

WATERLOO STATION, REFERENCE DESIGN REPORT

GREATER WELLINGTON
REGIONAL COUNCIL

August 2025

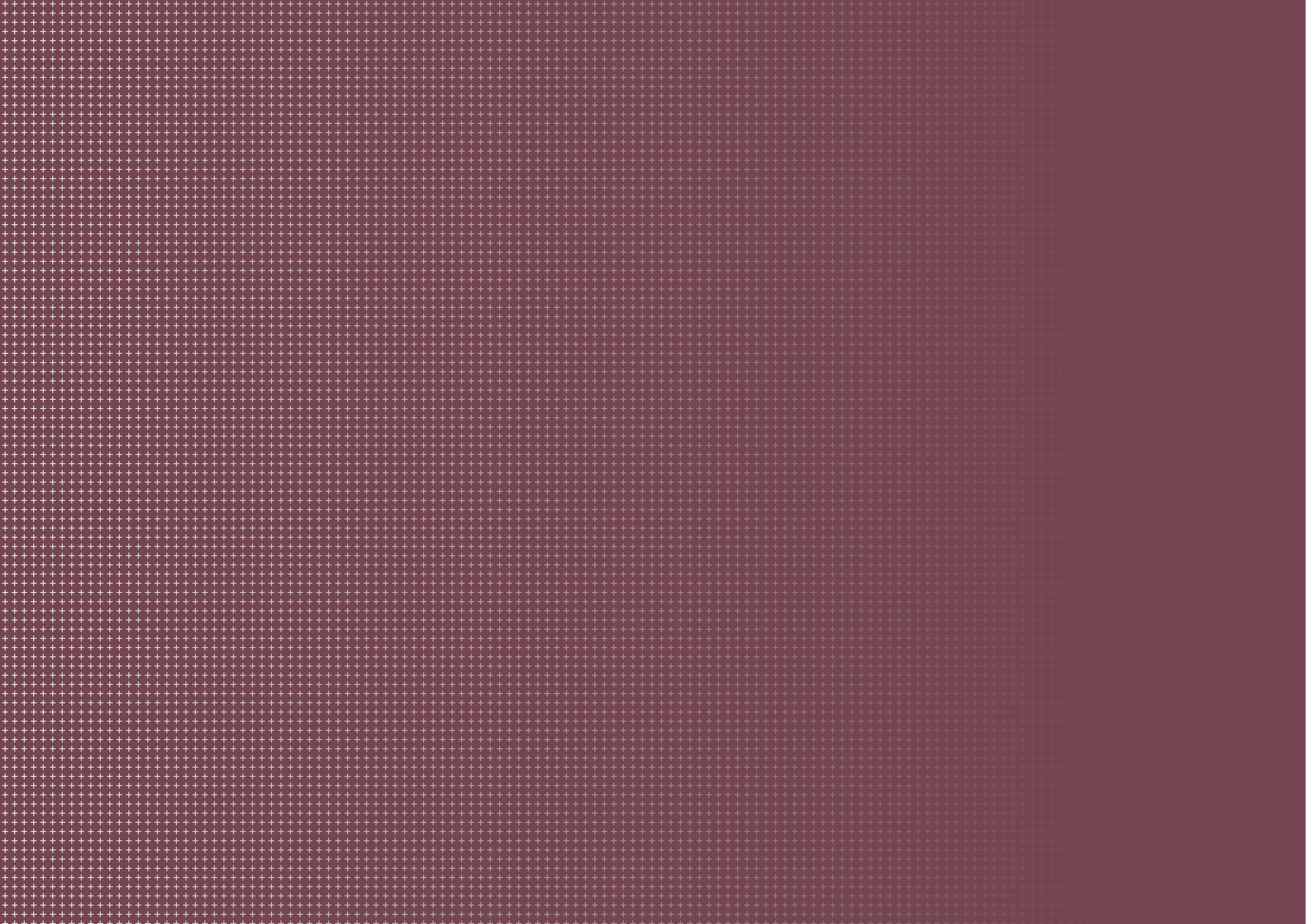


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1.0 EXECUTIVE SUMMARY



1.1 EXECUTIVE SUMMARY

Purpose and Context of This Report

This Reference Design Report presents the preferred station design option, selected through a comprehensive feasibility and design process for the redevelopment of Waterloo Station.

The project aims to transform the station into a modern, accessible, and future-ready transport hub that supports regional growth, promotes mode shift, and enhances the daily experience of its users.

The design has been developed through a collaborative with Greater Wellington Regional Council, the design team and key stakeholders. It responds to a range of site-specific constraints and opportunities, including the protection of the Waiwhetū Aquifer, the need for seismic resilience and the importance of maintaining pedestrian access across the rail corridor.

The station layout supports multi-modal integration, with upgraded bus interchanges, improved pedestrian links, and provision for future commercial development.

Project Phases and Outputs

The project has progressed through three key phases:



Position Within Project Documentation

This Reference Design Report builds on the outcomes of the Define and Discover stage and the Feasibility Study, which included a multi-criteria assessment (MCA) of station layout options.

This report follows the initial project inputs, the Design Brief and Site Investigations and the Feasibility Study.

Document Structure

This report is structured to guide the reader through the Reference Design for Waterloo station. The report provides an overview of the existing station and its context and then explores the proposed station design.

The report is organised as follows:

- Section 1 – Executive Summary
- Section 2 – Context and framing of the project
- Section 3 – Existing context
- Section 4 – Design Response – Urban Context
- Section 5 – Station Design
- Sections 6 – Environmental and sustainability features
- Sections 7 – Next steps
- Appendices – Supporting material, including all options considered at each stage and detailed assessment workbooks

Project Team

The study was delivered by a multidisciplinary Design Team in collaboration with the client and key stakeholders.

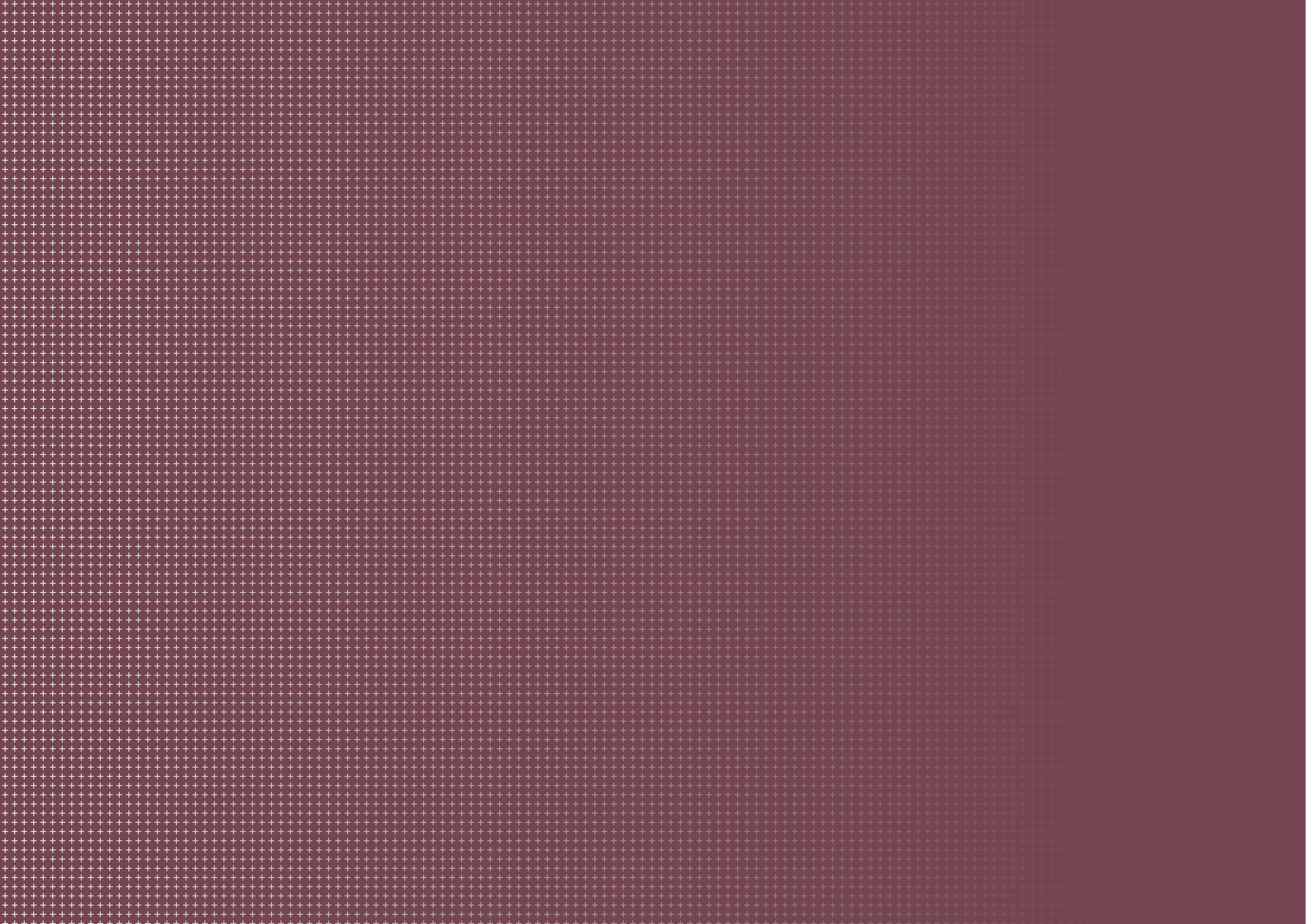


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2.0 INTRODUCTION

2.1 INTRODUCTION

VISION/DRIVERS

The Reference Design for the redevelopment of Waterloo Station aims to enhance local identity and optimise land use, supporting Greater Wellington's goals for transit-oriented development within the station precinct. The design focuses on improving the passenger experience by delivering an accessible, legible and intuitive interchange that encourages public transport use and accommodates future population growth in Lower Hutt. It also preserves the station's role as a community connector between Trafalgar Square and Oxford Terrace.

The project aims to transform the station into a modern, accessible, and future-ready transport hub that supports regional growth, promotes mode shift, and enhances the daily experience of its users.



Background & Case for Change

Waterloo Station has been identified as a Priority Development Area by the Wellington Regional Leadership Committee (WRLC) and Greater Wellington Regional Council (GWRC), due to its strategic location, existing infrastructure challenges, and potential to support regional growth. Originally constructed in 1988, the station is now approaching the end of its design life. The roof structure requires significant maintenance, the underpass presents seismic vulnerabilities, and the overall station layout no longer meets contemporary accessibility standards.

The precinct surrounding the station includes approximately 19,000m² of developable land, much of which is currently underutilised. This presents a unique opportunity to transform the station into a catalyst for transit-oriented development (TOD), linking Lower Hutt with Wellington Central, Upper Hutt, and the Wairarapa. The redevelopment aims to address infrastructure renewal, improve multimodal connectivity, and unlock commercial and civic potential within the precinct.

Strategic Vision and Drivers

The redevelopment of Waterloo Station is guided by a clear and ambitious vision: **to create a modern, accessible, and future-ready transport hub that enhances the daily experience of users and supports the region’s long-term growth.** This vision is rooted in the strategic objectives of GWRC and WRLC, which have identified Waterloo as the region’s first TOD site.

The station is envisioned as a civic space that facilitates efficient transport interchange while contributing meaningfully to the urban fabric of Lower Hutt. It is designed to be a catalyst for urban intensification, economic development, and community wellbeing. The new station will offer a safe, legible, and inclusive environment that encourages mode shift from private vehicles to public and active transport, while also supporting commercial activity and placemaking.

Several key drivers underpin the design and planning of the station and ensure that the station will serve as a benchmark for future infrastructure projects in the region.

Key Drivers

Operational Continuity

The station must remain fully functional throughout construction, particularly for school children and commuters who rely on it as a key east–west connector.

TOD Enablement

The design minimises the station footprint to preserve developable land and integrates with the surrounding precinct to support future growth.

Enhanced Customer Experience

Improvements to wayfinding, accessibility, and amenity are central to the design, including universal access, intuitive layouts, and a welcoming public realm.

Aquifer Protection

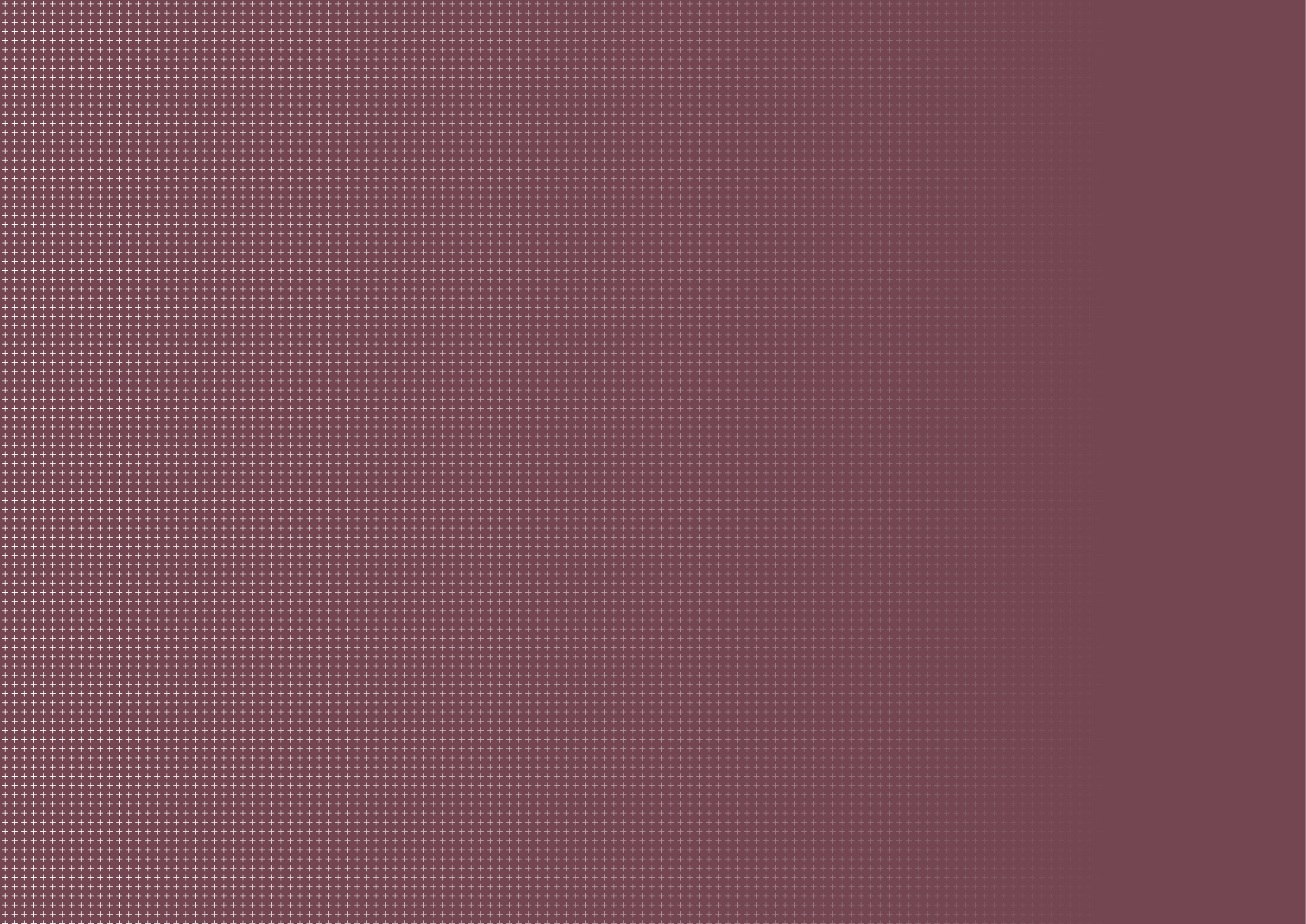
The Waiwhetū Aquifer, a vital regional water source, requires careful management of foundation depth and stormwater to prevent contamination.

Futureproofing

The station is designed to accommodate projected increases in patronage, support evolving transport technologies such as electric buses and on-demand services, and allow for staged construction and future upgrades.

Sustainability and Resilience

The design incorporates energy-efficient systems, climate adaptation strategies, and durable materials to reduce lifecycle costs and environmental impact.



3.0 EXISTING CONTEXT

3.1 EXISTING CONTEXT CONSTRAINTS & OPPORTUNITIES

This section identifies how the primary project constraints and development opportunities have informed the Reference Design.

Deteriorating Station Roof

Constructed in 1988, the existing roof structure is corroded and suffers from ongoing maintenance issues. It is nearing the end of its design life, with uncertain residual lifespan and no confirmed cost estimate for repair or replacement. This condition has prompted the need for a full roof renewal and presents an opportunity to reimagine the station's architectural identity.

Underpass Condition and Seismic Risk

The existing pedestrian underpass, also built in 1988, shows signs of deterioration including tile delamination and water ingress near electrical infrastructure. Its seismic performance is uncertain, and structural strengthening would be challenging due to the need to maintain operations. Historical subway alignments further complicate the positioning of new foundations.

Station Accessibility

The current station underpass ramps and stairs are not compliant with Building Code- D1 Access Requirements. This means that they would need to be significantly modified to meet the accessibility requirements of the broader community. In addition, the current station platforms are in poor condition with uneven surfaces and platform edges that don't meet D1 or KiwiRail's platform requirements.

Waiwhetū Aquifer and Foundation Limitations

The station is located near the Waterloo bore field, which draws from the Waiwhetū Aquifer—a critical source of drinking water for the region. Deep foundations and intrusive groundworks pose a contamination risk and must be avoided. Pile depth is limited to above the aquitard, and ground improvement may be required to ensure suitable founding conditions. These constraints significantly influence structural design and construction methods.

Proximity to Critical Infrastructure

The station borders the Waterloo Water Treatment Plant and active railway tracks. Construction near these assets must avoid vibration, settlement, and disruption. Foundation techniques must be carefully selected, and works near the rail corridor may require block-of-line periods, adding complexity to staging and delivery.

Civil Services and Below-Ground Infrastructure

The site contains aging water supply pipes, undersized wastewater networks, and stormwater assets nearing end-of-life. A 900mm-diameter wastewater trunk main lies shallow beneath the southeast corner of the site and must be protected. Additionally, while most of the site sits above the 100-year flood level, parts of the northwest edge are vulnerable in a 440-year event, requiring flood resilience measures.

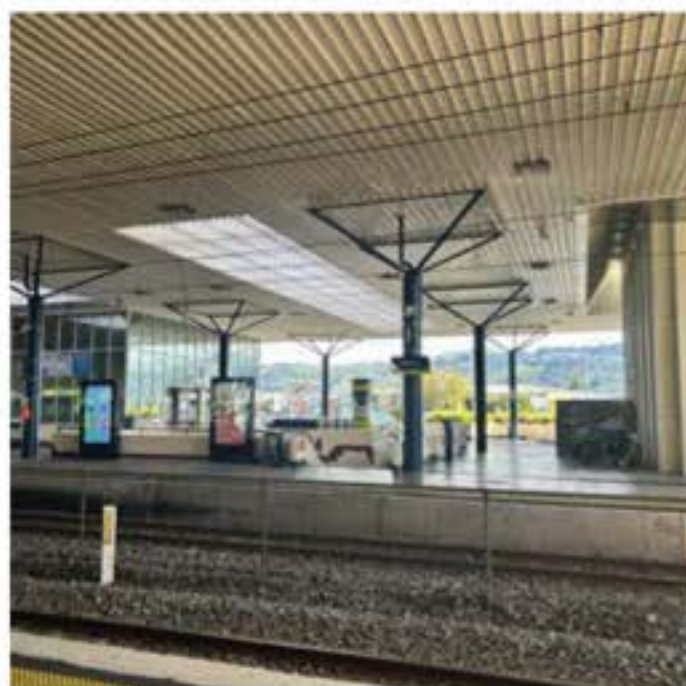


Figure 1: Photo of the existing station roof

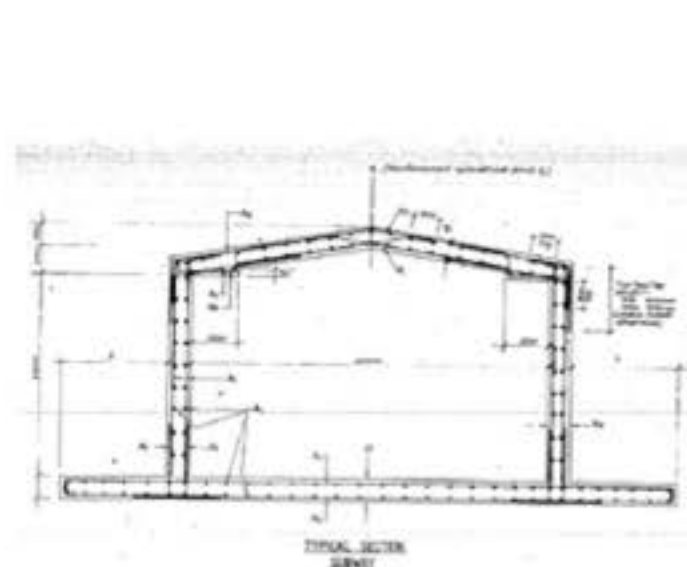


Figure 2: Existing Underpass drawings



Figure 3: Stormwater Assets



Figure 4: Flood Extents

Summary of Site Specific Opportunities and Constraints

OPPORTUNITIES

- Development to be TOD enabling
- Popularity of public transport in Lower Hutt
- Current GW land holdings
- Existing underpass

CONSTRAINTS

- Current land boundaries and land ownership
- Aquifer and Wellington Water building
- Ground conditions
- Maintenance of cross corridor pedestrian connection through station
- Need to minimise impact on station operations throughout construction

KEY

1. Retain current road alignment
2. Aquifer and water treatment plant
3. Public cross corridor connection
4. Station operations, safety and track geometry
5. 5m separation from Water Treatment Plant
6. Waterloo Road Overbridge

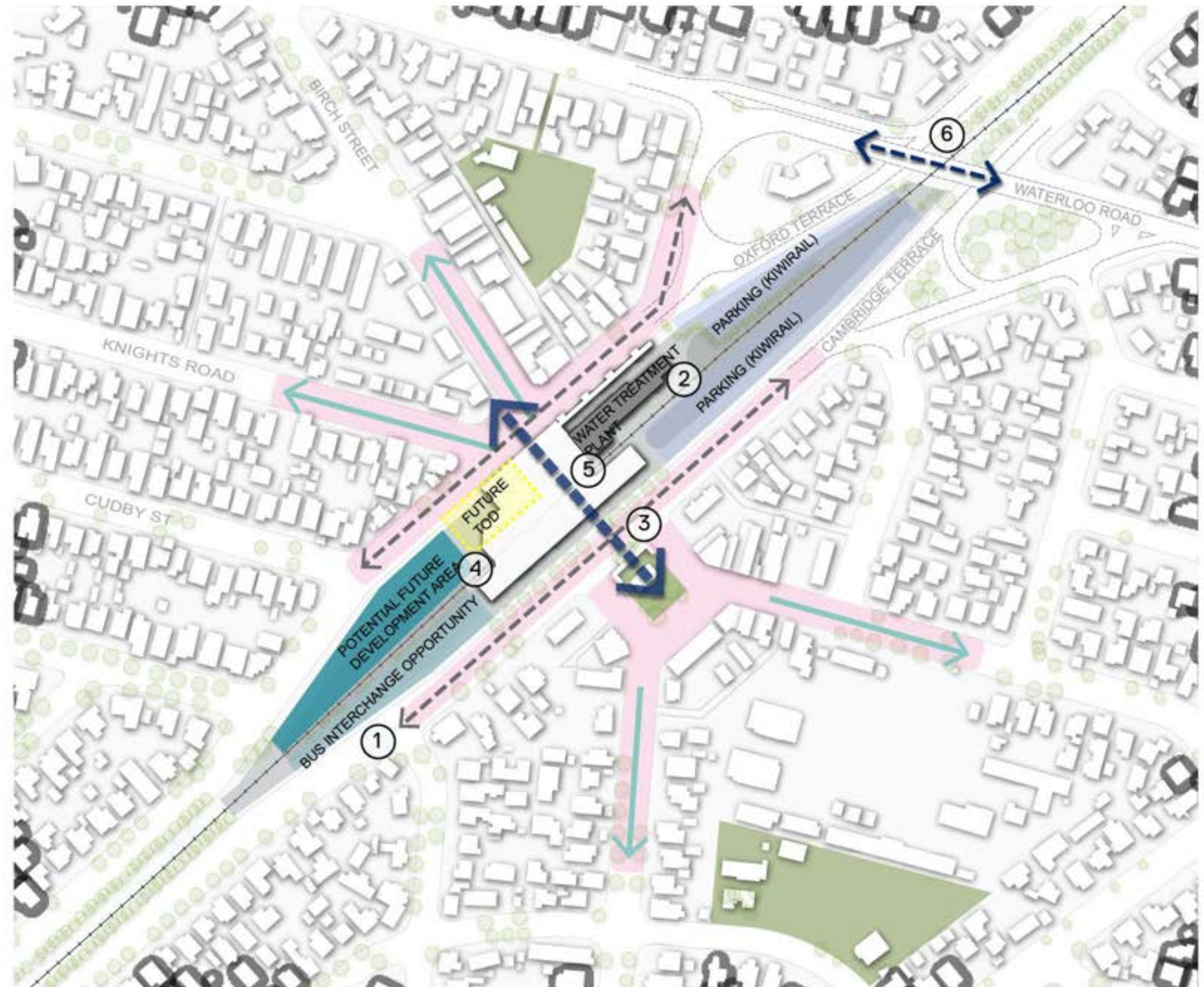


Figure 5: Underpass during morning peak

3.2 EXISTING CONTEXT

TRANSPORT CONTEXT

Urban & Transport Context

Waterloo Station is a key multimodal interchange on the Metlink network, serving both the Hutt Valley and Wairarapa lines. It connects Lower Hutt with Wellington CBD and surrounding suburbs. The station sits at the convergence of several roads, reinforcing its role as a civic anchor.

Transport Context

As the second busiest station on the Metlink rail network, Waterloo plays a vital role in regional transport.

It serves both the Hutt Valley and Wairarapa lines, supporting express and stopping services that connect Lower Hutt to Wellington Central and beyond. The station functions as a strategic multimodal interchange, facilitating seamless transfers between rail and bus services.

The station's strategic significance is reinforced by several key drivers:

- **Regional Connectivity:** Waterloo facilitates transfers between key urban and suburban centres across the Wellington region. It links Lower Hutt with Wellington CBD, Petone, Upper Hutt, and the Wairarapa.
- **Catchment Growth:** Residential intensification within the immediate catchment is forecast to grow by 25–40% over the next 30 years, driven by urban development and infill housing.
- **High Existing Public Transport Mode Share:** Current ridership levels are strong, particularly during weekday commuter peaks, reflecting a mature and well-utilised public transport system.
- **Future Demand Drivers:** Upcoming changes, including the implementation of a National Ticketing System (which will introduce integrated zonal fares across bus and rail) and the Lower North Island Rail Integrated Mobility (LIMRIM) programme, are expected to drive further increases in patronage by enhancing service frequency, reliability, and the quality of rolling stock.

These factors underscore the importance of ensuring that the station and interchange are sized and configured to meet current and future functional needs, while remaining adaptable to emerging travel patterns and operational requirements.

Bus Catchment

Waterloo Station's bus catchment is anchored by Wainuiomata, which contributes the largest share of bus-to-rail transfers. During peak morning hours, over 60% of bus arrivals at the station originate from Wainuiomata, with additional feeder routes from Naenae and Kelson. This strong bus patronage highlights the importance of integrating feeder services into the station layout to support mode shift and future growth. Enhancements to the bus interchange and pedestrian connections will ensure the station continues to serve as a reliable and efficient hub for public transport users across the region.

Cycling

There is a well-used protected cycleway to the north of Waterloo Station but there is poor east-west access to Hutt City Centre, and south from the station.

- A standard Metlink two-level bicycle rack is provided on the eastern side of the platform. It is currently underutilised possibly because its location means there is a lack of passive surveillance.
- Future plans to provide an east-west cycle lane on Knights Road (funded in LTP) would improve safe cycling options to the Station.
- The Waterloo overbridge over the train tracks is a hostile road environment so many cyclists making the east-west connection prefer to use the underpass.



Figure 6: Existing and Future Bus Network (Source: Metlink)



Figure 7: Waterloo Station Stops / Services (existing stop arrangement)

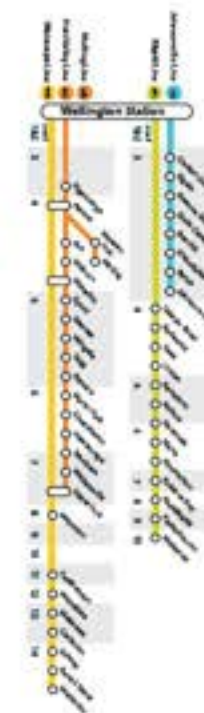


Figure 8: Wellington Regional Rail Network



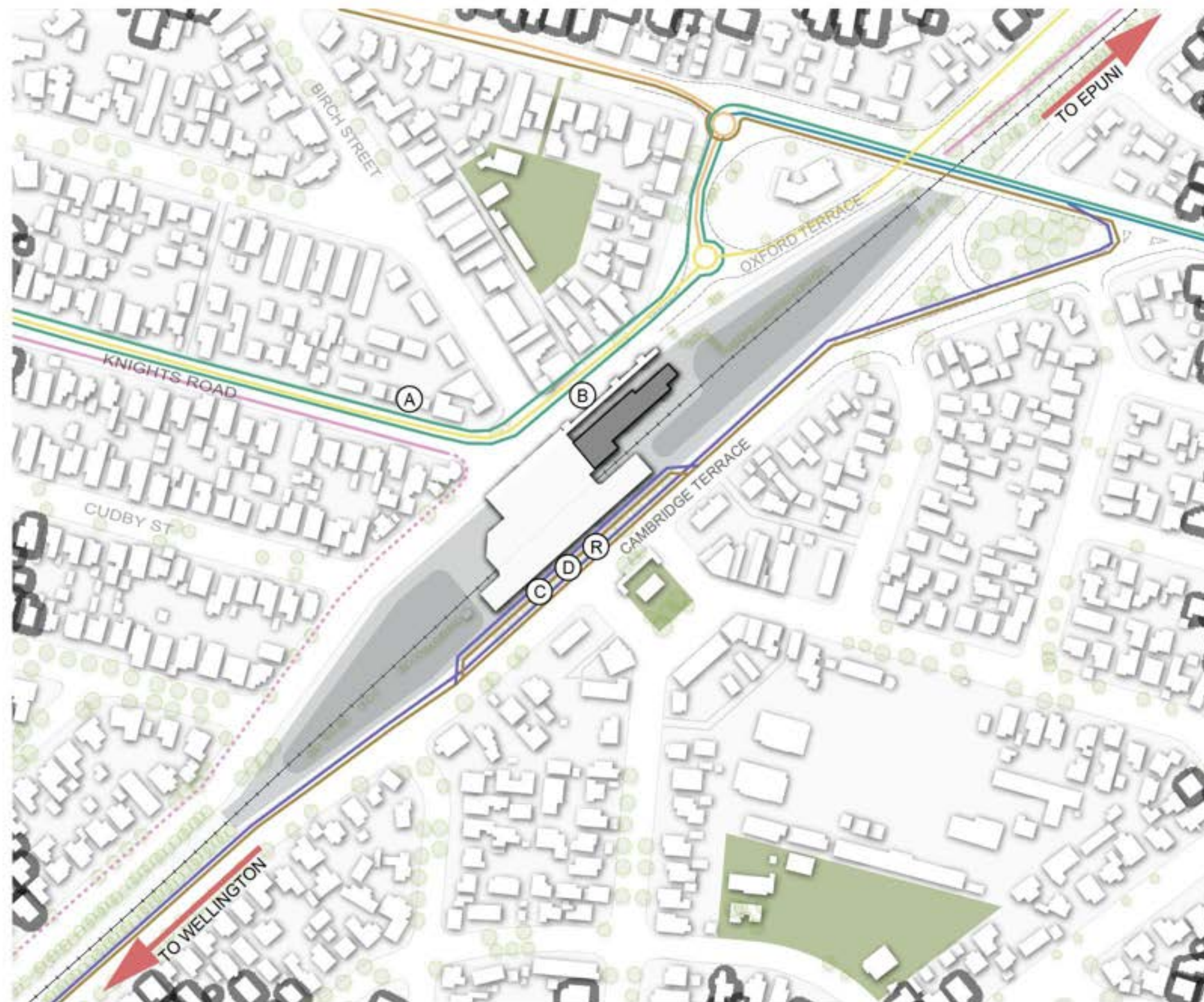
Figure 9: Waterloo to city centre - east west link - proposed and put on hold for future funding as part of 2024-2027 LTP

BUS ROUTE

- 121
- 130
- 145
- 149
- 150
- 160
- 170

CYCLE ROUTE

- Protected Cycle Lane
- Quiet Route (no infrastructure)
- Future East-West Cycleway (2024-2027 LTP)



3.3 EXISTING CONTEXT

URBAN & LANDSCAPE

Waterloo Station Overview

Waterloo Station is located in the Hutt Valley, situated on both the Wairarapa and Hutt Valley rail lines. It falls within the jurisdiction of the Hutt City Council and Greater Wellington Regional Council, primarily serving the suburbs of Waterloo, Lower Hutt Central, and Woburn.

Positioned within a formal, orthogonal street layout—typical of early planned settlements—the station functions as a civic anchor. Roads converge towards it, reinforcing its central role in the transport and urban network.

Urban Context

Waterloo Station is at the heart of a diverse urban precinct, bridging two contrasting environments:

East of the Station: This area features Trafalgar Square and a low-rise local centre with civic spaces, green areas, and pedestrian-friendly streets. It supports community activity and offers strong potential for placemaking and public realm enhancements.

West of the Station: Characterised by industrial uses, including the Waterloo Water Treatment Plant and associated infrastructure. While less structured, it offers opportunities for future redevelopment and improved amenity.

Station Civic Anchor and Community Connector

The broader area is undergoing transformation, with increasing residential intensification and mixed-use developments. The station plays a key role in supporting pedestrian movement across the rail corridor and connecting public spaces. It also acts as a catalyst for future transit-oriented development.

Its strategic location and connectivity make it a vital access point for employment, education, and social services. The station must be designed to meet growing demand while remaining flexible for future transport technologies and service upgrades.

Station Precinct & Land Ownership

The precinct comprises approximately 19,000m² of developable land, with ownership shared between Greater Wellington and KiwiRail. The design minimizes the station footprint to preserve land for future development.

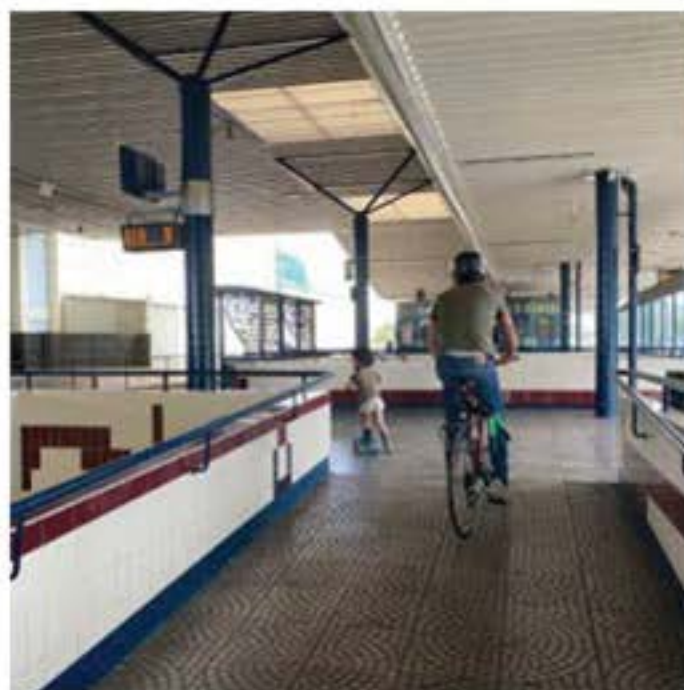


Figure 10: Underpass during morning peak

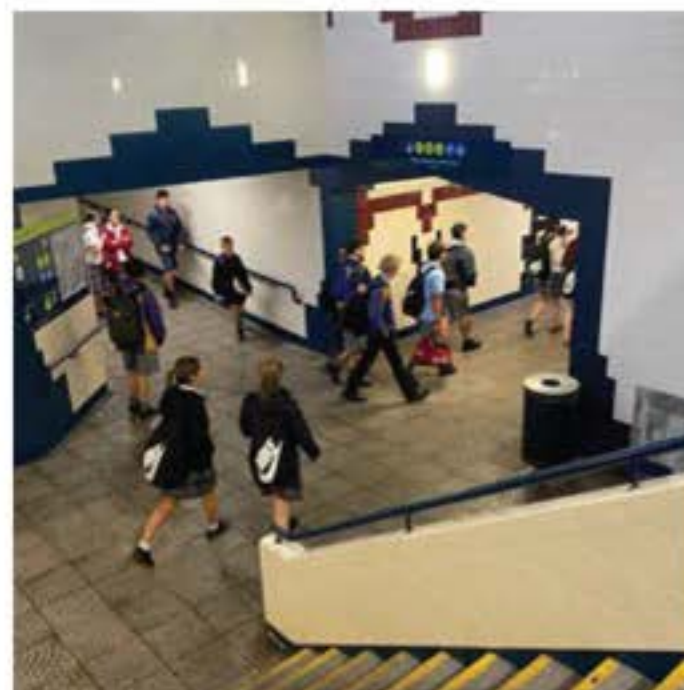


Figure 11: Te Awa Kairangi Hutt River and Waiwhetia have significant values for mana whenua



Figure 12: Local landscape: River plain - braided river/islands, flowing water in large swamp podocarp forest - kahikatea, pukatea, manakau with tawa and mahoe, and supplejack and kiekie vine

Urban Form

1. The local street layout intersects with the railway line and two parallel roads, Oxford Terrace on the west side and Cambridge Terrace on the east.
2. The streets radiate out on the Oxford Terrace side of the station. The roads on the Cambridge Terrace side focus in towards Trafalgar Square.
3. The station is an 'island' located between two busy roads.
4. Cars dominate the area around the station with large parcels of land dedicated to park and ride.
5. The underpass acts as an east west connector.
6. Buildings around the station are mostly one and two storey although the District Plan provisions allow new building heights up to 22m.

Landscape

7. The trees on Oxford and Cambridge Terraces screen the rail infrastructure from the local roads, residential areas and Trafalgar Square.
8. Trafalgar Square is a formal public space with small retail shops and services, this is lacking on the western side of the station.
9. The square and frontage to Cambridge Terrace is blocked by the underpass infrastructure and Pohutukawa trees, severing a clear sight-line to the Station.
10. Non endemic Pohutukawa trees are the predominant tree species. The area would have once supported Kahikatea, Totara, Raupo and other trees as part of the indigenous landscape.
11. Urban realm has minimal amenity and green infrastructure, greening is used for screening rather than for public space amenity.



3.4 FORECAST PASSENGER DEMAND

Future passenger demand has been estimated to determine the appropriate station sizing for future capacity, and to assist with identifying infrastructure needs to ensure the station is fit for future use. Developed with input from Wellington’s Transport Analytics Unit (WTAU) and Metlink, the assessment used 2046 as the design year (15 years after assumed opening date), with futureproofing considered out to 2061.

Forecasting future passenger demand

Waterloo is a strategically important station within the regional network. Despite recent softness in passenger numbers across the rail network, there are several factors that will lead to substantial growth in patronage at Waterloo Station in the medium to long term. This includes:

- Significant uplift in housing numbers within the direct catchment of Waterloo Station, with new, denser housing already built or planned
- Wider growth (e.g. Wainuiomata) increasing patronage on feeder bus routes

- Integrated fares and ticketing that will be enabled through the introduction of the National Ticketing System which is likely to drive increased demand, including fare integration across modes, capping, and potential for a distance-based fare structure.
- LIMRIM and other planned investment will also increase frequency and reliability, as well as quality of rolling stock
- Understanding this growth is critical to ensure that a rebuilt Waterloo Station is fit for purpose to meet future demand – and to futureproof where required to avoid inefficient investment or oversizing of some station elements (e.g. lifts, stairs, platforms).

These factors will drive higher demand for rail services and reinforce the importance of ensuring Waterloo Station remains fit for purpose through its next generation of use.

CURRENT DEMAND AND SNAPPER DATA INSIGHTS
To establish a robust baseline, Snapper data for the week of 11–17 March 2024 was analysed, covering the morning peak (06:00–09:00) and evening peak (15:00–18:00). This period falls within the 95th percentile of

annual usage and is considered representative of high network demand.

Data from Monday and Friday was excluded due to lower travel volumes typically associated with work-from-home patterns. Weekend data was also excluded. The analysis therefore focuses on the Tuesday to Thursday average, offering a clearer view of typical weekday commuter patterns.

- Key findings:**
- Passenger flows are strongly tidal, with high inbound demand in the morning (toward Wellington CBD) and outbound demand in the evening
 - The Hutt Valley Line (HVL) carries the majority of passengers due to its higher service frequency relative to the Wairarapa Line (WRL)
 - Snapper boarding and alighting profiles were used to inform arrival and departure patterns and peak load conditions

FORECASTING FUTURE DEMAND
Passenger forecasts were sourced from the Wellington Strategic Demand Model, as well as historical Snapper

data to understand growth rates. These were used to estimate demand on both inbound and outbound platforms during the morning peak.

The per annum growth rates from were used to interpolate the growth for the 2046 Design Year and extrapolate the 2061 Ultimate Design Year. As growth rates for the modelled data were applied to the existing Snapper data, growth was re-based to the year 2024 rather than the 2018 model base year.

The resultant growth rates are shown in Figure 9, and show the highest growth rates for alighting in the morning peak and boarding in the evening peak which correlate with the aspiration of Waterloo becoming a growing destination.

Applying the growth rates from Figure 4 to the existing Snapper data for the average peak weekday, results in the Design Year and Ultimate Design Year passenger demands in Table 1 and Table 2

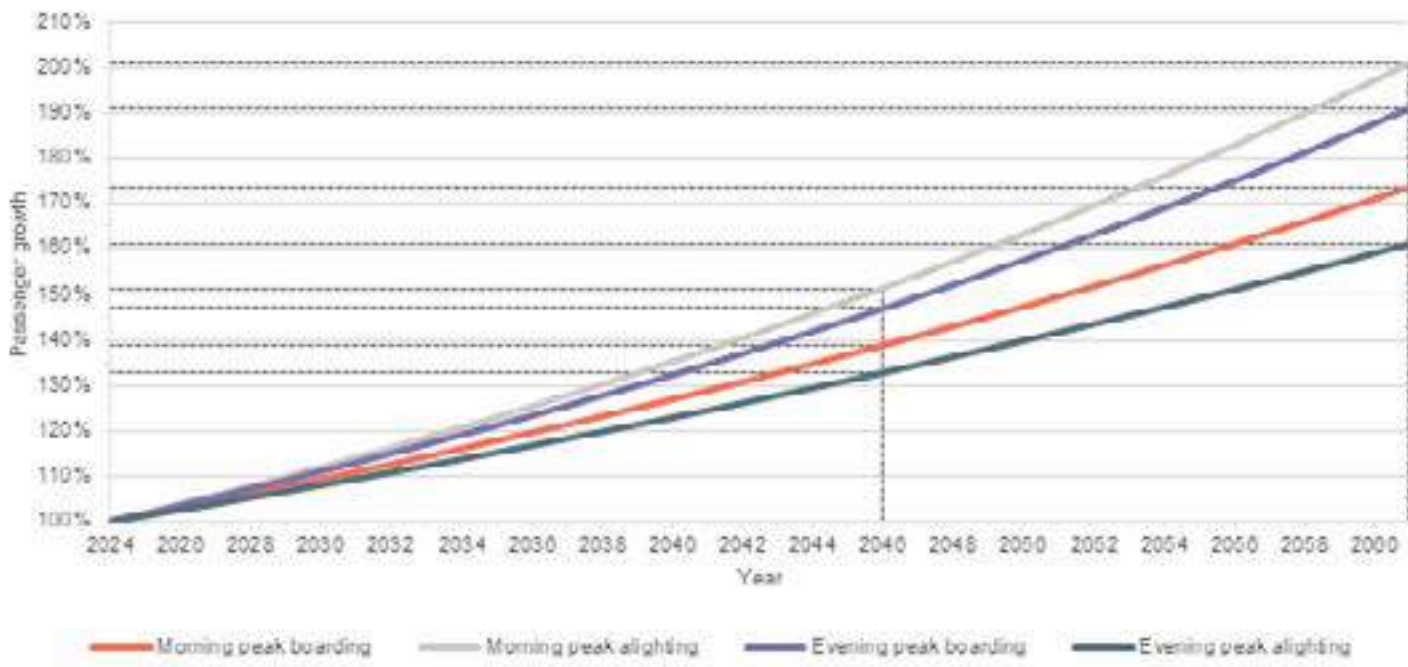


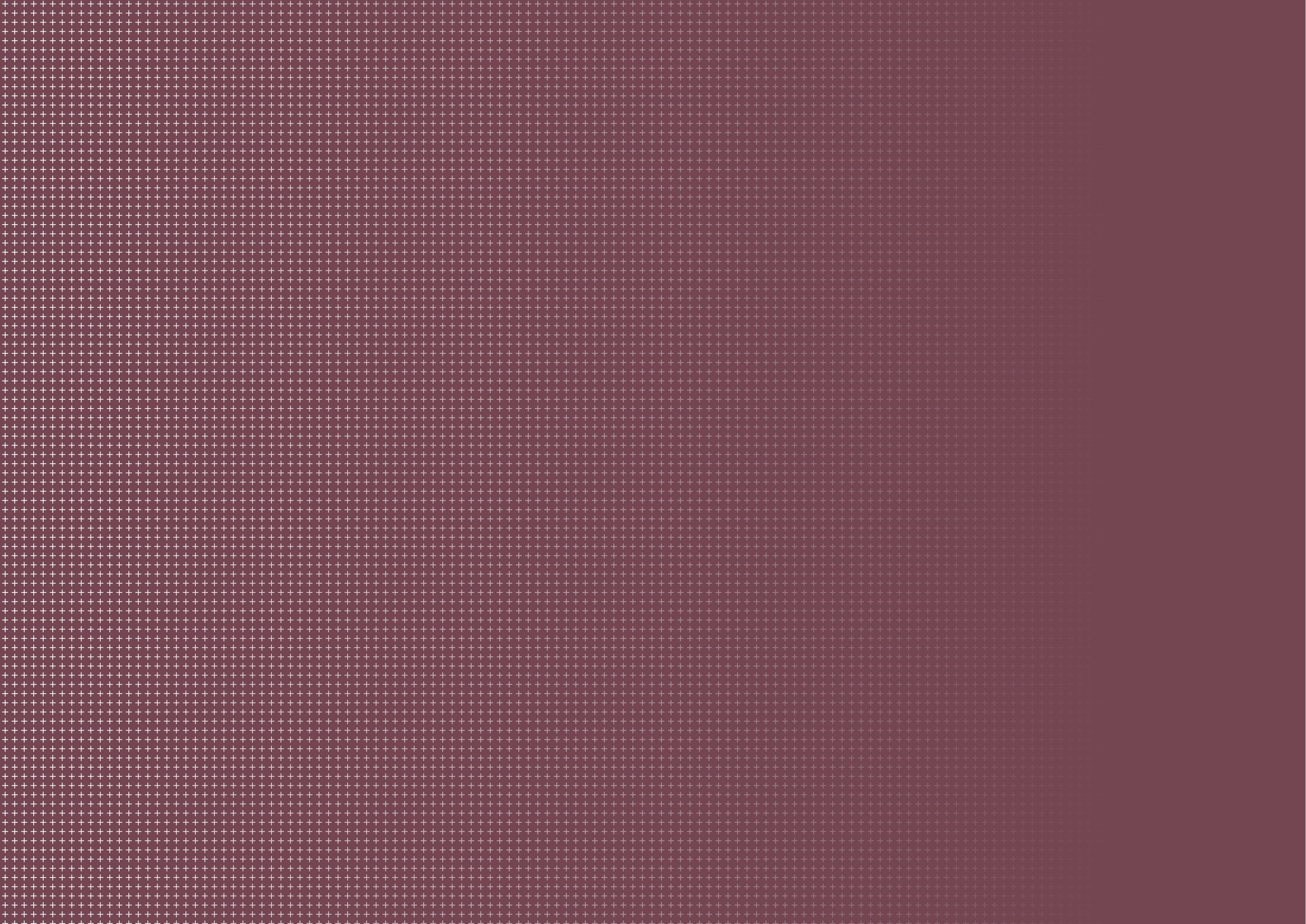
Figure 13: Waterloo Station passenger growth rates

	2024		2046		2061	
Line	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
HVL (Inbound)	1702	131	2364	198	2957	263
WRL (Inbound)	167	25	232	38	291	50
Inbound Total	1869	156	2596	236	3248	313
HVL (Outbound)	144	40	200	61	250	81
WRL (Outbound)	2	3	3	5	3	6
Outbound Total	146	43	203	66	253	87

Table 1: Design Year and Ultimate Design Year morning 3-hour peak passenger demands by line and direction

	2024		2046		2061	
Line	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
HVL (Inbound)	90	122	133	163	173	197
WRL (Inbound)	0	0	0	0	0	0
Inbound Total	90	122	133	163	179	197
HVL (Outbound)	145	1423	213	1892	277	2297
WRL (Outbound)	20	107	29	142	38	173
Outbound Total	165	1530	242	2034	315	2470

Table 2: Design Year and Ultimate Design Year evening 3-hour peak passenger demands by line and direction



4.0 DESIGN RESPONSE

4.1 DESIGN RESPONSE

KEY DESIGN MOVES

The vision set for Waterloo Station was to create a modern, accessible, and future-ready transport hub that enhances the daily experience of users and supports the region's long-term growth.

