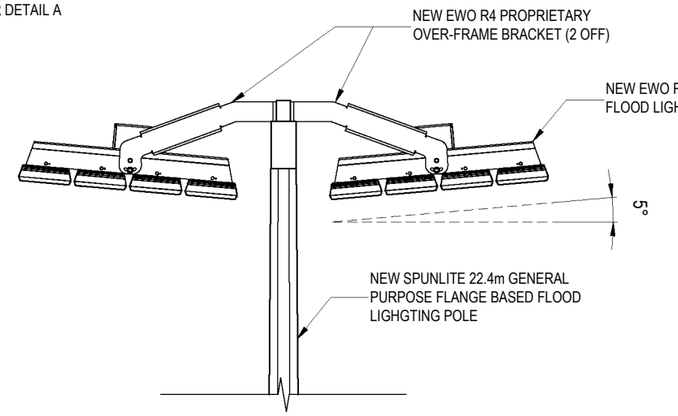
END ELEVATION

SPUNLITE 22.4m OCTAGONAL GENERAL PURPOSE FLANGE BASED POLE AND EWO R4 LED FLOODLIGHT MOUNTED TO 0.6m CROSS ARM

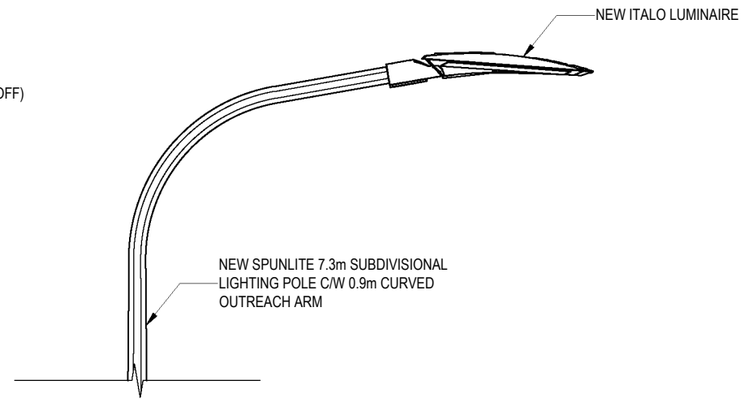


END ELEVATION

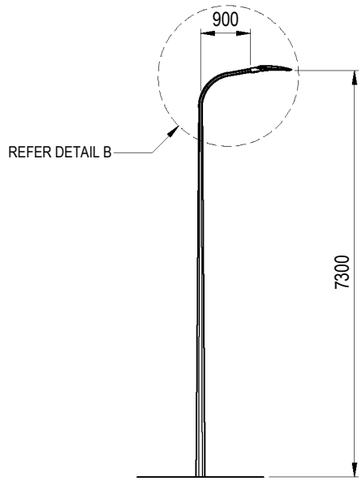
SPUNLITE 22.4m OCTAGONAL GENERAL PURPOSE FLANGE BASED POLE AND EWO R4 LED FLOODLIGHTS (2 OFF) MOUNTED TO EACH SIDE OF 0.6m CROSS ARM



DETAIL A

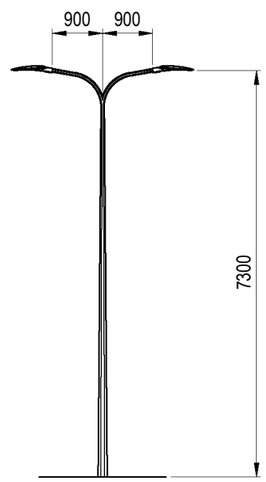


DETAIL B



END ELEVATION

SPUNLITE 7.3m SUBDIVISIONAL GROUND PLANTED POLE C/W 0.9m SINGLE CURVED ARM AND ITALO LED LUMINAIRE



END ELEVATION

SPUNLITE 7.3m SUBDIVISIONAL GROUND PLANTED POLE C/W 0.9m DOUBLE CURVED ARMS AND ITALO LED LUMINAIRES (2 OFF)

NOTES

1. POLE AND LUMINAIRE DETAILS ARE INDICATIVE ONLY.
2. FINAL POLE CONFIGURATIONS, LUMINAIRE DETAILS AND MOUNTING ARRANGEMENTS SHALL BE FINALISED DURING DETAILED DESIGN.

NOTE: REFER TO FIG: 67 FOR LIGHTING LEGEND, NOTES AND EQUIPMENT SCHEDULE

KiwiRail
Backbone of integrated transport networks

Stantec

Job No: 310003007

KIWIRAIL HUB
SITE 3-G2 LIGHTING POLE
AND LUMINAIRE MOUNTING DETAILS

Drawn By: IAN CAMPBELL
Scale: NTS

FIG: 76

Palmerston North
118 Fitzherbert Avenue, Palmerston North 4410
PO Box 13-052, Armagh
Christchurch 8141
Tel +64 6 357 4034
Fax +64 6 356 1164

Please visit **www.stantec.com** to learn more about how Stantec design with community in mind.

Stantec