The design balances operational functionality, architectural clarity, and urban integration. It allows for staged delivery and future adaptability, futureproofing the station to evolve in line with transit-oriented development (TOD) objectives.

Developed through a rigorous feasibility and optioneering process, and informed by multidisciplinary input and stakeholder engagement, the design addresses the need to enable TOD, accommodate a multimodal interchange, and respond to existing road and rail constraints. Flexibility is central to supporting long-term growth, mode shift, and evolving transport needs.

Key Design Moves

1. PLATFORM REALIGNMENT:

Platform 2 is repositioned to align with Platform 1, creating a clear, symmetrical layout that simplifies passenger movement and forms a compact interchange footprint. This alignment also maintains the required 5-metre buffer from the adjacent Water Treatment Plant.

2. CROSS-CORRIDOR CONNECTIVITY:

A new overpass and at-grade pedestrian crossing over Cambridge Terrace replace the existing underpass. This improves both visual and physical connections between Oxford Terrace, Cambridge Terrace, and Trafalgar Square. The removal of underpass structures enhances visibility, accessibility, and reduces long-term seismic risk. Overpass creates a bookend to the station and relates to scale of Water Treatment Plant.

3. INTERCHANGE CONFIGURATION:

Platform 2 directly connects with the realigned eastern bus interchange, creating a compact and efficient interchange layout. This configuration reduces transfer times and supports both current and future bus operations, including demand-responsive services. The western bus stops are also retained and upgraded, ensuring a fully integrated and balanced interchange on both sides of the station.

Spatial Organisation & Secondary Elements

The three key design moves establish the core structure of the station and interchange. Together, they form a clear framework and spatial organisation and relationship with the broader precinct / public realm, that guides movement, interchange.

Supporting design elements such as vertical transport, entrances, forecourts, public realm treatments, and futureproofing measures are layered onto this framework. These secondary moves reinforce the primary structure by enhancing accessibility, amenity, cultural expression, and long-term adaptability, ensuring the station functions not only as infrastructure, but as a public place.

VERTICAL TRANSPORT

Two new enclosed circulation cores, each with accessible lifts and stairs, are symmetrically located to align with the repositioned platforms and new overpass.

STATION FOURCOURTS LINK TO PUBLIC REALM

ENTRANCES AND FORECOURTS:

Entrances positioned to align with pedestrian desire lines and key urban connections, such as Trafalgar Square and Knights Road.

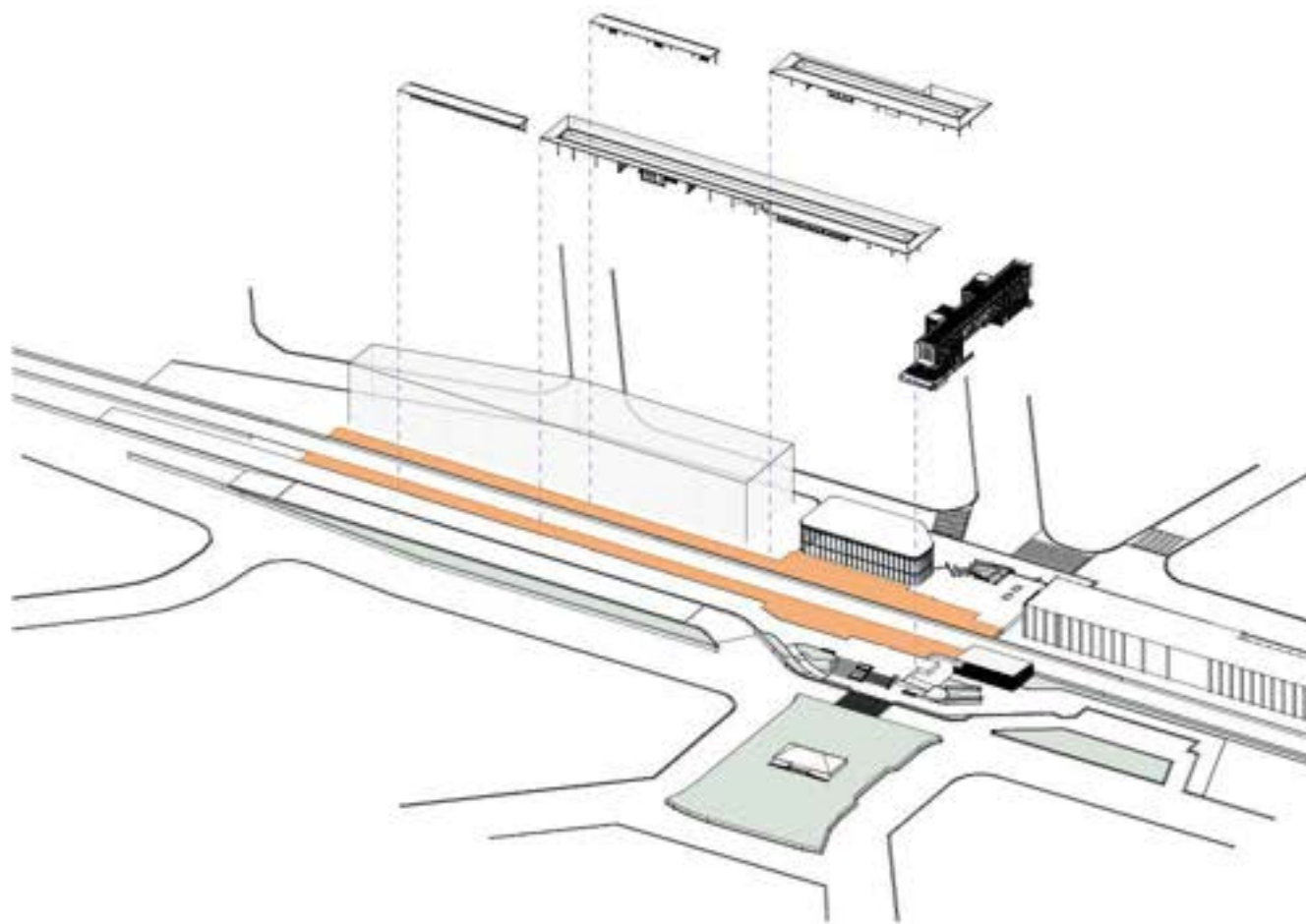
A secondary entrance directly serves the eastern interchange, strengthening the link between Platform 2 and bus services while improving legibility and accessibility from multiple directions.

PUBLIC REALM

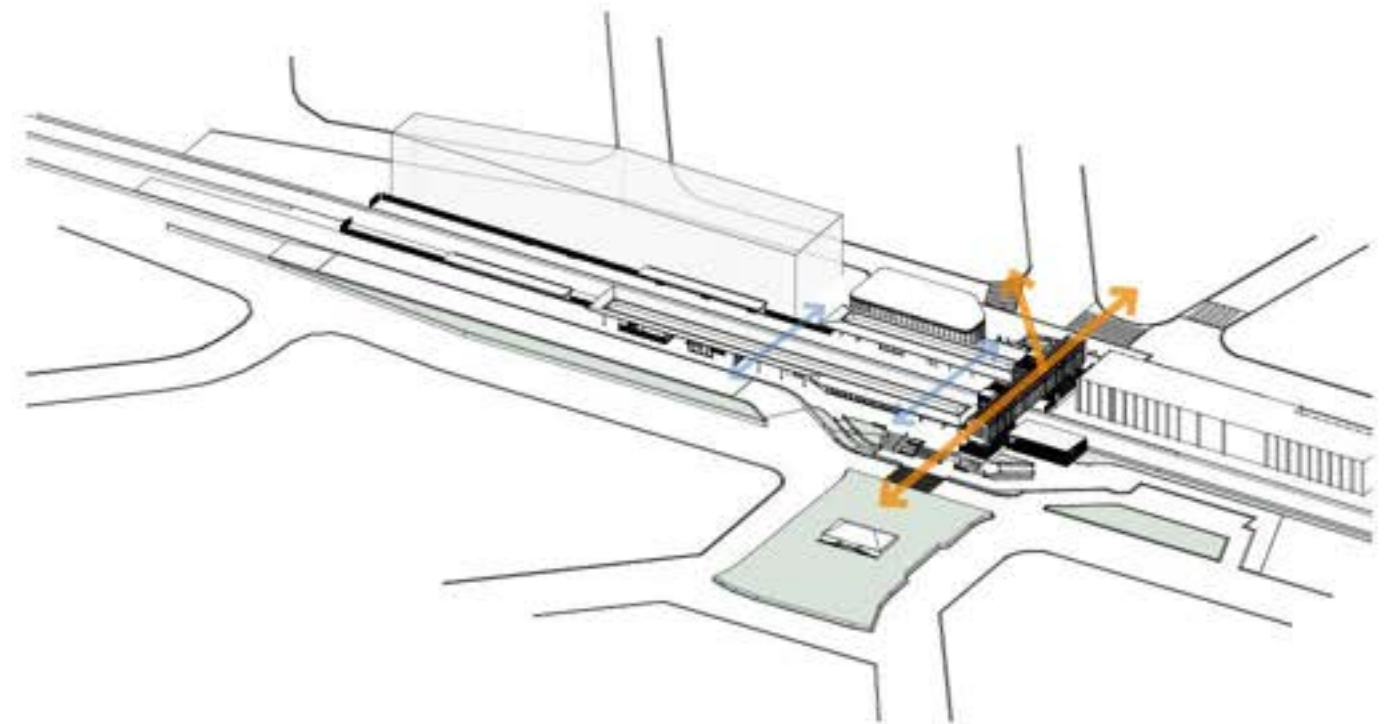
The public realm is central to the station's identity and function. It enhances connectivity, supports intuitive movement, and provides high-quality spaces for people to gather, wait, or pass through. Forecourts, landscaping, and integrated cultural elements contribute to placemaking, reflect local identity, and reinforce the station's role as a civic anchor within the precinct.

FUTUREPROOFING AND FLEXIBILITY:

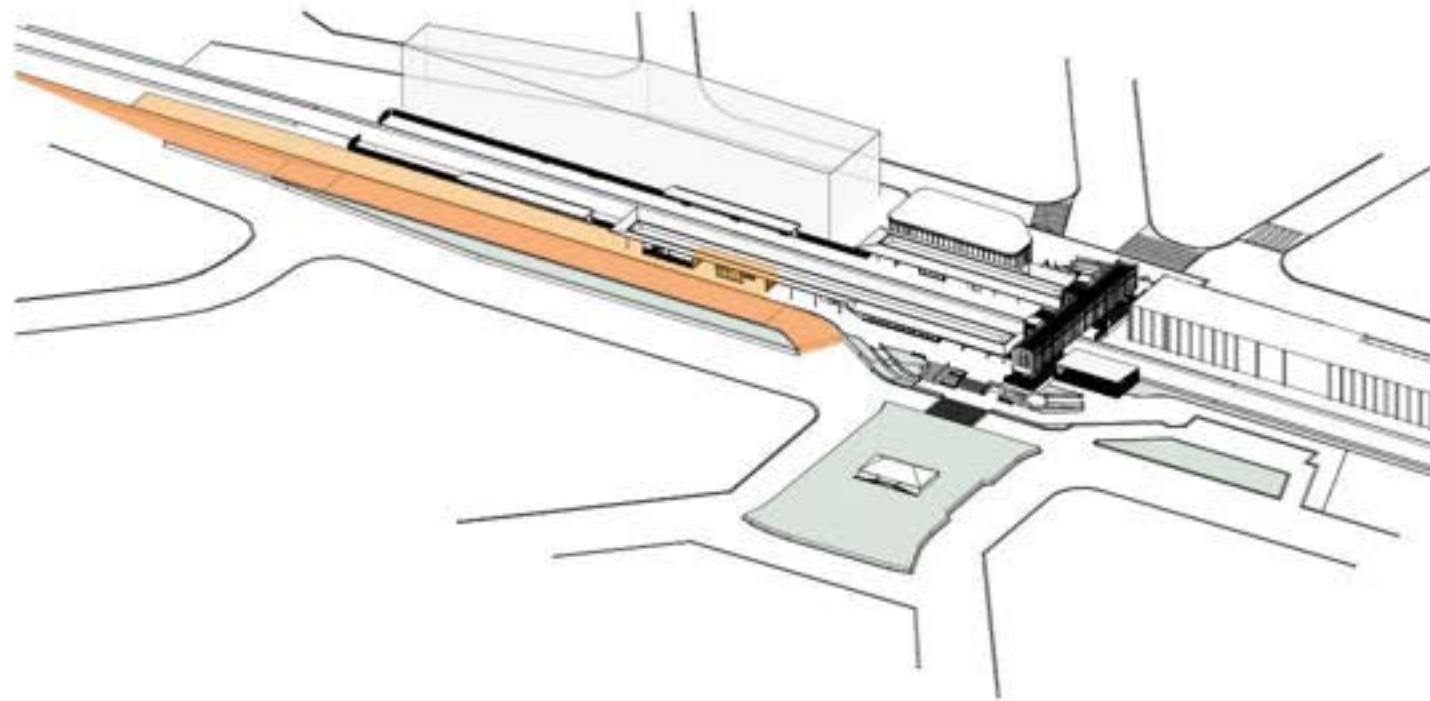
The design allows for staged construction and future upgrades, including provision for gate lines, electric bus charging infrastructure, and commercial development within the station footprint.



1. PLATFORM REALIGNMENT



2. CROSS-CORRIDOR CONNECTIVITY CONNECTION



3. INTERCHANGE CONFIGURATION

4.2 DESIGN RESPONSE

RELATIONSHIP WITH PRECINCT

Relationship with the Precinct

The new design for Waterloo station reinforces its role as both a vital link in the rail network and a central amenity for the surrounding area. The new station and interchange are designed to facilitate future urban development while respecting the existing neighbourhood.

The station and interchange design responds to the the formal, grid-like layout of the surrounding city. Entrances and forecourts are strategically aligned with key pedestrian paths, effectively extending the public space. This integration promotes smooth and effortless movement while solidifying the station's role as a key local landmark.

The overpass connects the Oxford and Cambridge Terrace station forecourts and an at-grade pedestrian crossing provides the link from the Cambridge Terrace forecourt to Trafalgar Square. The alignment of the overpass continues the axial routes that converge toward the station, creating both a visual and physical link between the station, interchange and the precinct.

Sense of Place

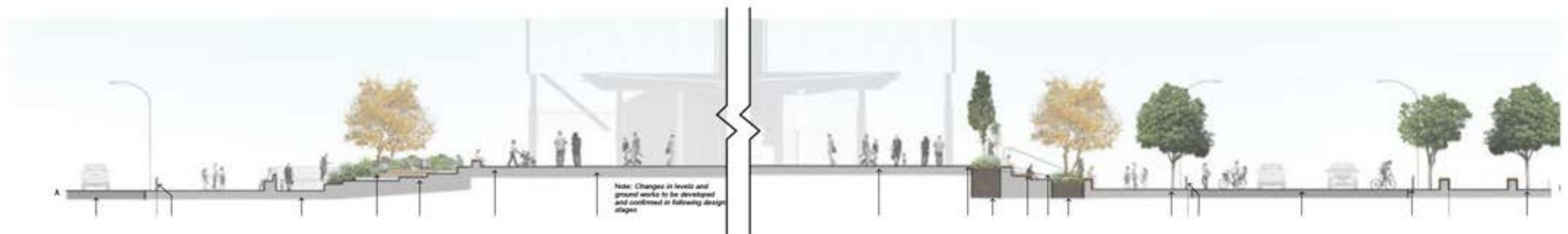
The forecourts and public realm are the largest placemaking elements of the project. Their design—including planting selection, surface treatments, and seating—play a critical role in shaping the station's character, its amenity and its presence within the wider precinct. Features like rain gardens and pedestrian-friendly paving reinforce the station as a place for meeting, dwelling, and moving through.

Opportunities for public art and cultural expression are embedded in the design, including potential integration of Mana Whenua narratives, helping to reflect local identity and values.

CPTED

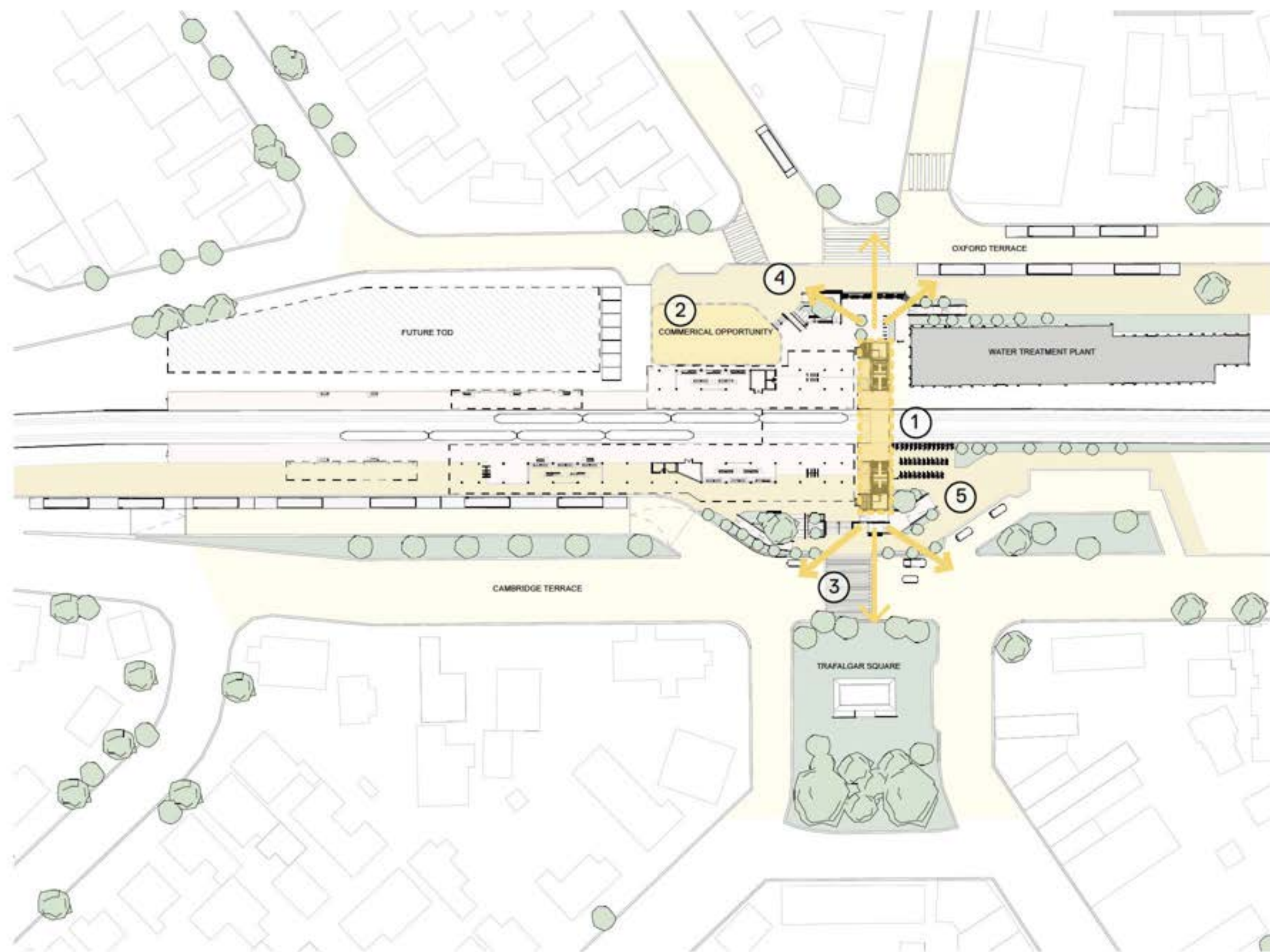
Crime Prevention Through Environmental Design (CPTED) principles guided the design of the station and interchange. All public spaces are designed to minimise obstructions and eliminate blind spots, with open layouts, glazed lifts and transparent overpasses enhancing visibility and passive surveillance.

Potential commercial developments are located to foster activity and further encourage passive surveillance and community ownership of the space.



KEY

1. Overpass acts as a visual and physical link - relationship with WTP
2. Commercial spaces are located to enhance passive surveillance
3. At grade crossing connects Cambridge Terrace forecourt to the station
4. Oxford Terrace Forecourt/public space
5. Cambridge Terrace Forecourt/public space



4.3 DESIGN RESPONSE LANDSCAPE

Landscape/Urban

1. Signalised at-grade crossing across Cambridge Terrace to enable direct movements to station from east and to overpass - also allows more direct desire lines (than underpass) to the two different entry points.
2. Existing underpass replaced with an overpass that continues to provide community east west link and platform access.
3. Underpass on Trafalgar Square replaced with open space that visually links square to the front of the station creating a new station frontage on the east-facing side of the open space square.
4. Improved crossings at Oxford Terrace, Knights Road, Birch Street and Pohutakawa Streets to provide improved bus stop links.
5. 'Pause points' introduced into public realm, these provide areas for sitting/waiting outside the station canopy. The 'pause points' sit in the flow of the steps and movement routes and respond to stone/islands in a river current.
6. Opportunity for co-design with local stakeholders-ground plane, vertical elements, tree types, water design and station overpass
7. Raised table crossing points on side streets to Trafalgar Square (not pedestrian crossings).
8. Ramps to provide access onto Cambridge Terrace and Oxford Terrace for wheeled users and people with reduced mobility.
9. Visible, secure bike parking on the east and west sides in proximity to ramps.
10. Rain gardens along side the main roads to take stormwater runoff and improve water quality prior to discharge. On Cambridge Terrace, these also reduce people trying to cross away from the signalised crossing point.
11. Direct station access for people arriving from PUDO and accessible parking on the north east area by passage under the overpass.
12. Park and ride pushed away from the immediate adjacency to the station entry and public realm to reduce conflicts and elevate the priority for people on foot and using PT interchange.





KEY

1. Karaka tree
2. Rewa Rewa tree
3. Titoki tree
4. Lancewood tree
5. Kowhai tree
6. Rewa Rewa tree flower
7. Kowhai flower with tui
8. Rain garden grasses
9. Raupo/rain garden plant
10. Integrated steps and seating
11. Informal seating
12. Paving pattern (etched concrete - Wellington Thorndon Quay example)

4.4 DESIGN RESPONSE

PASSENGER MOVEMENT

Passenger Experience & Accessibility

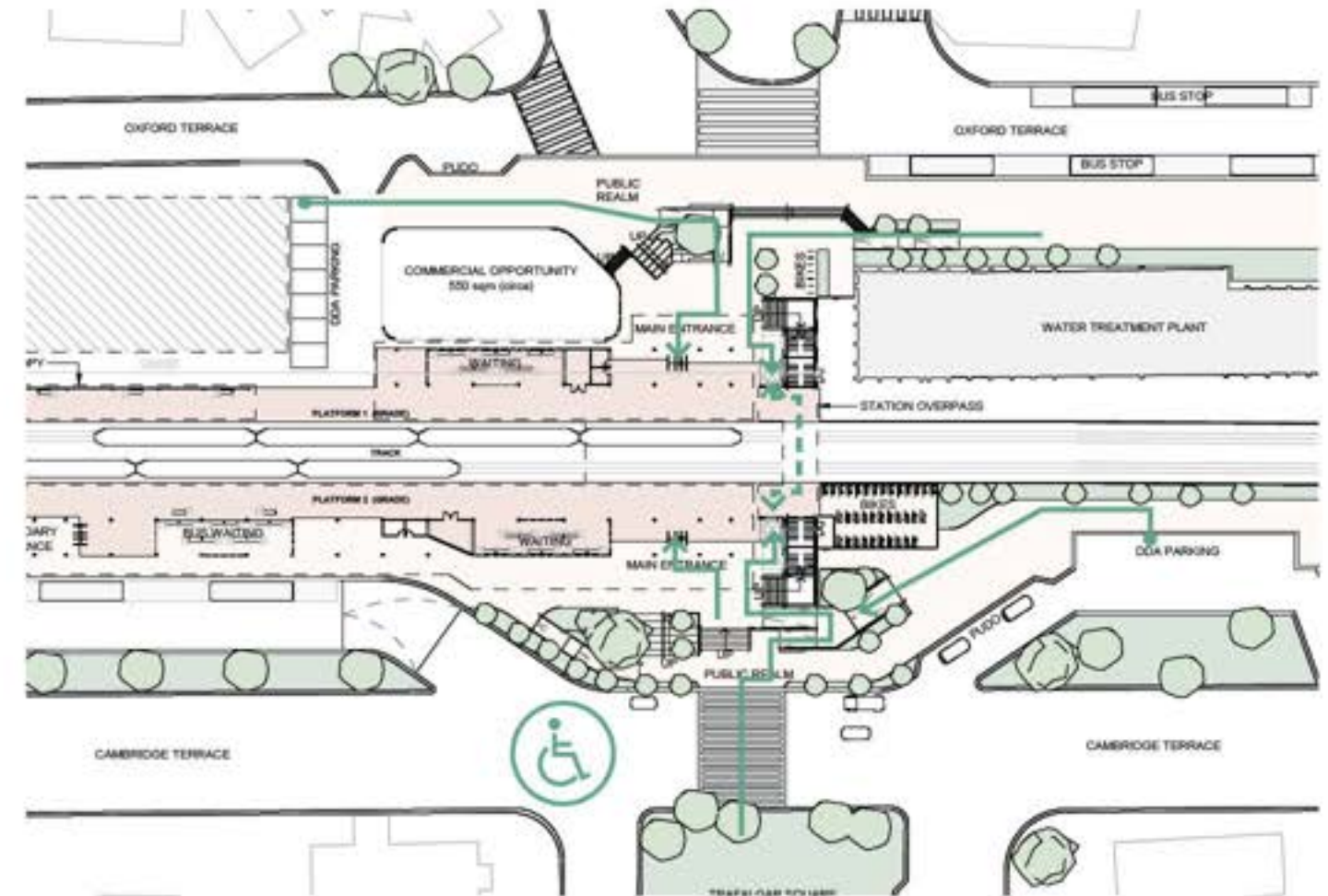
Passenger experience is a central consideration in the station design, which prioritises intuitive movement, minimal congestion, and universal access. The layout supports peak tidal flows with platform widths, queuing zones, and circulation paths sized to meet forecast demand. Entrances align with pedestrian desire lines, and vertical transport ensures step-free access throughout.

As civic spaces stations providing public amenity for both commuters and community, including quality landscaped forecourt - public spaces, cross rail access, toilets, weather-protected waiting areas are with seating, real-time information displays, and Snapper kiosks to support seamless multimodal transfers.

Design for Accessibility

Accessibility is fully integrated to support independent and safe movement for all users, regardless of age or ability. Key features include:

- Step free access to station, interchange and across the rail,
- Accessible lifts, compliant stairs, and accessible toilets on both platforms
- Accessible parking provisions,
- Tactile indicators, legible signage and and hearing augmentation systems are provisioned for,
- material choices to enhance comfort and navigation.



Accessible access path



Approach to the Secondary Entrance and gateway from Cambridge Terrace



Approach to the station from Cambridge Terrace



View from Platform 1, semi-enclosed waiting areas to the left.



View from the Overpass, travelling from Cambridge Terrace to Oxford Terrace

KEY

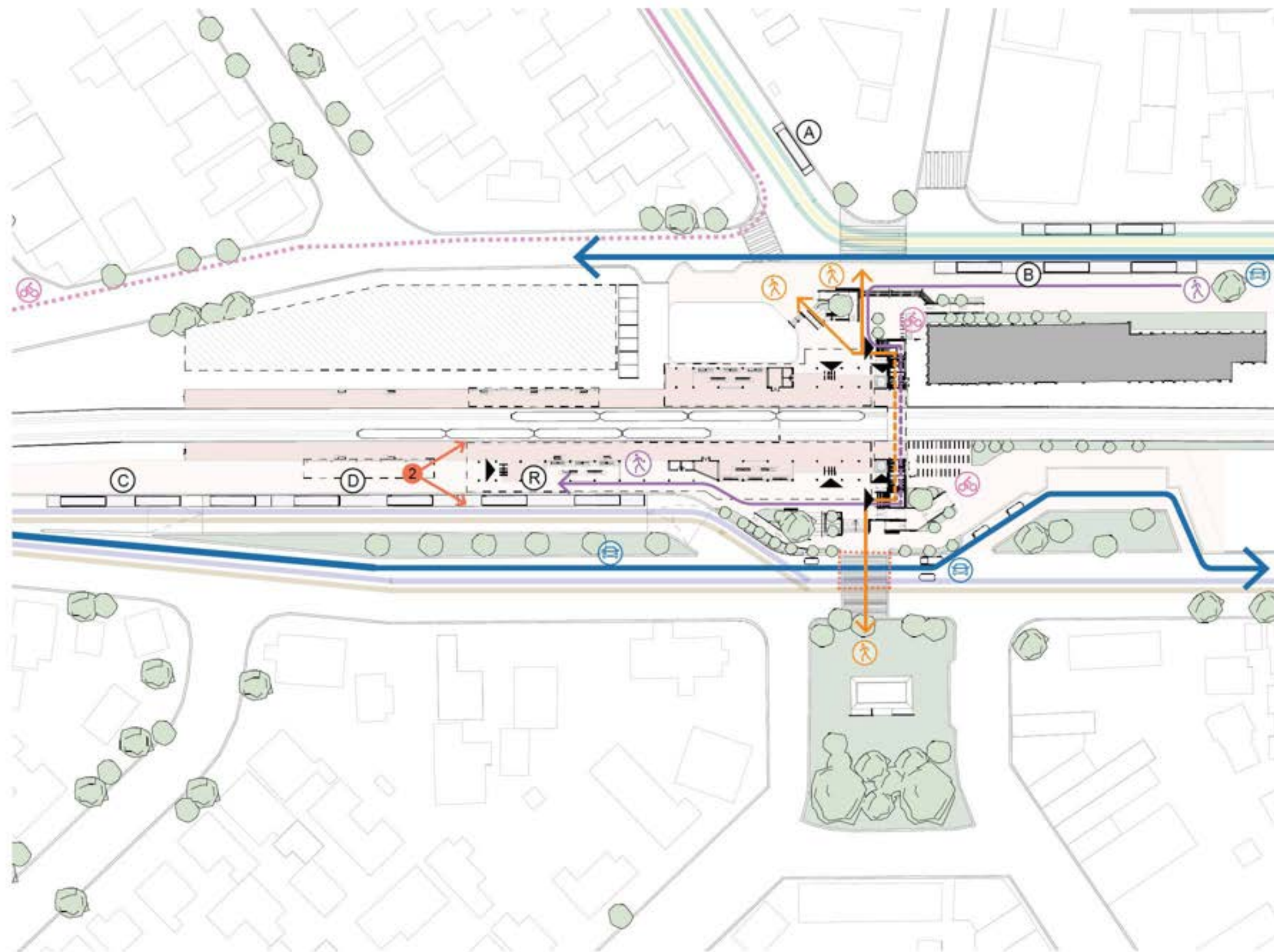
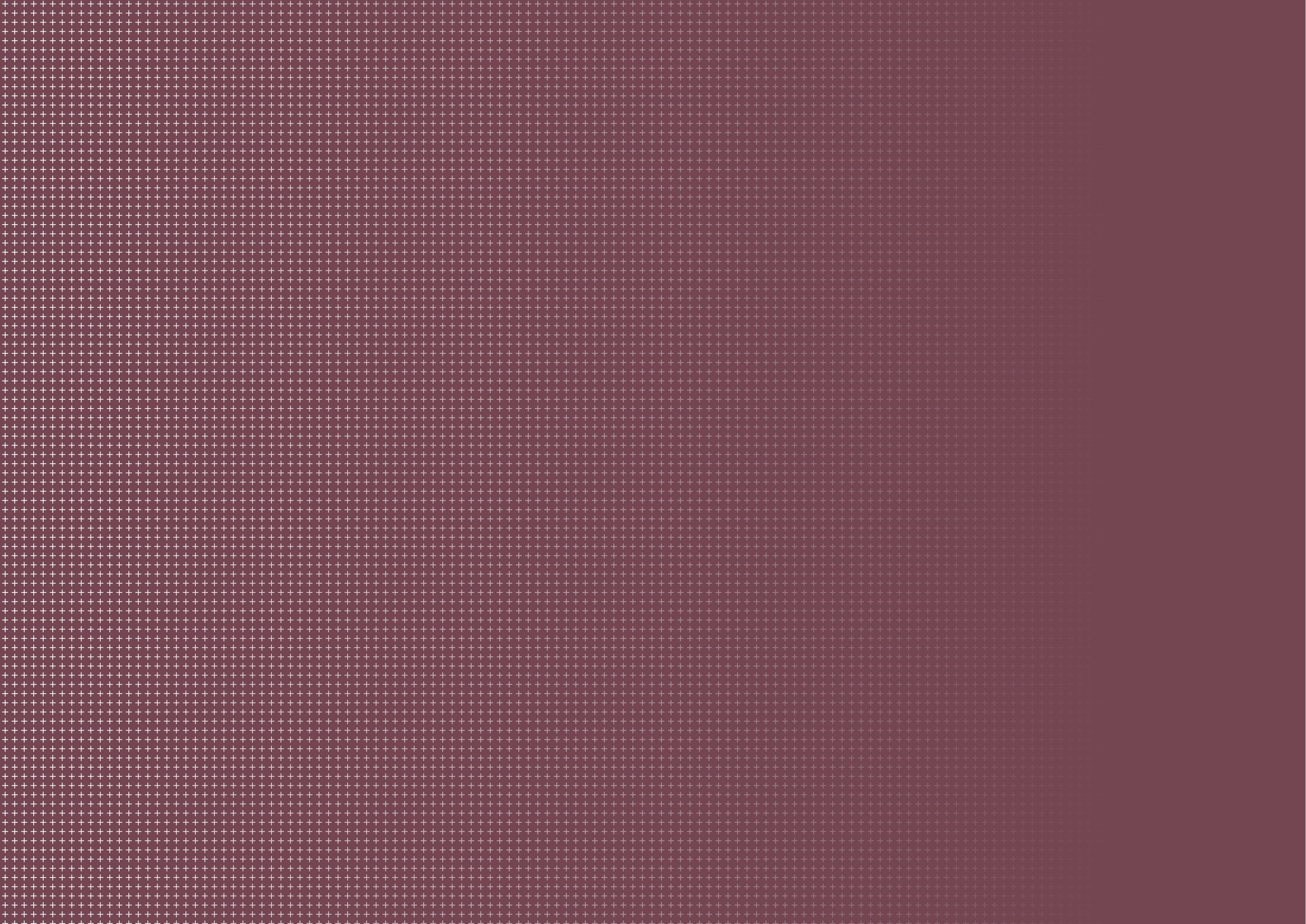


Figure 14: Station and interchange plan



5.0 STATION DESIGN

5.1 STATION DESIGN OVERVIEW

Station Sizing

Passenger demand forecasts indicate significant growth in the catchment area, driven by residential intensification and regional transport improvements. The design year is set at 2046, with futureproofing to 2061. Planning has accounted for peak hour flows, tidal movement patterns, and mode shift targets, ensuring that all spaces meet minimum service levels and allow for safe, efficient movement. (refer to appendix for station program based on the 2046 design year).

The station and interchange are structured around key elements, each contributing to a coherent, legible, and adaptable transport interchange:

Station Elements

1. PLATFORMS

- Split and aligned platform configuration: Platform 1 serves Epuni, Platform 2 serves Wellington
- Platforms are designed to KiwiRail standards: 5.0m wide, 190m long, with a maximum 4.2m clearance from localised obstructions, accommodating 8-car trains.
- Platforms are end-loaded - main entry from Northern end of Platforms, with an additional mid-platform entry on Platform 2 to align with the Eastern Bus Interchange.
- Platform canopies provide weather protection to approximately 70% of each platform.
- Seating on platform under the canopies 48
- Wind shelter provided for each platform
- Station closure line - fencing and future proofing for the installation of ticket gatelines and roller shutter

2. RAIL CORRIDOR CROSSING

- Community access across the rail and cross platform access is provided via a new overbridge, replacing the existing underpass,
- The overpass acts as the central organising structure, creating a safe, legible link between the eastern and western sides,
- It frames views across the Hutt Valley and establishes a strong civic presence for the station.
- Overpass is an unpaid link providing access outside

of station closure line, provides 24h access across rail for community,

3. VERTICAL CIRCULATION

- Overbridge is linked via symmetrically configured VT cores consisting of glazed lifts and stairs, which provide accessible, weather-protected access.
- Circulation elements are enclosed for comfort and safety, with clear sightlines to support intuitive passenger movement,
- Stairs incorporate bike channels to allow for easy cycles across the bridge,
- Compliant 4m run-off zones are provided for all VT elements and platform entries.

Station Amenities

4. STATION ENTRIES

- Station entries are located at the northern end of the platforms, adjacent to the overbridge.
- The configuration of main entries and vertical transport (VT) on each platform is symmetrical, creating a simple and legible layout that supports intuitive wayfinding.
- An additional mid-platform entry on Platform 2 aligns with the Eastern Bus Interchange, improving multimodal connectivity and reducing walking distances.
- Entry canopies mark key station approaches, align with pedestrian desire lines, and provide weather protection, these areas also support retail and advertising opportunities on the unpaid side,
- Snapper readers and futureproofing for gate lines are integrated at entry points.

5. WAITING AREAS

- Waiting areas with integrated seating are located under main entry canopies, next to station entries,
- These Lightweight, glazed structures are naturally ventilated, provide weather protection while maintaining visibility and passive surveillance.

6. TOILETS

- Station design provides for toilet provision one block per platform, each with an accessible and a unisex

toilet

- Platform 1 toilets are accessed from station closure line,
- Platform 2 toilets are accessed from the public side / Eastern Interchange,
- Toilets would be automatically closed outside of station opening hours.

Interchange

The interchange has been planned to support multimodal connectivity and operational efficiency, provides for flexibility and futureproofing. Refer to Transport Report in the Appendix for further details.

7. THE EASTERN INTERCHANGE:

- Is upgraded and consolidated to support high-frequency services and future growth,
- Additional secondary entry to platform 2 to minimise interchange times.

8. WESTERN INTERCHANGE

- Retains and improves existing bus stops and relationship to station,

9. BICYCLE PROVISIONS

- Secure bicycle parking for 100 bikes is integrated across two entrances, with passive surveillance and provision for future expansion, alongside pick up and drop-off (PUDO) spaces and active mode links.

10. PUDO (PICK UP AND DROP OFF) PROVISIONS

Pick up, drop areas for passengers are provided on both sides of the station.

11. DDA PARKING

- 8 accessible parking bays have been provided on each side of the station with step free access routes supporting these.

Commercial Opportunity

12. COMMERCIAL AREA

The Commercial Area which is indicated as part of the station proposal has been documented for the purpose of the reference design as a 3 storey building (GF, L1,

L2). The building has a footprint of 550sqm, with a total GFA of 1650 sqm over 3 floors. This building is subject to further development in the next phase once GWRC requirements are known

Material Selection & Safety

- The material selection considered durable, low-maintenance materials to reduce operational costs
- Crime Prevention Through Environmental Design (CPTED) principles are applied throughout,
- Fire and life safety systems are embedded to ensure safe evacuation in emergency scenarios.

KEY

1. Platforms
 2. Rail corridor crossing
 3. Vertical circulation
 4. Station entries
 5. Waiting areas
 6. Toilets
 7. The eastern interchange:
 8. Western interchange
 9. Bicycle provisions
 10. PUDO (pick up and drop off)
 11. DDA parking
 12. The commercial area
- C Bus stops

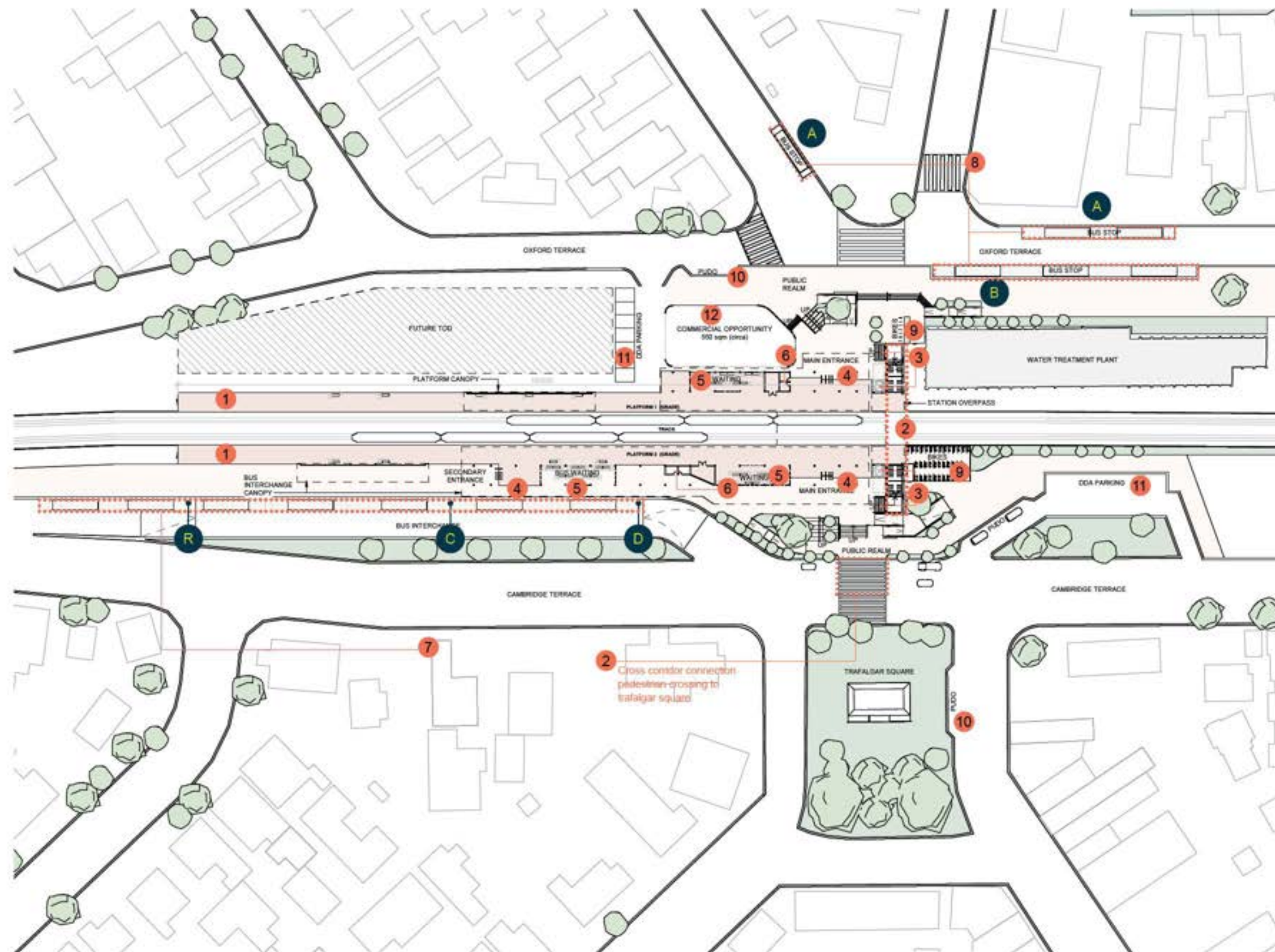


Figure 15: Station and interchange plan

5.2 STATION ELEMENTS

OVERPASS

Overpass

The pedestrian overpass at Waterloo Station is a central architectural and functional element, connecting Oxford Terrace to Cambridge Terrace and linking the two sides of the town. The bridge is designed to celebrate the act of crossing, with open ends that frame views to the surrounding landscape and civic spaces, creating moments of pause and orientation for users.

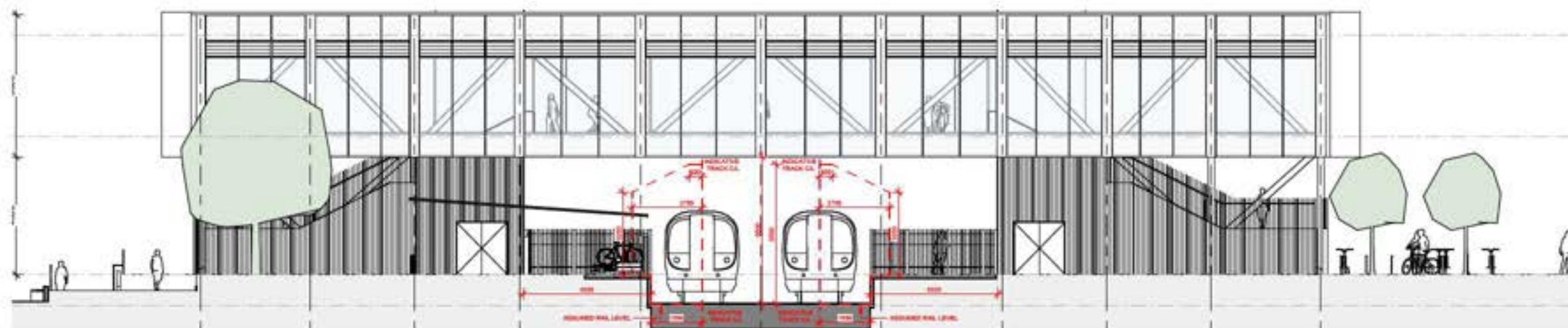
Architecturally, the overpass is expressed through transparency and simplicity. Glazed façades with patterned, ceramic frit and low-emissivity (low-e) coatings mitigate solar gain while allowing daylight to filter through, creating a dynamic play of light and shadow. These treatments contribute to thermal comfort and energy efficiency, while also offering opportunities for cultural storytelling and visual identity, potentially incorporating Mana Whenua design elements.

The overpass is passively ventilated through permanently fixed, weatherproof louvres located at ceiling level. These allow for continuous airflow without compromising weather protection or visual clarity. Ventilation could be further supported by strategically placed openings and full height louvres in areas that pose no safety issues from electrified lines below.

enabling a full-height glazed expression without the need for mechanical systems.

Material selection has been guided by a focus on durability, ease of maintenance, and long-term performance. The structure employs robust, low-maintenance finishes such as coated steelwork, durable glazing systems, and non-slip and durable flooring that can withstand high levels of daily use and exposure to the elements. Surfaces are designed to resist wear, minimise cleaning requirements, and reduce whole-of-life costs, ensuring the overpass remains safe, functional, and visually coherent over its design life.

The bridge structure is deliberately expressed and legible, reinforcing its role as a functional connector within the station precinct. Structural elements such as beams, columns, and bracing are articulated with clarity, allowing users to intuitively understand the bridge's purpose and orientation. This approach enhances wayfinding, supports architectural coherence, and contributes to the station's identity as a civic and infrastructural landmark.



North Elevation:
Expressed Structure
provides a clearly
articulated legible
bridge design



Ceramic frit applied to glass facade mitigate solar gain. Patterns can incorporate Māori Whenua design.



Unadorned glass facades provide a clean, easy to maintain surface that is durable.



Battened ceilings can discreetly accommodate services and provide acoustic dampening.



Battened ceilings can discreetly accommodate services and provide acoustic dampening.



5.3 STATION ELEMENTS

VERTICAL TRANSPORT

Vertical Transport

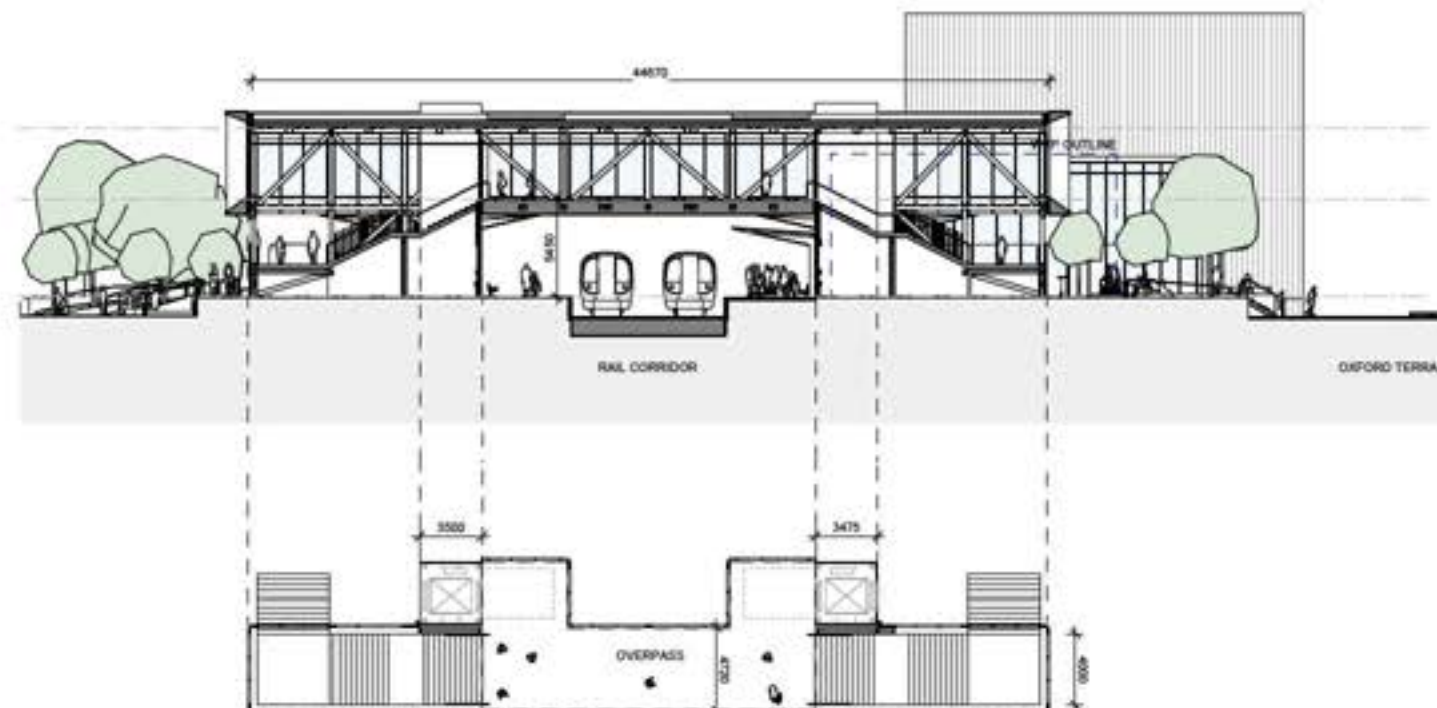
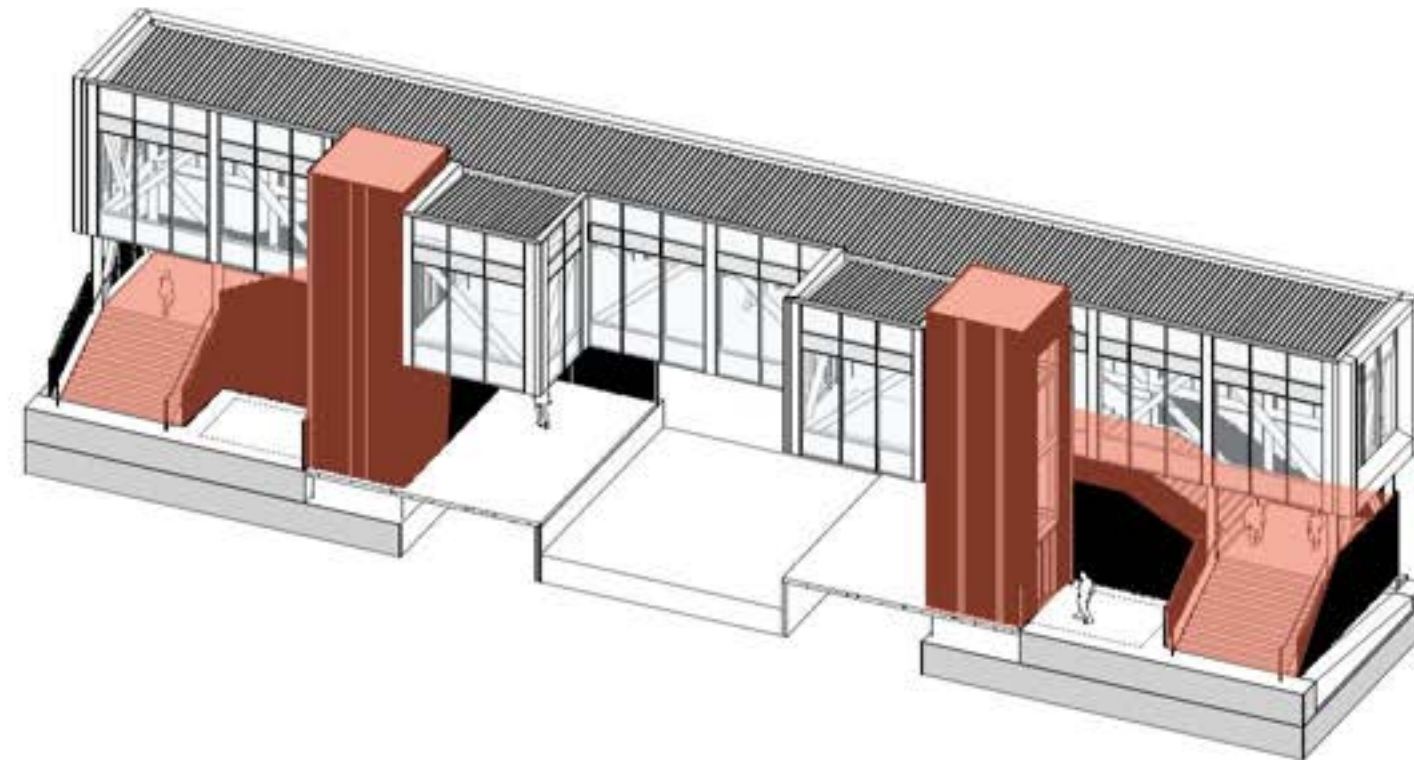
Vertical movement at Waterloo Station is facilitated through two enclosed circulation cores, each containing lifts and stairs designed to ensure universal access and intuitive wayfinding. These elements are positioned for maximum visibility and ease of use, supporting seamless transitions between the station forecourt, concourse, and platforms. The architectural expression of vertical transport is consistent with the station's overall design language—transparent, legible, and welcoming.

Lifts

Each circulation core includes a single large-capacity lift designed to accommodate two individuals with bicycles simultaneously. This ensures that passengers travelling with bikes, mobility devices, or prams can access platforms without delay or congestion. The lift cabins are visible from both the concourse and bridge levels, enhancing passive surveillance and user comfort. Glazed panels on the lift shafts contribute to the station's open and contemporary aesthetic, while solid surfaces are used strategically to reduce solar gain and mechanical ventilation requirements. The lift design balances accessibility, safety, and operational efficiency.

Stairs

The staircases are designed as architectural extensions of the bridge, with glazed balustrades and open sightlines that support intuitive movement and passive surveillance. Each stair includes provision for integrated bike channels, allowing cyclists to wheel their bikes alongside them without lifting. This feature supports active transport and aligns with the station's broader sustainability and mode-shift goals. The stair design also incorporates tactile indicators, compliant handrails, and coordinated lighting to ensure safety and comfort for all users.





Lift Towers: Vertical, textured aluminium cladding with glazed sections for visibility. Generous proportions of the lift car provide sufficient space for bike access.



Stairs: Open lower runs engages directly with forecourt, it is visible on approach and clearly articulates the access route.



Stairs: Provision for bike channels on the stairs enables cycling connection between Cambridge Terrace and Oxford Terrace



Materials: Handrails and stair nosing's to be provided and aligned with accessible requirements. Robust materials proposed; stainless handrails, steel stairs and durable surfaces



5.5 STATION ELEMENTS ENTRIES & WAITING AREAS

Entry Canopy

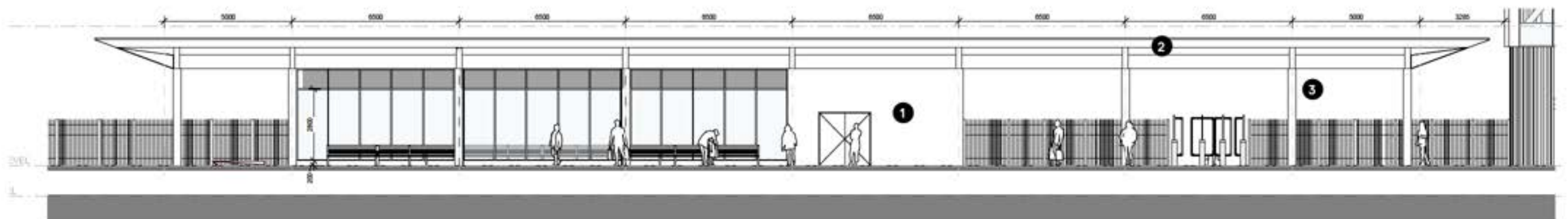
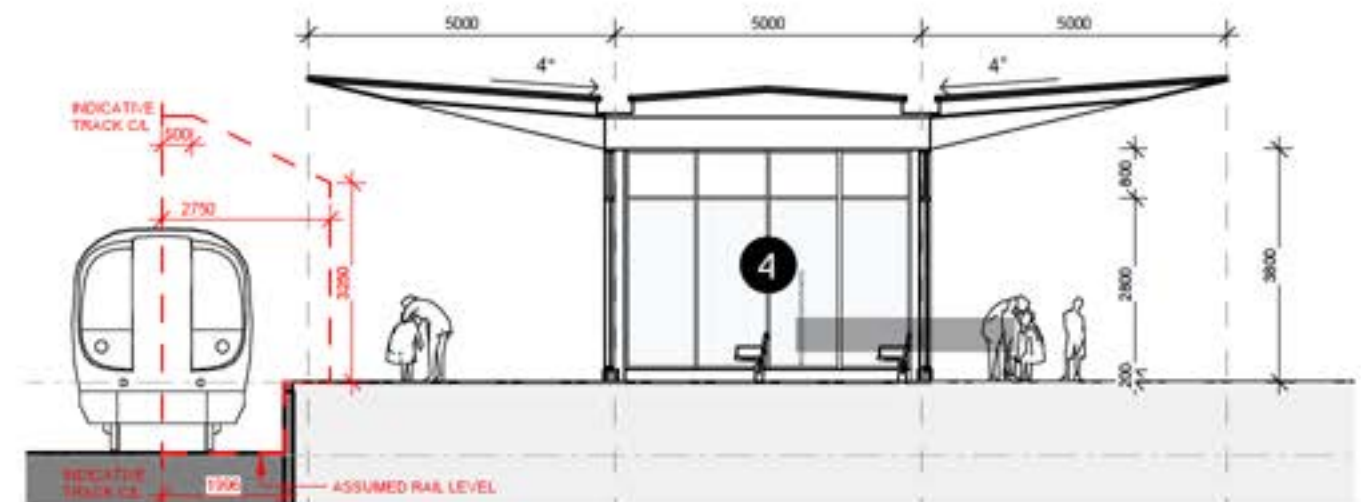
The entry canopy at Waterloo Station defines the arrival experience and acts as a key architectural element that connects the public realm with the station interior. Designed as a floating surface supported by slender columns, the canopy maximises openness and pedestrian flow while providing generous weather protection across the forecourt and entry points. Its clean soffit and bespoke edge detail contribute to a contemporary design language that complements the wider station architecture.

The canopy structure integrates lighting, signage, and services in a streamlined manner, supporting intuitive wayfinding and enhancing the station's legibility. It also provides coverage to adjacent vertical transport elements, and visually connects with the platform canopies to create a cohesive architectural identity. Opportunities for cultural expression are embedded in the design, with potential for Mana Whenua narratives to be incorporated into the canopy soffit or as gateway markers / Poe.

Waiting Areas

The waiting areas at Waterloo Station are designed to offer comfort, visibility, and protection from the elements. Defined by a series of glazed partitions, set strategically between the structural grid and columns of the main canopies, these semi-enclosed glazed spaces provide seating, offer ample locations for ceiling mounted real-time information displays, and proximity to Snapper kiosks. They will be naturally ventilated with permanent openings and high level ventilation via perforated metal panels. Their placement ensures clear sightlines to key station elements, supporting intuitive movement and wayfinding.

Each waiting area is fully accessible, with compliant entry thresholds, ample space for manoeuvring between fixed seating, tactile indicators, and good access to vertical transport. Materials are selected for durability and ease of maintenance, while glazing ensures passive surveillance and a sense of openness. The design also allows for future adaptability, with space provision for additional seating or digital infrastructure. These areas are conceived not just as functional shelters, but as part of the station's civic character, welcoming, inclusive, and integrated with the public realm.





1 Wall Cladding: Ribbed block veneer provides solid, textured contrast to glazed waiting areas



2 Main Canopy: A floating plane with thin edges, supported on elegant columns



3 Entry Gates: Opportunity to be framed and defined with entry markers, and Station signage



4 Waiting Areas: Glazed wind breaks provide protection from elements.

5.6 STATION ELEMENTS

PLATFORMS

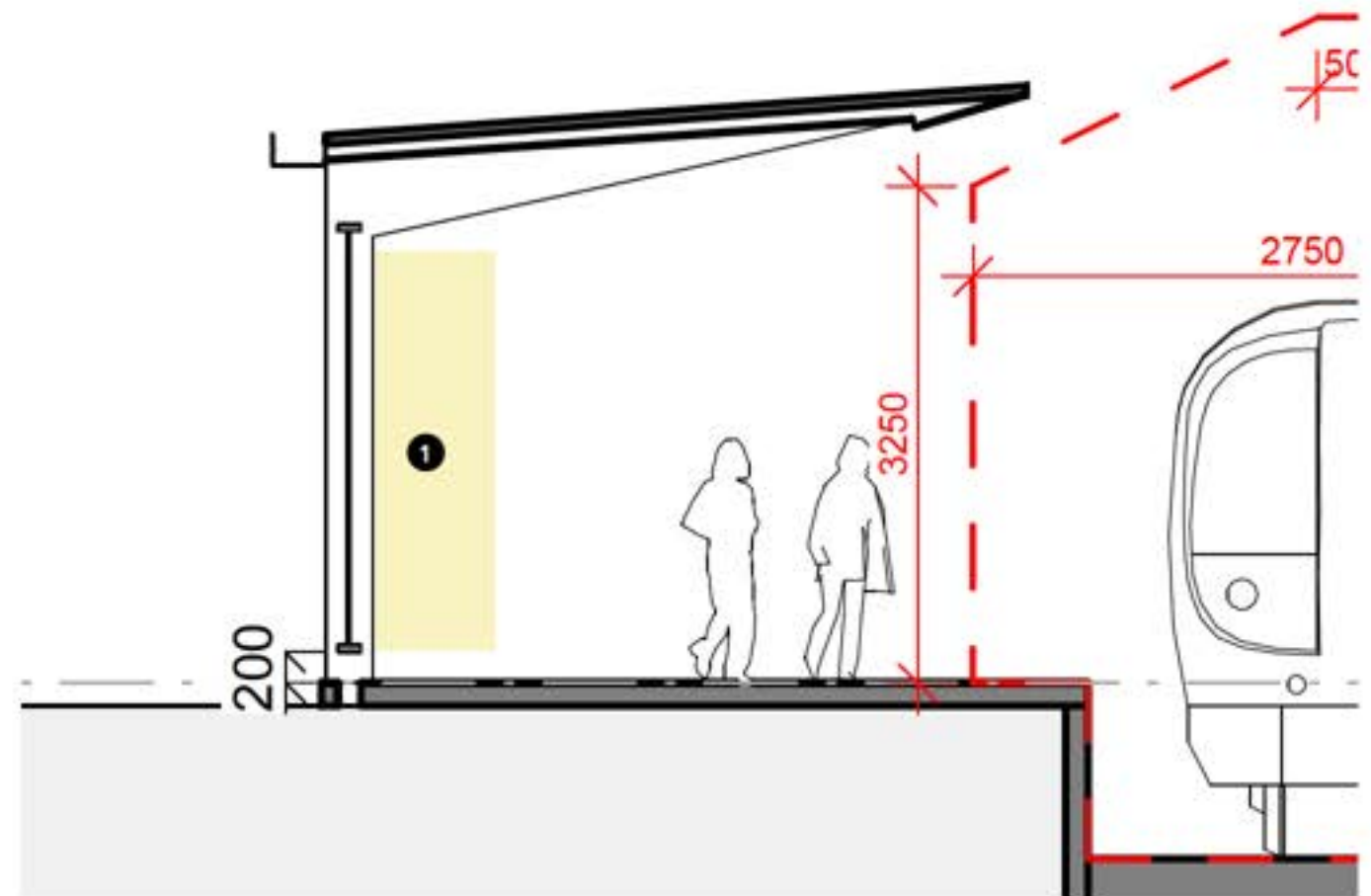
Platform Canopies

The platform canopies at Waterloo Station are designed to provide a refined and functional architectural response that complements the station's overall design language. They offer generous weather protection across the length of both platforms, covering waiting areas, seating, and key circulation zones. The canopy structures are visually lightweight, with a consistent modular rhythm that supports ease of construction, future adaptability, and material efficiency.

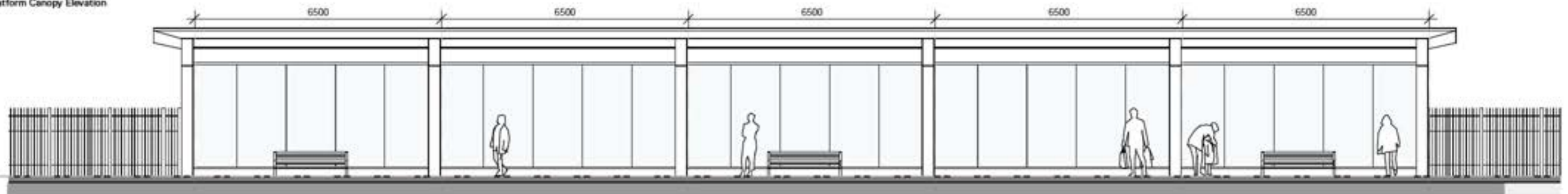
The canopy soffits are clean and uncluttered, integrating lighting, signage, and services in a coordinated manner. The design references the architectural treatment of the main entry canopies, creating a cohesive visual identity across the station. The canopy edges are defined by a bespoke folded profile, contributing to a contemporary and elegant appearance.

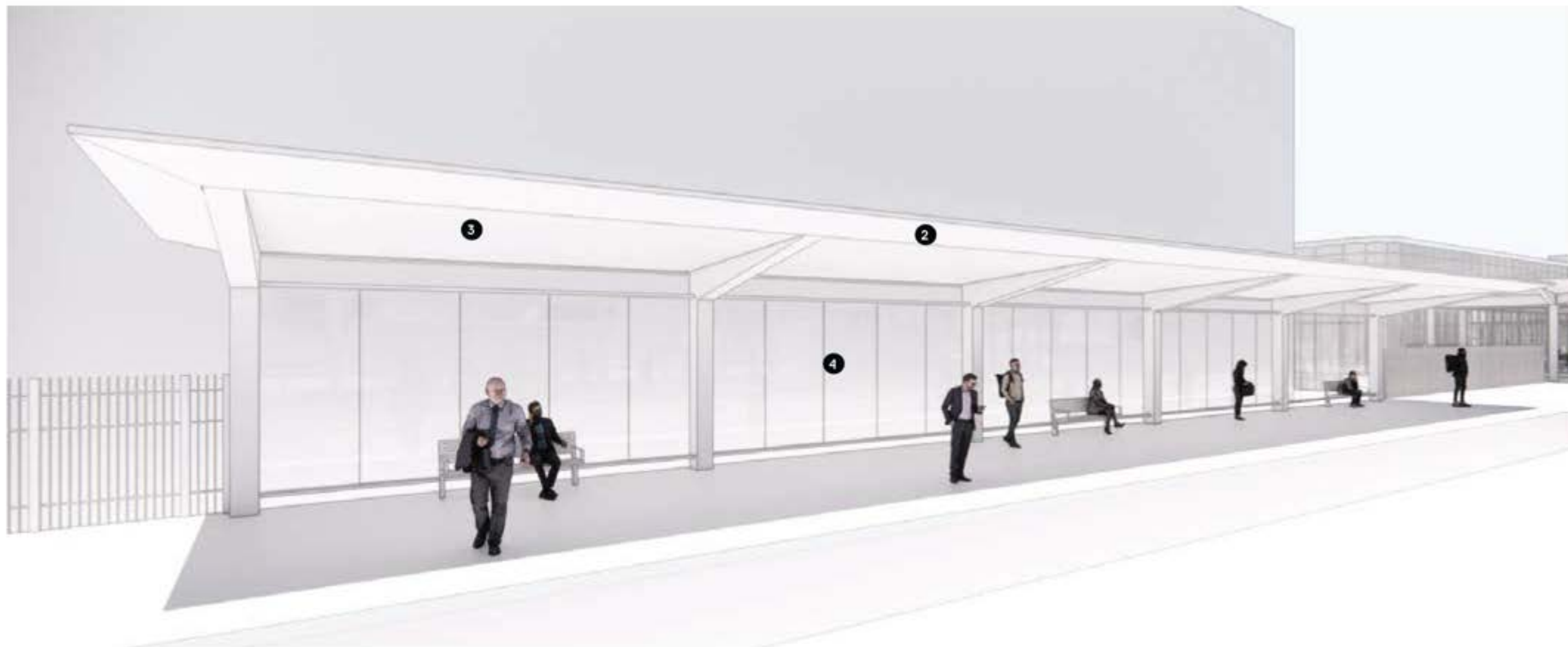
Glazed panels are incorporated at the rear of the canopies to provide additional shelter from prevailing winds and enhance passenger comfort. These glazed wings may also be configured to include integrated advertising panels, offering opportunities for commercial activation without compromising the architectural clarity of the station. The glazing modules are designed to accommodate anti-graffiti film and Metlink branding, supporting both durability and wayfinding.

The structural system is modular, allowing for flexibility in layout while maintaining a consistent architectural expression. The canopy design also considers opportunities for cultural expression, with the potential for Mana Whenua narratives to be integrated into the soffit panels or structural elements. These canopies not only provide shelter but also contribute to the station's sense of place and identity, enhancing the passenger experience from arrival to departure.



Platform Canopy Elevation





1 Advertising screen opportunities: These could be located perpendicular to the glazed wind breaks for additional weather protection.



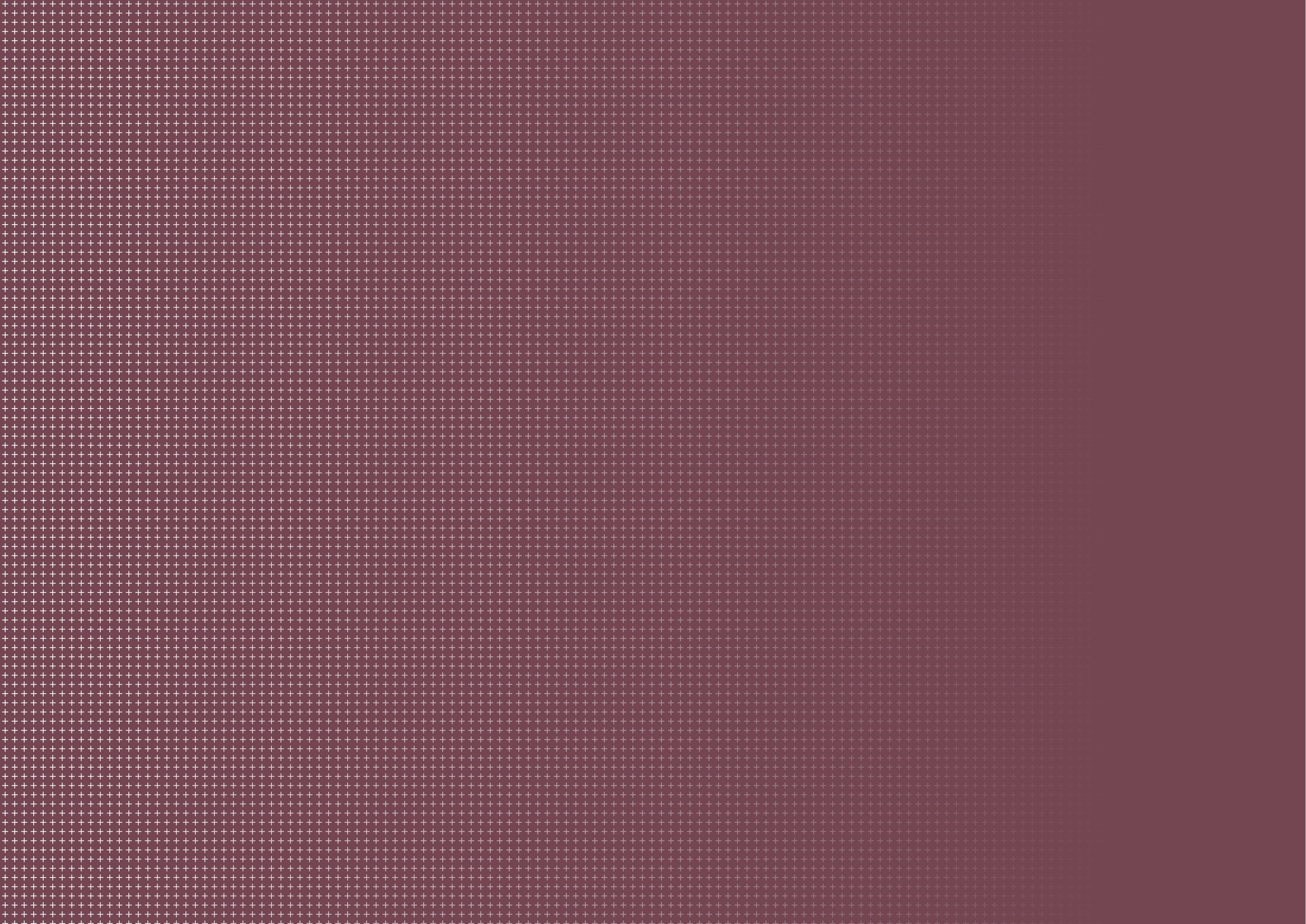
2 Platform Canopy Roof: A floating plane with thin edges, supported on elegant columns



3 Platform Canopy Soffits: Clean, uncluttered surfaces



4 Glazed wind breaks provide protection from elements.



6.0 STATION ENVIRONMENTAL & SUSTAINABILITY FEATURES

6.1 ENVIRONMENTAL & SUSTAINABILITY FEATURES

The station design embeds sustainability principles across the architectural elements. Environmental performance is driven by passive design, durable materials, and resilience to climate change.

Energy, water, and waste can be managed through integrated strategies that reduce reliance on external resources and promote long-term adaptability. Options for solar panel array and rainwater harvesting are illustrated in the diagrams. And natural ventilation strategies have been considered in the design of occupied spaces.

6.1 Passive Design & Energy

Natural ventilation is the primary environmental conditioning strategy, supported by large canopy overhangs that provide solar shading and reduce heat gain. As well and provision for opening with perforated panels and weatherproof louvres. Daylight is maximised

at entries and concourses, limiting reliance on artificial lighting while ensuring good visibility and comfort. Ceiling voids are designed to accommodate insulation, mitigating solar heating and improving thermal performance. The glass facade on the overpass will utilise Low glazing, with selections guided to minimise solar gain. Additional mitigation can be achieved with a printed ceramic fit patten. The overall approach prioritises passive means to regulate temperature and airflow, lowering operational energy demand while enhancing passenger amenity.

6.2 Materials & Lifecycle

Durability is a key driver in material selection, ensuring robustness in high-use areas and minimising long-term replacement and waste. Materials such as steel, aluminium, glass, and concrete provide strength, vandal resistance, and reduced lifecycle impacts.

A rational, modular approach to layout and cladding systems enables efficient construction, consistency in detailing, and adaptability for future expansion. Exposed structural elements are used where appropriate, reducing material redundancy while celebrating the architectural character. Locally available and low-embodied energy materials are prioritised to support sustainability outcomes.

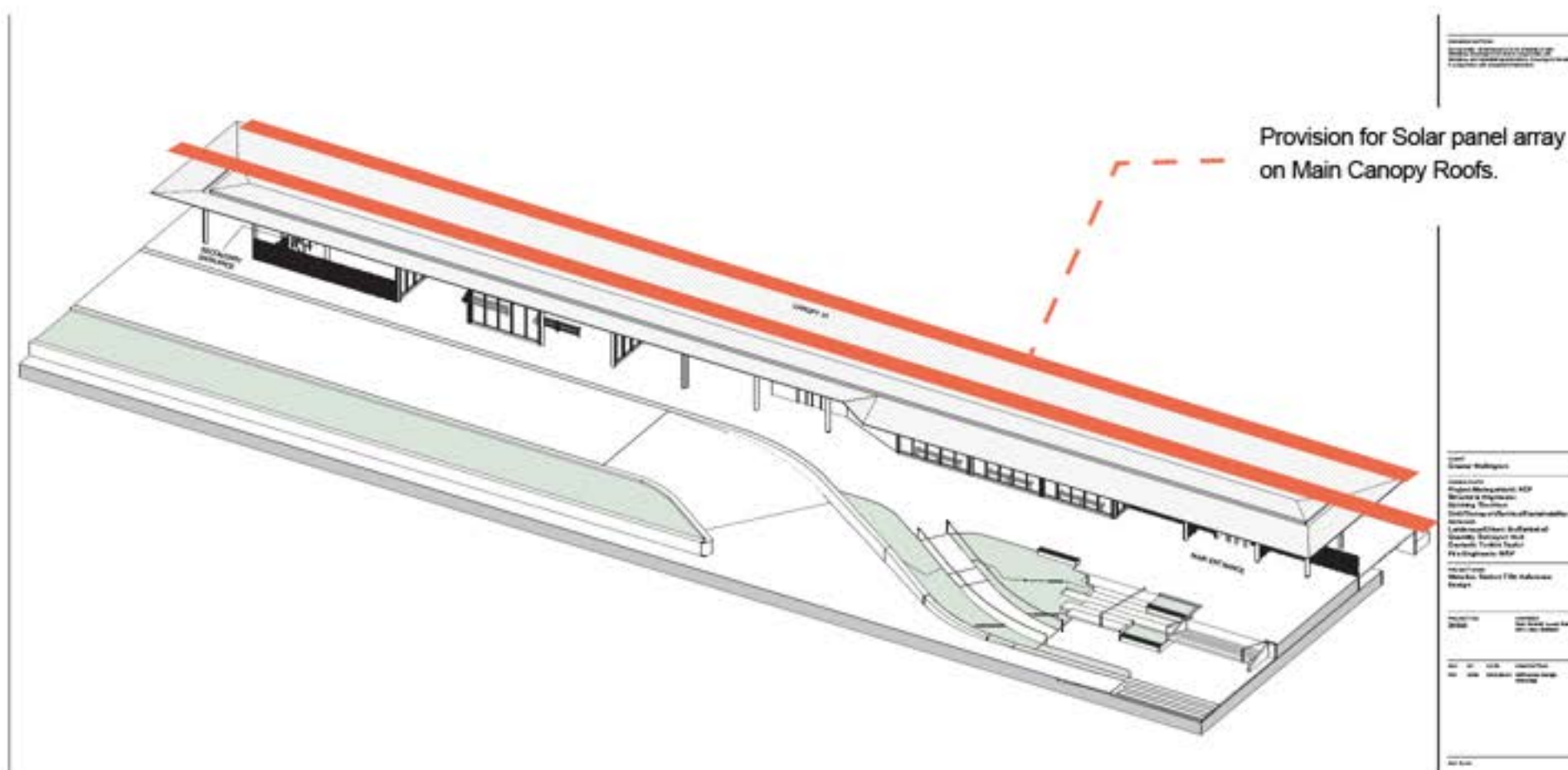
6.3 Climate Resilience

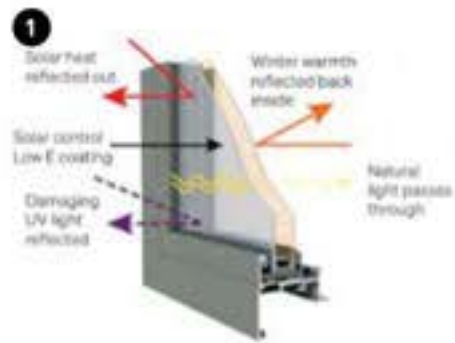
The design anticipates increasing climate variability, with spatial allowances for surface water drainage at platforms and concourse levels, and over-capacity gutters to manage future rainfall intensification. The elevated overpass structure is inherently less susceptible to flooding and sea level rise, especially in contrast to the existing underpass, providing resilience to extreme weather events.

Entrances at ground level are positioned and elevated to reduce flood risk, while external elements are constructed from robust, long-lasting materials capable of withstanding severe heat, storm, and wind exposure.

The large overhangs and solar mitigation integrated into the Canopy and Overpass designs will protect against increased solar intensity and heat.

Collectively, these strategies ensure the station remains operational, safe, and durable under changing climate conditions.





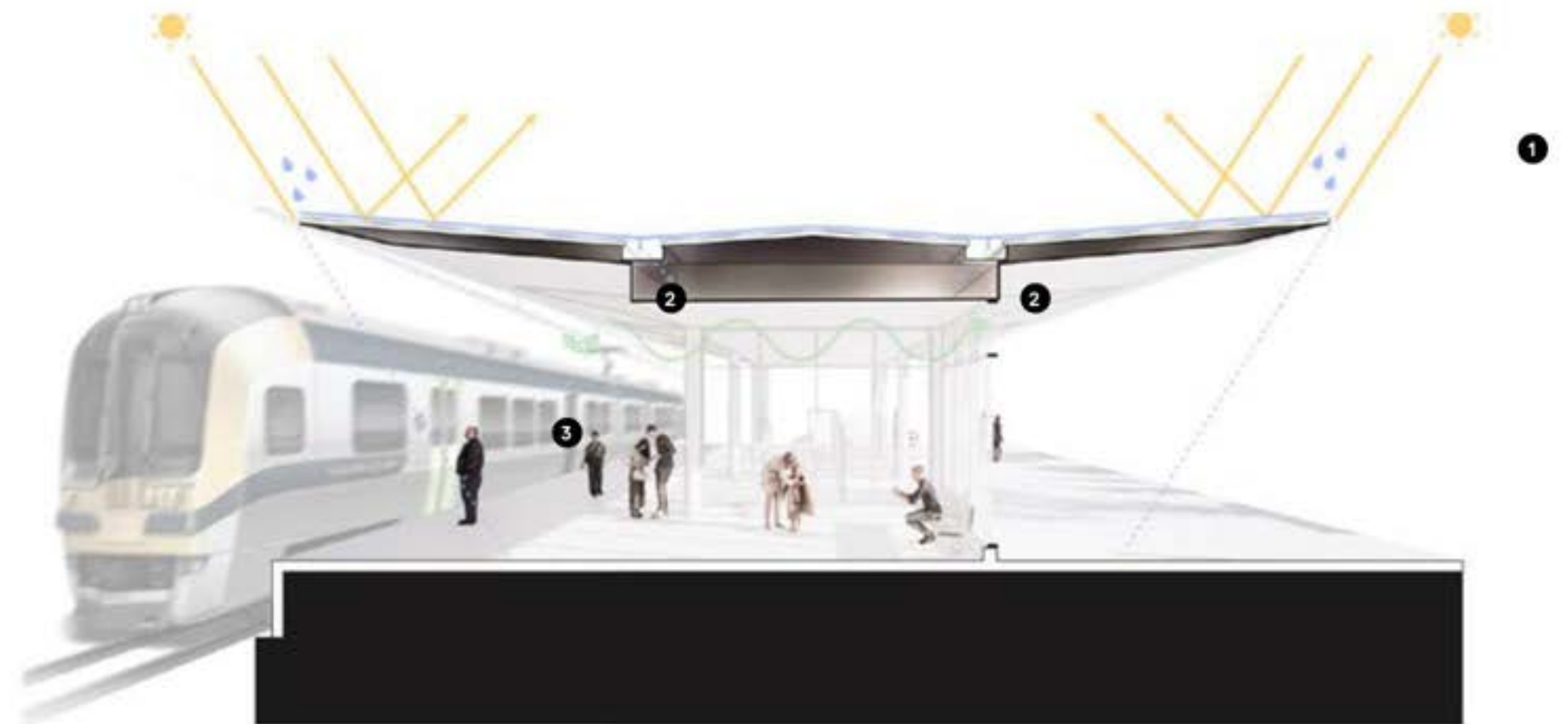
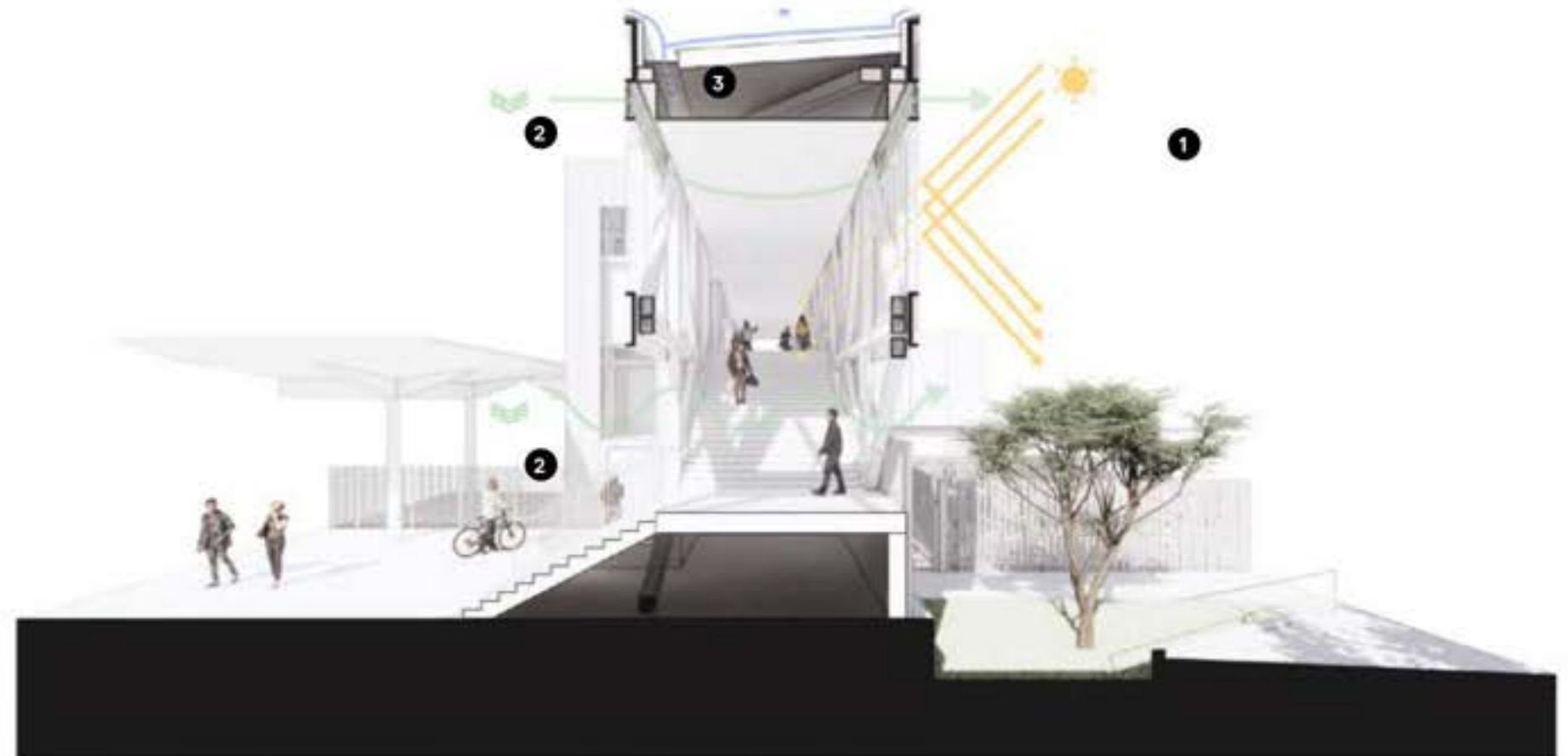
Ceramic Fint and Low E glass to minimise solar gain.



Provision for rainwater harvesting from the roof areas. Can be re-used on site with storage and filtering



Perforated panels set into joinery and Weatherproof louvres allow natural ventilation



7.0 NEXT STEPS

7.1 NEXT STEPS

PROGRESSING THE PROJECT

7.1 Reference Design Development

The reference design will progress into a phase of further refinement, with underlying assumptions tested and validated. Additional layers of detail will be developed across architectural, structural, services, and landscape elements, ensuring the design is well-coordinated and technically robust. A key focus of this stage will be sequencing and staged delivery, with the design tested against construction logistics to maintain operational continuity throughout works. Ongoing collaboration with the consultant team will confirm constructability, resolve interfaces, and prepare the project for subsequent delivery phases.

7.2 Cost Assessment

A comprehensive cost assessment will be led by RLB to evaluate the proposed design against budgetary parameters. This process will provide clear feedback on affordability and identify areas where scope, sequencing, or material selection may be optimised. Value management may be undertaken as required to align the design with cost constraints, ensuring that project objectives are achieved without compromising functionality or long-term performance.

7.3 Stakeholder Engagement

The next stage will expand stakeholder engagement beyond the project team to include Greater Wellington, the wider community, transport users, and representatives of Iwi and Mana Whenua. This dialogue will ensure that the station design reflects local values, cultural identity, and user needs while maintaining alignment with regional transport and growth strategies. Broad-based engagement will help strengthen support for the project and confirm its role as both a transport hub and a civic landmark.

8.0 APPENDICES

8.1 STATION PROGRAM

WATERLOO STATION, INTERCHANGE PROGRAM AND PARAMETERS

The Station and Interchange requirements, along with the sizing of its elements, was developed during the Define and Discover stage. This was based on the client brief and technical requirements guided by relevant standards, as well as Design Team best practice inputs, which outlined elements and their sizing required for a modern, functional station.

Area requirements were developed based on these inputs, helping define the key components and their spatial needs. The technical requirements incorporated detailed specifications necessary for station operation, as informed by client expectations, relevant standards, and best practice guidelines. Some findings from the site investigations also informed the station program.

During the Feasibility Stage, the focus was on locating primary and secondary elements, establishing their bulk, sizing, spatial arrangement, and identifying any interdependencies.

Primary Elements:

- Platform / Concourse
- Interchange – (parameters further detailed in the next section)
- Cross-corridor access (for both commuters and community)
- Vertical circulation (lifts, stairs, and ramps)

Secondary Elements:

- Canopy - Entry and Platform canopy
- Commercial opportunity within station footprint
- Station amenity - including waiting areas, toilets, bike parking, station closure provision

STATION DESIGN ELEMENTS

- **Platform Length:** 190 meters
- **Side Platform Width (Minimum Operational):** 3m–5m
- **Island Platform Width (Minimum Operational):** 9.6m
- **Sheltered Waiting Area:** 247m²
- **Seating Capacity:** Minimum 60 seats

- **Public Toilets:** 1 fully accessible bathroom with at least 4 toilets, changing table in at least one accessible toilet
- **Platform Fixtures & Furnishings:** Bins and Seating

BUS INFRASTRUCTURE

- **Bus Layover Bays:** 2
- **Bus Stops:** 10 (subject to adjustment based on final design options)
- **Bus Shelters:** Use standard shelter kit of parts (size to be confirmed)
- **Weather Shelter** (Bus ↔ Rail Boarding): Required for protection during transfers

PARKING & ACCESS

- **Accessible Parking Bays:** Minimum 16
- **Emergency Vehicle Bay:** 1
- **Maintenance/Refuse Truck Bay:** Shared, 1 total
- **Public Connections** Across Rail Corridor: Direct and accessible—suitable for wheel users

BIKE FACILITIES

- **Bike Parking Formats:** Protected/secure types integrated to reduce concealment risk
- **Bike Parking Spaces:** Minimum 100 (client baseline: 32)

VERTICAL MOVEMENT & ACCESS

- **Stairs** – Outbound Platform: See Station Sizing Section
- **Stairs** – Oxford Terrace Access: See Station Sizing Section
- **Underpass:** See Station Sizing Section
- **Ramps:** See Station Sizing Section, Gradient Options: 1:20 (no handrails) or 1:12

ENVIRONMENTAL FEATURES

- **Shelter Orientation:** East/west aspect to ensure passive solar warmth and comfort during AM/PM peak periods



Figure 16: Station sizing diagram to achieve a LOS C or better (2046 design year)

8.2 STATION ARCH DRAWINGS & SCHEDULES

25044/ WATERLOO STATION- TOD REFERENCE DESIGN

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DRAWING NOTICES
Do not scale - all dimensions to be checked on site.
Grimshaw drawings to be read in conjunction with Grimshaw and specialist specifications. Drawings to be read in conjunction with consultant information.

CLIENT
Greater Wellington

CONSULTANTS
Project Management: RCP
Structural Engineers: Dunning Thornton
Civil/Transport/Service/Sustainability: Aurecon
Landscape/Urban: Boffamiskell
Quantity Surveyor: RLB
Geotech: Tonkin Taylor
Fire Engineers: WSP

PROJECT NAME
Waterloo Station TOD Reference Design

PROJECT NO.
25044

ADDRESS
Hutt Central, Lower Hutt
5011, New Zealand

REV	BY	DATE	DESCRIPTION
P01	GRM	2025.07.15	Issue for Information
P02	GRM	2025.07.18	Supplementary Information
P03	GRM	2025.07.22	Supplementary Information
P04	GRM	2025.07.25	Issue for Coordination
P05	GRM	2025.07.29	Issue for Coordination
P06	GRM	2025.08.08	Reference Design Drawings

KEY PLAN

METRES
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@ 1:100

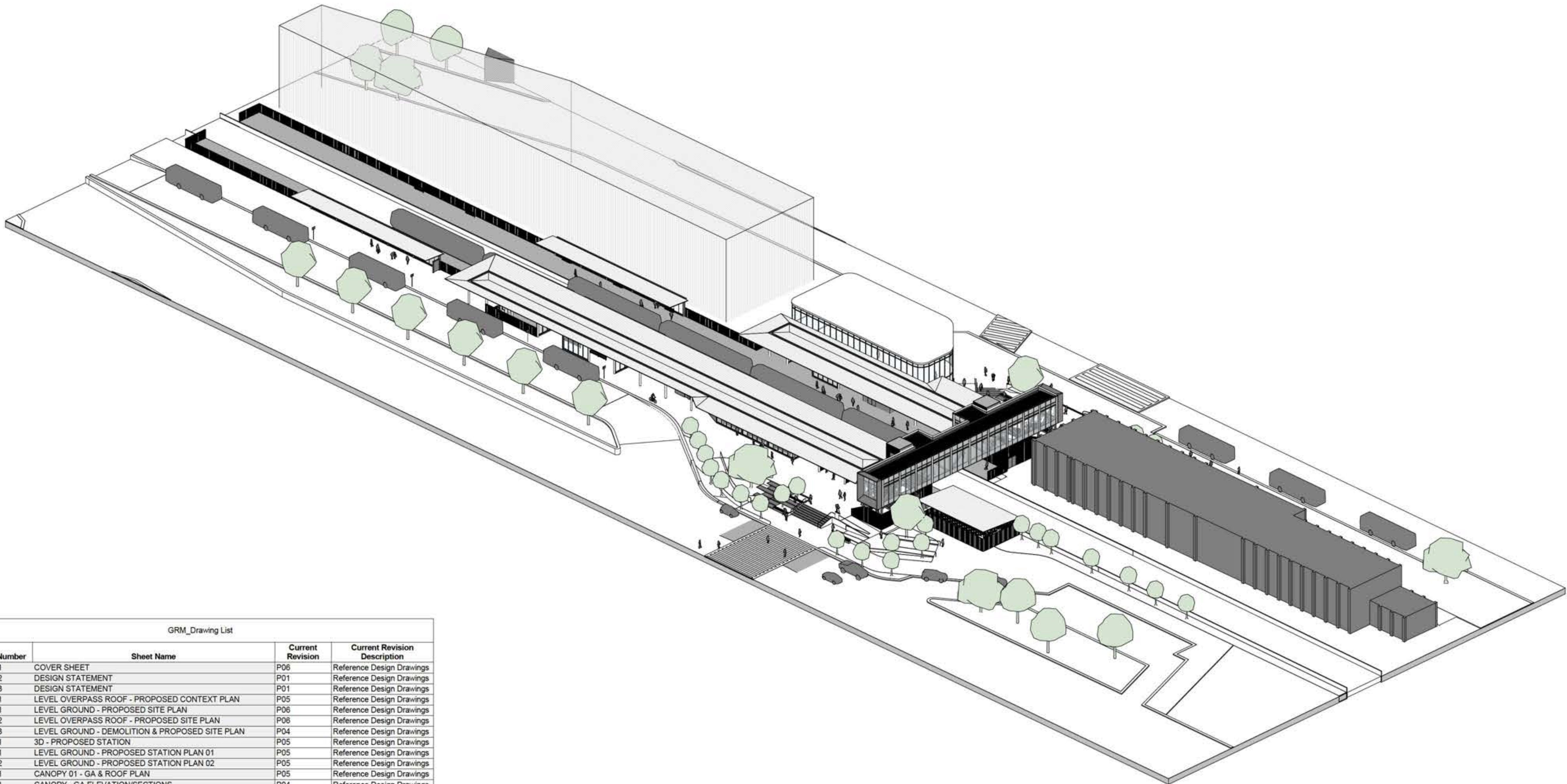
DRAWING TITLE
COVER SHEET

SCALE
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STATUS
For Information

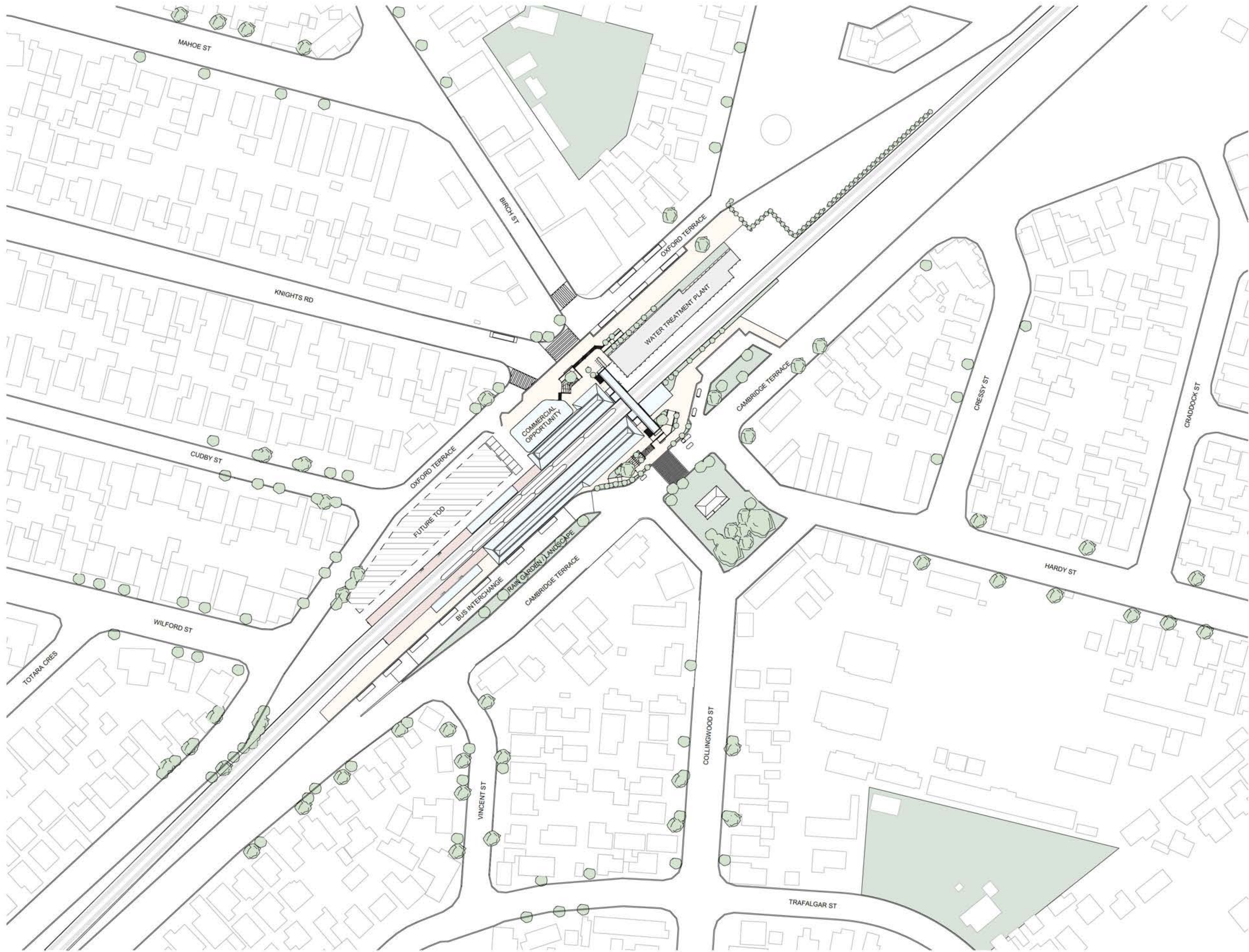
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MC	BP	MH	2025.08.08	P06

DRAWING NO:
A00 1001



GRM_Drawing List

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A04 3001	OVERPASS - GA SECTIONS	P06	Reference Design Drawings
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A18 1002	MATERIALS AND FINISHES KEY - OVERPASS	P01	Reference Design Drawings
A18 1004	MATERIALS AND FINISHES SCHEDULE 02	P01	Reference Design Drawings
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A01 2004	LEVEL GROUND - DEMO SITE PLAN	P01	Supplementary Information
A01 2005	LEVEL ROOF - DEMO SITE PLAN	P01	Supplementary Information



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 - STATION PRECINCT
 - GREENERY
 - ROOF

CLIENT
Greater Wellington

CONSULTANTS
Project Management: RCP
Structural Engineers: Dunning Thornton
Civil/Transport/Service/Sustainability: Aurecon
Landscape/Urban: Boffamiskell
Quantity Surveyor: RLB
Geotech: Tonkin Taylor
Fire Engineers: WSP

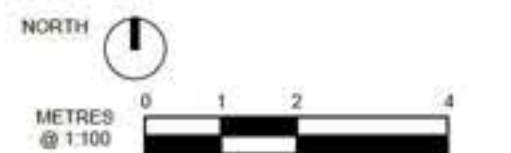
PROJECT NAME
Waterloo Station TOD Reference Design

PROJECT NO.
25044

ADDRESS
Hutt Central, Lower Hutt
5011, New Zealand

REV	BY	DATE	DESCRIPTION
P01	GRM	2025.07.15	Issue for Information
P02	GRM	2025.07.18	Supplementary Information
P03	GRM	2025.07.25	Issue for Coordination
P04	GRM	2025.07.29	Issue for Coordination
P05	GRM	2025.08.08	Reference Design Drawings

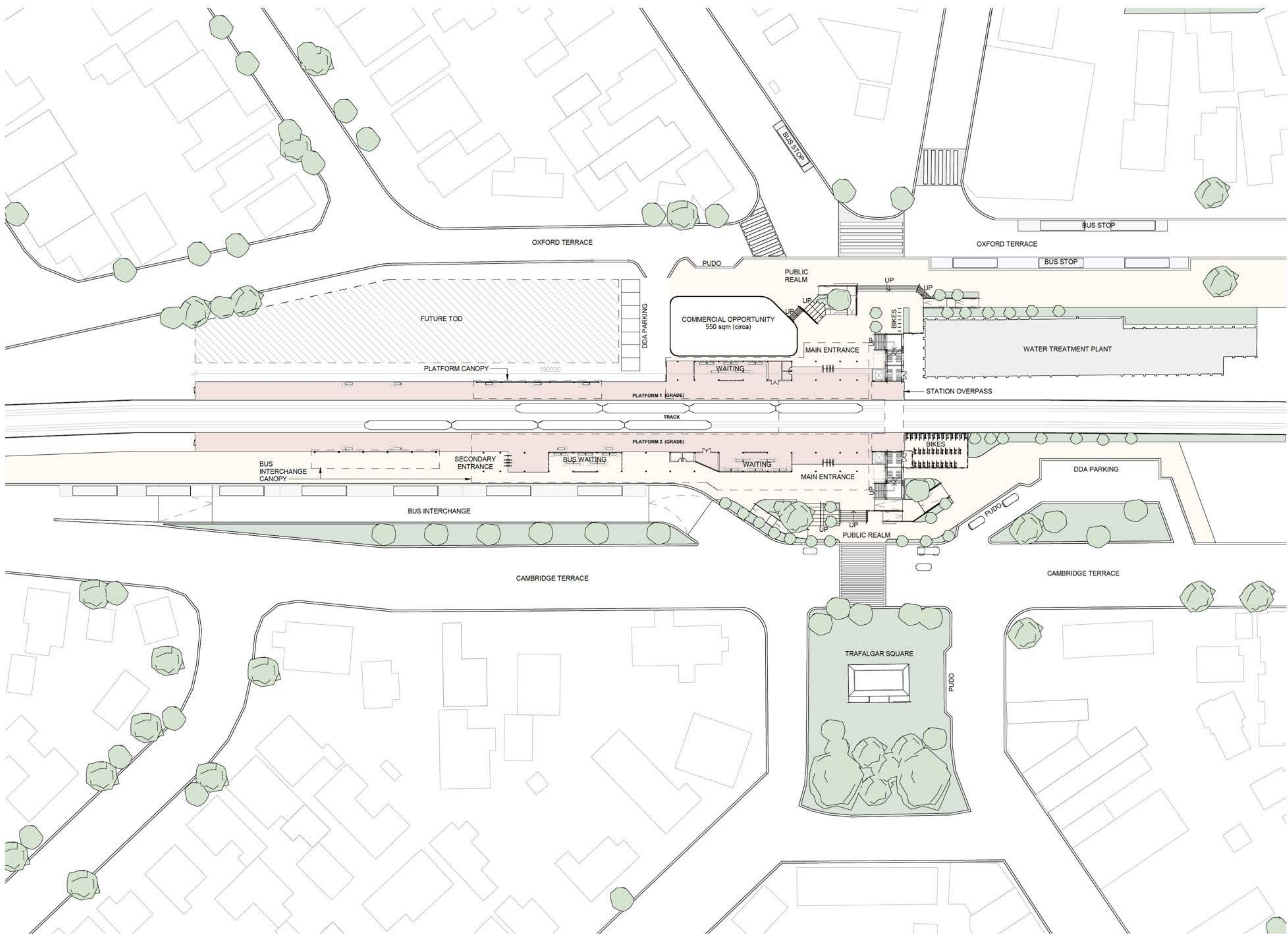
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DRAWING TITLE
LEVEL OVERPASS ROOF -
PROPOSED CONTEXT PLAN
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STATUS
For Information

DRW	CH	APPR	DRW DATE	REV
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A02 1001



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Landscape/Urban: Boffamiskell
Quantity Surveyor: RLB
Geotech: Tonkin Taylor
Fire Engineers: WSP

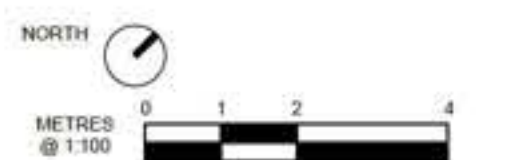
PROJECT NAME
Waterloo Station TOD Reference Design

PROJECT NO.
25044

ADDRESS
Hutt Central, Lower Hutt
5011, New Zealand

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P01	GRM	2025.07.15	Issue for Information
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KEY PLAN



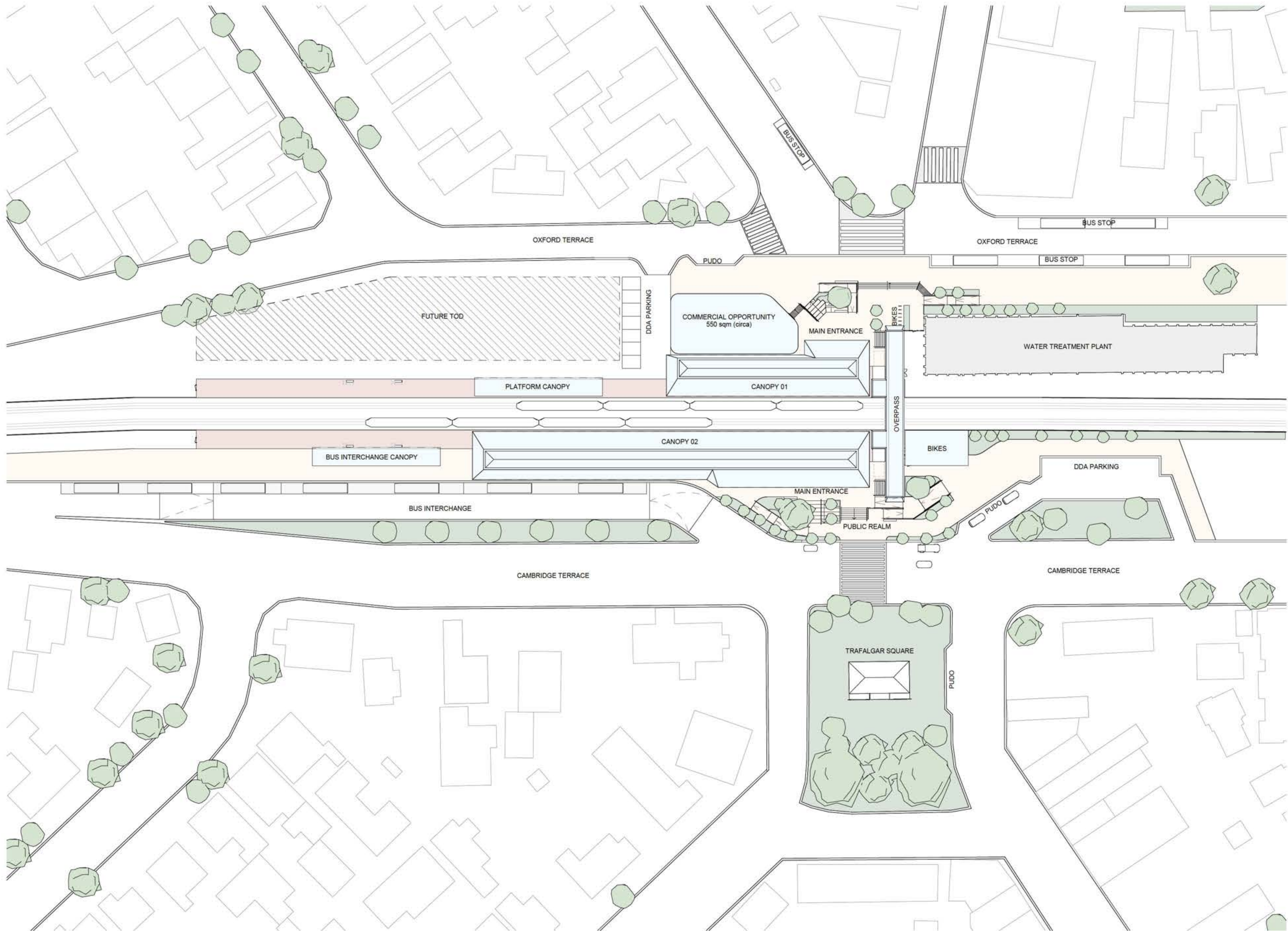
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STATUS
For information

DRW	CH	APPR	DRW DATE	REV
MC	BP	MH	2025.08.08	P06

DRAWING NO:
A02 2001



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Landscape/Urban: Boffamiskell
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Geotech: Tonkin Taylor
Fire Engineers: WSP

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P05	GRM	2025.07.29	Issue for Coordination
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KEY PLAN

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DRAWING TITLE

LEVEL OVERPASS ROOF -
PROPOSED SITE PLAN

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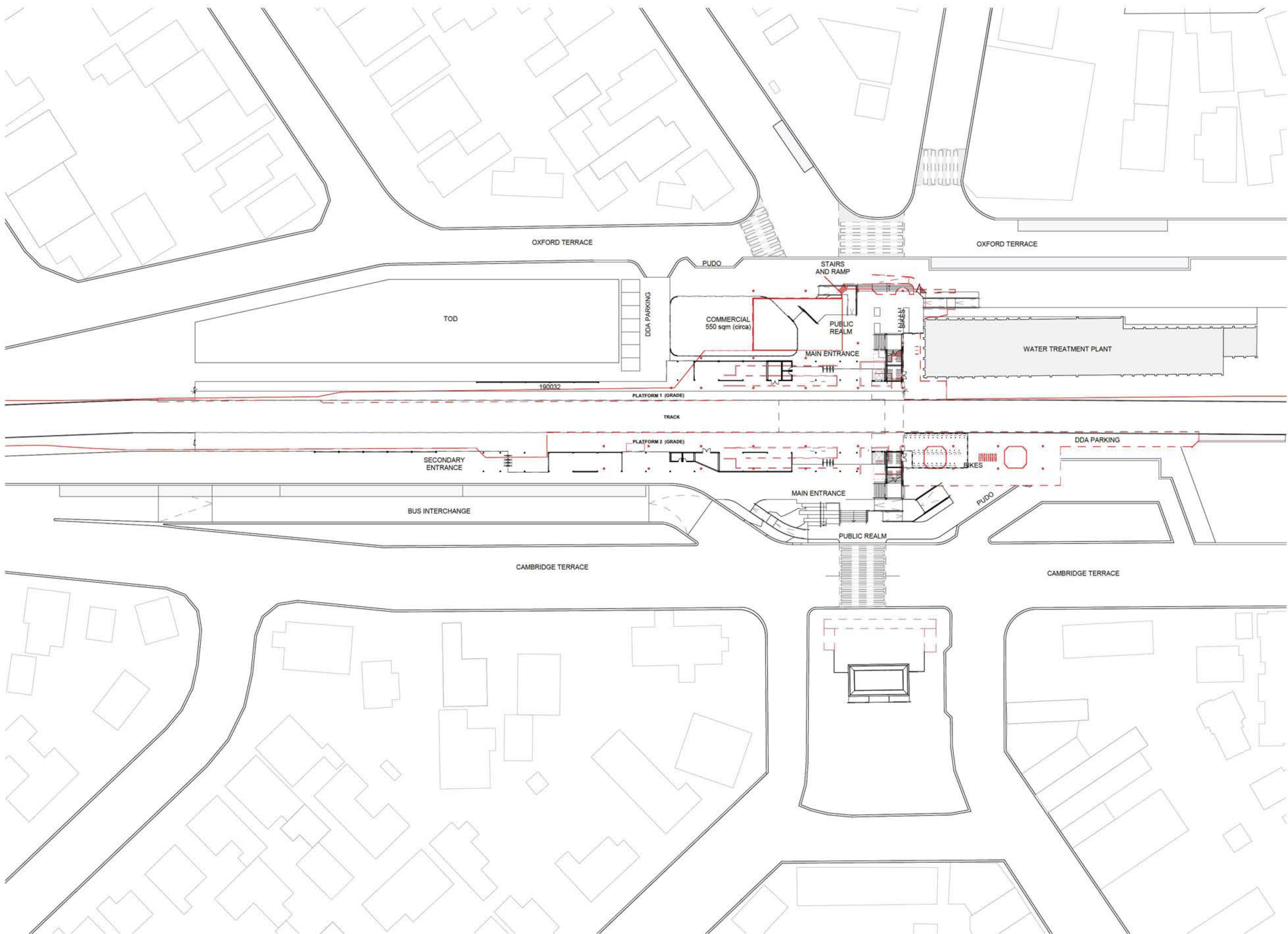
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DRAWING NO.

A02 2002



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Landscape/Urban: Boffamiskell
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Geotech: Tonkin Taylor
Fire Engineers: WSP

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P02	GRM	2025.07.25	Issue for Coordination
P03	GRM	2025.07.29	Issue for Coordination
P04	GRM	2025.08.08	Reference Design Drawings

KEY PLAN

DRAWING TITLE
LEVEL GROUND - DEMOLITION & PROPOSED SITE PLAN

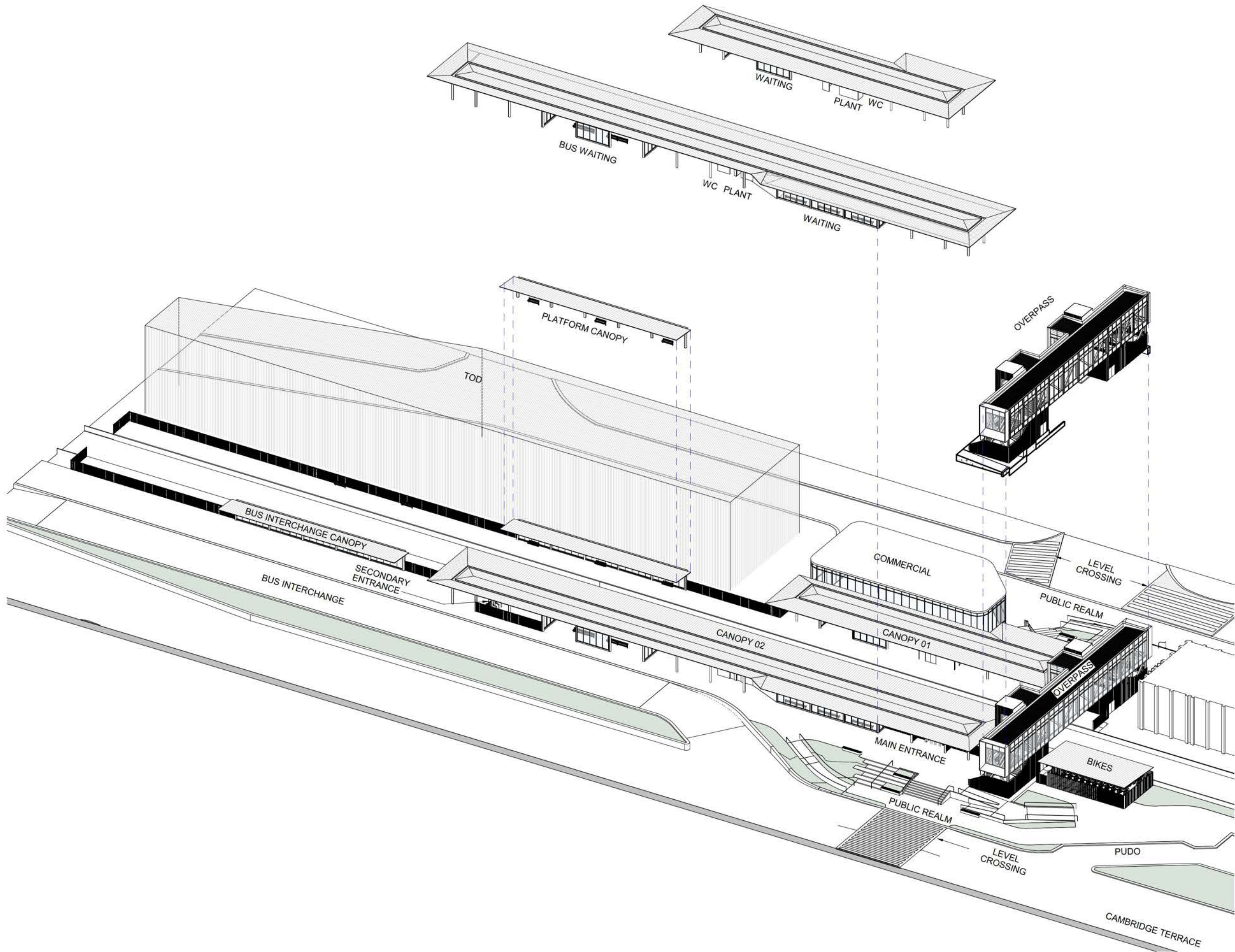
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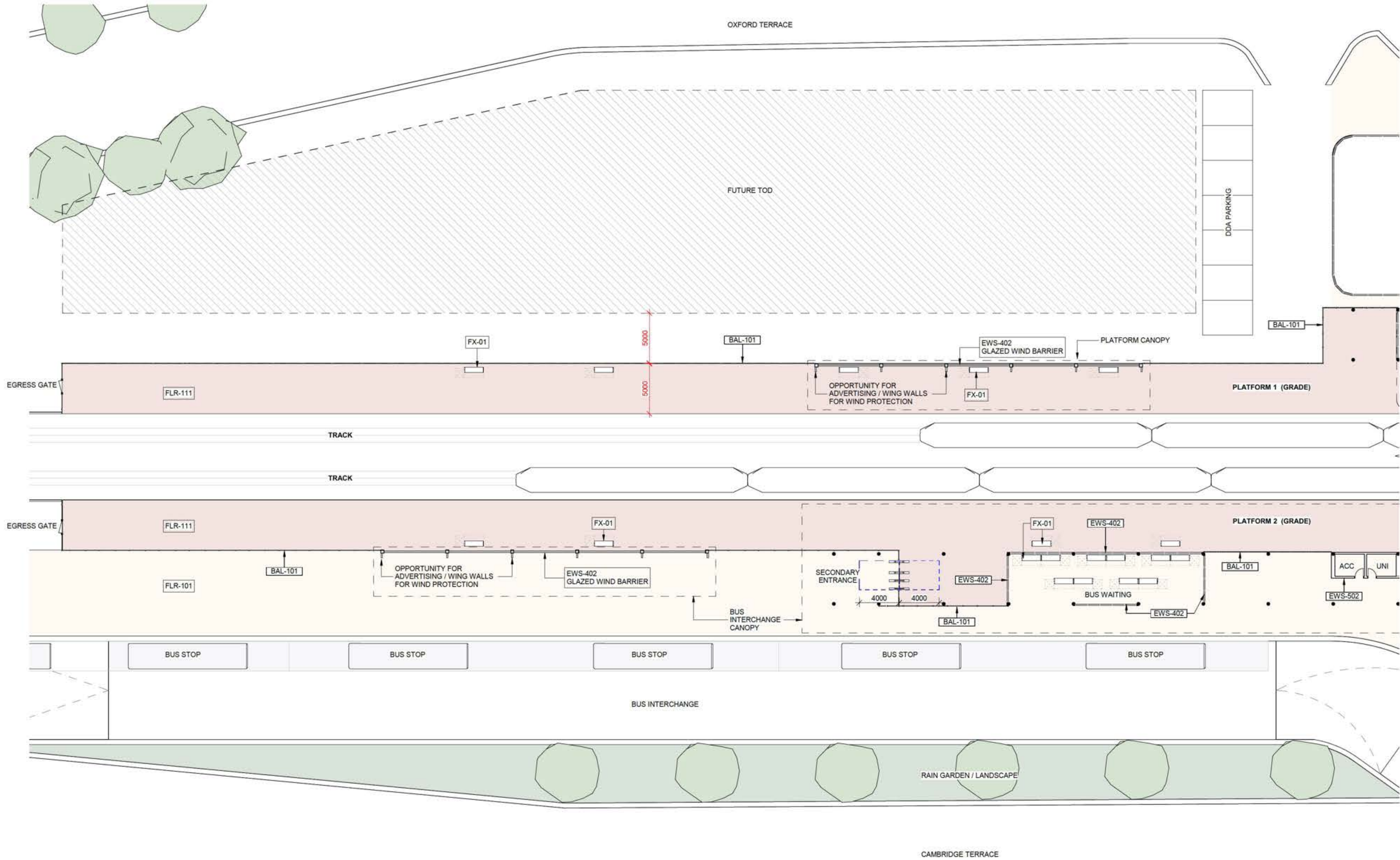
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P02	GRM	2025.07.22	Supplementary Information
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Geotech: Tonkin Taylor
Fire Engineers: WSP

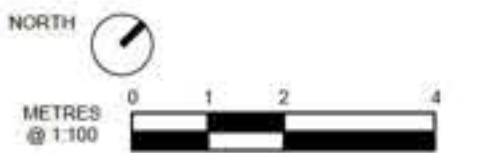
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PROJECT NO.
25044

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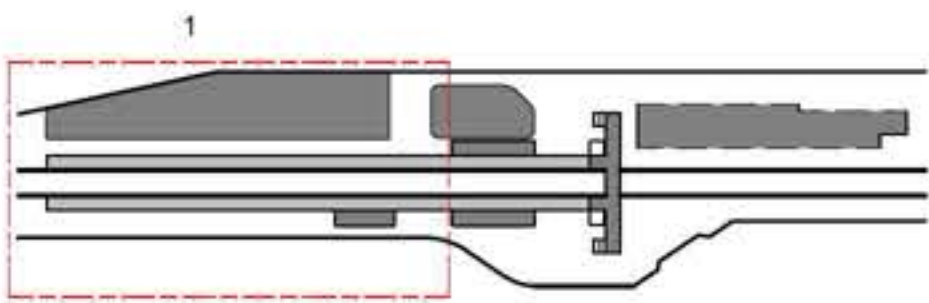
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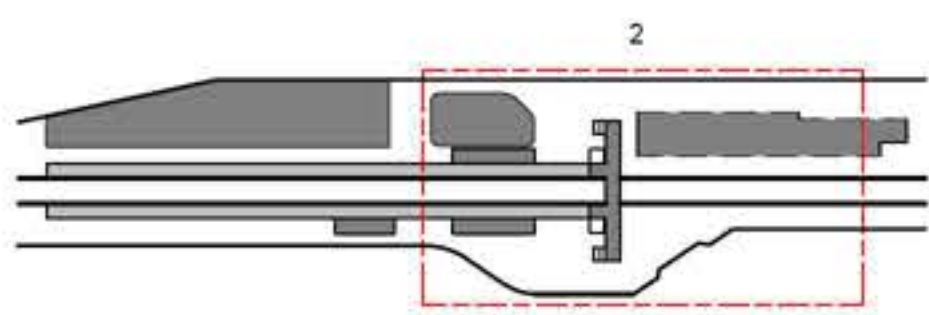
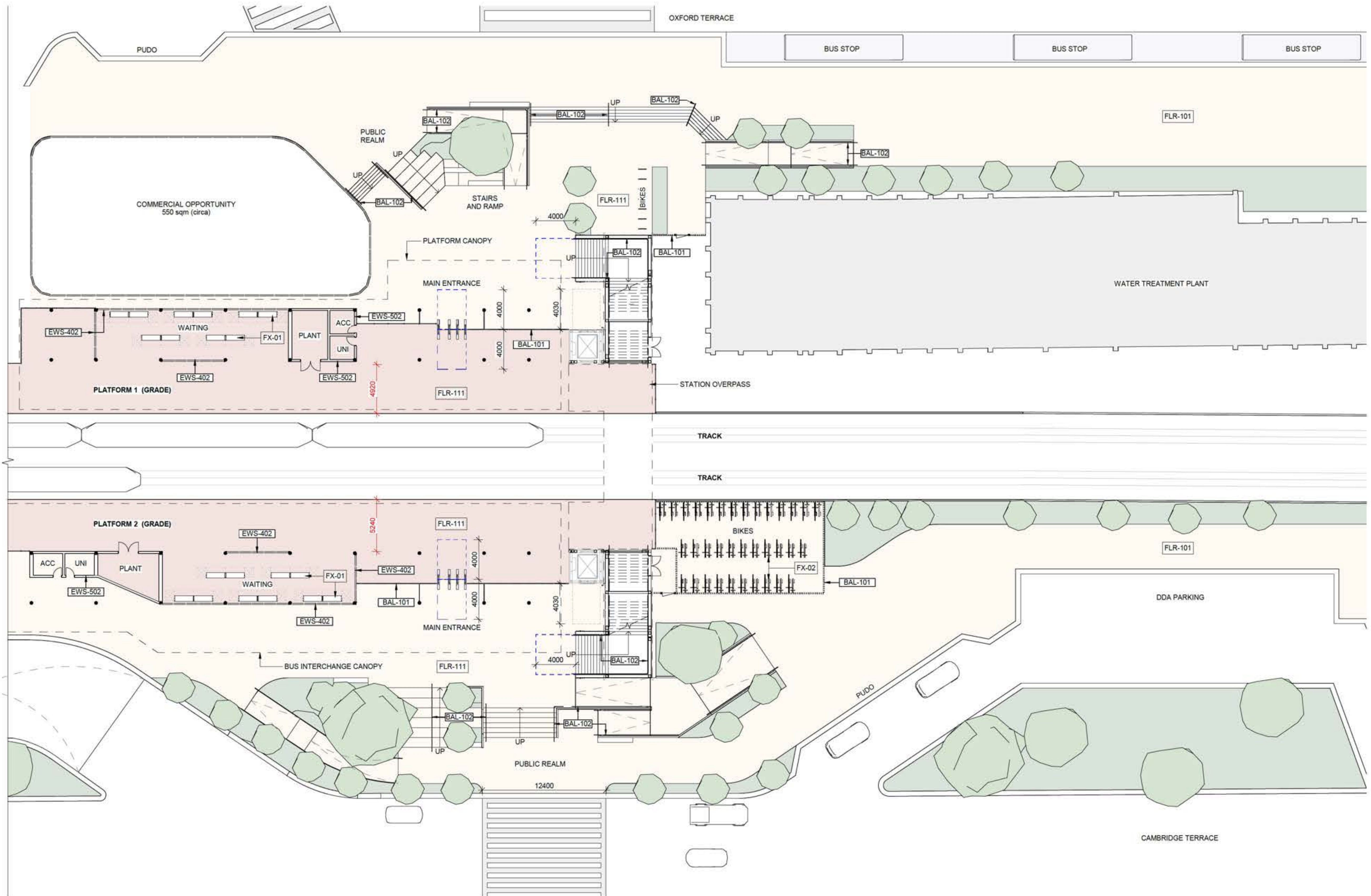
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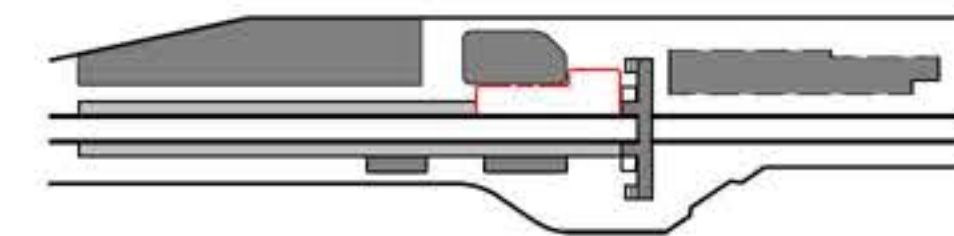
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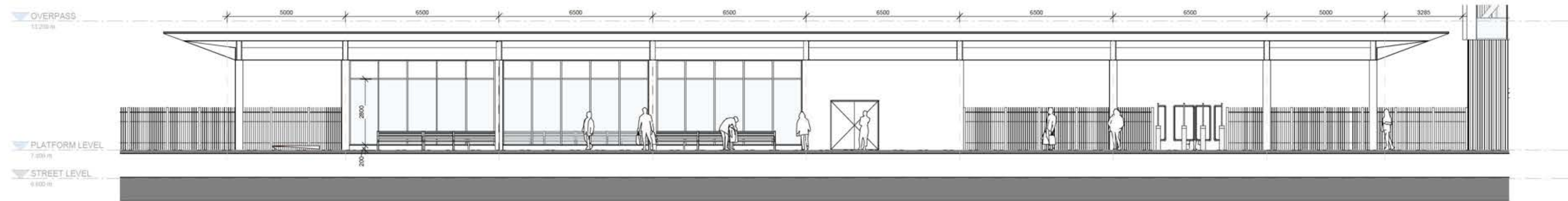
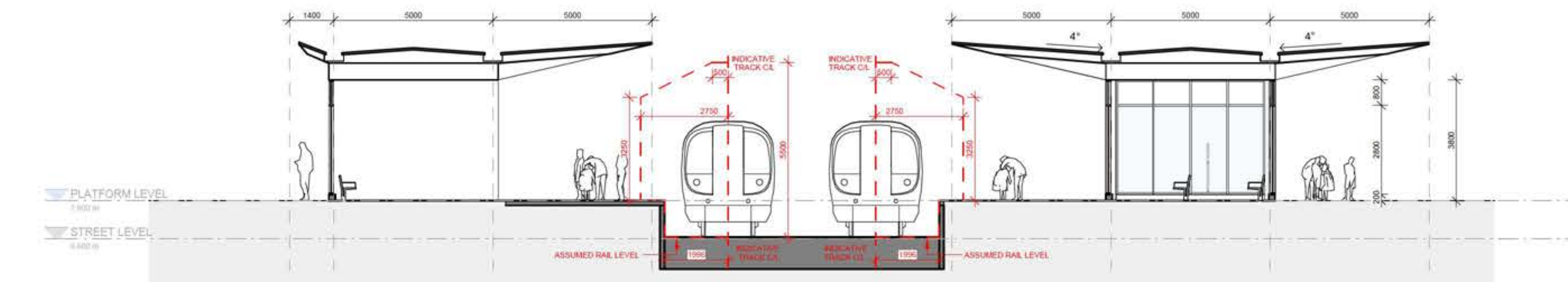
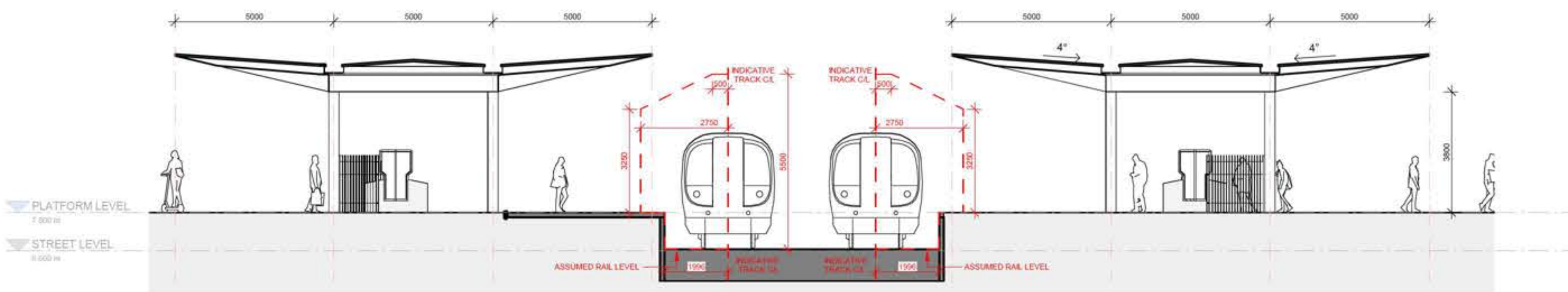




1 CANOPY 01 - ROOF PLAN
1:100

2 CANOPY 01 - GA PLAN
1:100



1 CANOPY 01 - GA ELEVATION
1:1002 CANOPY 01 & 02 - GA SECTION 01
1:1003 CANOPY 01 & 02 - GA SECTION 02
1:100

REFER TO SHEET A03 1001 FOR SECTION AND ELEVATION CUT

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Landscape/Urban: Boffamiskell
Quantity Surveyor: RLB
Geotech: Tonkin Taylor
Fire Engineers: WSPPROJECT NAME
Waterloo Station TOD Reference
DesignPROJECT NO.
25044
ADDRESS
Hutt Central, Lower Hutt
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P01	GRM	2025.07.18	Supplementary Information
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P03	GRM	2025.07.25	Issue for Coordination
P04	GRM	2025.08.08	Reference Design Drawings

KEY PLAN

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For Information

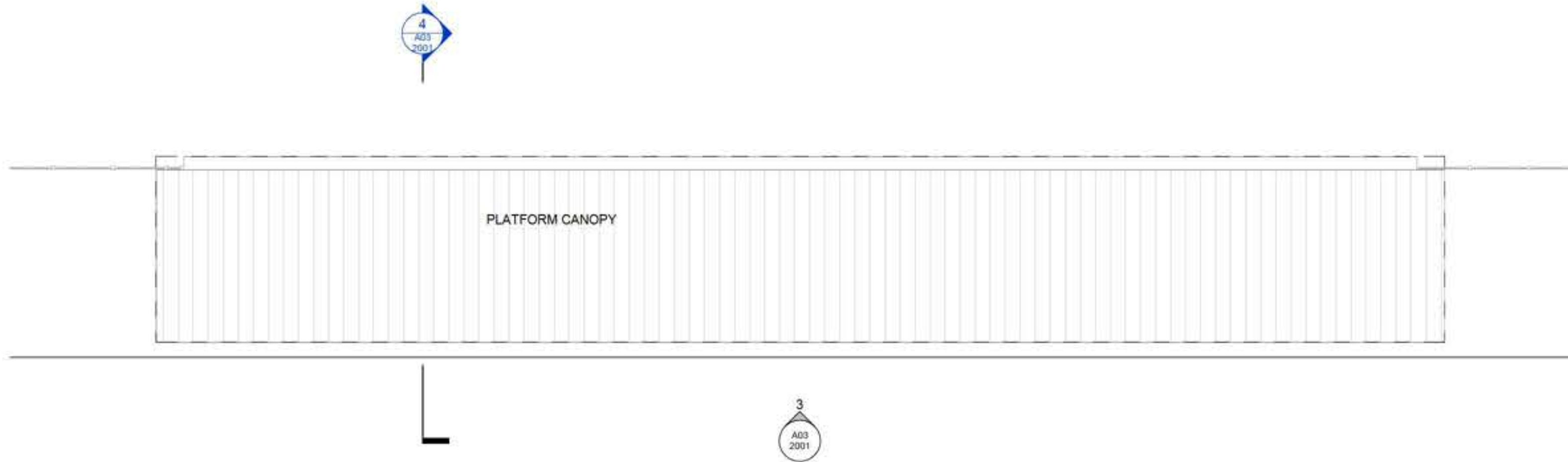
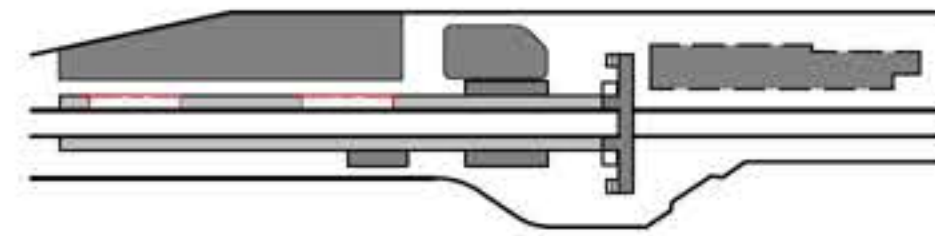
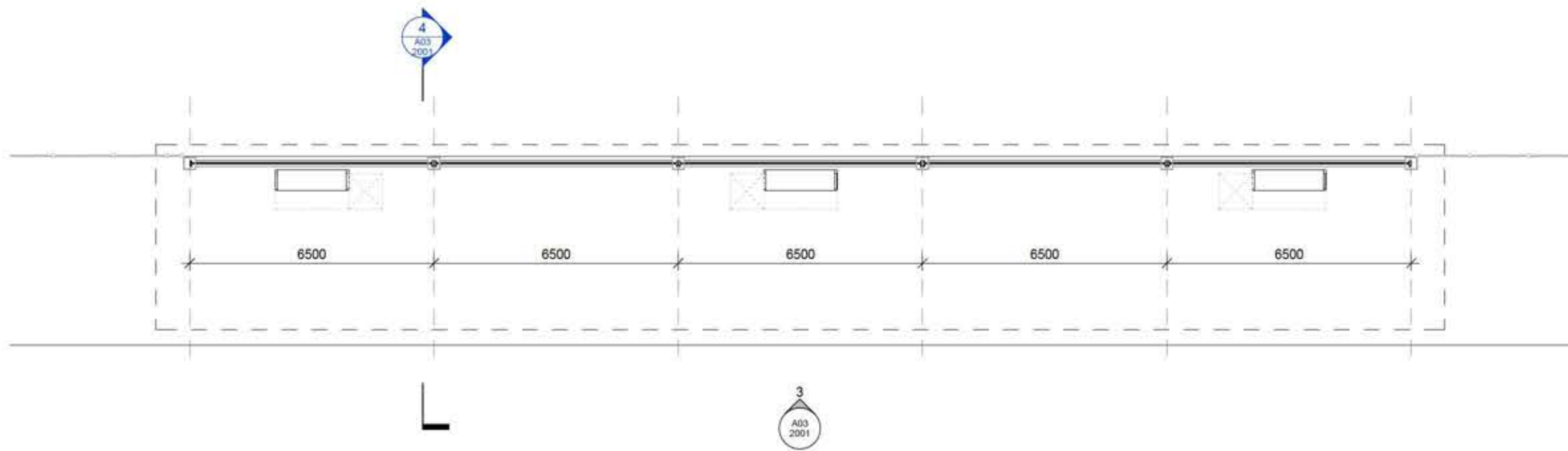
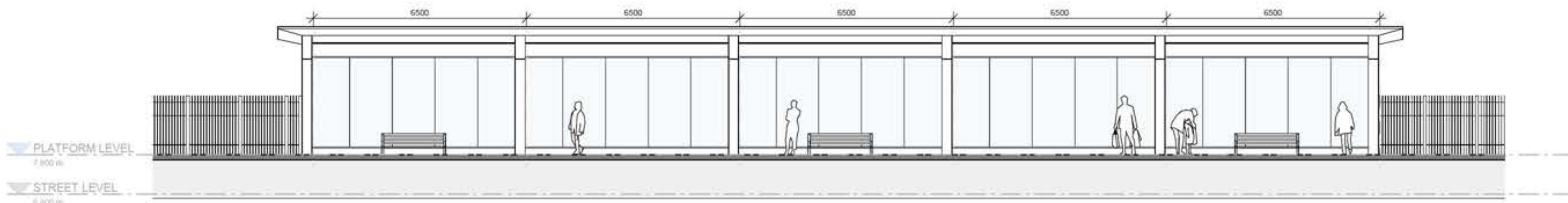
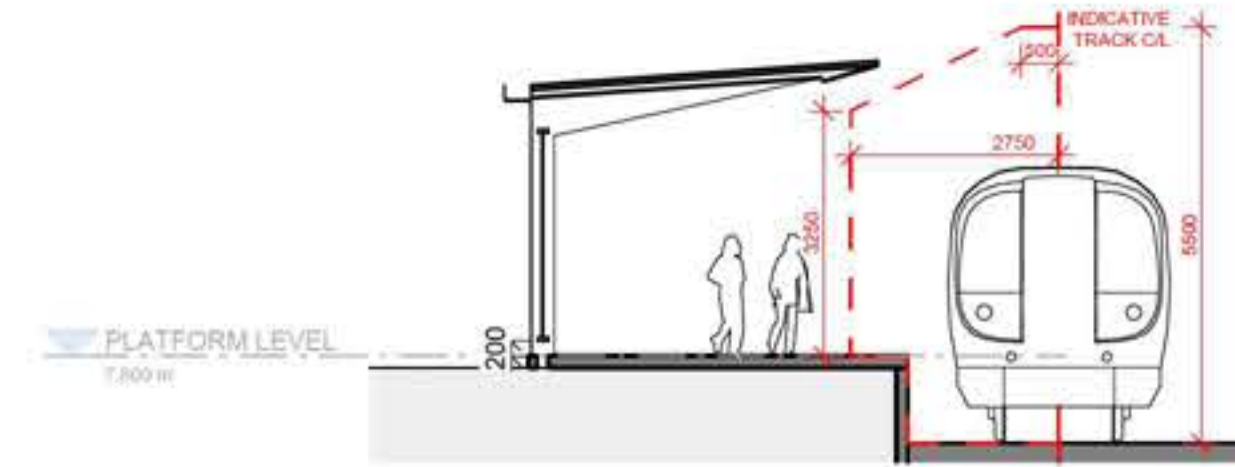
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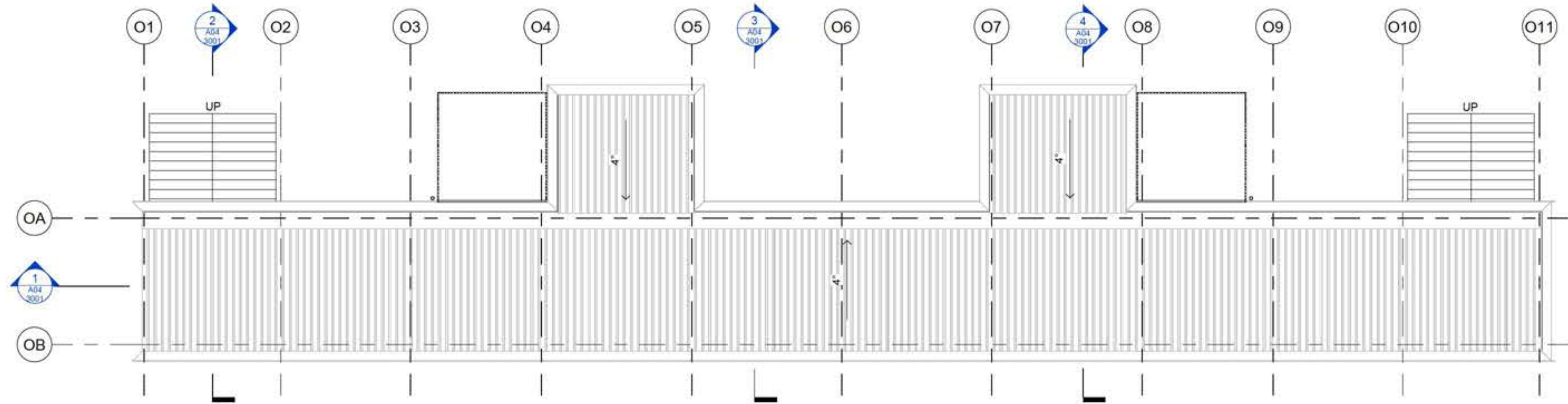
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Civil/Transport/Service/Sustainability:
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Landscape/Urban: Boffamiskell
Quantity Surveyor: RLB
Geotech: Tonkin Taylor
Fire Engineers: WSPPROJECT NAME
Waterloo Station TOD Reference
DesignPROJECT NO.
25044 ADDRESS
Hutt Central, Lower Hutt
5011, New Zealand

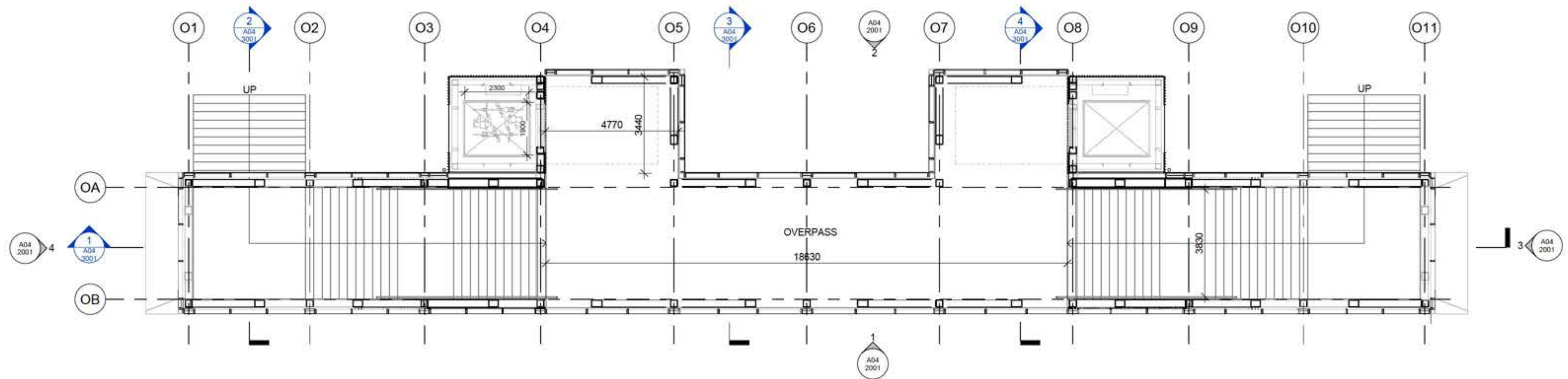
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P04	GRM	2025.07.29	Issue for Coordination
P05	GRM	2025.08.08	Reference Design Drawings

KEY PLAN

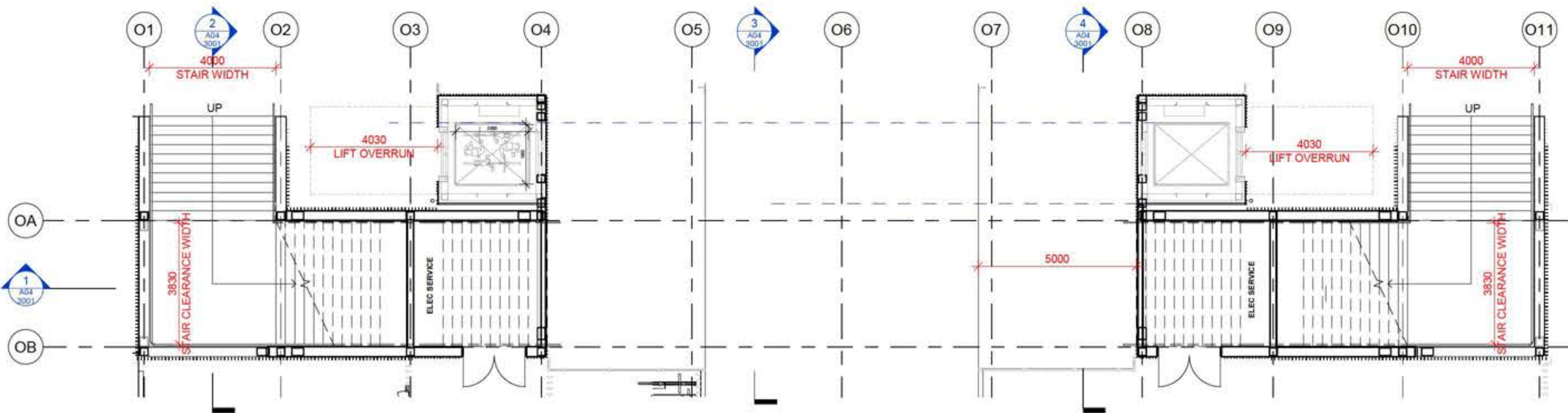
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MC BP MH 2025.08.08 P05DRAWING NO:
A03 20011 PLATFORM CANOPY_ROOF PLAN
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1:1003 PLATFORM CANOPY_GA ELEVATION
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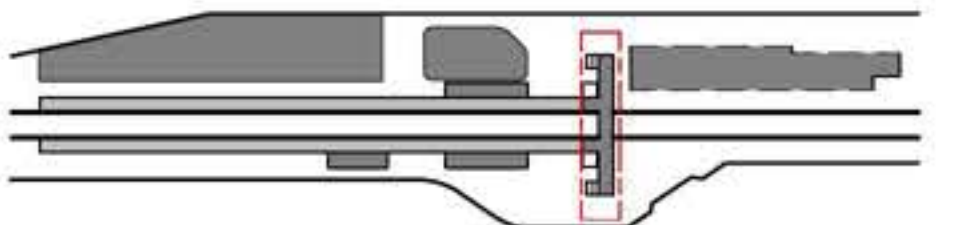
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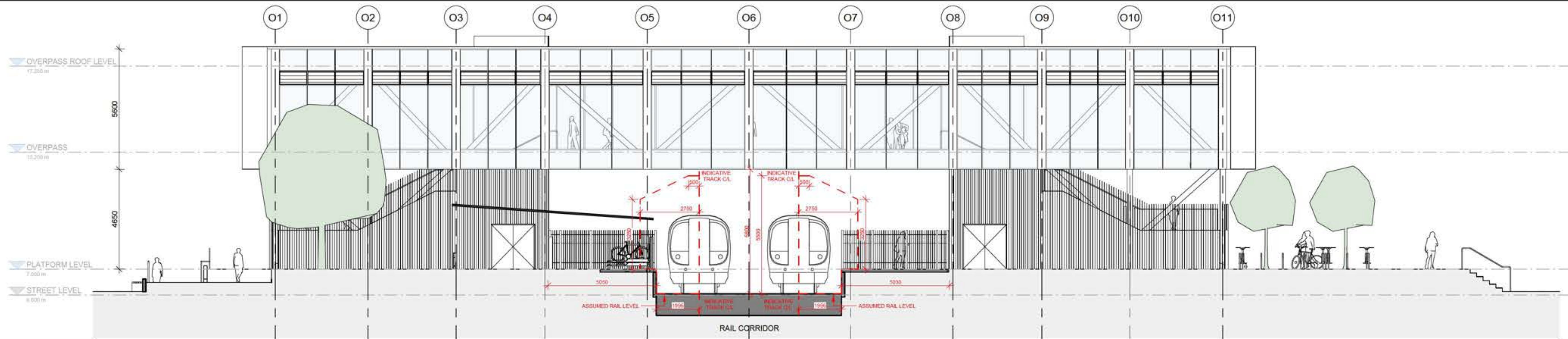


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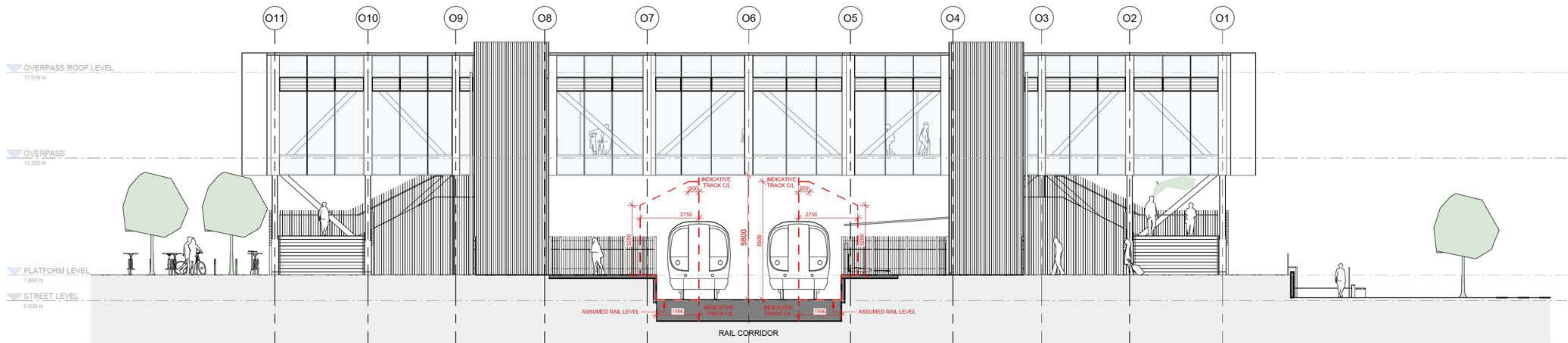
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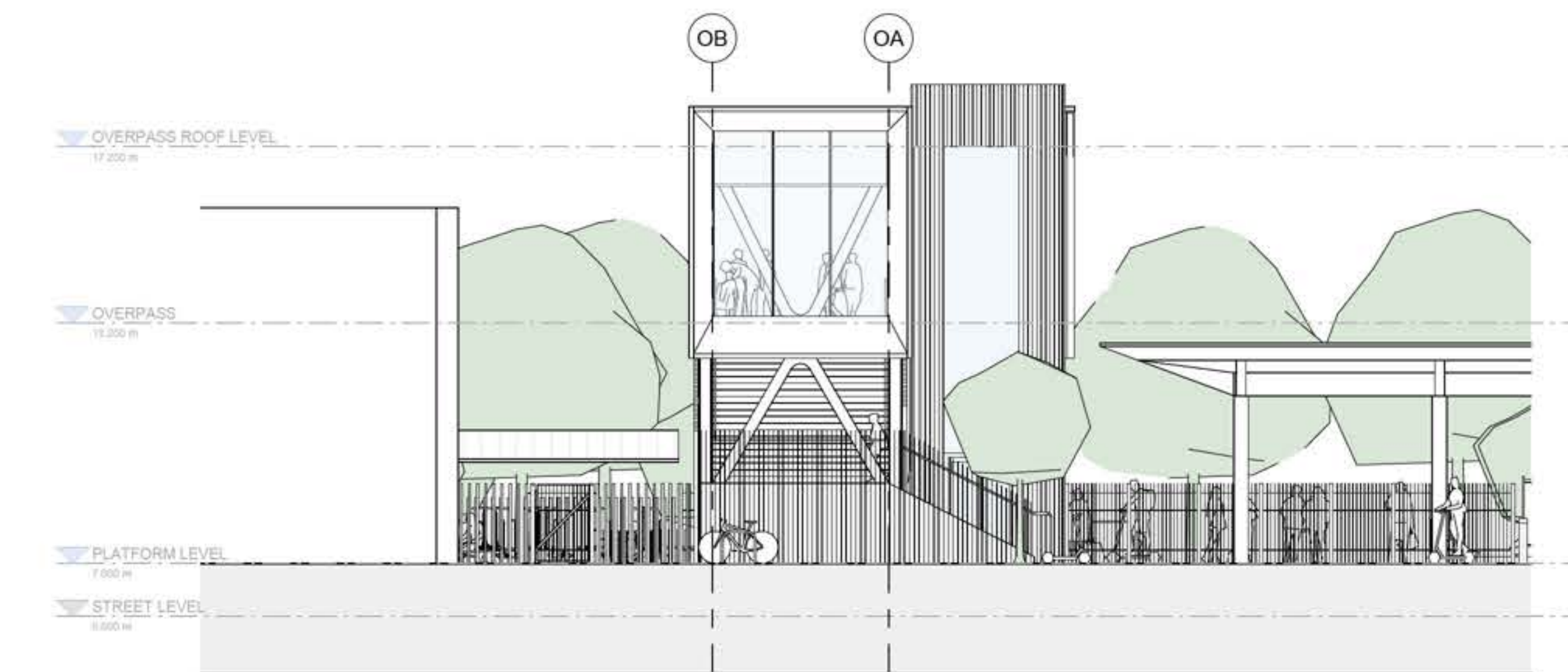


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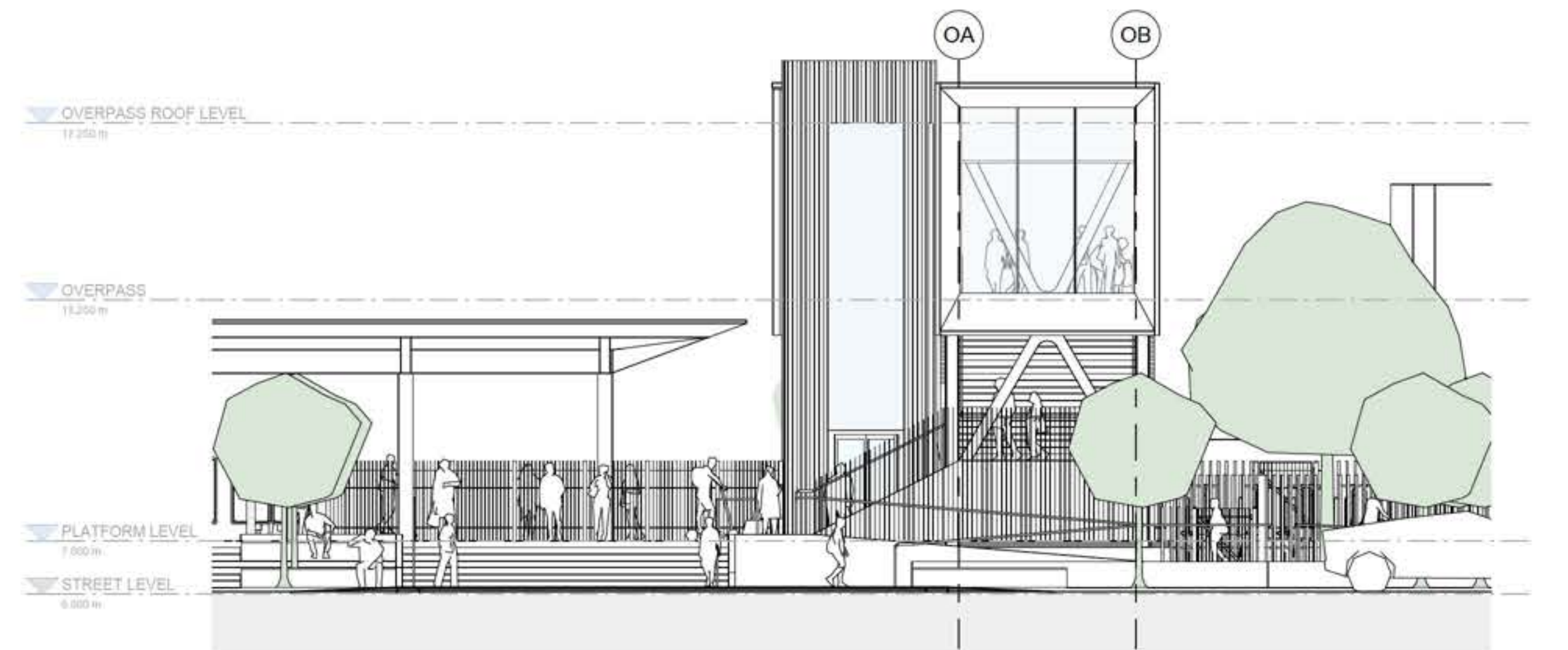
REFER TO SHEET A04 1001 FOR ELEVATION CUT



2 OVERPASS_GA SOUTH-WEST ELEVATION
1:100



3 OVERPASS_GA NORTH-WEST ELEVATION
1:100



4 OVERPASS_GA SOUTH-EAST ELEVATION
1:100

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Structural Engineers: Dunning Thornton
Civil/Transport/Service/Sustainability: Aurecon
Landscape/Urban: Boffamiskell
Quantity Surveyor: RLB
Geotech: Tonkin Taylor
Fire Engineers: WSP

PROJECT NAME
Waterloo Station TOD Reference Design

PROJECT NO.
25044
ADDRESS
Hutt Central, Lower Hutt
5011, New Zealand

REV	BY	DATE	DESCRIPTION
P01	GRM	2025.07.15	Issue for Information
P02	GRM	2025.07.18	Supplementary Information
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P05	GRM	2025.07.29	Issue for Coordination
P06	GRM	2025.08.08	Reference Design Drawings

KEY PLAN

DRAWING TITLE
OVERPASS - GA ELEVATIONS

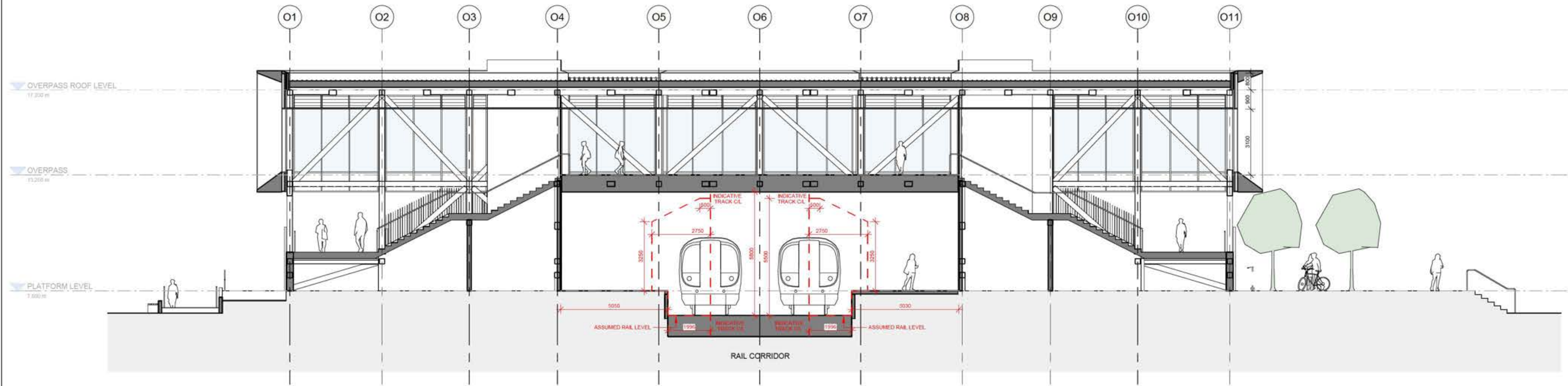
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MC	BP	MH	2025.08.08	P06

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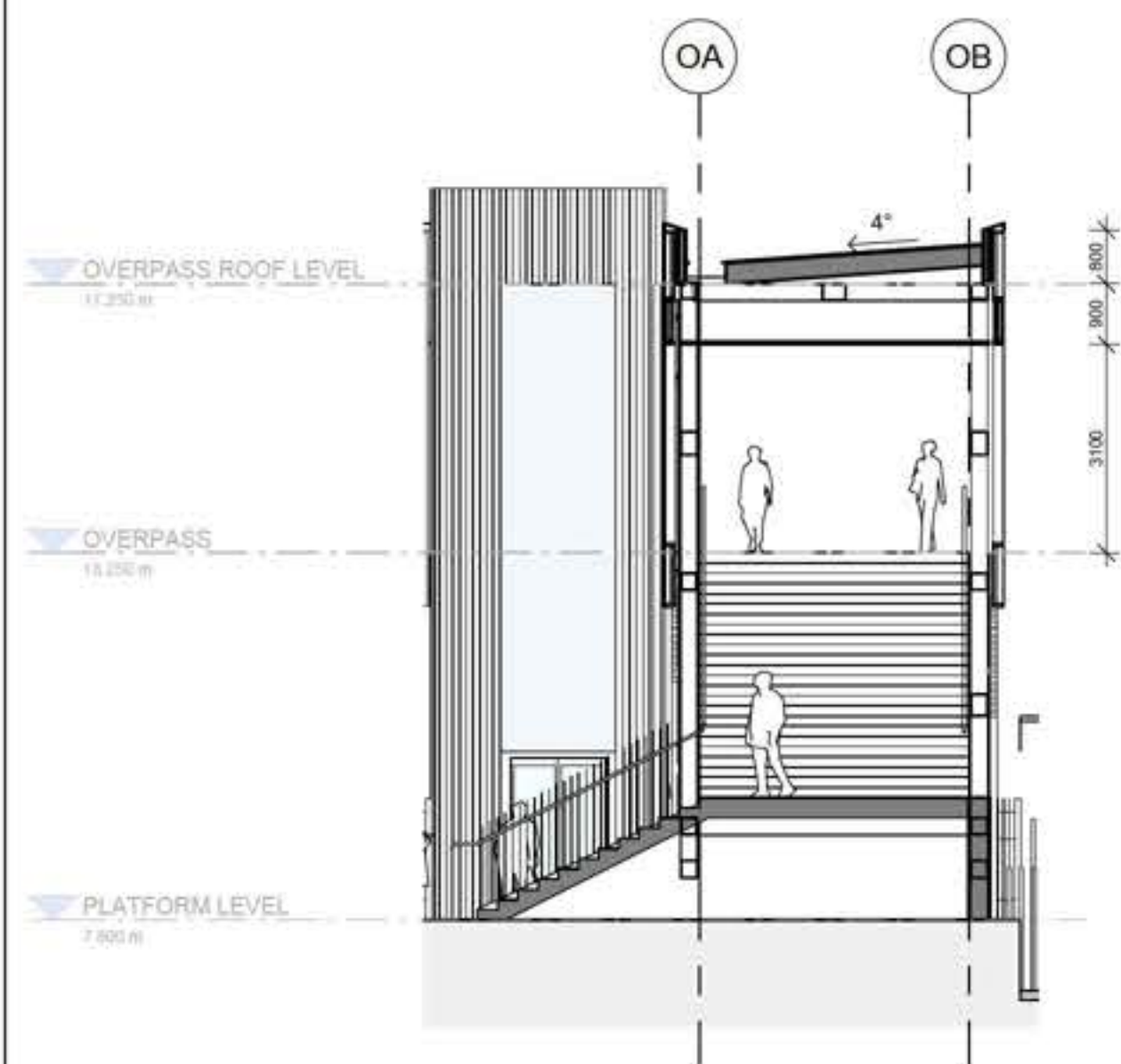
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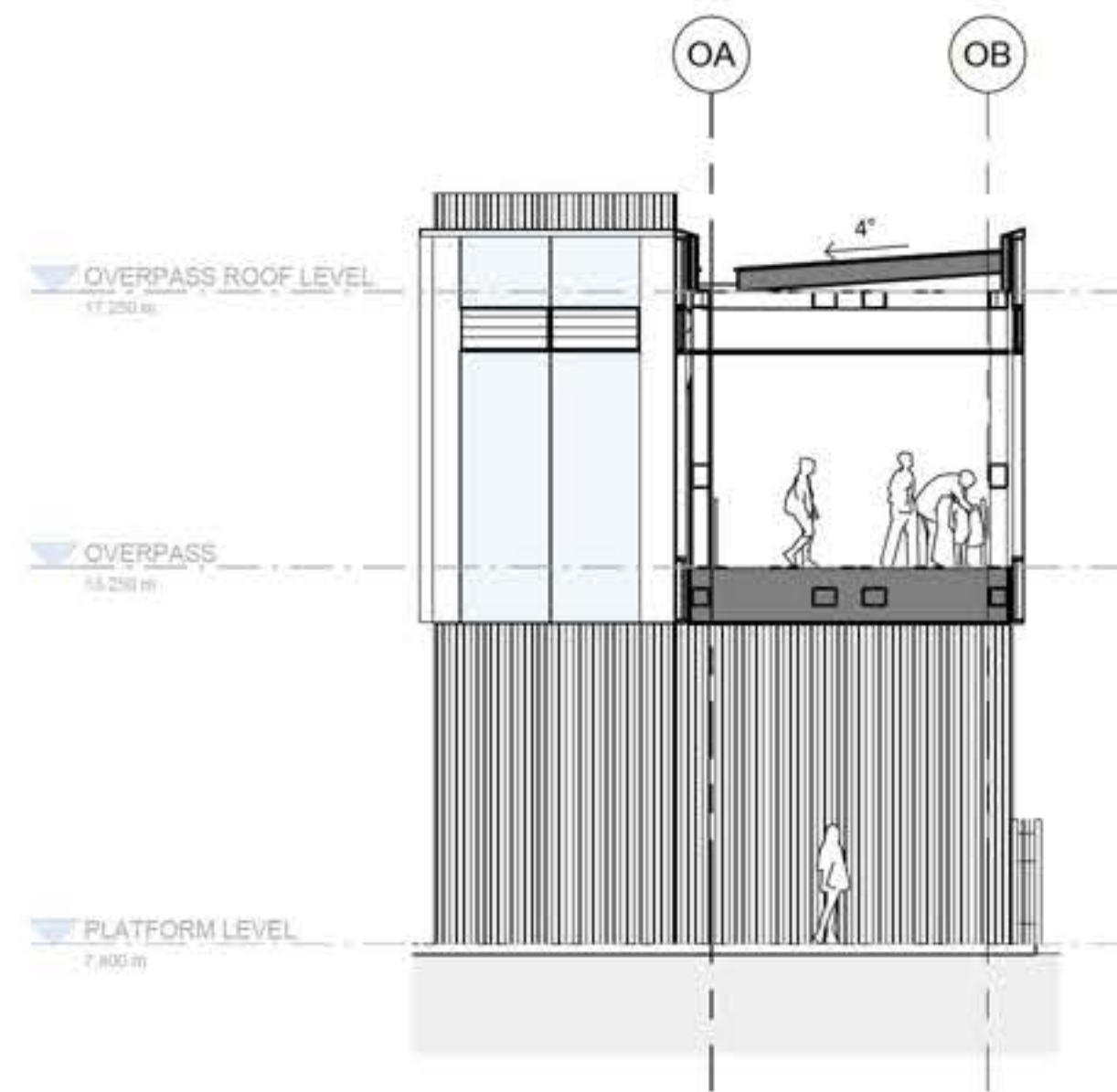


① OVERPASS - GA LONG CROSS SECTION
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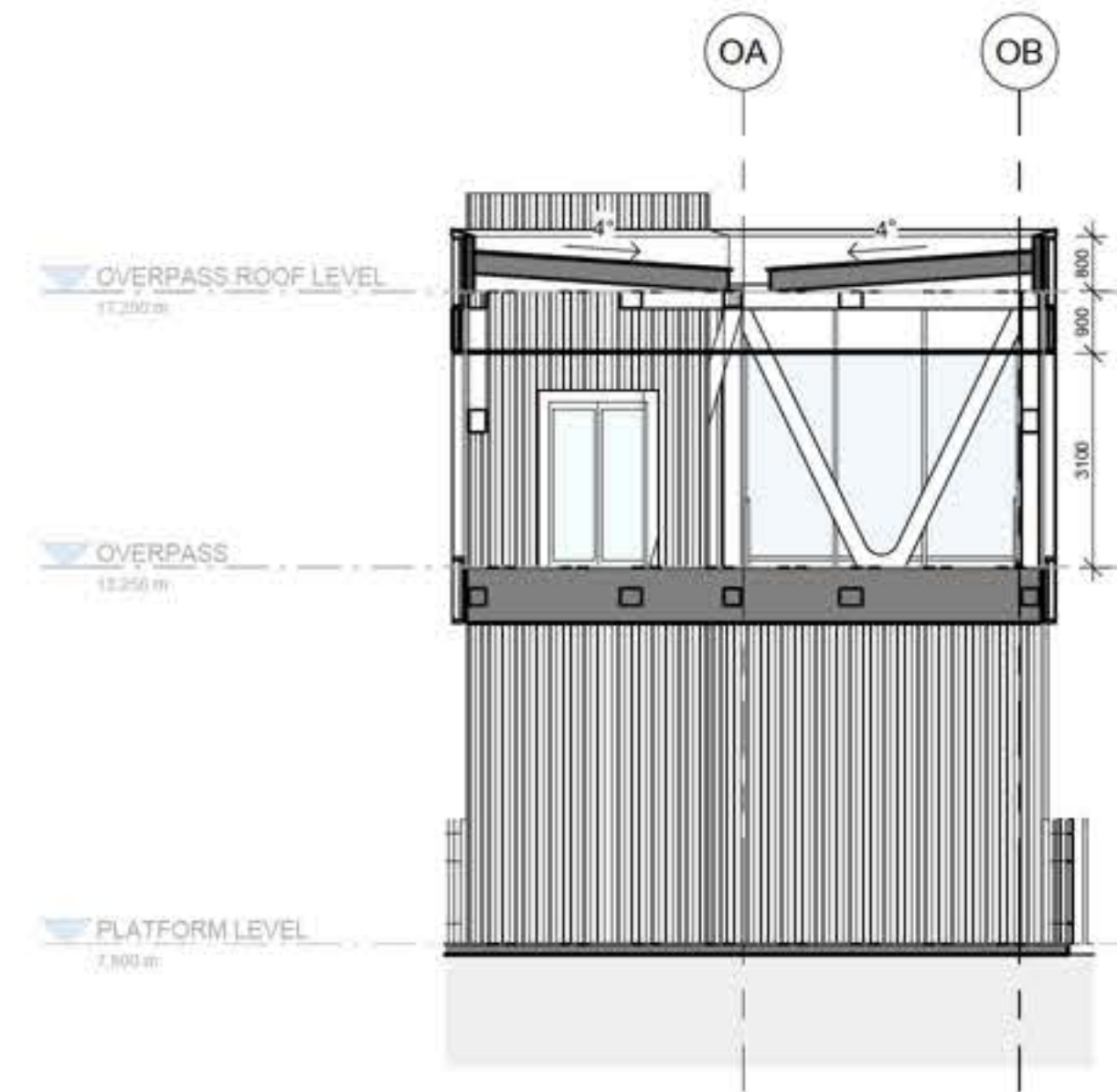
REFER TO SHEET A04 1001 FOR SECTION CUT



② OVERPASS - GA SHORT CROSS SECTION 01
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③ OVERPASS - GA SHORT CROSS SECTION 02
1:100



④ OVERPASS - GA SHORT CROSS SECTION 03
1:100

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Civil/Transport/Service/Sustainability:
Aurecon
Landscape/Urban: Boffamiskell
Quantity Surveyor: RLB
Geotech: Tonkin Taylor
Fire Engineers: WSP

PROJECT NAME
Waterloo Station TOD Reference
Design

PROJECT NO.
25044
ADDRESS
Hutt Central, Lower Hutt
5011, New Zealand

REV	BY	DATE	DESCRIPTION
P01	GRM	2025.07.15	Issue for Information
P02	GRM	2025.07.18	Supplementary Information
P03	GRM	2025.07.22	Supplementary Information
P04	GRM	2025.07.25	Issue for Coordination
P05	GRM	2025.07.29	Issue for Coordination
P06	GRM	2025.08.08	Reference Design Drawings

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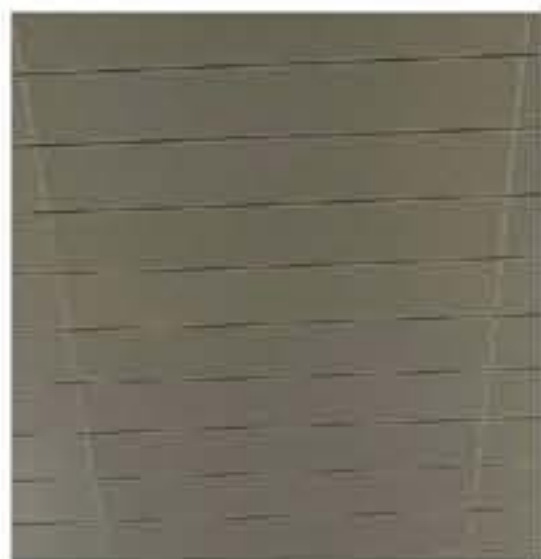
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STATUS
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DRW CH APPR DRW DATE REV
MC BP MH 2025.08.08 P06

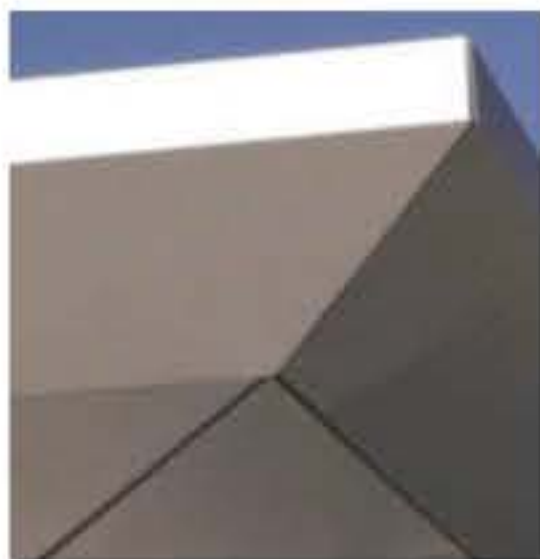
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CLG-101
Panelised aluminium
ceiling system,
'champagne riche'



CLG-102
Panelised aluminium
ceiling system, metallic
panels



TRM-001
Canopy edge profile



BAL-101
1.8m Platform fencing
and stair balustrades.
Fabricated in steel,
galvanized with Dulux
Monument paint finish or
similar.



EWS-402
Glazing System with
Metlink branded Anti
Graffiti Film

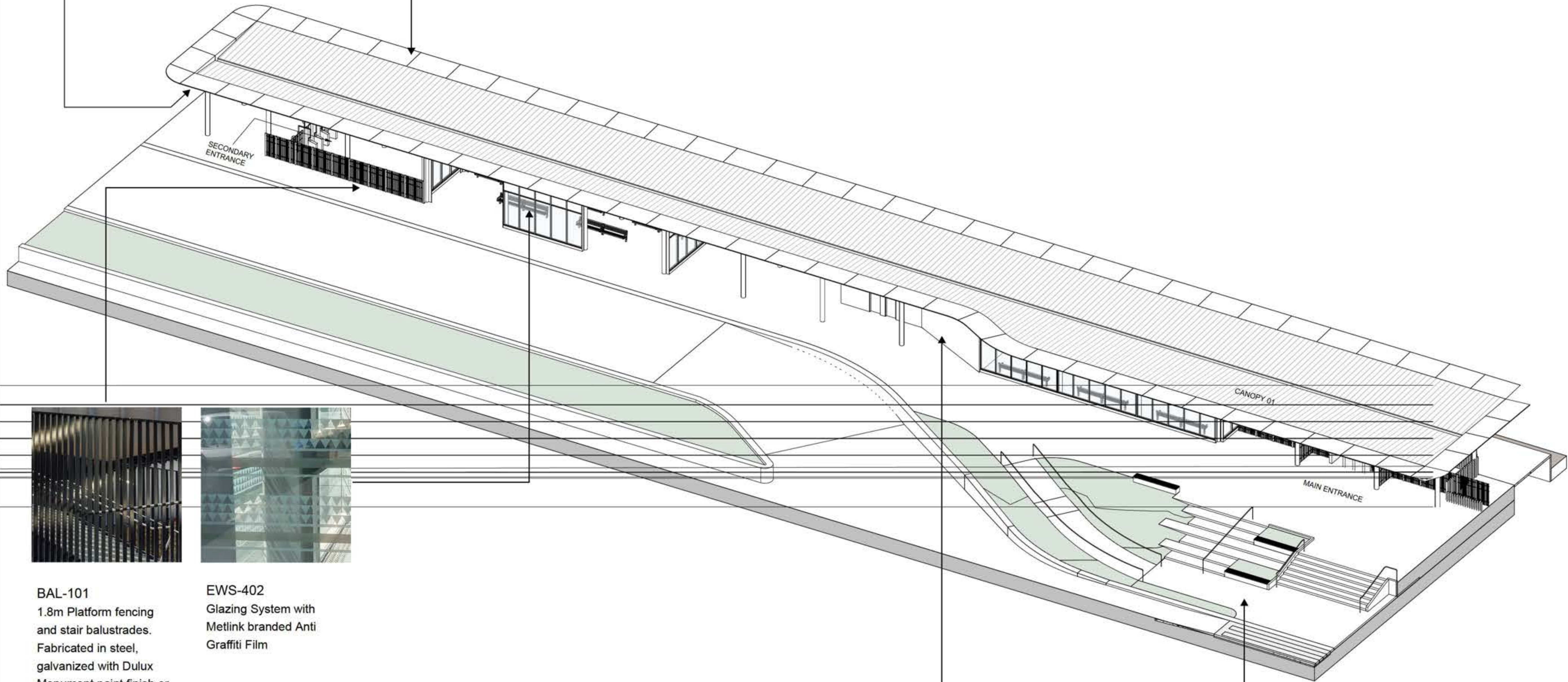


EWS-502
Fluted Brick cladding by
ViBlock.
Charcoal colour



FLR-111
Concrete Surface:
Exposed Aggregate

FLR-112
Concrete Surface: Broom
Finish



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CANOPIES AND PLATFORM

SCALE
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DRAWING NO.

A18 1001



EWS-401
Curtain wall glazing
system.



CLG-101
Aluminium batten ceiling
system



EWS-501
Aluminium cladding
system



BAL-101
1.8m Platform fencing
and stair balustrades.
Fabricated in steel,
galvanized with Dulux
Monument paint finish or
similar.



EWS-501
Aluminium cladding
system

① 3D - OVERPASS 01

② 3D - OVERPASS 02

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25044 ADDRESS
Hutt Central, Lower Hutt
5011, New Zealand

REV	BY	DATE	DESCRIPTION
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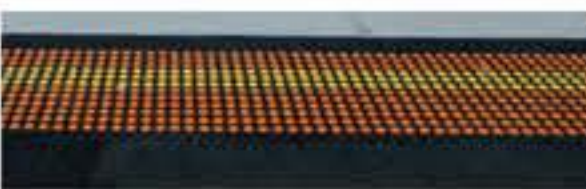
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DRAWING TITLE
MATERIALS AND FINISHES KEY -
OVERPASS

SCALE
@A1 STATUS
For information

DRW	CH	APPR	DRW DATE	REV
MC	BP	MH	2025.08.08	P01

DRAWING NO.
A18 1002

Code	Name	General Description	Location	Image	Benchmark Supplier
BAL-100	Balustrades and Handrails				
BAL-101	Slatted steel fence	1.8m Platform fencing and stair balustrades. Fabricated in steel, galvanized with Dulux Monument paint finish or similar.	Station security line (Platform fencing), stair balustrades		Metal Fabricator
BAL-102	Stainless steel balustrade	Stainless Steel	Bridge Stairs, forecourt stairs, accessible ramps		Metal Fabricator
CLG-100	Ceilings and Soffits				
CLG-101	Ceiling Battens	Extruded aluminium ceiling battens, 50x100mm, 100mm spacing between battens	Overpass Ceiling		Rokane or Similar
CLG-111	Panelised Aluminium Ceiling - Type 1	Concealed grid suspended aluminium ceiling, panelised Colour: Interpon D2525 Champagne Riche Satin YW277G	Platform Canopy Soffits / Ceilings		Rokane or Similar
CLG-112	Panelised Aluminium Ceiling - Type 2	Concealed grid suspended aluminium ceiling, panelised Colour: Timber sublimation	Platform Canopy Soffits / Ceilings		Rokane or Similar
EWS-400	External Wall System - Glazed Composite Systems				
EWS-401	Unitised Glazed Wall	Structural Glaze Aluminium Joinery system. Double Glazed with low-e glass and Ceramic frit to manage solar gain. Colourback glass to spandrels.	Overpass		APL, Woods or similar
EWS-402	Unitised Glazed Wall	Commercial shop front style glazing system. Single glazed with Laminated toughened glass or similar. Anti scratch film with Metlink Graphics and branding	Waiting Areas		Metroglass, Viridian, Woods Glass
EWS-500	External Wall System - Metal Cladding				
EWS-501	Aluminium Cladding - Monument	Aluminium cladding Vertical Extruded cladding system on cavity. Profiles TBC. Anti graffiti powder coat finish	Lift Tower		Nuwall or similar
EWS-502	Fluted Brick Cladding- Charcoal	Fluted brick cladding over cavity and light framed walls.	Platform WC's, Plant rooms		ViBlock
EWS-600	External Wall System - Metal Screens				
EWS-601	Perforated Metal Panels	Perforated aluminium panels set into glazing system. Powdercoat finish to match surrounding.	Ventilation panels to Waiting areas, covering Overpass Louvre Grilles.		Metal fabricator Supplied
FLR-100	Flooring				
FLR-101	Asphalt	Pedestrian grade asphalt flooring Asphalt depth: 20mm minimum (40mm around tactile areas)	New pavements outside station boundary.		Civil Contractor
FLR-111	Concrete Surface Option: Exposed Aggregate	Concrete paving 300x600mm, recycled aggregate, grey tone 1 Or : Exposed aggregate laid concrete paving with oxide in mix	Platforms, Forecourt, Steps and landscaped areas		Civil Contractor
FLR-112	Concrete Surface Option: Broom Finish	Concrete paving 300x600mm, recycled aggregate, grey tone 2 Or : Broom finish laid concrete paving with oxide in mix	Platforms, Forecourt, Steps and landscaped areas		Civil Contractor

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Civil/Transport/Service/Sustainability:
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Landscape/Urban: Boffamiskell
Quantity Surveyor: RLB
Geotech: Tonkin Taylor
Fire Engineers: WSP

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Waterloo Station TOD Reference Design

PROJECT NO.
25044

ADDRESS
Hutt Central, Lower Hutt
9011, New Zealand

REV BY DATE DESCRIPTION
P01 GRM 2025.08.08 Reference Design Drawings

KEY PLAN

METRES
@ 1:100

DRAWING TITLE
MATERIALS AND FINISHES
SCHEDULE 01

SCALE
@A1

STATUS
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MC BP MH 2025.08.08 P01

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A18 1003

FLR-121	Precast coping edge	Supplied by KiwiRail or similar			
	Tactile Pavers	Tactile Pavers to platform edges, stair landings and along accessible routes	Platforms, Stairs, Accessible ramps		Freedom Strategies or Simialr
LVR-100	Louvres				
LVR-101	Aluminium Louvre	Storm Resistant Horizontal Fixed Aluminium Mechanical Louvre's Exterior face to have perforated Aluminium Screen.	Integrated into overpass glazing system.		Construction Specialities or Similar
PFS-100	Paint Finish				
PFS-101	Monument	Dulux Monument	Steel structures, security fencing, balustrades		Dulux or colour matched with specified paint system
TRM-100	Trim				
TRM-111	Extruded Leading Canopy Edge Profile	Fabricated aluminium profile for canopies	Canopies		Metal Fabricator
RFS-100	Roofs				
RFS-101	Profiled aluminium roof deck	Dimond Heritage Tray ColorCote Magnaflow	Canopies		Dimond
RFS-102	Profiled Prefinished Steel Roofing	Brownbuilt 900 [BB900] ColorCote Magnaflow	Overpass		Dimond

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KEY PLAN

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1

2

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DRAWING TITLE

MATERIALS AND FINISHES

SCHEDULE 02

SCALE

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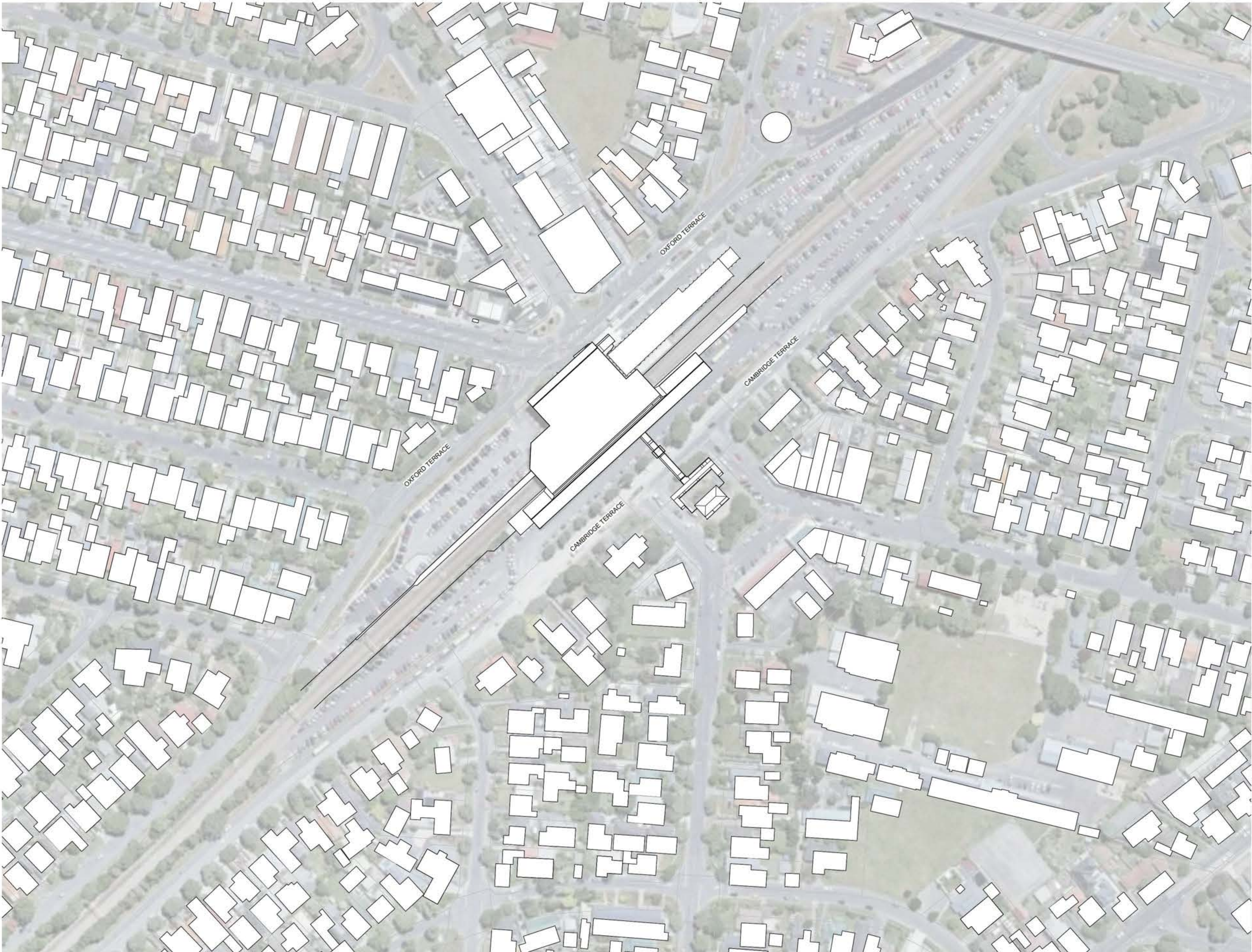
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PROJECT NO.
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P02	GRM	2025.07.18	Supplementary Information

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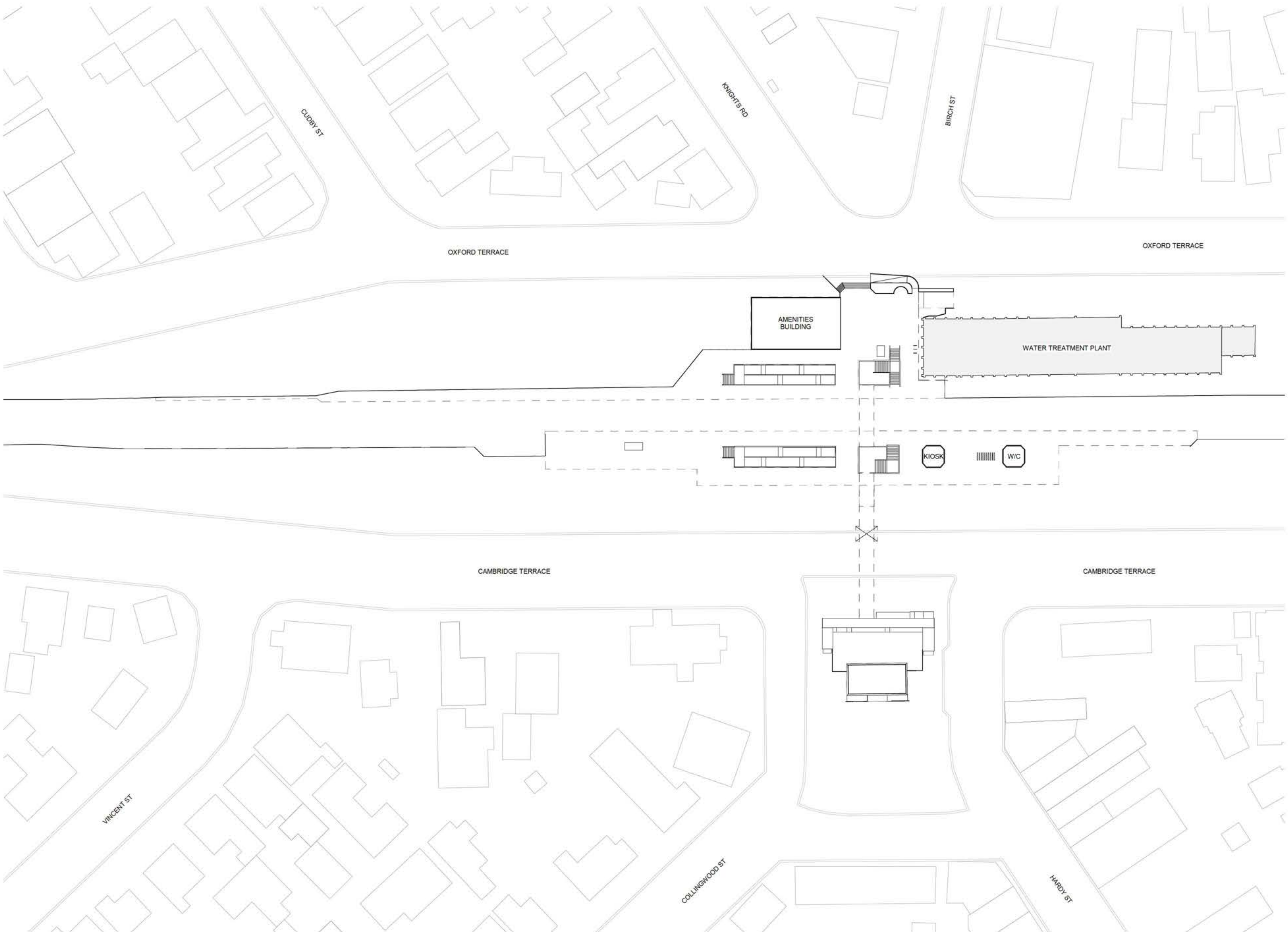
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DRAWING TITLE
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SCALE
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STATUS
For information

DRW	CH	APPR	DRW DATE	REV
MC	BP	MH	2025.07.18	P02

DRAWING NO:
A01 1001



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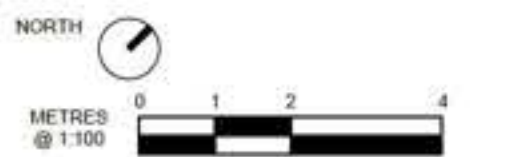
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KEY PLAN



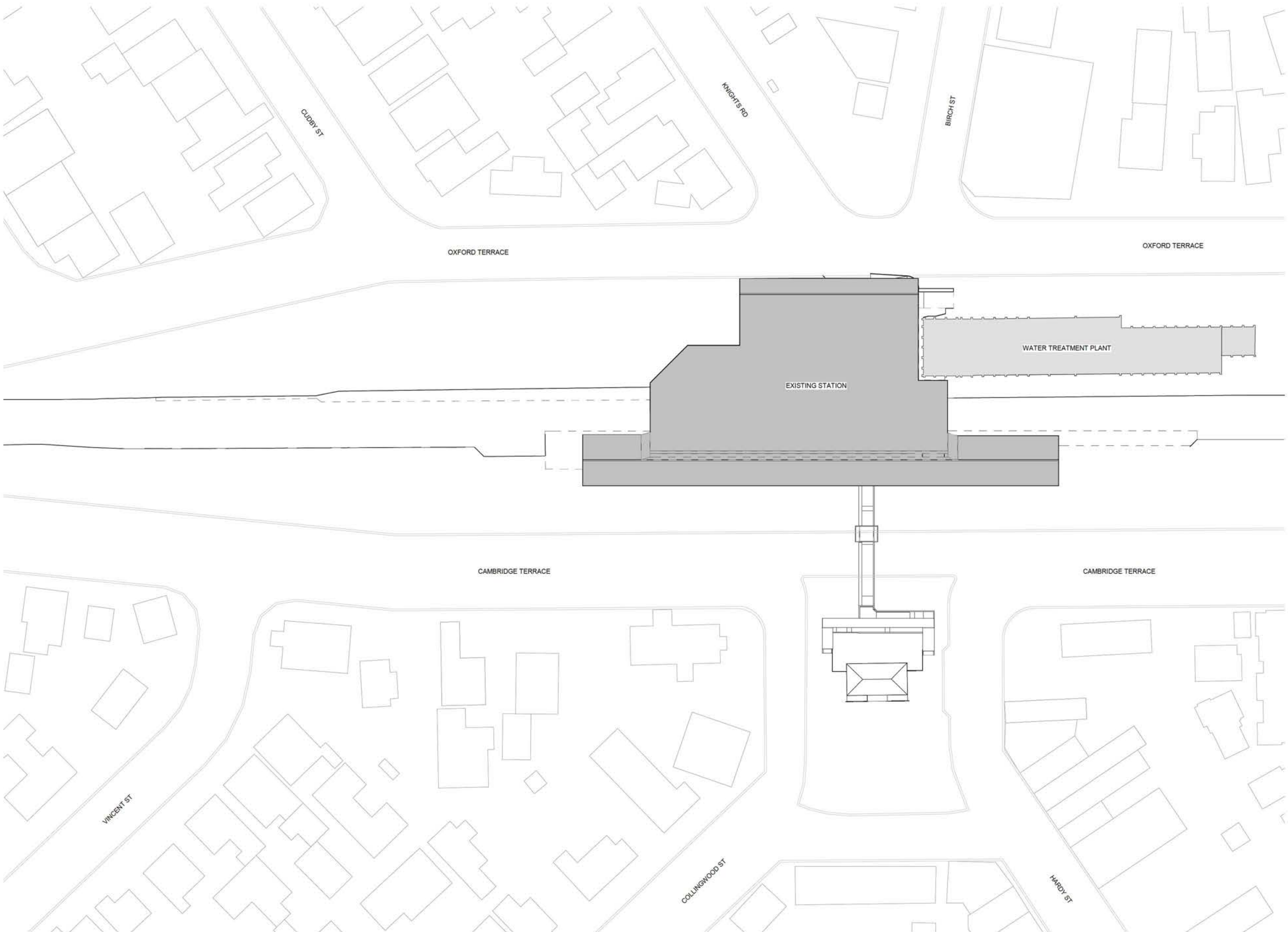
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1 : 500 @A1

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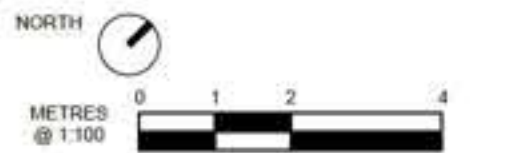
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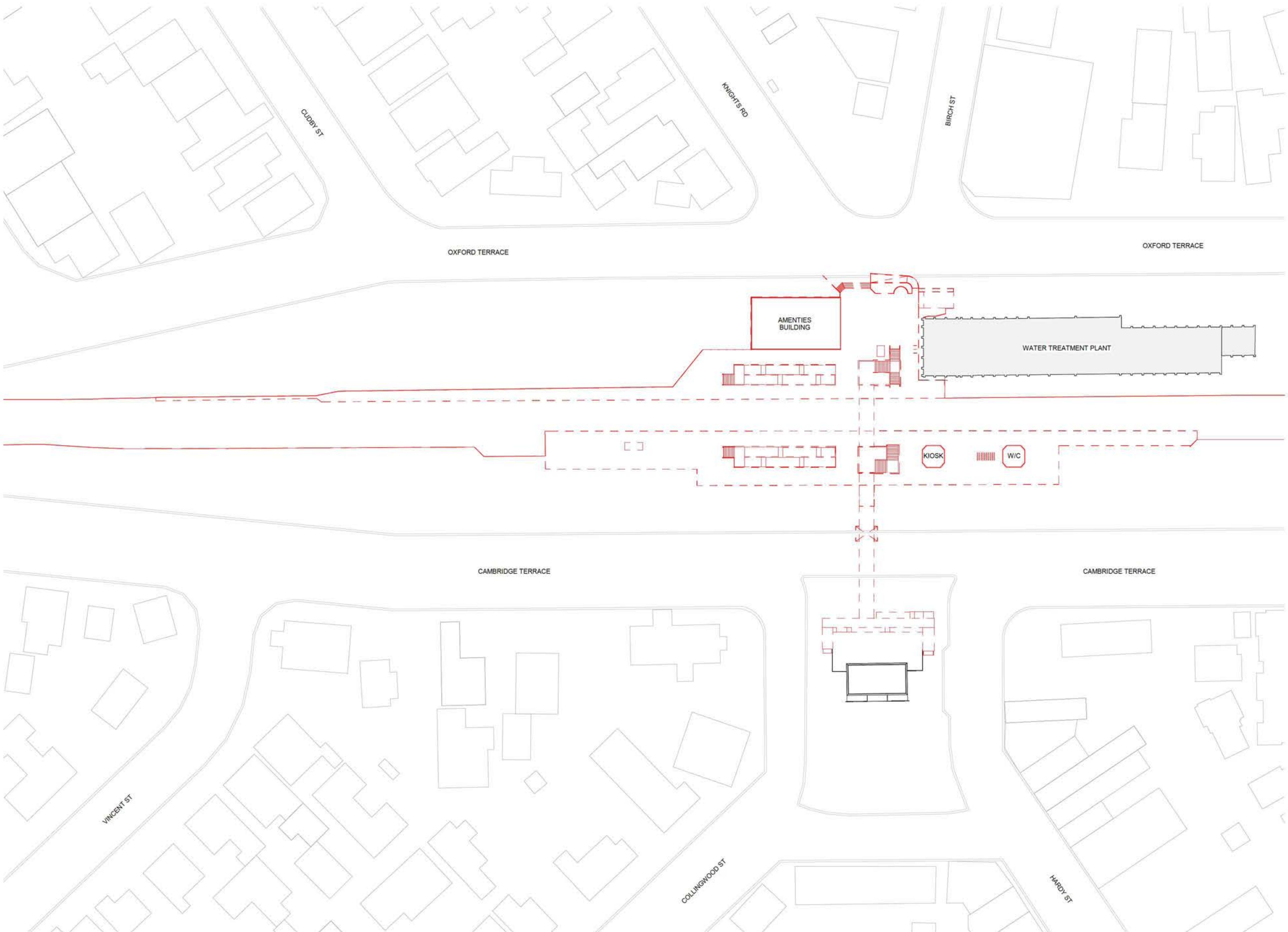
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LEVEL ROOF - EXISTING SITE PLAN

SCALE
1 : 500 @A1

STATUS
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KEY PLAN

NORTH
METRES @ 1:100

DRAWING TITLE
LEVEL GROUND - DEMO SITE PLAN

SCALE
1 : 500 @A1

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DRAWING NO:
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8.3 TRANSPORT PLANNING & RAIL

Waterloo Train Station

Reference Design Report Transport
Planning and Rail

Greater Wellington Regional Council

Reference: 528886

Revision: B

2025-08-21



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Title		Title	
Technical Director		Project Manager	

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1 Executive Summary

This technical report provides a comprehensive account of the transport planning and rail design inputs underpinning Stage 3 of the Waterloo Station Reference Design, focusing on the development and evaluation of the Reference Design - the preferred station configuration identified through an integrated multi-criteria assessment process.

Drawing from existing network conditions, forecast travel demand, and strategic goals, the Reference Design has been developed to deliver a safe, legible, and future-ready public transport interchange that directly supports mode shift, transit-oriented development (TOD), and the long-term resilience of the Hutt Valley transport system.

The Reference Design includes aligned, upgraded platforms with level boarding to improve passenger experience and operational flexibility. While the design avoids major track realignment, minor platform encroachment into the southern curve will require KiwiRail approval. A Systems Breakdown Structure (SBS) has been developed to manage requirements and support future assurance processes. Early engagement with KiwiRail will be essential to confirm impacts on signalling, safety cases, traction power, and corridor structures, ensuring the design remains certifiable, buildable, and safe.

The Reference Design delivers a unified, customer-centric multimodal interchange that addresses current operational constraints, enhances multimodal connectivity, and unlocks strategic development opportunities within Greater Wellington Regional Council's (GWRC) designated Priority Development Area (PDA) at Waterloo. It is designed to meet the needs of current and future users through the integration of aligned upgraded platforms, a new pedestrian overpass and at-grade crossing, a rationalised Park and Ride facility, and upgraded bus interchange infrastructure, while maintaining and improving active mode access across the precinct. This configuration is best aligned with the region's transport, land use and climate change objectives.

2 Introduction

Waterloo Station is a key node in the Wellington Region's public transport network. Located on the Hutt Valley and Wairarapa Lines, it serves as the primary interchange for Naenae, Wainuiomata, Seaview, and Kelson, and connects into regional services linking Upper Hutt, Wellington City, and the Wairarapa. With over 14,000 rail boardings weekly and functioning as a key bus-rail transfer point, the station is strategically positioned to enable mode shift, reduce transport emissions, and unlock urban development within Lower Hutt City.

The Reference Design process responds to several interrelated drivers:

- End-of-life infrastructure, including the legacy 1987 spaceframe canopy and associated accessibility, safety, and maintenance challenges.
- Patronage growth linked to service upgrades under the Lower North Island Rail Integrated Mobility (LNIRIM) programme.
- Regional commitments to deliver housing and employment intensification through the Wellington Regional Growth Framework (WRGF).
- Greater Wellington's ambitions for TOD and station precinct optimisation under the WRLC Priority Development Area framework.

This report details the transport planning and rail design rationale for The Reference Design, including forecast demand, layout configuration, modal integration, customer outcomes, risk mitigation and strategic value alignment.

2.1 Strategic Alignment and Design Drivers

The Reference Design responds directly to the strategic policy environment within which the station operates. Key alignments include:

- **Wellington Regional Growth Framework (WRGF):** Supports housing intensification and sustainable urban form within the Hutt Valley corridor.
- **GWRC Long-Term Plan and Public Transport Plan:** Prioritises improvements to customer experience, station access, and regional connectivity.
- **Smarter Connections Strategy:** Reinforces station hierarchy, optimising interchange function and reducing walking distances.
- **Park and Ride Strategy:** Supports rationalisation of oversupplied parking in favour of access improvements and urban development.
- **Access Hutt City, Our Climate Future:** Supports a shift to lower-emission travel through increased PT mode share and high-amenity interchanges.

The design brief sets out specific transport outcomes, including achieving Level of Service C for rail passengers during the peak 15-minute period, ensuring that all modal connections are accessible and legible, minimising customer walking distances between arrival modes, and delivering a compact interchange footprint that preserves the potential for the TOD.

3 Forecast Passenger Demand

Passenger demand forecasting is a foundational component of the Waterloo Station Reference Design. Waterloo is a strategically significant station for the region, with demand forecast to grow substantially in coming years.

This work ensures the station, and its facilities are appropriately scaled to meet future user needs while allowing flexibility to accommodate growth driven by transit-oriented development (TOD) and network investment.

Despite a recent softness in passenger numbers across the rail network, there are a number of factors that will lead to substantial growth in patronage at Waterloo Station in the medium to long term. This includes:

- Significant uplift in housing numbers within the direct catchment of Waterloo Station, with new, denser housing already built or planned.
- Wider growth (e.g. Wainuiomata) increasing patronage on feeder bus routes.
- National Ticketing System is coming – zonal fares (bus + rail) likely to drive increased demand.
- LNIRIM and other planned investment will also increase frequency and reliability, as well as quality of rolling stock.

Understanding this growth is critical to ensure that a rebuilt Waterloo Station is fit for purpose to meet future demand – and to futureproof where required to avoid inefficient investment or oversizing of some station elements (e.g. lifts, stairs, platforms). Further information can be found in the **Appendix A** (Waterloo Station Pedestrian Modelling Memo).

3.1 Approach and Methodology

Passenger forecasting was undertaken using a combination of:

- Snapper card data (March 2024) representing the 95th percentile of demand across the year.
- Wellington Transport Analytics Unit (WTAU) modelling, informed by Sense Partners' regional growth assumptions.
- Statistical interpolation and extrapolation to derive 2046 and 2061 design year figures.
- Pedestrian modelling and station sizing analysis, including static level-of-service assessments.

This analysis considered typical weekday conditions (Tues - Thurs) and excluded Monday and Friday to account for post-COVID hybrid work patterns.

3.2 Forecast Growth and Station Demand

Rail passenger growth projections from 2018 to 2053 range between 30% and 70%, depending on the scenario used. Sense Partners' upper growth estimates - used for design - anticipate a 180% increase in patronage between 2024 and 2061, while Stats NZ data suggests a 120% increase over the same period

In absolute terms, the busiest 15-minute evening peak in 2046 could see:

- **Inbound:** 7 boardings, 38 alightings
- **Outbound:** 12 boardings, 433 alightings

For the **morning peak**:

- **Inbound:** 430 boardings, 15 alightings
- **Outbound:** 22 boardings, 23 alightings

These forecasts reflect continued tidal commuter flows, with high inbound demand in the morning and outbound in the evening, predominantly on the Hutt Valley Line.

3.3 Station Sizing and Design Implications

To meet future needs, the station must maintain Level of Service C (LOS C) during peak periods under normal operations. However, a temporary degradation to LOS D during delayed services in peak conditions from the 2040s is accepted as a cost-effective compromise.

The 2061 dimensions are retained as a futureproofing target, although actual built provision at opening (2031) may be lower, with the option to scale up.

Key insights from the modelling include:

- Capacity is sufficient for expected peak 15-minute loads in both 2046 and 2061 with the proposed sizing.
- Platform circulation and vertical access elements (e.g., stairs) will require design attention to meet peak clearance needs.
- Snapper gate numbers and positioning must allow for redundancy and peak throughput (minimum 4 per entrance recommended).

These modelling outputs have informed the functional and spatial requirements in the design brief and have informed sizing of specific elements in the Stage 3 Reference Design development.

3.4 Station Sizing: Performance of the Reference Design

Station sizing assessment of the Reference Design highlights the following:

- Platform circulation and vertical access elements provide sufficient space to meet LOS C during peak periods under normal operations and meet LOS D during delayed services in peak conditions for the years 2046 and 2061.

- Additional Snapper gates required on the outbound platform to cater to the alighting passenger demand in the evening peak (six additional gates required for year 2046, and a further three for 2061).
- Lack of alternative (or redundant) step-free access to and from the overpass in the event of a lift failure.

The pedestrian level of service performance of the station elements over time (with the exception of platforms, which provide sufficient width for the 2061 design year) are provided in Figure 3-1 to Figure 3-4 based on the widths provided in The Reference Design.

The figures provide an indication of potential level of service performance from Rail Day One to the 2061 design year for both normal and degraded operations. In general, the figures show that the target level of service performance for normal and degraded operations can be met, with a slight exceedance at the overpass stairs for beyond the year 2058. the year 2058.

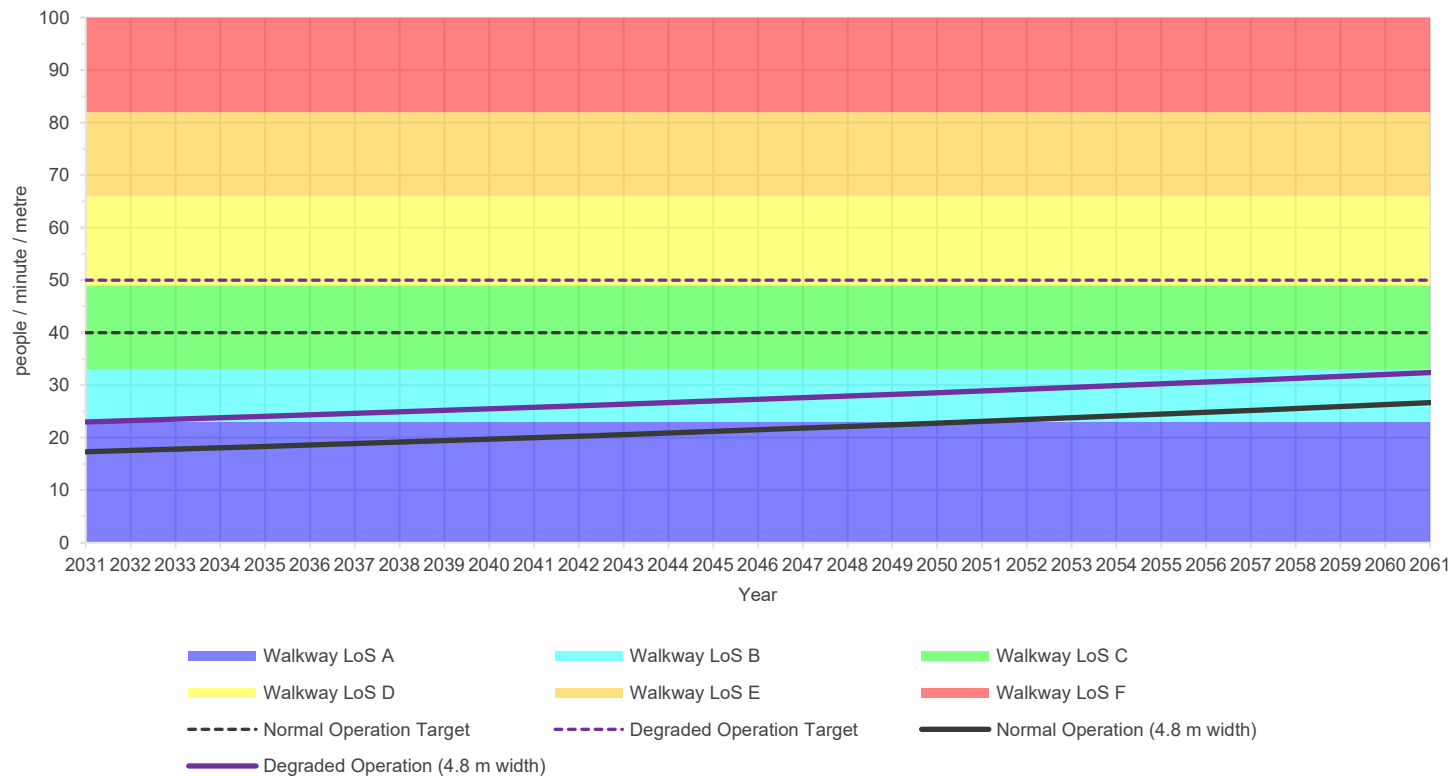


Figure 3-1 Overpass evening peak walkway Level of Service performance

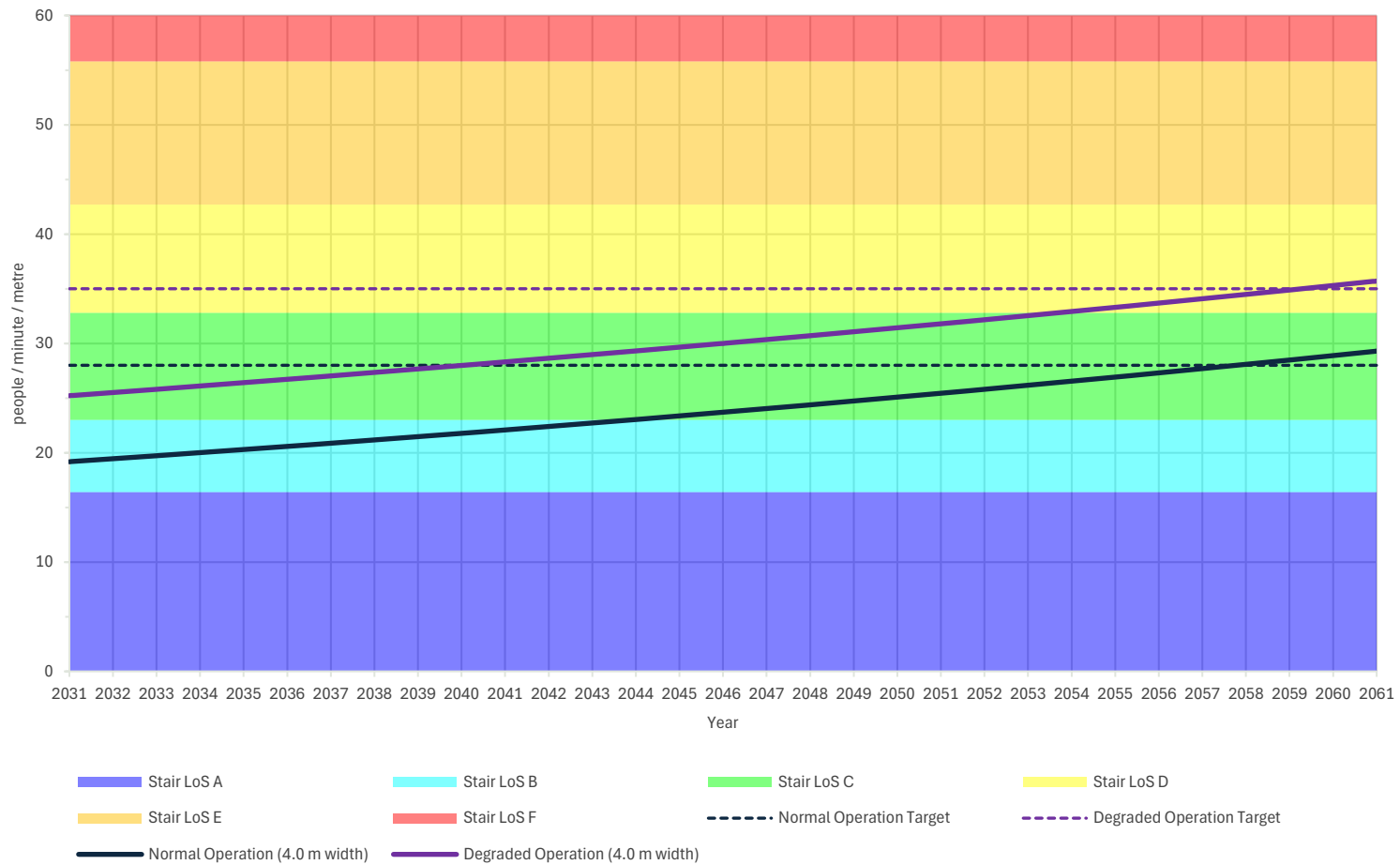


Figure 3-2 Overpass staircase evening peak stair Level of Service performance

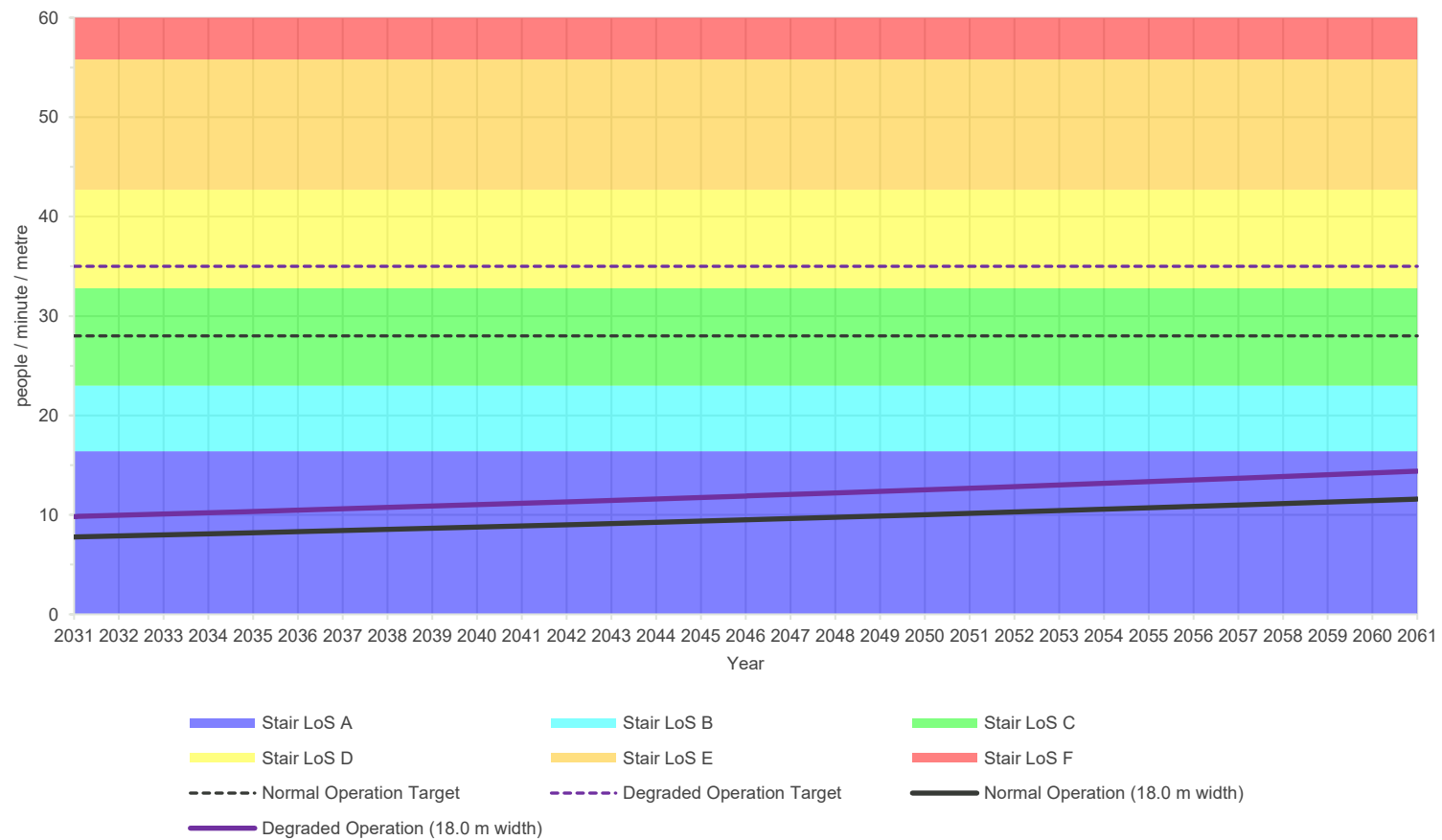


Figure 3-3 Oxford Terrace staircase evening peak stair Level of Service performance

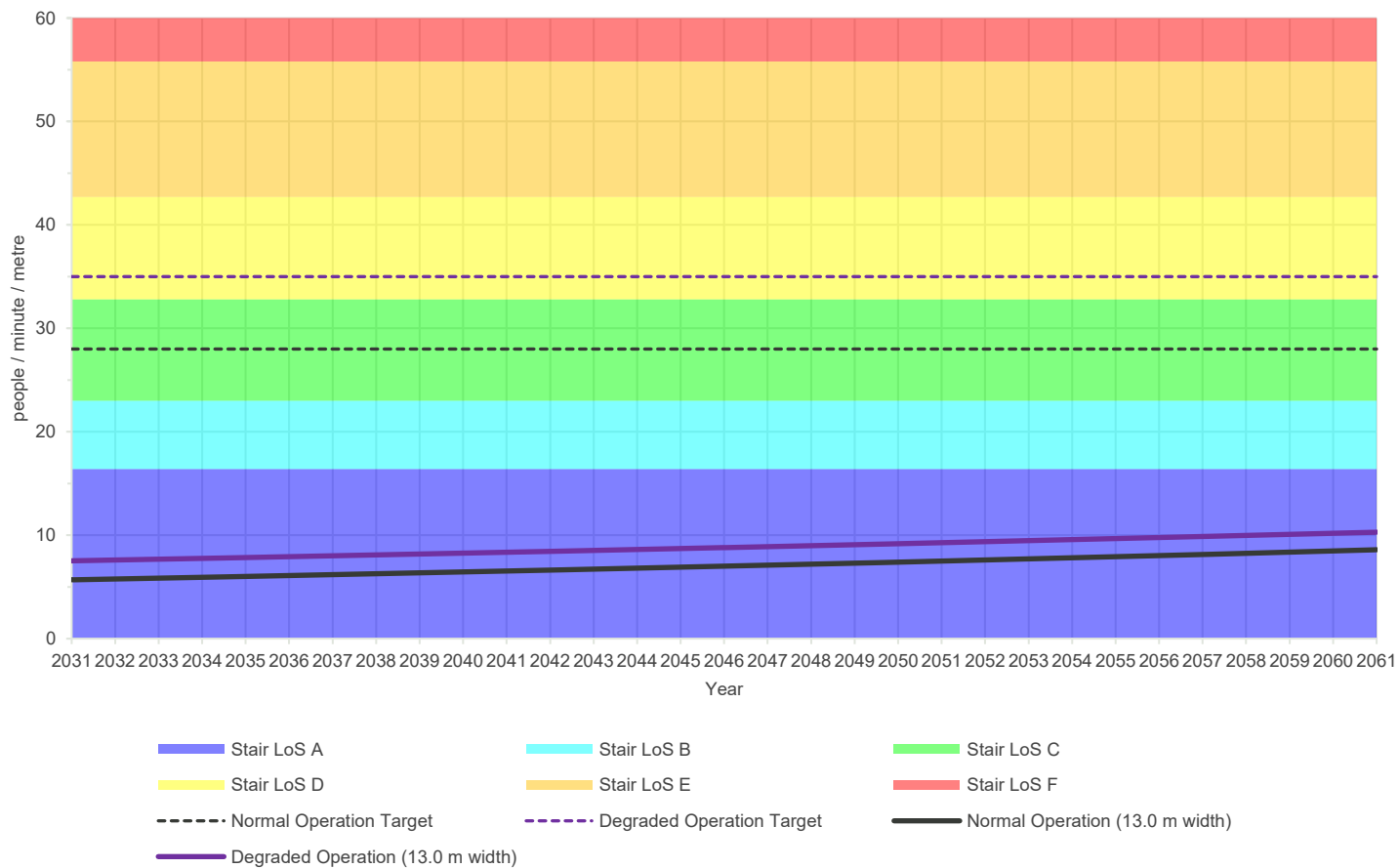


Figure 3-4 Cambridge Terrace staircase evening peak stair Level of Service performance

4 Reference Design by Mode

4.1 Bus Interchange Configuration

Waterloo Station performs a critical multimodal role in the Wellington public transport system. It acts as the principal interface between the Hutt Valley and Wairarapa rail lines and a range of high-frequency bus services connecting Lower Hutt's key growth areas including Wainuiomata, Naenae, Kelson and Seaview. The Reference Design strengthens this role by delivering a bus interchange that is legible, scalable and aligned with future network growth and intensification.

The interchange has been deliberately configured to enable seamless bus to rail transfers while supporting efficient operations (balanced with the needs of other modes), future service flexibility and land use uplift in the surrounding precinct. This aligns with Greater Wellington's strategic goals for mode shift, access equity and integrated land use and transport outcomes.

4.1.1 Functional and Operational Requirements

The interchange design reflects the expectations outlined in Greater Wellington's Public Transport Minimum Requirements and is grounded in evidence from current usage patterns and future demand modelling.

Key functional expectations include:

- **Capacity for long-term growth**

The design accommodates peak service volumes through to 2046 and 2061, including provision for fleet electrification and increased boarding activity driven by higher-density land use.

- **Flexible stop layout**

Bus stops are designed for efficient headways, minimising delays while enabling consistent dwell times. Lengths and configurations support GWRC vehicle specifications and allow for future timetable intensification or service reorganisation.

- **Passenger amenities and infrastructure**

Each bus bay includes high-quality shelters, lighting, real-time information displays and accessible kerbside infrastructure. This supports a consistent and comfortable experience for all users.

4.1.2 Bus Network

The 2041 future bus network is assumed to remain unchanged from the existing conditions. Figure X illustrates this network (taken from the Metlink database), with bus routes servicing the station identified by the red outline. Of the following routes, only the 145 – and 149 – terminate at Waterloo Station. All other services through-route.

- 121 – Stoke Valley Heights
- 121 – Seaview
- 130 - Naenae
- 130 – Petone
- 145 – Belmont
- 145 – Waterloo Station
- 149 – Waterloo Station (Loop Service)
- 150 – Kelson
- 150 – Maungaraki
- 160 – Wainuiomata North
- 160 – Lower Hutt
- 170 - Wainuiomata South
- 170 - Lower Hutt



Figure 4-1: Existing and Future Bus Network (Source: Metlink¹)

4.1.3 Bus Volumes

Table 4-1 below lists the existing and future 2041 bus volumes for all Waterloo station bus services. Note the future scenario volumes were taken from GWRC's Minimum Requirements document. In the 2041 scenario, 72 buses per hour will service Waterloo Station, an increase of 34 from the existing volumes.

Table 4-1: Existing and Future (2041) Bus Volumes

Service Name (With Destination)	Existing Peak Hour Volume (buses per hour)	2041 Peak Hour Volume (buses per hour)
121 – Stoke Valley Heights	2	4
121 – Seaview	3	4
130 – Naenae (Timed Rail Connection)	4	6
130 – Petone	4	6
145 – Belmont (Timed Rail Connection)	3	4
145 – Waterloo Station	3	4
149 – Waterloo Station (Termination - Loop Service)	2	4
149 – Waterloo Station (Commencement - Loop Service – Timed Rail Connection)	2	4
150 – Kelson (Timed Rail Connection)	3	6
150 – Maungaraki	3	6
160 – Wainuiomata North (Timed Rail Connection)	6	6
160 – Lower Hutt	4	6
170 – Wainuiomata South (Timed Rail Connection)	3	6
170 – Lower Hutt	5	6
Total	48	72

4.1.4 Service Grouping

Four bus stops currently serve Waterloo Station (Figure 3-2). Stops A and B are located on the western side of the station, with stops C and D to the east. There is an additional rail replacement bus service stop (double stop), northeast of stop D. This stop is only used by buses serving as a replacement service for the rail services when they are inoperable.

4.1.5 Stop Requirements

Given the 2041 bus network does not feature any changes from the existing, the service grouping for each stop will remain unchanged.

The 2041 stop requirements are based on NZTA public transport design guidance for 'split' bus stops¹. As each stop serves separate bus routes, the design needs to allow for independent operation i.e. buses can enter and exit the stop independently of each other.

With a 60 second dwell time (based on best practice), one bus bay can service ~25 buses per hour, with two split bus bays, 50 buses per hour. Whilst one bus bay per stop is enough capacity, the inclusion of timed rail connection services will increase this requirement. For each 'timed rail connection', a dedicated bay is required as these services wait for the connecting rail service.

Table 4-2 below lists the services that use each stop in 2041, the number of bays required, and the stop length.

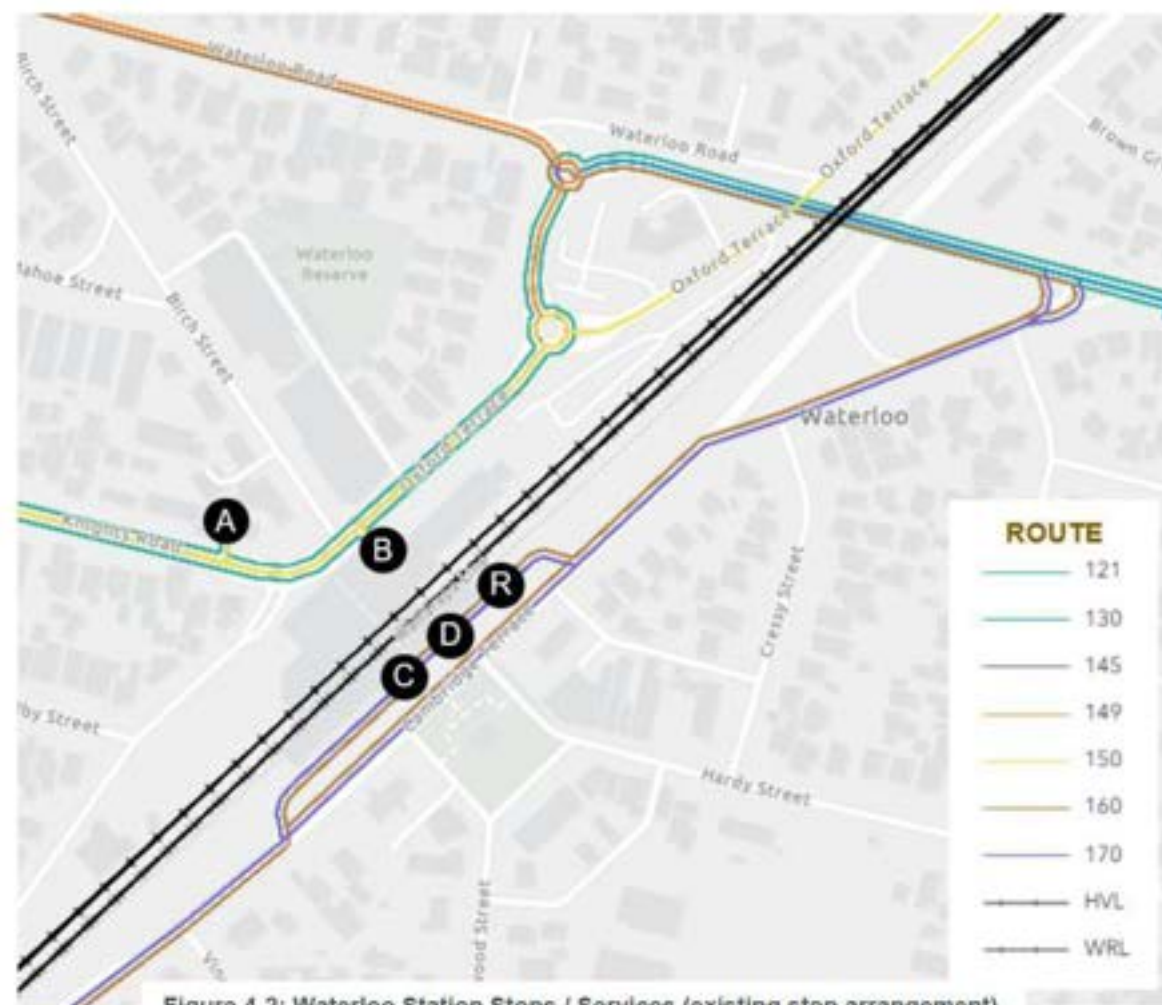


Figure 4-2: Waterloo Station Stops / Services (existing stop arrangement)

Table 4-2: Waterloo Station Stop Requirements

Stop	Service	2041 Stop Volumes		2041 Bay Requirement	
A	121 – Seaview	4	16	1	3 (Triple Stop)
	130 – Naenae (Timed Rail Connection)	6		1	
	150 – Kelson (Timed Rail Connection)	6		1	
B	121 – Stoke Valley Heights	4	24	1	3 (Triple Stop)
	130 – Petone	6			
	150 – Maungaraki	6		1	
	145 – Belmont (Timed Rail Connection)	4			
	145 – Waterloo Station	4			
C	160 – Lower Hutt	6	12	1	2 (Double Stop)
	170 - Wainuiomata South (Timed Rail Connection)	6		1	
D	160 – Wainuiomata North (Timed Rail Connection)	6	12	1	2 (Double Stop)
	170 - Lower Hutt	6		1	
R	Rail Replacement Services	Triple stop as per minimum requirements			

4.1.6 Stop Lengths

GWRC's minimum requirements set out lengths for bus stops. As the design vehicle, a 13.5m standard bus has been selected. With this design vehicle, each stop is made up of the following dimensions:

- Entry taper – 15 metres
- Bus bay – 15 metres
- Exit taper – 9 metres (6 metres for rail replacement services)

This results in a single stop length is 39 metres. For double and trip stops, only an additional exit taper (9m), and bus bay (15m) is required per bay. This gives the following stop lengths:

- Single bay/stop - 39m
- Double bay/stop (split operation) – 63m
- Triple bay/stop (split operation) – 87m
- Triple bay/stop for rail replacement services (split operation) – 78m

Should there be spatial constraints that do not support these GWRC minimum requirements, best practise lengths can be used as an alternative:

- Entry taper – 9 metres
- Bus bay – 15 metres
- Exit taper – 5 metres

With these requirements, the following stop lengths are provided:

- Single bay/stop - 29m
- Double bay/stop (split operation) – 49m
- Triple bay/stop (split operation) – 69m

Table 4-3 below provides a summary of the stop length requirements for each Waterloo Station stop, based on both the GWRC minimum requirements, and best practise guidelines.

Table 4-3: Waterloo Station Stop Lengths

Stop	Stop Requirement	Stop Length (GWRC Minimum Requirements)	Stop Length (Best Practise Guidelines)
A	Double Stop	63m	49m
B	Double Stop	63m	49m
C	Double Stop	63m	49m
D	Double Stop	63m	49m
R	Triple Stop	78m	69m

4.1.7 Interchange Design Philosophy

Throughout the optioneering and evaluation process, the bus interchange design was guided by four core principles:

- **Consolidation and integration**

The eastern interchange is consolidated into a compact, high-amenity cluster located adjacent to the station's primary entry. This enhances wayfinding, simplifies transfers and creates a clearer spatial relationship between modes.

- **Proximity to rail platforms**

Bus stops are positioned as close as practicable to platform entrances to minimise walking distances and streamline passenger movement. This supports faster and more intuitive transfers and reduces overall journey times.

- **Operational optimisation**

Stop locations and assignments were informed by existing service data and adjusted to reflect future ridership volumes, headways and turnback requirements. Design testing considered both normal operations and degraded scenarios such as rail replacement.

The interchange layout has been designed to enable future service integration, supporting emerging transport modes that improve flexibility and coverage. This includes provision for Demand Responsive Bus (DRB) services which can adapt to dynamic user needs and support equitable access.

The layout also accommodates Bus Replacing Train (BRT) operations during rail service disruptions, ensuring continuity of travel during planned or unplanned outages. Additionally, the design allows for first and last mile solutions targeted at low-density or disconnected areas, extending the functional reach of the station and supporting a more resilient and inclusive network.

4.1.8 Features of the Recommended Configuration (The Reference Design)

The final recommended configuration under the Reference Design strikes a balance between user experience, operational efficiency and long-term adaptability.

Key features include:

- **Upgraded western interchange**

Upgrades existing bus stops with significant improvements to infrastructure, including widened footpaths, weather protection, lighting and real-time service information.

- Introduction of a new double-stop on Oxford Terrace (stop A)

- **Consolidated eastern interchange**

Forms a new, high-quality cluster of stops immediately adjacent to the rail station entrance. This delivers seamless interchange connections and improves precinct legibility.

- **Seven active bus bays in total**

Including layover and set-down bays, the interchange is designed for efficient throughput and reduced congestion during peak periods. (*requires signalisation due to the relocated bus access).

- **Separation from car-based access**

The interchange layout clearly separates bus movement from pick-up and drop-off and private vehicle areas, improving safety and reducing modal conflict at the station entrance

The bus interchange configuration under The Reference Design supports a step change in public transport performance at Waterloo Station. It enhances the station's function as a multimodal hub, integrates with long-term urban growth patterns and delivers a high-quality customer experience. This unlocks broader network efficiency and enables the land use transformation objectives sought through the precinct redevelopment.

4.2 Active Mode Access

Improved access for people walking and cycling is central to The Reference Design, which prioritises safe, direct, and high-quality active mode connections as an enabler of mode shift, health, and social outcomes. These upgrades align with the Wellington Regional Mode Shift Plan, reinforce Waterloo Station's role as a high-performing interchange, and futureproof the precinct for higher-density, transit-oriented development.

The design responds directly to constraints identified in earlier assessments - including fragmented crossings, poor visibility, and low perceptions of safety - and implements a suite of interventions that remove barriers and unlock access to key destinations such as Lower Hutt CBD, Wainuiomata, Naenae, local schools, and community facilities.

Key interventions include:

- **New at-grade signalised crossing on Cambridge Terrace**

A strategically located, legible pedestrian crossing provides a direct east–west desire line between the station entrance and surrounding community, aligned with existing key walking routes. The signalised facility replaces reliance on the subway, improving safety and visibility, and supporting more direct and equitable access for all users, including children and people using mobility aids.

- **Improved western access via Oxford Terrace**

Access routes are upgraded to support safe and comfortable walking connections from the western residential catchments. Raised safety platforms across side roads reduce vehicle speeds, enhance pedestrian visibility, and improve permeability through the street network.

- **CPTED-informed overpass with weather protection**

A weather-protected overbridge provides an all-weather alternative route between platforms and across the corridor. It is designed with passive surveillance, clear sightlines, and universal access features - including gentle gradients, lifts, and tactile guidance.

- **Prominent, secure cycle parking**

Cycle parking is located in highly visible, passively surveilled areas near key station entrances. This supports user confidence, encourages uptake of active modes, and deters theft or vandalism. The facilities are designed to accommodate a mix of bike types, including e-bikes and cargo bikes.

- **Integration with the Beltway Cycleway and street network**

The station connects directly into existing and future active mode corridors, including the Beltway Cycleway, Oxford Terrace, and Birch Street. These connections enable catchment expansion, reduce pressure on parking, and support end-to-end multimodal journeys.

- **Scalable infrastructure for future micro-mobility**

The design includes space for expansion of bike parking and allows for the introduction of additional facilities such as shared e-scooter parking and end-of-trip amenities. These futureproofing measures ensure flexibility as user needs and technologies evolve.

The Reference Design repositions active transport as a primary access mode to Waterloo Station. The design not only removes longstanding barriers to walking and cycling but embeds high-quality infrastructure into the fabric of the precinct. This elevates the station's role as a civic anchor, supports sustainable travel behaviour, and reinforces the precinct's readiness for higher-density, transit-oriented growth.

4.3 Pick-up, Drop-off and Taxi Facilities

A high-performing multimodal interchange requires deliberate planning for short-stay access movements. In The Reference Design, dedicated Pick-Up and Drop-Off (PUDO) and taxi facilities are provided at both primary station entries - supporting customer choice, reducing reliance on informal behaviours, and improving the overall user experience.

By formally accommodating these access needs, the design strengthens the station's role as a local and regional hub, while aligning with the modal access hierarchy established in the Wellington Regional Public Transport Plan. This hierarchy prioritises walking, cycling, and public transport over private vehicles, but acknowledges the essential function of short-stay vehicular access for certain users - including families, the elderly, and those with limited mobility.

Key features include:

- **Co-located PUDO and accessible parking bays**

Drop-off areas are integrated with mobility parking near station entries, reducing walking distances and supporting universal access. This co-location allows for intuitive use by drivers and ensures compliance with best-practice access standards.

- **Safe and legible access design**

PUDO areas are designed with clear wayfinding, passive surveillance, and logical placement within the station forecourt. Dedicated turning movements are separated from pedestrian desire lines to reduce conflict, while surface treatments and signage reinforce appropriate use.

- **Efficient turnaround and dwell space**

Designated zones allow for short dwell times without impeding through movement or compromising bus circulation. Turnaround capacity has been dimensioned to accommodate typical AM and PM peak demand, while maintaining reliable access for taxis and drop-off vehicles during special events or rail disruptions.

- **De-risking informal behaviour**

By formalising taxi and PUDO access, the design mitigates the safety risks associated with current informal practices (e.g. stopping in live traffic lanes or at bus stops). This is a critical enabler of station safety and system reliability - particularly in a precinct expected to see significant patronage growth and urban intensification.

- **Integrated within wider interchange movement patterns**

PUDO facilities are strategically located to complement pedestrian and micromobility networks, enabling seamless transition for all users without compromising the operational efficiency of higher-priority modes such as buses or active transport.

The proposed PUDO and taxi facilities represent a shift from ad hoc accommodation of car-based access toward a more intentional, user-centred approach that supports system performance, accessibility, and safety. This is essential to delivering a complete and inclusive interchange experience - and to achieving the long-term mode shift, accessibility and placemaking goals of the Waterloo Station redevelopment.

4.4 Park and Ride Provision

Waterloo Station currently provides one of the largest Park and Ride (P&R) facilities in the Wellington region, with approximately 780 spaces. However, analysis of demand patterns reveals inefficient use of this resource. A high proportion of users originate from within the local walk-up or bus catchments - indicating that car-based access is displacing more sustainable modes, undermining mode shift objectives and reducing the opportunity to leverage precinct land for higher value uses.

The Reference Design responds to these challenges by rebalancing car access within a broader integrated access strategy. The total supply of P&R spaces is reduced to approximately 341, better aligning provision with regional access priorities and freeing up significant developable land for transit-oriented development and public realm improvements.

Key features and strategic outcomes include:

- **Alignment with the Station Access Hierarchy**

The reduced parking supply reflects GWRC's access hierarchy, which prioritises walking, cycling, and public transport as the primary modes for station access. Car-based access is preserved for users from outlying areas beyond the public transport catchment - but de-emphasised for those with viable non-car alternatives.

- **Incentivises mode shift for short-distance users**

By removing the oversupply of free parking, the Reference Design encourages local residents and commuters from nearby suburbs (e.g. Waterloo, Woburn, Naenae) to walk, bike, or use connecting bus services. This supports a more efficient use of transport capacity and reduces traffic congestion on approach roads.

- **Releases land for precinct uplift**

The reduction in P&R footprint unlocks a substantial portion of the Greater Wellington-owned site for higher-value land uses. This includes mixed-use development, public spaces, and improved interchange infrastructure - creating a more vibrant, people-centred station precinct that contributes to Hutt City's long-term growth objectives.

- **Supports future parking management strategies**

Whilst the Reference Design establishes the spatial baseline, further optimisation will be enabled through active parking management tools. These may include:

- **Pricing strategies** to manage peak demand and prioritise high-need users.
 - **Access prioritisation** for carpooling, mobility users, and regional travellers.
- These tools ensure flexibility to adapt to future travel patterns and regional emission reduction goals.

The Reference Design transitions Park and Ride from a blunt access mechanism to a targeted, demand-responsive tool that supports regional transport and land use objectives. It balances the needs of longer-distance travellers with the imperative to shift short-trip users to more sustainable modes - while unlocking land for urban intensification and amenity enhancement. This approach is consistent with national direction, local strategy, and best practice in transport hub development.

5 Design Refinement

This section outlines specific aspects that require further refinement and coordination during the next stage of the project, beyond the Reference Design stage. This is primarily because the road controlling authority is Hutt City Council, and the on-road changes will need to be developed in partnership with the council. This includes proposed bus stops, proposed signals and proposed on-road changes, including restrictions to turning movements.

5.1 Bus Stops

As part of the development of the Reference Design package, the design and layout of stop stops C, D and R were refined due to the spatial constraints, primarily caused by the relocation of the bus station access on Cambridge Terrace.

Swept path analysis confirmed that buses entering the interchange via a right-turn from Cambridge Terrace are unable to access the southernmost stop due to insufficient manoeuvring space.

A spatial assessment confirmed that there is a total of 144 meters of usable length within the interchange for safe bus movements. To meet the GWRC's minimum requirements and provide two double bay stops and one triple, 204 meters would be needed. Applying the best practice guidelines the required length could be reduced to 167 meters. The current Reference Design layout utilised 157 meters, but due to the spatial constraints revealed through vehicle tracking, only 144 meters can be considered realistically usable.

To resolve this, a revised bus stop layout (Figure4-1) has been proposed for stops C, D and R. The proposed layout maintains the seven-stop configuration by modifying the entry and exit taper lengths to best utilise the available 144m:

- A head-of-stop operation is recommended for each route group, whereby buses are instructed to always proceed to the front-most available bay.
- The revised design will support the requirement of independent entry and exit for each bus, maintaining operational flexibility.



Figure 5-1: Vehicle tracking - bus interchange and PUDO

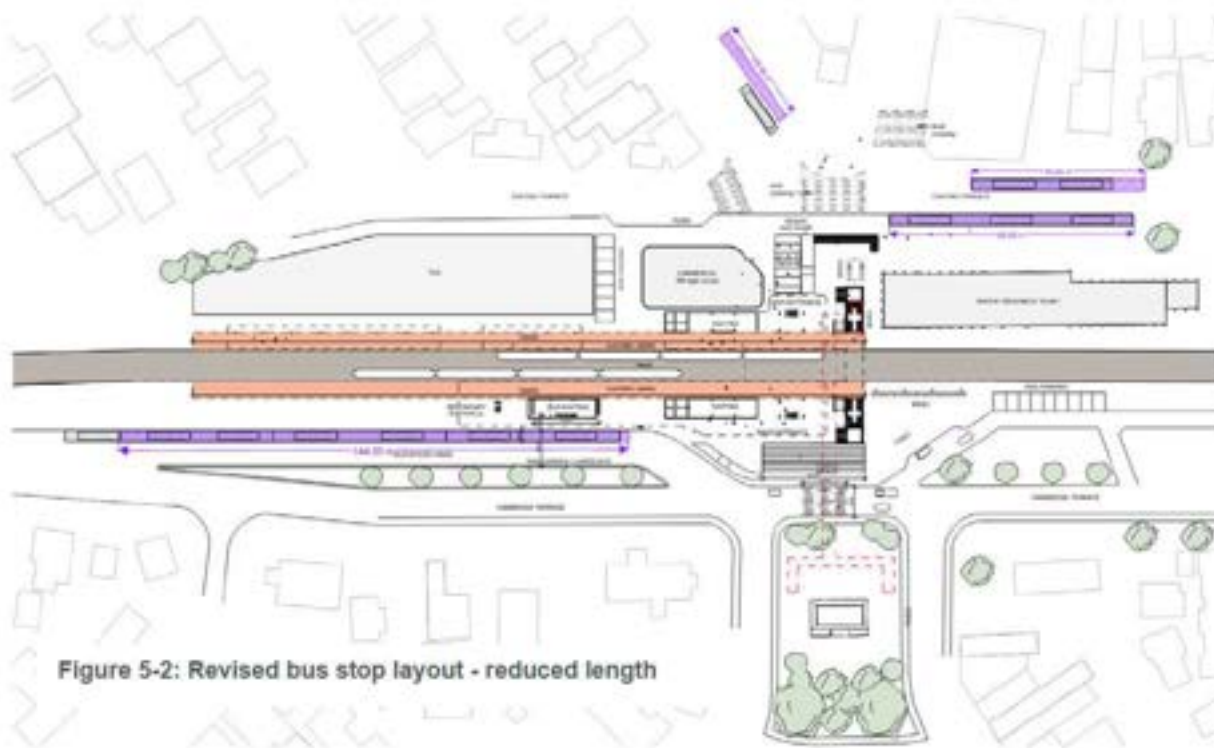


Figure 5-2: Revised bus stop layout - reduced length

Figure 4.2 illustrates the components of the revised layout:

- Stop A – 3rd stop (single) retained in existing location on Knights Road.
- Double stop increased in length to match requirements
- Stop C and D - two double bus bays (44m each)
- Stop R - One triple bus bay (55m) to accommodate for the rail replacement services
- Removed the 9m entry taper for Stop R
- Removed 5m exit tapers between route groups to maximise effective use of constrained space.
- Removed 5m exit taper at the head of stop of Stop C.

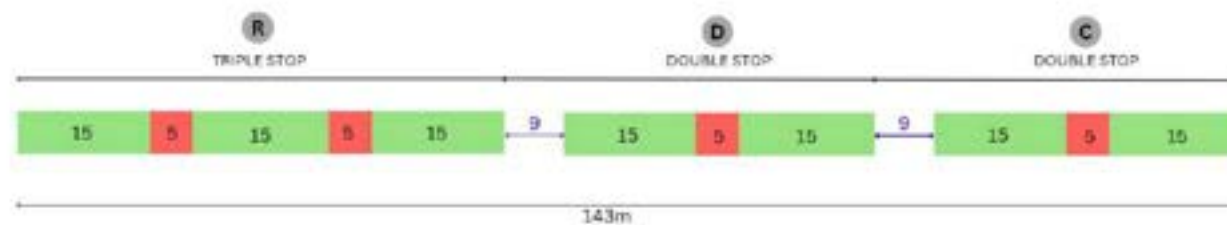


Figure 5-3: Schematic illustration of bus stop configuration

5.2 Pedestrian Crossings

All pedestrian crossings included in the Reference Design are assumed to be raised and designed in accordance with NZTA and Hutt City Council's design standards. As the detail needs to be worked through with Hutt City Council, the nature of the crossings shown in the Reference Design are indicative only and subject to design development.

While the revised crossings have not been developed in detail – the revised design should include similar safety features to maintain and/or improve on the existing layout.

One of the key client requirements is to prioritise pedestrian access and connections to the surrounding community via walking and cycling networks, with pedestrians given priority at all crossings. The two proposed pedestrian crossings cross a wide traffic lane (13m and 10m) so the pedestrian refuges need to be retained in the Reference Design.

The existing pedestrian crossings on Oxford Terrace includes pedestrian refuge islands and the intention is to retain those, noting that the dog leg / staggered crossing will be converted to a two-stage straight across crossing. Raising the crossings will further slow vehicles and visually prioritise pedestrian movements across access roads. It is noted Oxford Terrace and Cambridge Terrace are both bus routes, the raised crossings will be design in accordance with NZTA's Pedestrian Network Guidance².

Please see **Appendix B** (Waterloo Station – Pedestrian Crossings Design Note) for further detail on pedestrian crossing facilities.

5.3 PUDO Arrangements

The new PUDO bays on the northwestern side of the station are in close proximity to the two pedestrian crossings in the same area. Westbound vehicles traveling along Oxford Terrace to access these bays risk queuing back into the second pedestrian crossing if pedestrians are present at the westernmost crossing.

This situation also complicates right-turn movements from Knights Road onto Oxford Terrace when vehicles are already queued between the two crossings. Consequently, this may cause additional queuing along Knights Road for those waiting to turn right so further refinement is needed during the next stage of design development to optimise the PUDO facility.

To address these issues, further refinement of the northwestern PUDO bay location and the pedestrian crossing layout is necessary. One potential solution is to reduce the width of the first pedestrian crossing encountered

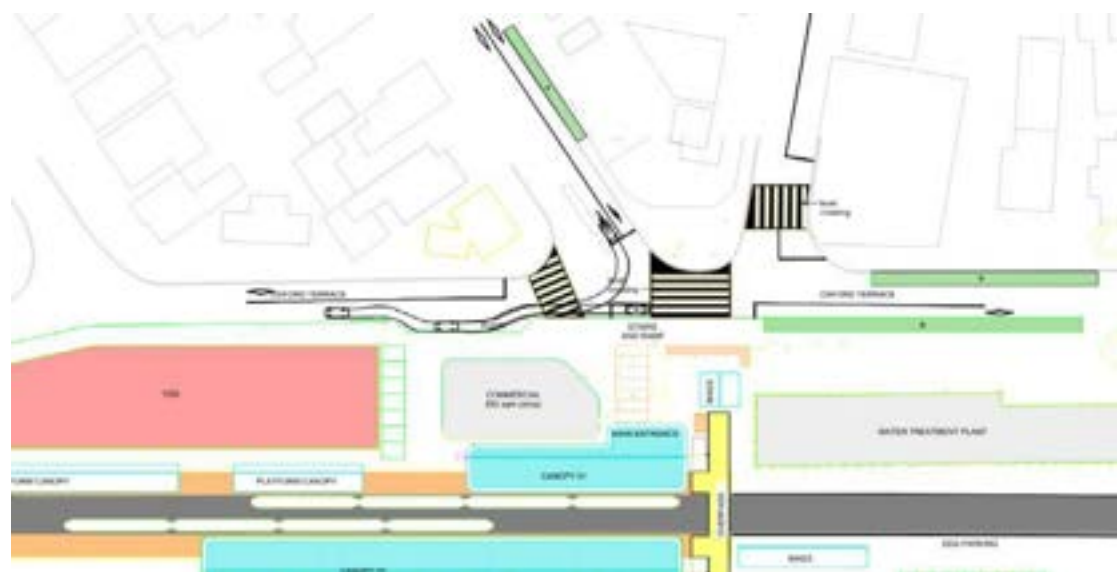


Figure 5-4: Oxford Terrace pedestrian crossing and PUDO interface

when traveling southbound, to increase the distance between the first and second crossings and improve traffic flow.

The PUDO facility on the northeast side of the station operates as a one-way circulation system. Due to its design and accessibility constraints, right-turn movements into the PUDO from Cambridge Terrace are either restricted or prohibited; therefore, it is recommended that access be limited to left turns only.

The introduction of the proposed pedestrian crossings will remove the existing southbound drop-off bays, which may create safety concerns related to on-street pick-ups and drop-offs.

Additional analysis and design refinement will be necessary to finalise the PUDO operations and explore potential options for accommodating southbound PUDO facilities.

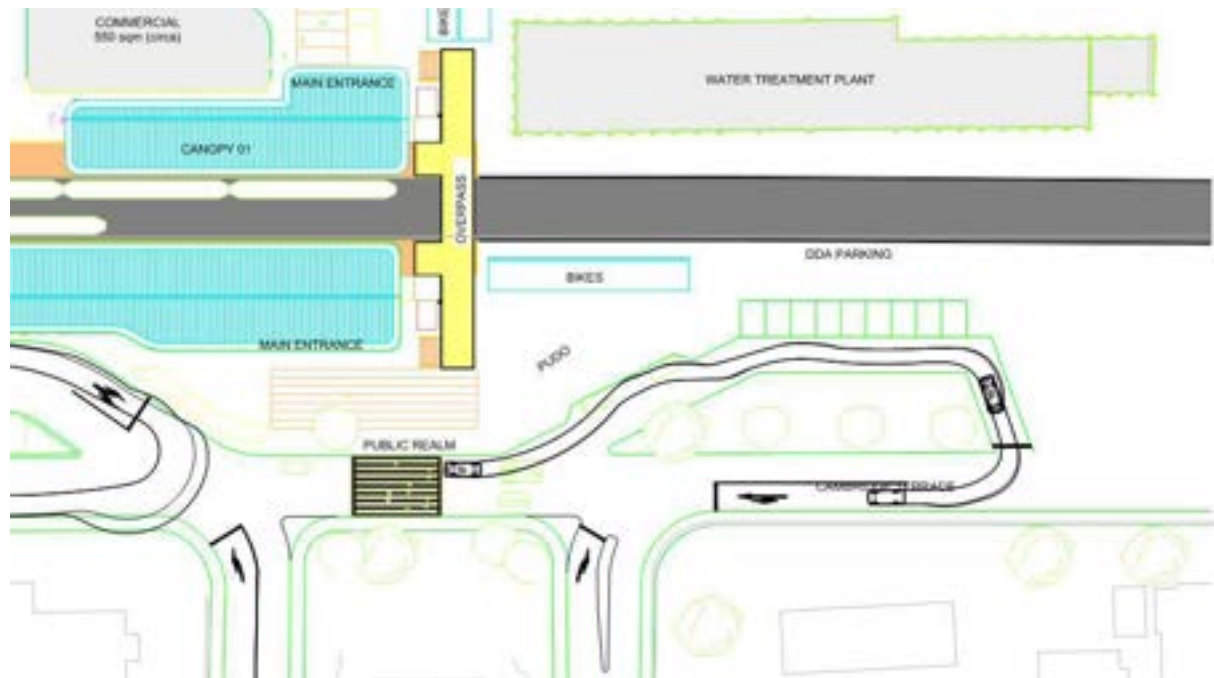


Figure 5-5: Cambridge Terrace PUDO arrangement

5.4 Wider Network / Local Road Impacts

Further assessment of local road and network impacts will be required in the next design stage to ensure the station integrates effectively with its wider context. Key areas of investigation include:

- **Network Assessment** – Review of surrounding street functions and access arrangements, including implications for Waterloo and Cambridge Terraces.

- **Modelling** – Local traffic modelling to test access scenarios, intersection performance, and multimodal demand under future growth.
- **Signal Phasing Design** – Assessment of traffic signal timing changes, particularly at Cambridge Terrace, to support increased pedestrian flows and safe crossing.
- **Network Impact Assessment** – Identification of wider network effects, including safety, congestion, and operational risks, to inform mitigation strategies.

These investigations will support a balanced and resilient multimodal network as the precinct intensifies.

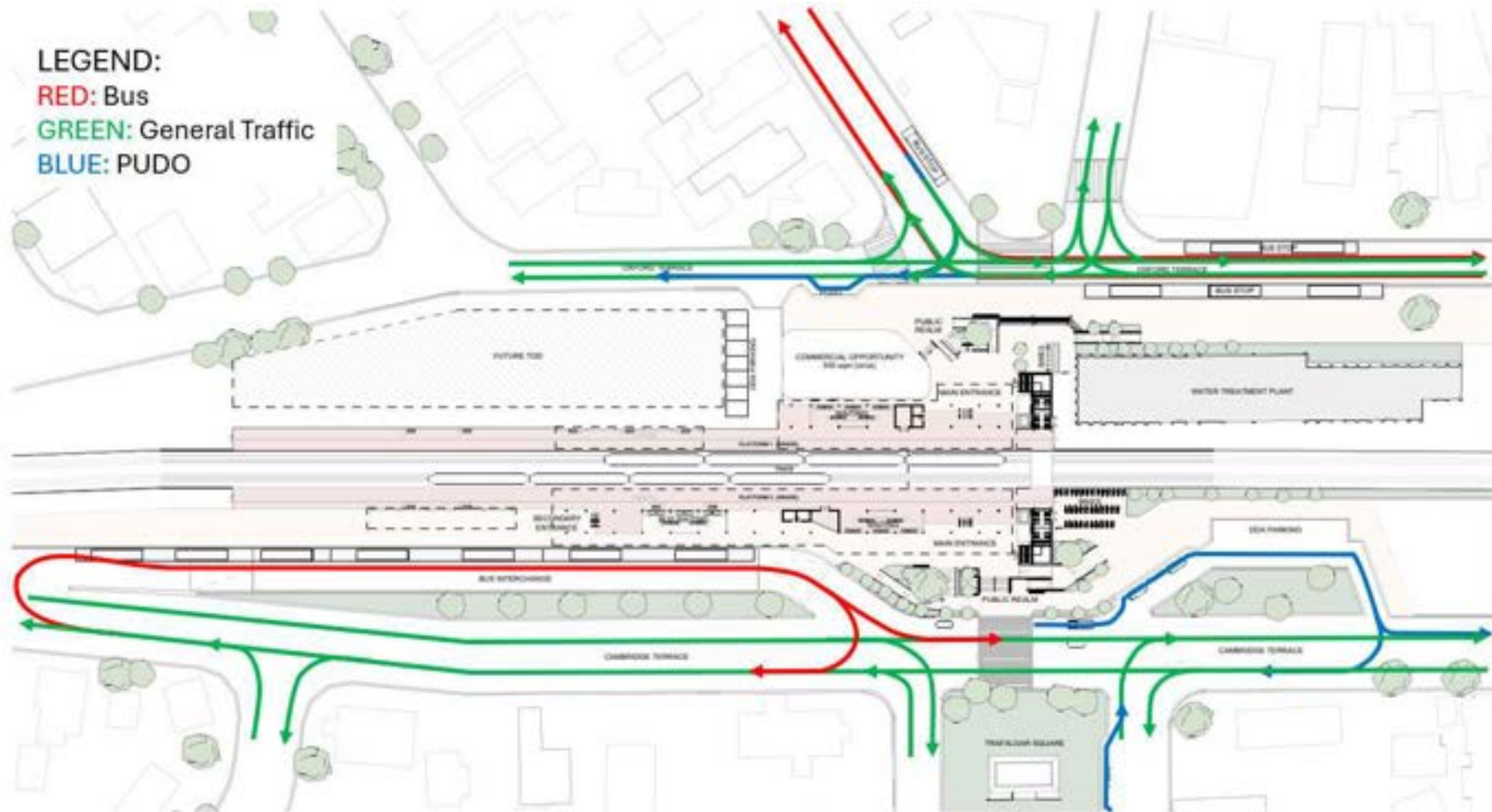


Figure 5-6: Required bus / general traffic / PUDO movements

6 Accessibility, Safety and Customer Experience

The Reference Design embeds accessibility and legibility as foundational design principles, ensuring Waterloo Station functions as an inclusive public space that supports people of all ages, abilities, and journey purposes. The station is designed to be easy to use - not just compliant - with a focus on creating intuitive, safe, and dignified journeys across all access modes.

The approach reflects the values of universal design and responds directly to Wellington region priorities for equitable access, social inclusion, and customer experience uplift. By combining robust technical standards with human-centred thinking, The Reference Design positions accessibility not as a constraint but as a driver of quality and performance.

Key elements of the design include:

- **Universal access across all station elements**

All entries, platforms, vertical circulation elements, and bus interchange facilities are designed to meet or exceed the requirements of NZS4121 and international universal design best practice. Step-free access is provided throughout, supported by lifts, tactile surfaces, and gentle gradients to support people using wheelchairs, mobility aids, or prams.

- **High-quality lighting and clear sightlines**

Lighting design ensures uniform coverage and minimises shadows and glare, enhancing perceptions of personal safety during early morning, evening, and off-peak travel. Visual transparency and open sightlines improve navigation and comfort, particularly for women, older people, and those travelling alone.

- **Consistent and intuitive wayfinding**

Wayfinding is integrated into the architecture and landscape, using Metlink brand standards to create a coherent, user-friendly experience across the precinct. Signage placement and language are designed for clarity and ease of comprehension, reducing reliance on prior knowledge or staff assistance.

- **Real-time information across modes**

Digital displays and audible announcements provide timely, reliable information for both rail and bus services. Information is positioned for easy viewing from key waiting areas and pedestrian paths, supporting seamless decision-making and reducing anxiety for users unfamiliar with the network or travelling under time pressure.

- **Well-located amenities for comfort and dignity**

Weather protection, seating, and public toilets (including accessible facilities) are placed where they are most needed - adjacent to platforms, entries, and bus stops. These elements support longer dwell times, enable rest for those who need it, and ensure the station is usable by all, regardless of physical condition or trip purpose.

The Reference Design transforms Waterloo Station into an interchange that is not only functional but welcoming, legible and inclusive. By embedding accessibility into every part of the design, it delivers a station experience that is easy to navigate, safe to use, and universally supportive - reflecting the values of equity, dignity, and customer focus that underpin a truly future-ready public transport network.

7 Constraints and Risk Management

7.1 Physical and Network Constraints

a. Platform Geometry and Alignment Constraints

The alignment of platforms (particularly in The Reference Design) requires physical realignment of Platform 2 to be consistent with Platform 1. While this improves wayfinding and station legibility, it imposes challenges related to:

- Impacts on the existing signal box and rail infrastructure.
- Potential disruption to rail operations during construction.
- Confined corridor geometry limiting flexibility for overpass design and pedestrian landing zones.

b. Vertical Level Changes

Cambridge Terrace presents a notable level change (~9 metres) to the rail corridor, complicating direct pedestrian connections. Risk exists that without sensitive design integration, vertical circulation elements (e.g. lifts, stairs) could become inaccessible or act as barriers to multimodal transfer.

c. Rail Corridor Operating Environment

The station is located on a live rail corridor serving both the Hutt Valley and Wairarapa Lines. Risks include:

- Operational disruption during construction, especially where works interface with track, OLE (overhead line equipment), and signalling systems.
- Constrained construction windows due to network availability.
- Health and safety risks associated with working adjacent to operating rail infrastructure.

7.2 Demand Forecasting and Capacity Risks

a. Demand Uncertainty

Passenger demand is projected to grow significantly (up to 180% to 2061 under Sense Partners high growth scenario)

- Over or under-sizing of facilities leading to operational and investment inefficiencies.
- Mismatch between future service levels and platform or vertical circulation capacity.
- Sensitivity to growth assumptions including TOD uptake, mode shift success, and macroeconomic factors.

b. Station Sizing Constraints

Static pedestrian modelling has identified minimum clear widths for platforms (5.0 m), stairs, and passageways. Risks include:

- Constraints in achieving these dimensions due to site boundaries, spatial competition with bus interchange and commercial elements.
- Potential congestion at key vertical circulation points (e.g. lifts, stairs), particularly in peak 15-minute periods. Dynamic pedestrian modelling can be undertaken at the next stage of design development to better understand this risk.
- Should overpass stair clear width be increased beyond 4.0 m a central handrail will be required which will further increase the overall stair width.
- Impact of non-rail pedestrian demand not included in the overpass sizing assessment.

8 Rail Standards and Operations

The Reference Design features aligned, upgraded platforms with level boarding. Platform realignment enhances operational efficiency, improves passenger distribution, and enables phased construction.

8.1 Systems Engineering and Safety Assurance

The Waterloo Station project intends to make significant changes to the existing station and adjoining infrastructure through which this becomes a multifaceted and significant endeavour that integrates infrastructure, technology, services, and human interaction. A project-specific requirements set is recommended to be prepared for project.

A project requirements set serves as the foundational blueprint for any successful project, transforming initial ideas into a structured, actionable plan. It defines the “what,” “why,” and “how” of a project - outlining deliverables, establishing boundaries, and setting criteria for success. By clearly articulating both the scope and exclusions, it prevents scope creep and ensures a shared understanding among stakeholders. This alignment fosters consensus and purposeful work by tying project activities directly to strategic objectives. As a guiding document, the requirements set informs every aspect of design and development, reducing ambiguity and guesswork while enabling deliberate, traceable decisions. It also underpins effective planning and risk management by providing the basis for cost estimates, scheduling, and milestone tracking.

It defines success in measurable terms, forming the foundation for testing, quality assurance, and final acceptance. By capturing needs early and precisely, the requirements set helps prevent costly rework, uncovers issues early, and ultimately ensures that the delivered solution meets expectations. In short, it is the single most important tool for bringing clarity, alignment, and control to a project.

The project requirements set should be a part of a wider systems engineering effort to demonstrate compliance for operating intent and safety.

8.2 Rail-Corridor Impacts

At its core, the primary purpose of a train station is to serve as a gateway and interface between the railway system and the public, facilitating the movement of people. The scope of the project is primarily aimed at undertaking the significant modification of the existing station. The scope and level of the imposition of the changes to the core railway infrastructure must be determined such that adequate design and project management can be applied.

To assist with the imposition, a System Breakdown Structure (SBS) has been prepared (refer to section 8.6) which provides a categorisation of major station and station adjacent elements. Applicable elements are identified and form the preliminary basis upon which the details of this report are structured.

8.3 Impact on Rail Safety Case Impact

Both KiwiRail and the train operator (GWRC) will have a Safety Case in place. The proposed changes to the station will need to be assessed by the respective Safety Case holders for their impact on the assumptions and dependencies that underly these safety cases.

This consultation should be carried out at early in the design phase.

8.4 Transport Authority Standards & Guides

The Wellington regional transport authority, GWRC, were not identified to have a transport infrastructure guide for use in the design of the station.

For reference, Auckland Transport publish Technical Design Manual (TDM), and specifically, the engineering design code for Public Transport – Rail Infrastructure which applies specifically to Auckland Metro commuter railways. There may be an opportunity to leverage this TDM for design aspects of Waterloo Station.

8.5 KiwiRail Standards

Where the project interfaces or interacts with the rail corridor, the project will be required to undertake works commensurate with KiwiRail requirements.

The identification of applicable KiwiRail standards is proposed based on the proposed project SBS. The applicable standards should be agreed with KiwiRail.

The proposed applicable standards are described in section 8.6.

8.6 System Breakdown Structure

A System Breakdown Structure (SBS) is a hierarchical decomposition of a complex system into smaller, more manageable components, sub-systems, and individual elements. It visually represents the entire scope of a project, breaking down high-level functionalities into increasingly detailed and definable parts. Each level of the SBS typically represents a deliverable or a work package, providing a clear and comprehensive overview of all the elements required to complete the system.

An SBS is particularly useful to establish during the Reference Design stage as it facilitates a systematic and structured approach to planning and design. In terms of Waterloo Station, it serves two purposes, it supports with the structuring and allocation of requirement to station elements which in turn, assists with managing systems engineering processes and assurance activities. Secondly, it enables project teams to identify all necessary components, allocate responsibilities, estimate costs more accurately, and manage risks effectively. By providing a common framework for understanding the system, the SBS ensures that all stakeholders have a shared vision of the project's scope, preventing omissions and promoting efficient communication and coordination among various disciplines like civil engineering, electrical systems, signalling, and architectural design. This structured approach helps in defining interfaces between different sub-systems early on, streamlining the design process and laying a solid foundation for subsequent project phases.

Railway stations are complex systems with numerous interacting elements which must adequately perform in order to achieve the operating intent and safety. To support the development approach, an SBS for the Waterloo Station project has been prepared and as shown in Table 8-1.

When the project progresses, the SBS will be the basis for apportioning of requirements to system elements, this in turn will provide a means for undertaking verification and validation activities at the later stages of design and construction.

8.7 Track Alignment

In the first instance, the station modifications should endeavour to avoid impacting or need to modify the existing track alignment. The rationale being that process to move can be time and resource intensive. It is also not expected to be a significant amount of track alignment that would be required to achieve an improved alignment for the station redesign. However, the alignment at the southern end of the proposed station platforms is an issue. The added length places them into the track existing track radius. Whilst it is minimal, it will lead to a separation between the train vehicle and the platform edge for this region as the vehicle navigates the curve.

KiwiRail have a requirement within C-ST-PL-4109, section 6.4, that curved platforms should be avoided.

“New platforms should be constructed on straight track. Where conditions/service requirements necessitate platforms on curves, the design of each new curved platform must be developed in conjunction with the Operator and design approval sought from KiwiRail”.

The rationale being largely related to the PTI issues, and exposure to collision from derailed trains. The lower limit for platforms on the outside of track curves is 1350m, which the expectation is that this curve radius exceeds this value by a significant amount, though yet to be formally determined. Clarification should be sought from KiwiRail as to their willingness accept a curved platform end (noting that only a part of the platform would need to be a curve) within the design.

If this agreement is not able to be reached, the project will need to coordinate and liaise with KiwiRail to agree to the design for realignment of track at the southern end, in order to achieve a straight alignment.

8.8 Traction Power Impact

An overhead line equipment (OLE) designer, Ralph Moulang (Aurecon) was consulted in order to provide early design input into what needs to be considered early in the design. A variable, as identified in section 8.7, is whether the track alignment will need to be modified through the station. The Traction OLE system needs to follow the track alignment and maintain stagger arrangements accordingly.

If the track alignment remains as is, the imposition on the OLE is minimised. However, if the track is realigned, then the OLE will need to be adjusted. The OLE designer advised that the current OLE masts were installed circa 2015/16 and have the ability to accommodate movement of the OLE wire without needing to change or upgrade the supporting structures, though this will be assessed and confirmed in concept design.

Regardless of whether the OLE is modified, is the clearance requirements of the OLE structures with overhead structures. KiwiRail standards, require install heights to be at 4800mm, and a 300mm clearance margin. The caveat with this however, is that the as-built current OLE arrangements at the site need to be confirmed. KiwiRail have been approached to provide the current as-built information, so that the pedestrian overbridge design can be adequately informed.

Please note that the Wellington Electrified Area (WEA) uses a DC electrical system for traction power. This does have an influence on the electrical design of railway structures, particularly around the earthing and bonding arrangement that are adopted within the structures.

8.9 Signalling Design

Within the station, and within the scope of works is an existing signalling hut. This will need to be moved to alternative point. This will need to be agreed with KiwiRail.

Where the signalling hut is relocated, the interconnections and routing for the signalling will need to be modified. The impact and scope of this should be assessed early and must be done in consultation with KiwiRail who will in turn, should consult Siemens who are the contracted party for the signalling design.

The repositioning of the platforms will modify the stopping locations for train at the station. The signalling design will need to be updated regardless of whether the alignment is modified or not. Siemens, as contracted by KiwiRail will be responsible for implementing the final changes into the signalling control system, noting the distinction between the physical equipment and the software-based control systems and software. The Signal Sighting Committee must be consulted early to confirm suitability of wayside signal locations.

There is a possibility that derogations exist at the site for the underground signalling routings. Caution should be applied to review whether a difference exists between the 'as-built' information and actual physical install location.

8.10 Platforms

According to the KiwiRail Property GIS, the existing platforms are owned by KiwiRail. Any modifications to these platforms should be with the permission of KiwiRail. In addition, the eventual ownership of the completed platforms should be agreed.

The proposed platform design is the result of a necessity to avoid conflict between the existing water treatment plant, which is located at the north. The proposed platform design is also the result of a necessity to balance the spatial requirements on either side of the alignment, and the functions the station is expected to provide (e.g., intermodal connections, etc.).

As discussed in section 8.7, due to the platform lengths being proposed, the platforms will encroach into the track curve at the southern end. As previously mentioned, agreement from KiwiRail to implement partial platform curves should be received.

The platform coping edges are an important aspect of the platform design as they are the direct interface between the train vehicle and the platform. The current intent is to comply with the requirements provided in C-ST-PL-4109, which identifies the clearance requirements, and the layout of edge markings, which comprises a 300mm wide white painted line along the platform edge, with TGSI, at a minimum of 1200mm from platform edge; and printed in yellow "Wait behind this line until train has stopped". This edge arrangement should be confirmed with KiwiRail. Note also that the coping edge design should be consistent with other stations along the network to ensure familiarity by rail users.

8.11 Pedestrian Bridge

The proposed pedestrian bridge will need to comply with the KiwiRail clearance requirements for structures next to the rail corridor.

Per section 8.8, the pedestrian bridge will also need to comply with the traction power system requirements.

8.12 Existing Underpass

Under the proposed design, the existing underpass which provides a grade separated means for getting across the rail corridor, would be replaced by the pedestrian bridge.

A decision will need to be made around what is to happen to the structure. There is an opportunity to repurpose it to be an undertrack crossing for station services. If this opportunity is not availed, a decision would need to be made around whether it would be to sustain it as is though without general access, or whether it is abandoned. If the decision is to abandon it, a decision would need to be made as to whether to backfill it or to remove it. An unmaintained subterranean asset poses a structural failure hazard to the track formation above. This decision should be made in consultation with KiwiRail.

Table 8-1: Proposed Station SBS

SBS L1 ID	SBS L1	SBS L2 ID	SBS L2	App.	Description	KiwiRail Standards	
SBS-1	Rail Vehicles			N/A			N/A
SBS-1	Rail Vehicles	SBS-1.1	Commuter & Passenger Trains	N/A		N/A	
SBS-1	Rail Vehicles	SBS-1.2	Freight Train	N/A			N/A
SBS-1	Rail Vehicles	SBS-1.3	Trailer Vehicle Subsystems	N/A		N/A	
SBS-1	Rail Vehicles	SBS-1.4	Engineering Vehicle Subsystems (EVSs)	N/A			N/A
SBS-2	Railway Operations, Management, & Control			N/A		N/A	
SBS-2	Railway Operations, Management, & Control	SBS-2.1	Automatic Train Protection	N/A			N/A
SBS-2	Railway Operations, Management, & Control	SBS-2.2	Automatic Train Operation	N/A		N/A	
SBS-2	Railway Operations, Management, & Control	SBS-2.3	Automatic Train Supervision	N/A			N/A
SBS-2	Railway Operations, Management, & Control	SBS-2.4	Automatic Despatch	N/A		N/A	
SBS-2	Railway Operations, Management, & Control	SBS-2.5	Operations and Management	N/A			N/A
SBS-3	Railway Infrastructure			N/A			
SBS-3	Railway Infrastructure	SBS-3.1	Ground System (including track substructures)	App.		Applicable to track formation, track drainage etc.	C-ST-FO-4110 Formation
SBS-3	Railway Infrastructure	SBS-3.2	Track System (including Trackwork Equipment)	App.	Applicable to all track superstructure.	T-ST-DE-5200 Track Design T-ST-AM-5400 T200 Network Engineering Track Handbook T-ST-DE-5212 Clearances C-ST-CD-4102 Corridor Drainage	
SBS-3	Railway Infrastructure	SBS-3.3	Signalling Systems & Infrastructure	App.		Applicable to signal equipment, structures and routing	T-ST-DE-5212 Clearances
SBS-3	Railway Infrastructure	SBS-3.4	Traction Power Systems Overhead Lines Equipment	App.	Applicable to OLE structures, Catenary wire system, power distribution networks.	E-SP-WE-61330 WEA Traction Overhead Design Specification E-ST-WE-0137 WEA DC Protection E-ST-WE-0115 WEA Earthing _ Bonding Design E-ST-WE-0114 WEA Asset Manual T-ST-DE-5212 Clearances	
SBS-3	Railway Infrastructure	SBS-3.5	Rail Level Crossings	N/A			

SBS L1 ID	SBS L1	SBS L2 ID	SBS L2	App.	Description	KiwiRail Standards	
SBS-3	Railway Infrastructure	SBS-3.6	Tunnels (train)	N/A			
SBS-3	Railway Infrastructure	SBS-3.7	Tunnels (Road-Under-Rail)	N/A			
SBS-3	Railway Infrastructure	SBS-3.8	Underpass (Pedestrian)	App.	Applicable to the existing pedestrian underpass	B-PR-GE-3011 Structure Principles	
SBS-3	Railway Infrastructure	SBS-3.9	Pedestrian Bridges	App.		Applicable if an above-grade pedestrian crossing is introduced.	T-ST-DE-5212 Clearances B-PR-GE-3011 Structure Principles
SBS-3	Railway Infrastructure	SBS-3.10	Road-over-Rail Bridges	N/A			
SBS-3	Railway Infrastructure	SBS-3.11	Rail-under-Road Bridge (Underpass)	N/A			
SBS-3	Railway Infrastructure	SBS-3.12	Rail Bridges	N/A			
SBS-3	Railway Infrastructure	SBS-3.13	Barriers (Protective), Barriers (Noise), Fencing,	N/A			
SBS-3	Railway Infrastructure	SBS-3.14	Earth Retention Systems	N/A			
SBS-3	Railway Infrastructure	SBS-3.15	Wayside Structures (Including Natural Features, Formations, and Urban Realm)	App.		Applicable to fences and hedges. (no additional wayside structures identified).	T-ST-DE-5212 Clearances
SBS-3	Railway Infrastructure	SBS-3.16	Ventilation and Environmental Control Structures	N/A			
SBS-3	Railway Infrastructure	SBS-3.17	Networks, Services and Utilities (Traction/ Non-Traction) (Including Support Buildings and Structures)	App.		Nothing identified.	S-ST-CW-2140 Construction of Cable Duct Routes C-ST-CD-4102 Corridor Drainage C-SP-AE-64322 Installation of Utility Structures on Railway Land

SBS L1 ID	SBS L1	SBS L2 ID	SBS L2	App.	Description	KiwiRail Standards	
SBS-4	Railway Stations			APPL.	Applicable to station operational requirements (CONOPS, OPSCON etc.).		
SBS-4	Railway Stations	SBS-4.1	Station Buildings	N/A			
SBS-4	Railway Stations	SBS-4.2	Concourse	N/A			
SBS-4	Railway Stations	SBS-4.3	Platforms	App.		Applicable to platforms	C-ST-PL-4109 Passenger Platforms B-PR-GE-3011 Structure Principles T-ST-DE-5212 Clearances
SBS-4	Railway Stations	SBS-4.4	Retail & Commercial buildings	App.	Applicable to concession stands, leased building space within the station area.	None.	
SBS-4	Railway Stations	SBS-4.5	Intermodal Facilities - Bus Stations/ Terminals	App.		Applicable to the bus stops provided at the station.	None.
SBS-4	Railway Stations	SBS-4.6	Intermodal Facilities - Train Terminals (Other)	N/A			
SBS-4	Railway Stations	SBS-4.7	Intermodal Facilities - Parking Facilities	App.		Applicable to the public car parking space provided at the site.	None.
SBS-4	Railway Stations	SBS-4.8	Intermodal Facilities - Personal Mobility Systems	N/A			
SBS-5	Railway Facilities			N/A			
SBS-5	Railway Facilities	SBS-5.1	Yards	N/A			
SBS-5	Railway Facilities	SBS-5.2	Depots	N/A			
SBS-5	Railway Facilities	SBS-5.3	Freight Terminals (including Sidings)	N/A			
SBS-5	Railway Facilities	SBS-5.4	Train Control Operations Centre	N/A			
SBS-6	Civil Networks, Services, & Utilities			N/A			
SBS-6	Civil Networks, Services, & Utilities	SBS-6.1	Electrical Infrastructure (Utility) (including Structures)	N/A			
SBS-6	Civil Networks, Services, & Utilities	SBS-6.2	Gas Utilities	N/A			

SBS L1 ID	SBS L1	SBS L2 ID	SBS L2	App.	Description	KiwiRail Standards	
SBS-6	Civil Networks, Services, & Utilities	SBS-6.3	Lighting Installations	N/A			
SBS-6	Civil Networks, Services, & Utilities	SBS-6.4	Wastewater Utilities & Systems (including Structures)	N/A			
SBS-6	Civil Networks, Services, & Utilities	SBS-6.5	Stormwater Utilities & Systems (including Structures)	N/A			
SBS-6	Civil Networks, Services, & Utilities	SBS-6.6	Potable Water Utilities (including Structures)	App.	Applicable to Waterloo Water Treatment Plant.	None. Note: Should comply with the clearance requirements T-ST-DE-5212 Clearances	
SBS-6	Civil Networks, Services, & Utilities	SBS-6.7	Telecommunications Networks and Services (including Structures)	App.		Mobile service operators have existing infrastructure installed at the site.	None.
SBS-6	Civil Networks, Services, & Utilities	SBS-6.8	Services, Networks, Utilities & Routing (including Structures)	App.	Applicable to underground power, water, telephony services. (Note: to confirm what is present)	None.	
SBS-7	Civil Infrastructure			N/A			
SBS-7	Civil Infrastructure	SBS-7.1	Ground System	App.	Applicable to ground structures for non-rail corridor aspects.	N/A	
SBS-7	Civil Infrastructure	SBS-7.2	Ground Improvement System	N/A			
SBS-7	Civil Infrastructure	SBS-7.3	Earth Retention Systems	N/A			
SBS-7	Civil Infrastructure	SBS-7.4	Tunnels (Vehicle)	N/A			
SBS-7	Civil Infrastructure	SBS-7.5	Underpasses	N/A			
SBS-7	Civil Infrastructure	SBS-7.6	Pedestrian Bridges	N/A		The pedestrian bridge being included in design is considered as a rail pedestrian bridge due to its primary purpose being a grade separated crossing of the railway.	
SBS-7	Civil Infrastructure	SBS-7.7	Road Bridges (Road over Road, Road over Ground etc.)	N/A			
SBS-7	Civil Infrastructure	SBS-7.8	Barriers (protective), Barriers (noise), Fencing.	N/A			
SBS-7	Civil Infrastructure	SBS-7.9	Parks and Recreational Areas	N/A			
SBS-7	Civil Infrastructure	SBS-7.10	Landscaping and Urban Realm features	App.		Applicable to station area and interfaced area.	None.
SBS-8	Roads and Accessways			N/A			
SBS-8	Roads and Accessways	SBS-8.1	Accessways	App.		Applicable to the road vehicle movement routes within the station boundary.	
SBS-8	Roads and Accessways	SBS-8.2	Highways & Roadways	N/A			

SBS L1 ID	SBS L1	SBS L2 ID	SBS L2	App.	Description	KiwiRail Standards	
SBS-8	Roads and Accessways	SBS-8.3	Public Transport Systems	N/A			
SBS-8	Roads and Accessways	SBS-8.4	Pedestrian and Cycle Infrastructure	N/A			
SBS-10	Railside Civil Assets (non-rail or civil infrastructure-related)	N/A					
SBS-10	Railside Civil Assets (non-rail or civil infrastructure-related)	SBS-10.1	Building Structures - Large Commercial	N/A			
SBS-10	Railside Civil Assets (non-rail or civil infrastructure-related)	SBS-10.2	Buildings - Small Commercial	App.		Applicable to the station	None.
SBS-10	Railside Civil Assets (non-rail or civil infrastructure-related)	SBS-10.3	Buildings - Small Residential	N/A			
SBS-10	Railside Civil Assets (non-rail or civil infrastructure-related)	SBS-10.4	Buildings - Large Residential	N/A			
SBS-10	Railside Civil Assets (non-rail or civil infrastructure-related)	SBS-10.5	Building Structures - Utilities	N/A			
SBS-10	Railside Civil Assets (non-rail or civil infrastructure-related)	SBS-10.6	Open Area - Car Parking facilities (excluding multi-storey parking structures)	N/A		Covered by SBS-4.7 Intermodal Facilities - Parking Facilities	None.
SBS-10	Railside Civil Assets (non-rail or civil infrastructure-related)	SBS-10.7	Open area - Storage Area/ Facility	N/A			
SBS-10	Railside Civil Assets (non-rail or civil infrastructure-related)	SBS-10.8	Open area - Parkland	N/A			
SBS-10	Railside Civil Assets (non-rail or civil infrastructure-related)	SBS-10.9	Open Area - Other	N/A			
SBS-10	Railside Civil Assets (non-rail or civil infrastructure-related)	SBS-10.10	Other	N/A			

9 Summary of Key Findings

The Reference Design represents the optimal outcome for Waterloo Station when assessed through a multimodal, integrated network lens. It performs most strongly against the project's strategic objectives by enabling mode shift, enhancing network legibility and accessibility, and supporting future urban form through Transit Oriented Development (TOD).

A Seamless, Legible Multimodal Interchange

From a network planning perspective, the Reference Design delivers the highest level of service for passengers through an aligned platform configuration, enabling intuitive and legible movement through the station. The simplification of vertical circulation elements - via a short overbridge and surface-level pedestrian crossing - creates clear desire-line alignment between bus stops, entrances and platforms. These connections minimise interchange times and reduce system friction for transfers between bus and rail modes, directly supporting patronage growth.

The design is structured to accommodate growing complexity in user journeys, including those involving walking, cycling, micromobility, and on-demand services. The Reference Design supports Metlink's station hierarchy and Greater Wellington's access prioritisation framework, positioning Waterloo as a true modal hub for Lower Hutt.

Supports Mode Shift and Urban Integration

The Reference Design supports mode shift objectives by co-locating upgraded bus facilities directly adjacent to the primary station entrance, reducing first/last mile barriers and enabling fast, convenient transfers. The eastern interchange is fully integrated into the station forecourt, while the western interchange is retained and enhanced to maintain operational flexibility. By reducing physical and cognitive effort associated with mode changes, The Reference Design reinforces public transport's competitiveness with private car travel - particularly for passengers from Wainuiomata, Naenae and Kelson, where seamless transfers are essential to viable network journeys.

Future-Ready and Scalable

The Reference Design is demand-led and appropriately futureproofed. Station sizing reflects high-growth scenarios informed by Sense Partners projections and tested through detailed static pedestrian modelling. The platform widths, vertical circulation, and validation infrastructure are specified to accommodate projected patronage in 2046 and 2061, while allowing for future upgrade pathways without major rebuild. This option preserves flexibility to accommodate changes in network operating patterns - such as Bus Replacing Train (BRT) operations or demand-responsive feeder services - providing resilience for future service models and changes in the way people travel.

Aligning Design with Rail Standards and Operational Requirements

The Reference Design for Waterloo Station establishes a robust foundation for implementation, balancing operational efficiency, rail integration, and system assurance requirements. While the design achieves key outcomes such as aligned platforms and compact interchange layout, it also introduces significant interface complexities with the rail corridor. A suite of further technical work is clearly understood, including the development of a project-specific requirements set, systems engineering processes, and early consultation with KiwiRail on signalling, safety case variation, track alignment, traction power, and platform geometry. These activities will be critical to managing delivery risks, ensuring compliance, and progressing confidently toward a buildable, consentable and certifiable design solution.

The Next Steps are Well Understood

Several aspects of the station access and interchange design require further refinement in collaboration with Hutt City Council, particularly where proposed changes affect the local road network. This includes the final location and configuration of on road bus stops. Similarly, the design of pedestrian crossings will be refined to align with council and NZTA standards.

In parallel, more detailed assessment is needed to confirm the wider traffic and network effects of the proposed changes. This includes signal phasing design (especially at Cambridge Terrace), and a network impact assessment to test safety, congestion, and multimodal integration to inform design refinement.

Appendix A

Forecast Demand Technical Memo

Memorandum

To	[REDACTED]	From	[REDACTED]
Copy	Emmet McElhatton	Reference	528886
Date	2025-07-17	Pages (including this page)	37
Subject	Waterloo Station Pedestrian Modelling Memo		

1 Introduction

To support the Waterloo Station feasibility study, static pedestrian modelling has been undertaken to inform initial station sizing and planning.

This memo details the sources of data, assumptions, limitations and exclusions, future year passenger demands development, the equations used, and the results of the static pedestrian modelling.

Static pedestrian modelling has been undertaken using passenger demand forecasts for a Design Year of 2046 (representing an indicative Rail Day One plus 15-years) and an Ultimate Design Year of 2061 (representing an indicative Rail Day One plus 30-years).

The memo includes an assessment of the preferred design option, Option 17, in terms of Level of Service performance of the proposed station element provisions over time (from Rail Day One to Rail Day One plus 30-years).

Note, numbers in this memo may not sum to the totals due to rounding.

2 Sources

Static pedestrian modelling has been informed by the reference documents and standards in Table 2.1.

Table 2.1 Reference documents

Document	Revision
Waterloo Transit Oriented Development – Public Transport Minimum Requirements	First Issue (10/04/2025)
Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure	Version 2
Design for Access and Mobility – Buildings and Associated Facilities	NZS 4121:2001
Metro Trains Melbourne – Stations and Public Precincts Standards – A1530	Version 5.0
Transport for New South Wales – Functional Spaces – Part 2 Stations – TS 04951.2:1.0	Version 1.0
Hong Kong MTR Corporation – New Works Design Standards Manual – Section 5 – Architecture and Station Planning	Revision A9
Waterloo B&A.xlsx	Version 1
Waterloo-Station-TOTO-15min_2024-03-11-to-2024-03-17 FIXED.xlsx	Version 2

3 Station layout

While the station layout has not been finalised, for the purpose of static pedestrian modelling a side platform arrangement has been assessed, with an indicative arrangement shown in Figure 3-1.

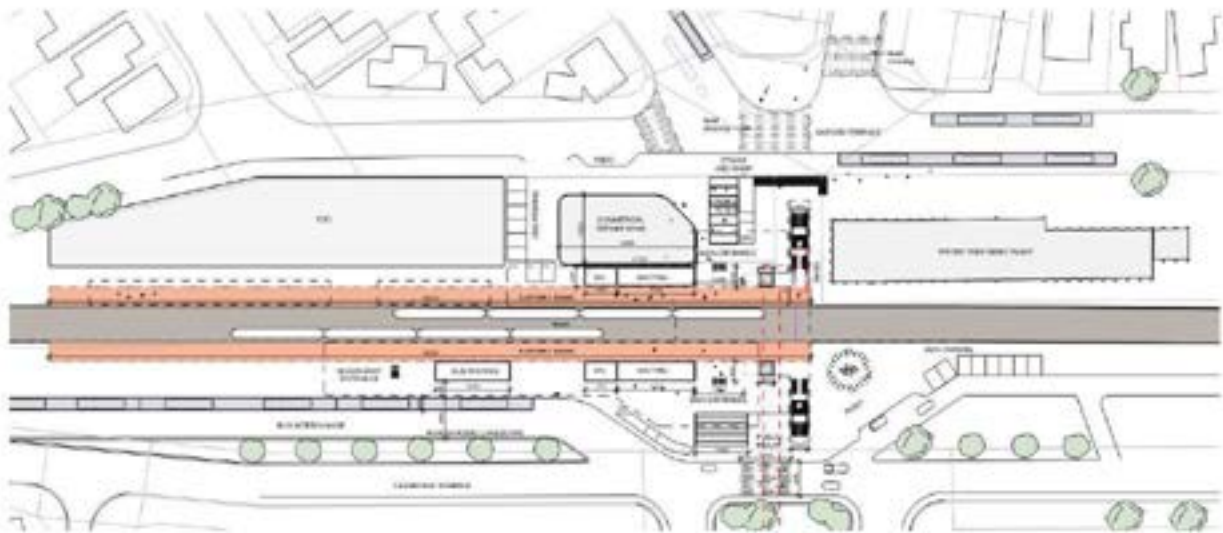


Figure 3-1 Indicative Waterloo Station side platform arrangement (Option 17)

4 Assumptions and data inputs

4.1 Assumptions

Assumptions adopted to undertake the static pedestrian modelling are provided in Table 4.1.

Table 4.1 Assumptions

Assumption	Value	Unit	Source
Peak 5-minute factor	0.4		Section 13 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Peak minute boarding factor	0.2		Section 2.2 - Waterloo Transit Oriented Development – Public Transport Minimum Requirements
Morning peak hour Hutt Valley Line train services	8	trains / hour / direction	Waterloo B&A
	7.5	minutes	
Morning peak hour Wairarapa Line train services	2	trains / hour / direction	Waterloo B&A
	30	minutes	
Evening peak hour Hutt Valley Line train services	8	trains / hour / direction	Waterloo B&A
	7.5	minutes	
	2	trains / hour / direction	Waterloo B&A

Assumption	Value	Unit	Source
Evening peak hour Wairarapa Line train services	30	minutes	
Hutt Valley Line alighting peak concentration	80	per cent	Section 2.2 - Waterloo Transit Oriented Development – Public Transport Minimum Requirements
Wairarapa Line alighting peak concentration	60	per cent	Section 2.2 - Waterloo Transit Oriented Development – Public Transport Minimum Requirements
Delayed service factor ¹	125	per cent	Section 2.2 - Waterloo Transit Oriented Development – Public Transport Minimum Requirements
Normal operation staircase flow rate	28	people / minute / metre	Table 15 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Degraded operation staircase flow rate	35	people / minute / metre	Table 15 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Staircase minimum clear width	1.2	m	Table 5 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Normal operation passageway flow rate	40	people / minute / metre	Table 15 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Degraded operation passageway flow rate	50	people / minute / metre	Table 15 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Passageway minimum clear width	1.8	m	Figure D10 – Design for Access and Mobility – Buildings and Associated Facilities – NZS 4121:2001
Snapper card gate flow rate	25	people / minute / scanner	Table 9 - Metro Trains Melbourne – Stations and Public Precincts Standards – A1530 Section 6.2.5 - Transport for New South Wales – Functional Spaces – Part 2 Stations – TS 04951.2:1.0
Snapper card gate redundancy	1	scanner (if less equal to or less than ten gates)	Section 14 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
	2	scanner (if greater than ten gates)	
Minimum Snapper card gate provision	3	Gates (per access point to the paid area)	Section 14 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Normal operation platform density	0.8	m ² / person	Table 15 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Degraded operation platform density	0.45	m ² / person	Table 15 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure

Assumption	Value	Unit	Source
Platform length	190	m	Section 2.6 - Waterloo Transit Oriented Development – Public Transport Minimum Requirements
Minimum platform width	5.0	m	Section 2.6 - Waterloo Transit Oriented Development – Public Transport Minimum Requirements
Platform distribution (Busiest quarter of platform)	35	per cent	Section 13 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Platform edge effect	1.0	m	Section 13 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Passageway edge effect	0.6	m	Section 14 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Cambridge Terrace (inbound) Station Forecourt Entrance split	17	per cent	Assumption
Cambridge Terrace (inbound) Entrance split	17	per cent	Assumption
Oxford Terrace (outbound) Entrance split	67	per cent	Assumption
Station entrance split uncertainty design factor	75	per cent	Clause 5.1.4.2 Hong Kong MTR Corporation – New Works Design Standards Manual – Section 5 – Architecture and Station Planning
1. The station elements have been designed to achieve the target flows rates for normal operation (i.e. achieving pedestrian level of service C) which does not account for a delayed service. The delayed services has been assessed based on the resultant widths for normal operation and checked against flow rates for degraded operation (i.e. achieving pedestrian level of service D).			

The station entrance split assumptions from Table 4.1 are show illustratively in Figure 4-1.



Figure 4-1 Waterloo Station assumed entrance splits

4.2 Existing passenger demand

Snapper data for 11 March to 17 March 2024 was analysed for the morning peak (06:00 to 09:00) and evening peak (15:00 to 18:00) to understand existing rail passenger demands and arrival / departure profiles for Waterloo Station.

March was adopted for the assessment as it represents the 'busy' month as shown in Figure 4-2 and is the month commonly used for Metlink service and investment planning

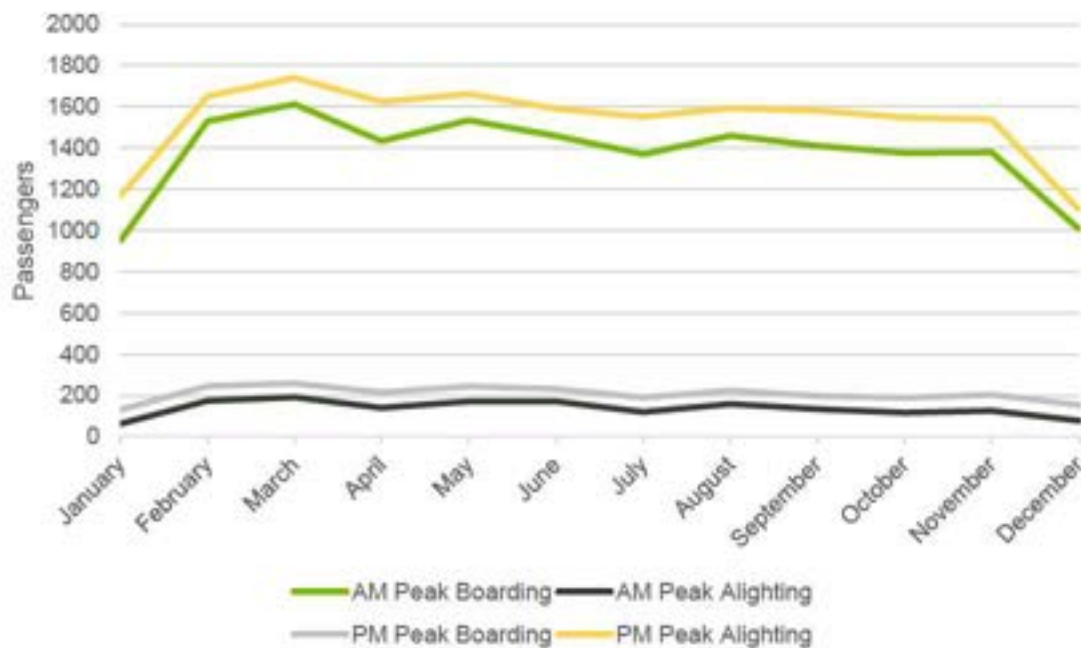


Figure 4-2 Waterloo Station year 2024 weekday daily average boarding and alighting volumes per month

Due to work from home behaviours, data for Monday and Friday was excluded from the assessment as the passenger demands were notably lower than other weekdays. In addition, weekend data was also excluded from the assessment due to lower passengers demands.

The average passenger boarding and alighting demands were therefore based on the data for Tuesday, Wednesday, and Thursday and separated by the Hutt Valley Line (HVL) and Wairarapa Line (WRL).

Passenger demands for the HVL are shown in Figure 4-3 and Figure 4-4, and passenger demands for the WRL are shown in Figure 4-5 and Figure 4-6. The data shows tidal passenger flows, with high inbound (towards Wellington CBD) in the morning and high outbound flows (away from Wellington CBD) in the evening. In addition, with the higher train frequency of the HVL (versus the WRL), the HVL receives most of the passenger demand.

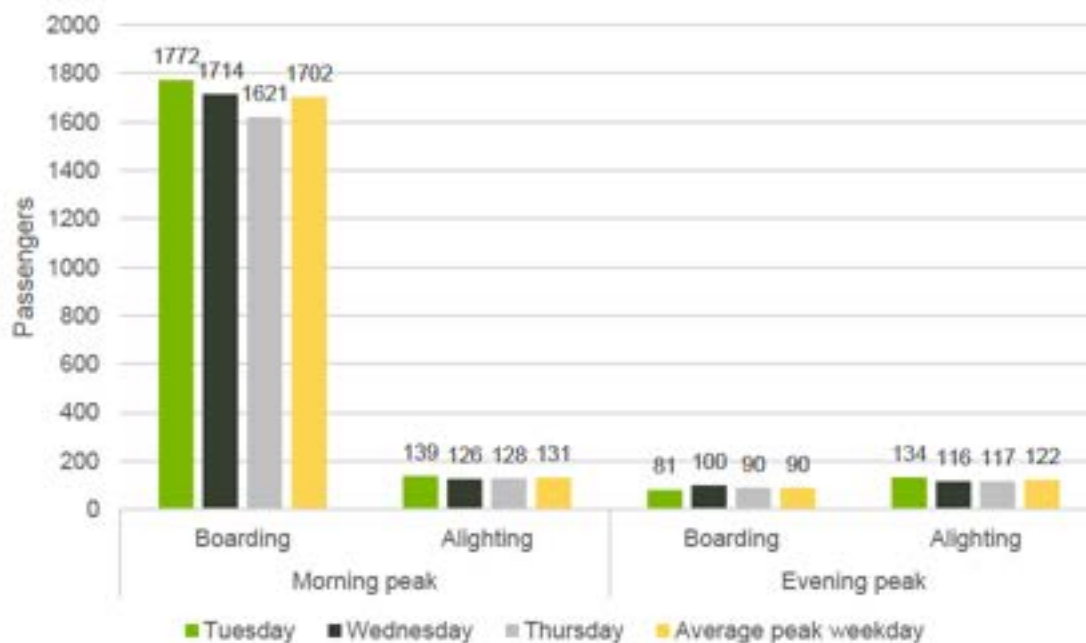


Figure 4-3 Hutt Valley Line (inbound) existing morning and evening 3-hour peak passenger demands

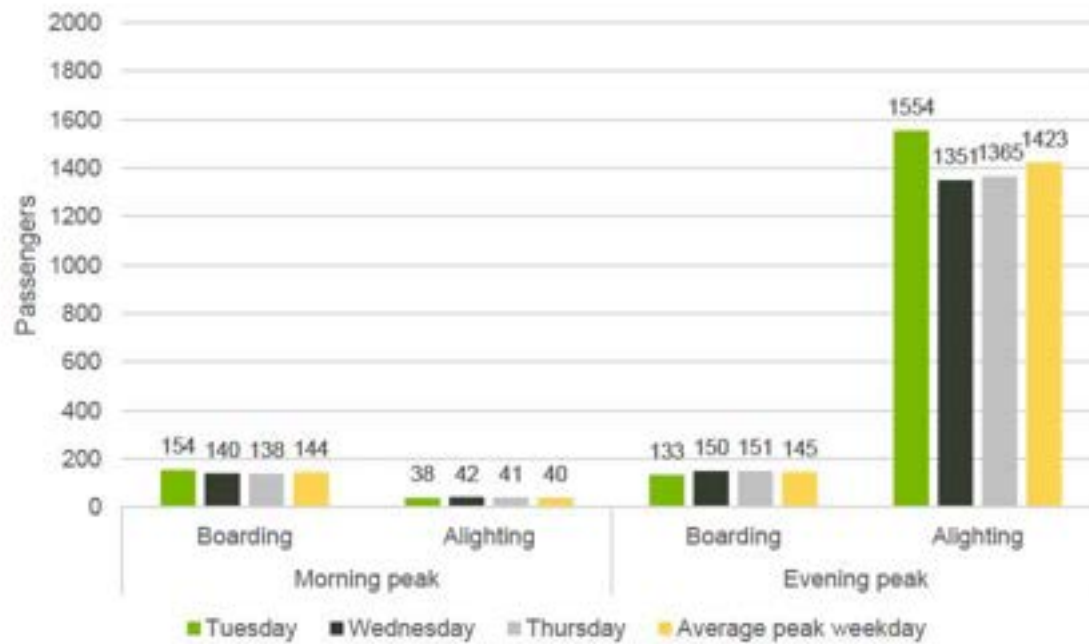


Figure 4-4 Hutt Valley Line (outbound) existing morning and evening 3-hour peak passenger demands

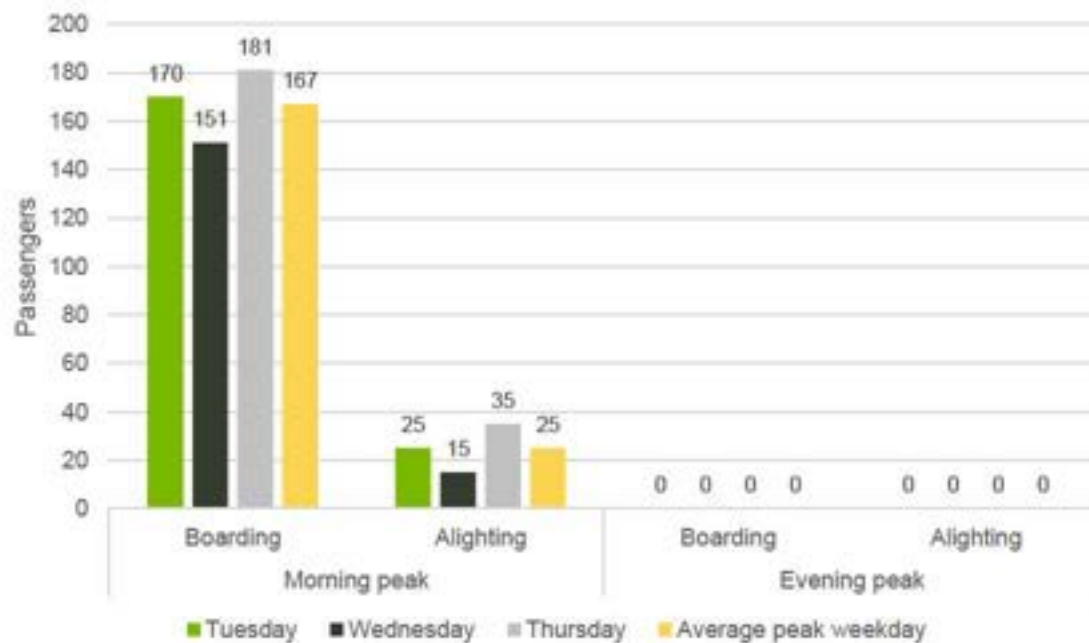


Figure 4-5 Wairarapa Line (inbound) existing morning and evening 3-hour peak passenger demands

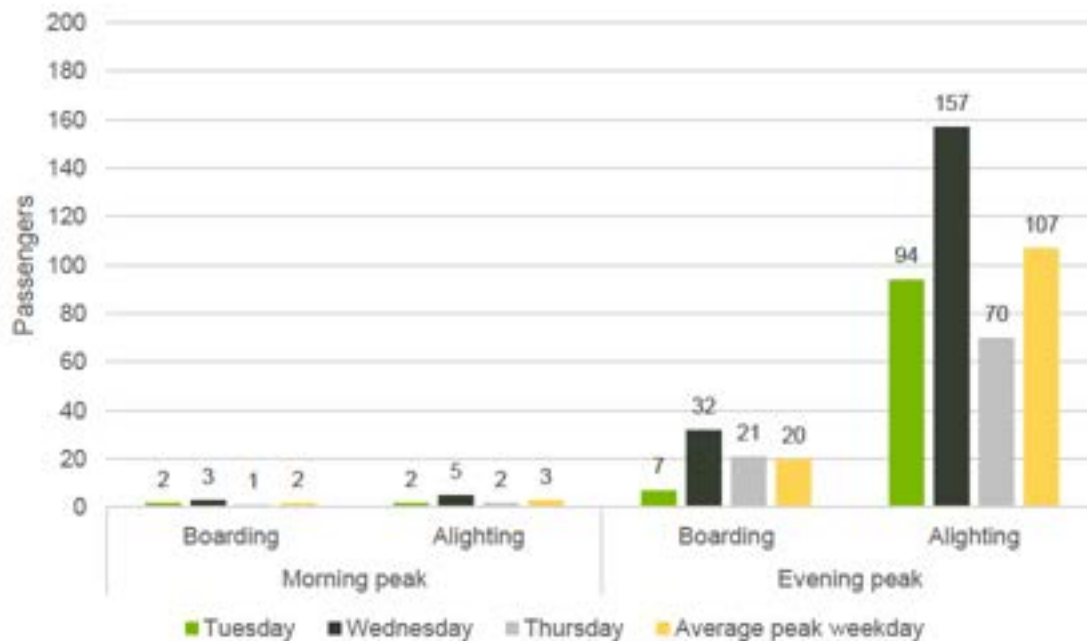


Figure 4-6 Wairarapa Line (outbound) existing morning and evening 3-hour peak passenger demands

4.2.1 Passenger demand distributions

The existing passenger demand distributions between the HVL and WRL for inbound and outbound services are shown in Table 4.2 and Table 4.3 for the morning and evening peaks respectively. The results show the majority of boarding and alighting in the morning peak to be to/from HVL inbound services. While for the evening peak the majority of boarding and alighting is to/from HVL outbound services.

These existing distributions were applied to the future passengers demands (see Section 4.2.2) due to the observed data being more suitable than using the modelled spits.

Table 4.2 Morning 3-hour peak passenger demand distributions

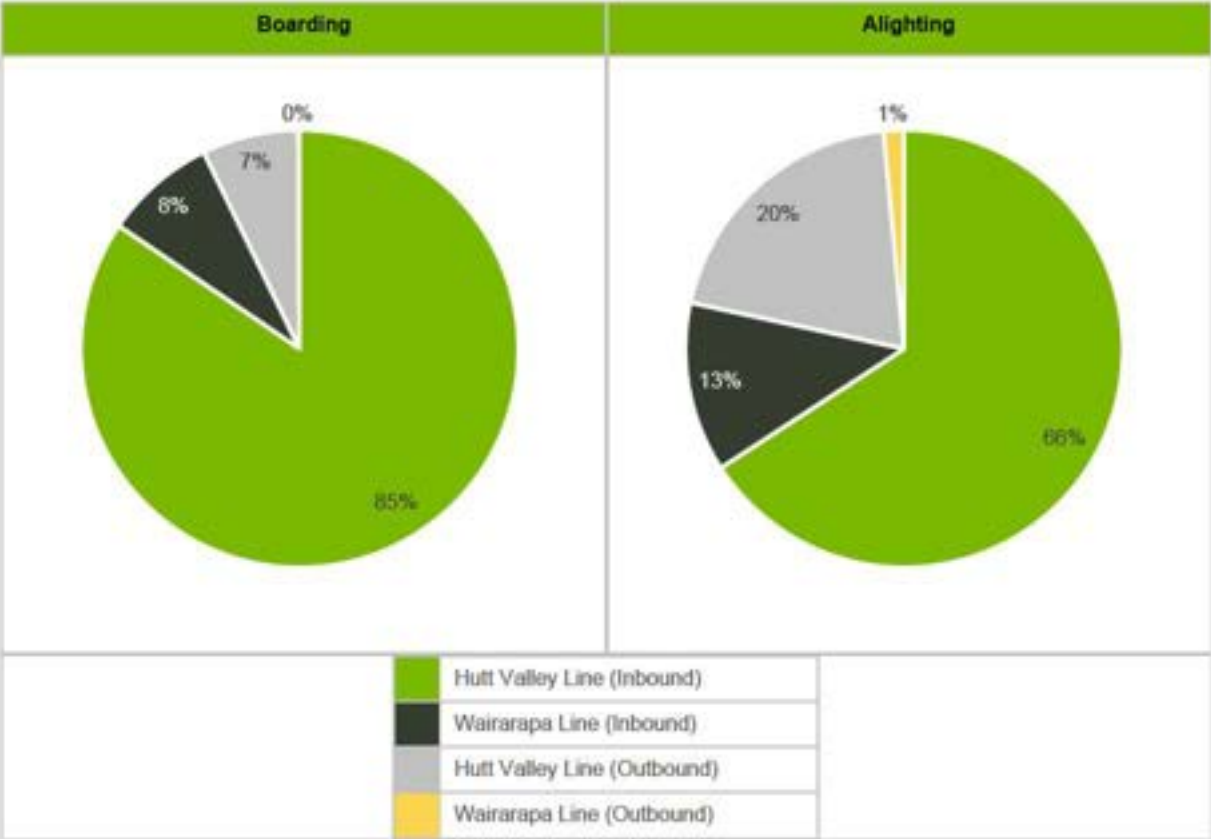
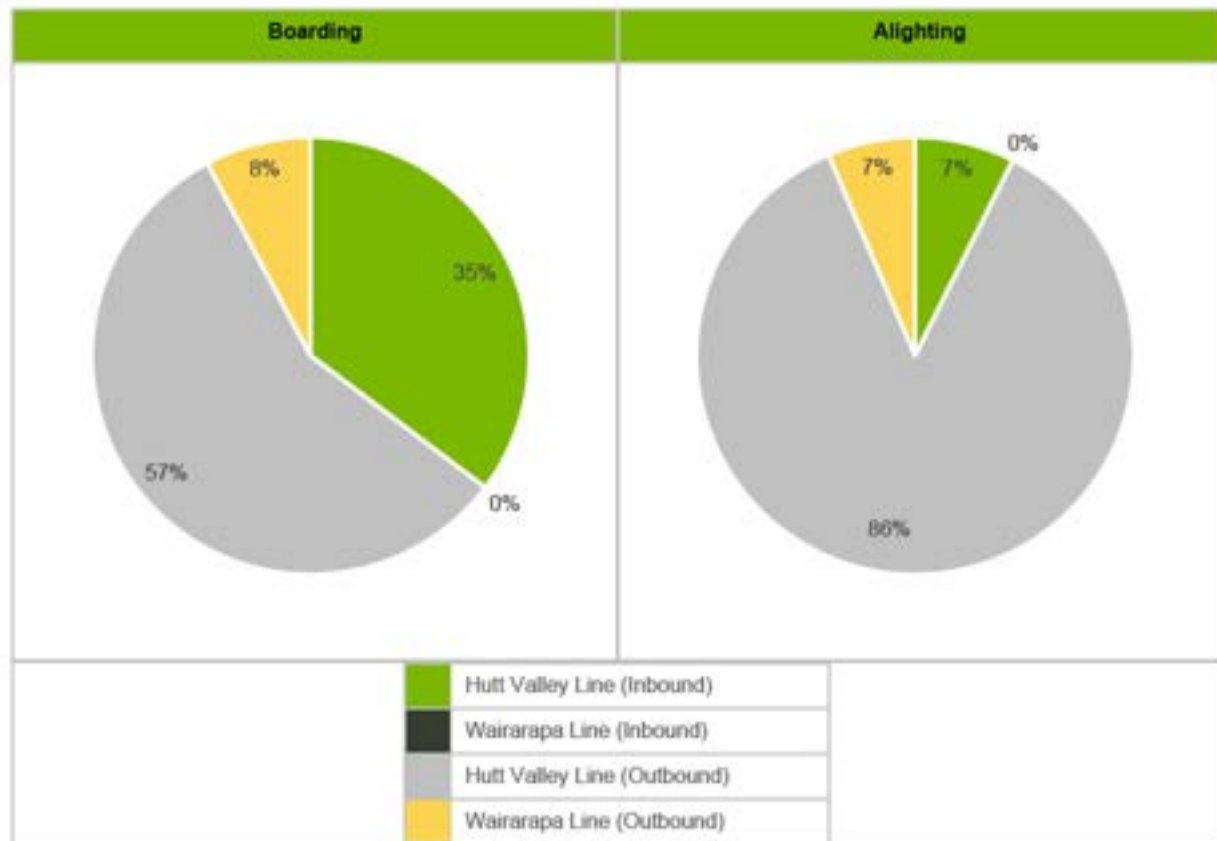


Table 4.3 Evening 3-hour peak passenger demand distributions



4.2.2 Passenger demand profiles

Passenger demand profiles were obtained from the existing Snapper data to understand the proportion of passengers across the morning and evening 3-hour time periods boarding and alighting train services in 15-minute intervals.

The existing profile was then applied to the future year data to identify the peak 15-minute boarding and alighting demands to undertake the static pedestrian modelling.

Hutt Valley Line

The HVL shows relatively even distribution of boarding demand throughout the morning and evening 3-hour periods with the typical peak 15-minute boarding demand representing approximately 18 per cent of the total 3-hour demand (see Figure 4-7 and Figure 4-9).

For alighting passenger profile, both the morning and evening peaks show clear spikes, likely correlating with the train timetable. The morning peak 15-minutes represents 36 per cent of the 3-hour alighting demand and the evening peak 15-minutes represents 23 per cent (see Figure 4-8 and Figure 4-10).

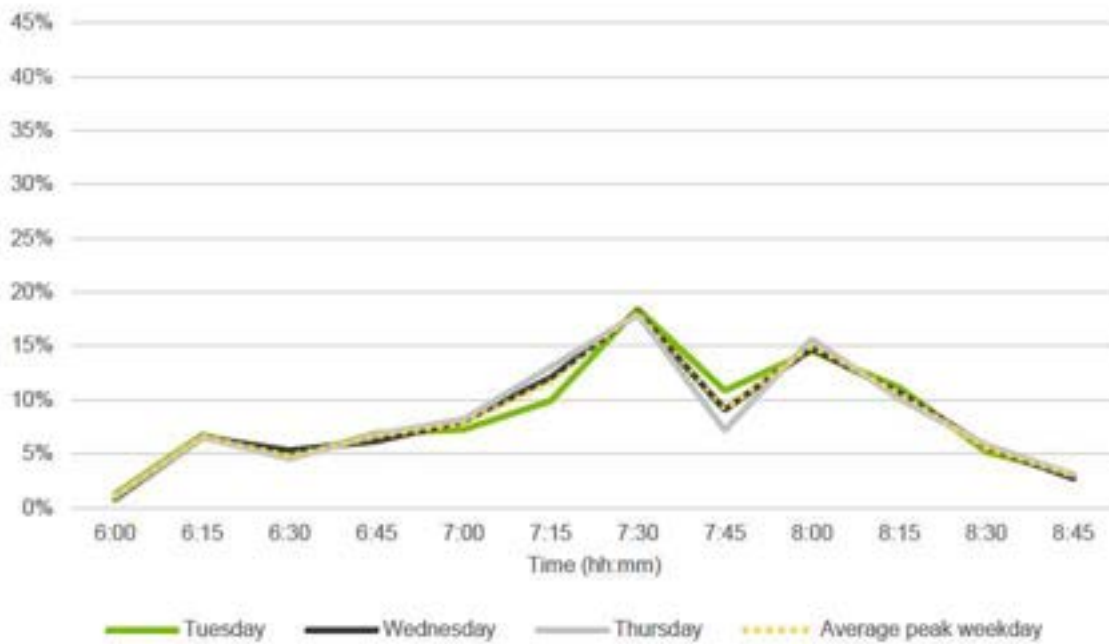


Figure 4-7 Hutt Valley Line morning peak passenger boarding profile

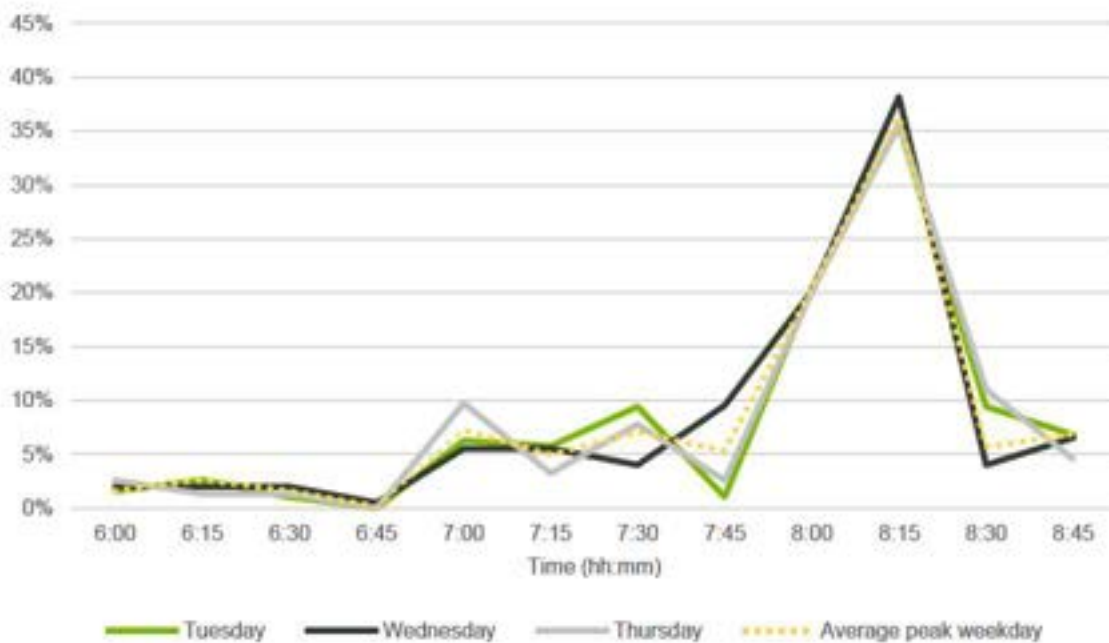


Figure 4-8 Hutt Valley Line morning peak passenger alighting profile

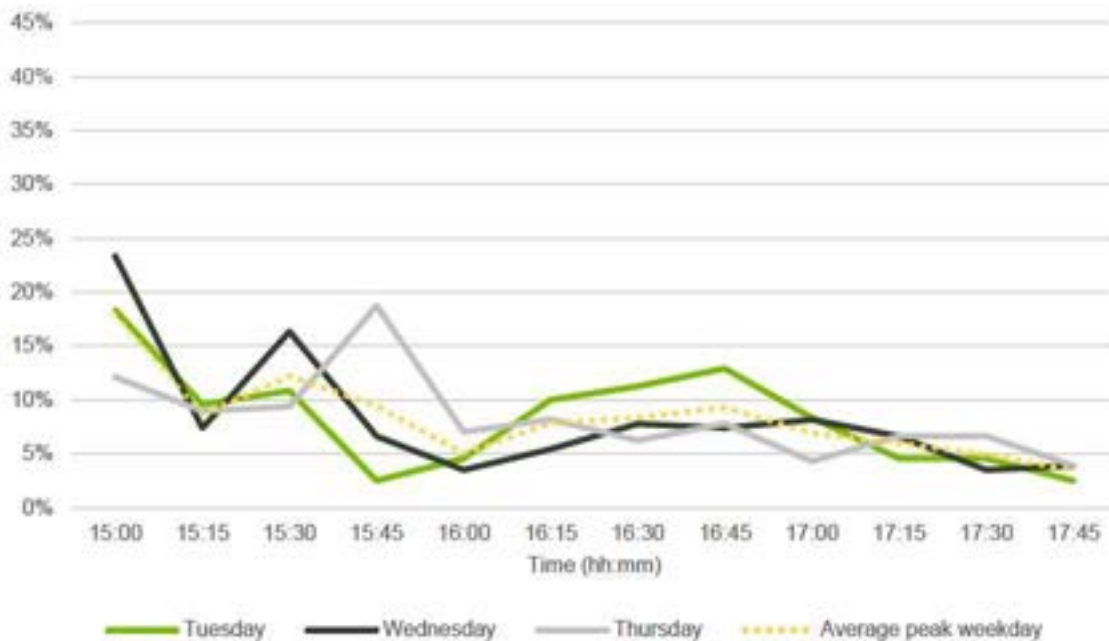


Figure 4-9 Hutt Valley Line evening peak passenger boarding profile

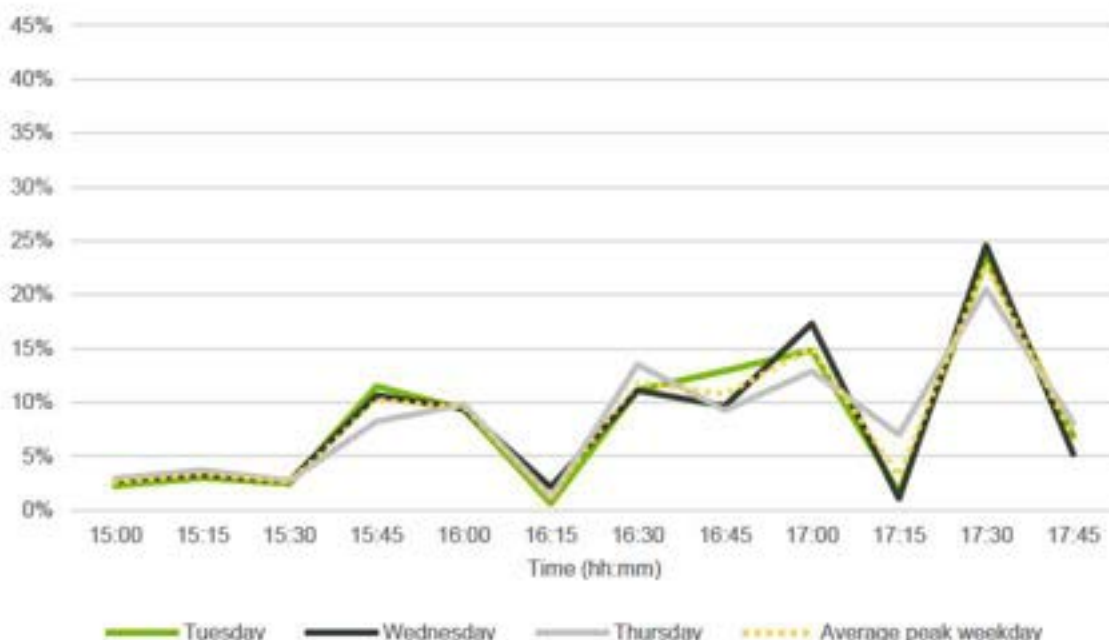


Figure 4-10 Hutt Valley Line evening peak passenger alighting profile

Wairarapa Line

The WRL shows peaks in boarding demand likely coinciding with timetabled train arrivals (with trains approximately every 30 minutes). The morning peak 15-minutes represents 62 per cent of the 3-hour alighting demand and the evening peak 15-minutes represents 46 per cent (see Figure 4-11 and Figure 4-13).

The alighting passenger profile also shows clear spikes, likely correlating with the train timetable. The morning peak 15-minutes represents 43 per cent of the 3-hour alighting demand and the evening peak 15-minutes represents 50 per cent (see Figure 4-12 and Figure 4-14).

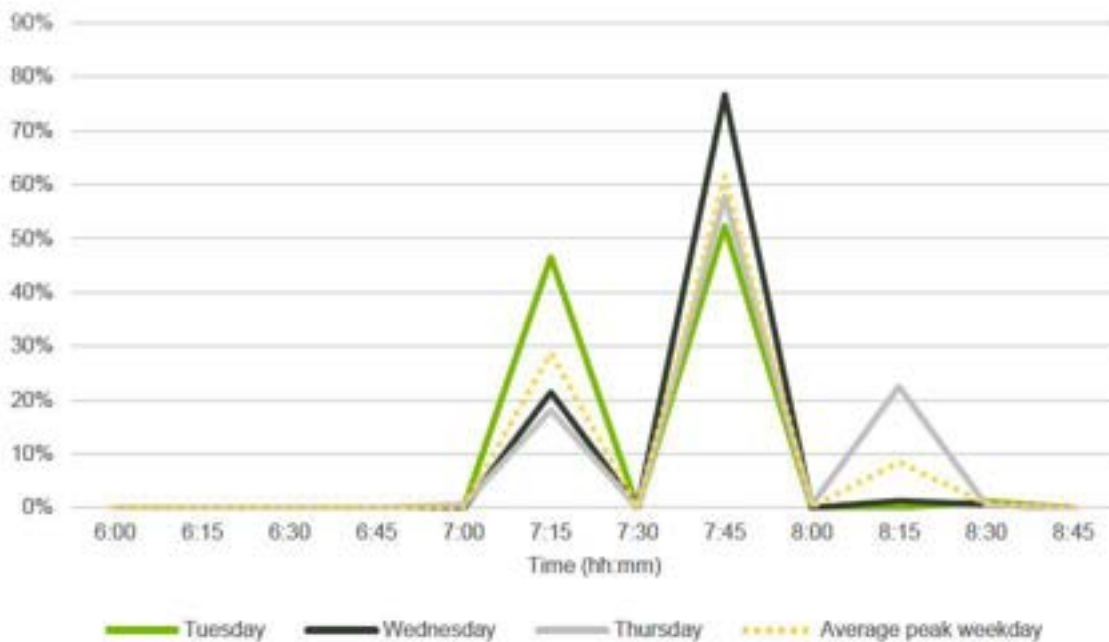


Figure 4-11 Wairarapa Line morning peak passenger boarding profile

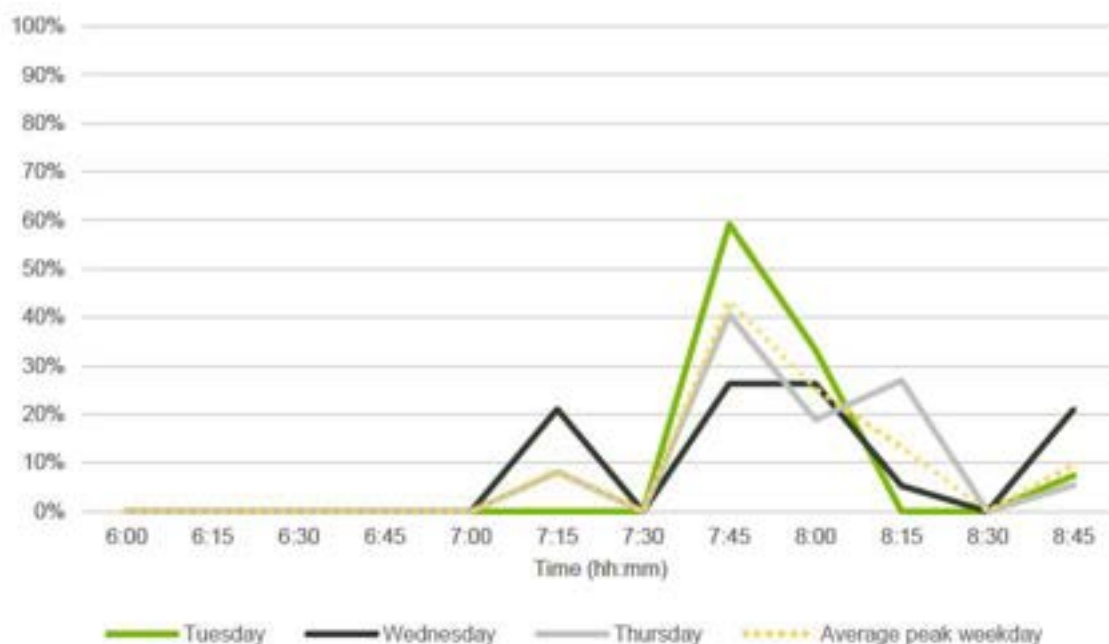


Figure 4-12 Wairarapa Line morning peak passenger alighting profile

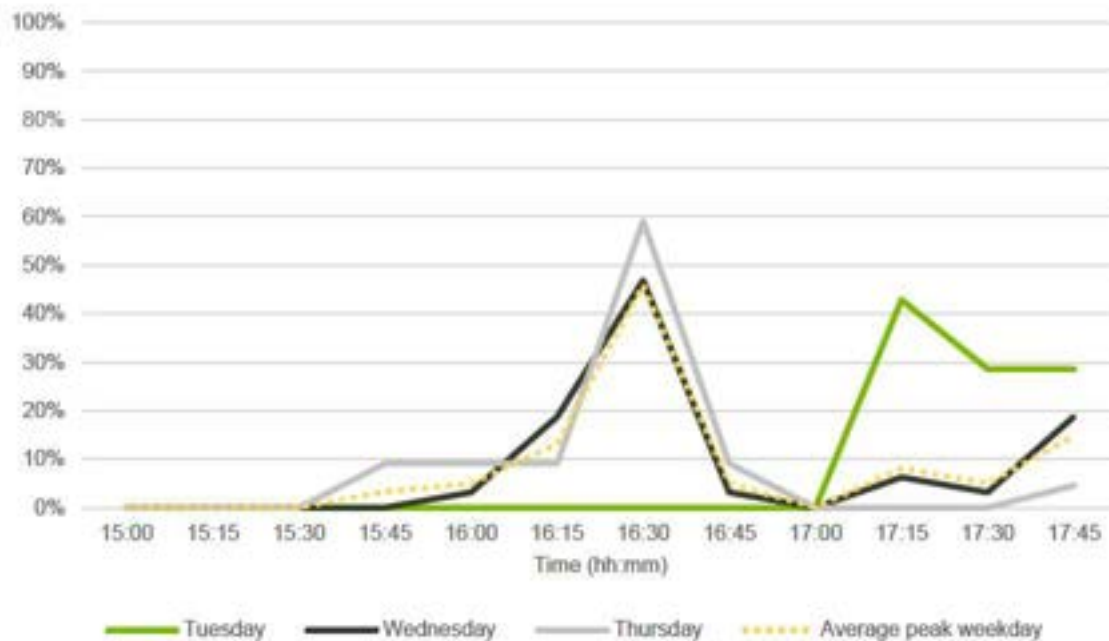


Figure 4-13 Wairarapa Line evening peak passenger boarding profile

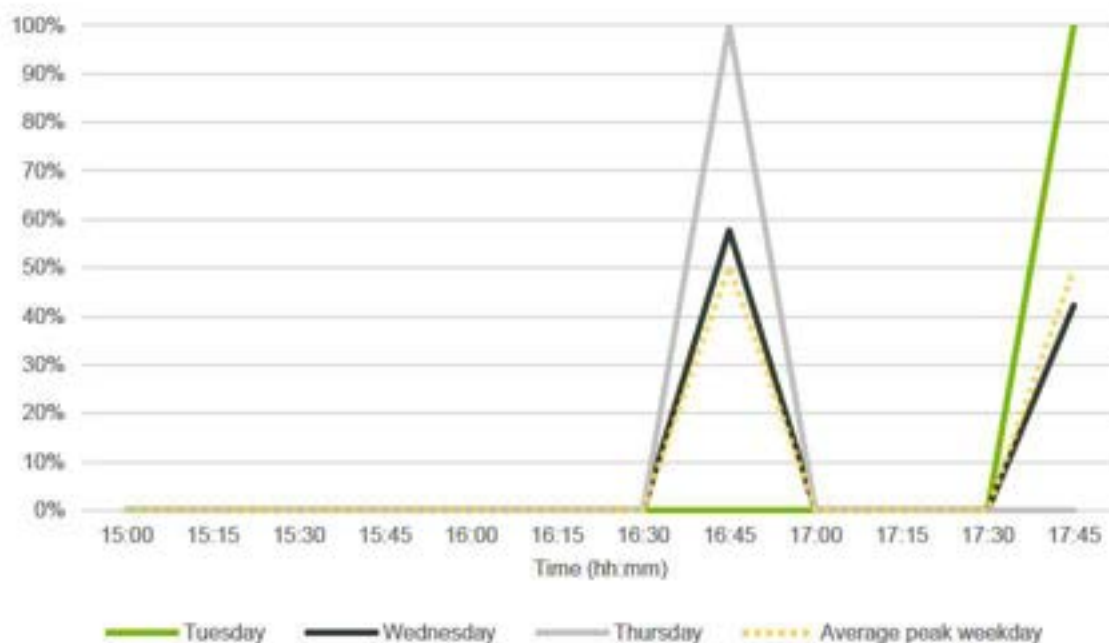


Figure 4-14 Wairarapa Line evening peak passenger alighting profile

4.3 Future passenger demand

Future passenger demand forecasts for the year 2053 were obtained from the Wellington Strategic Demand Model based on population and employment growth rates developed by Sense Partners. The demand forecasts for the morning and evening 3-hour peaks are shown in Table 4.4.

Table 4.4 Modelled morning and evening 3-hour peak passenger demands

Peak	2018		2053		Per annum growth rate (2018 to 2053)	
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
Morning	2073	431	3495	834	1.50%	1.90%
Evening	609	2019	1124	3175	1.77%	1.30%

The morning and evening 3-hour peak demands were distributed by line and direction based on the existing demand distributions shown in Table 4.2 and the outputs are shown in Table 4.5 and Table 4.6.

Table 4.5 Modelled morning 3-hour peak passenger demands by line and direction

Line	2018		2053	
	Boarding	Alighting	Boarding	Alighting
HVL (Inbound)	1751	283	2952	548
WRL (Inbound)	172	54	290	105
Inbound Total	1923	337	3242	653
HVL (Outbound)	148	87	250	169
WRL (Outbound)	2	6	3	13
Outbound Total	150	94	253	181

Table 4.6 Modelled evening 3-hour peak passenger demands by line and direction

Line	2018		2053	
	Boarding	Alighting	Boarding	Alighting
HVL (Inbound)	216	149	398	235
WRL (Inbound)	0	0	0	0
Inbound Total	216	149	398	235
HVL (Outbound)	345	1739	638	2734
WRL (Outbound)	48	131	88	206
Outbound Total	393	1870	726	2940

To account for travel behaviour changes between 2018 and 2024, due to covid and increased work-from-home, rather than using passenger demand numbers from the Wellington Strategic Demand Model, growth rates were obtained from the model which were then applied to the existing 2024 Snapper data. Therefore, better reflecting existing rail passenger demands which are anticipated to continue into the future.

The per annum growth rates from Table 4.5 and Table 4.6 were used to interpolate the growth for the 2046 Design Year and extrapolate the 2061 Ultimate Design Year. As growth rates for the modelled data were applied to the existing Snapper data, growth was re-based to the year 2024 rather than the 2018 model base year.

The resultant growth rates are shown in Figure 4-15 and Table 4.7, and show the highest growth rates for alighting in the morning peak and boarding in the evening peak which correlate with the aspiration of Waterloo becoming a growing destination.

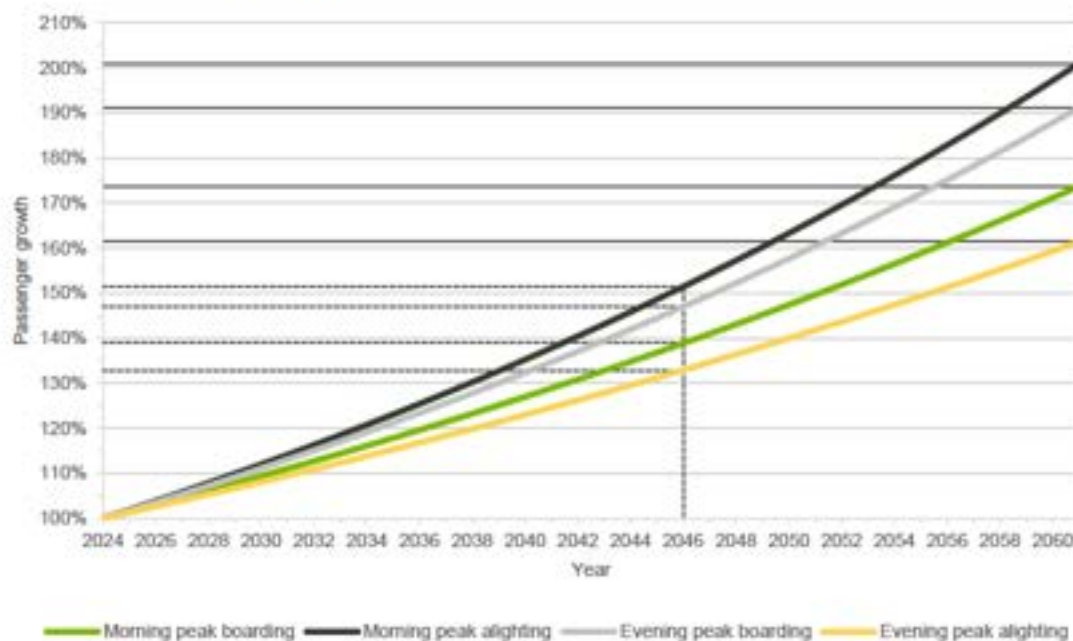


Figure 4-15 Waterloo Station passenger growth rates

Table 4.7 Waterloo Station passenger growth rates from the year 2024

Peak	2046		2061	
	Boarding	Alighting	Boarding	Alighting
Morning	139%	151%	174%	201%
Evening	147%	133%	191%	161%

Applying the growth rates from Table 4.7 and the passenger demand distributions from Table 4.2 and Table 4.3 to the existing Snapper data for the average peak weekday, results in the Design Year and Ultimate Design Year passenger demands in Table 4.8 and Table 4.9.

Table 4.8 Design Year and Ultimate Design Year morning 3-hour peak passenger demands by line and direction

Line	2024		2046		2061	
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
HVL (Inbound)	1702	131	2364	198	2957	263

Line	2024		2046		2061	
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
WRL (Inbound)	167	25	232	38	291	50
Inbound Total	1869	156	2596	236	3248	313
HVL (Outbound)	144	40	200	61	250	81
WRL (Outbound)	2	3	3	5	3	6
Outbound Total	146	43	203	66	253	87

Table 4.9 Design Year and Ultimate Design Year evening 3-hour peak passenger demands by line and direction

Line	2024		2046		2061	
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
HVL (Inbound)	90	122	133	163	173	197
WRL (Inbound)	0	0	0	0	0	0
Inbound Total	90	122	133	163	179	197
HVL (Outbound)	145	1423	213	1892	277	2297
WRL (Outbound)	20	107	29	142	38	173
Outbound Total	165	1530	242	2034	315	2470

5 Limitations and exclusions

The static pedestrian modelling included in this memo includes the following limitations:

- Detailed station entry and exit split information was unavailable and therefore to de-risk elements of the station impacted by the adopted assumptions a 75% reduction in flow rates was applied to station elements at station entrances (as per Hong Kong MTRC approach [see Table 4.1]).
- Passenger demand forecasts were produced for the year 2053, the Ultimate Design Year (2061) forecasts are based on extrapolation with assumes continuation of the modelled annual growth between 2018 and 2053.

The static pedestrian modelling included in this memo excludes the following items:

- Non-rail passengers' usage of the station (e.g. the usage of the proposed overpass to travel between Oxford Terrace and Cambridge Terrace)
- Emergency egress performance
- Back of House areas
- Public toilets
- Usage of ticket offices
- Public precinct

6 Methodology

6.1 Passenger demand

Passenger demand forecasts from Section 4.3 were used to develop peak train boarding and alighting volumes and peak minute volumes for the purposes of determining the minimum provision of passenger station elements. The process to develop these volumes generally followed the process outlined in Section 2.2 of the Waterloo Transit Oriented Development – Public Transport Minimum Requirements, with the exception of the application of the 125% uplift to account for a delayed service (see Table 4.1 for further details).

An overview of passenger demand methodology is provided in Figure 6-1.

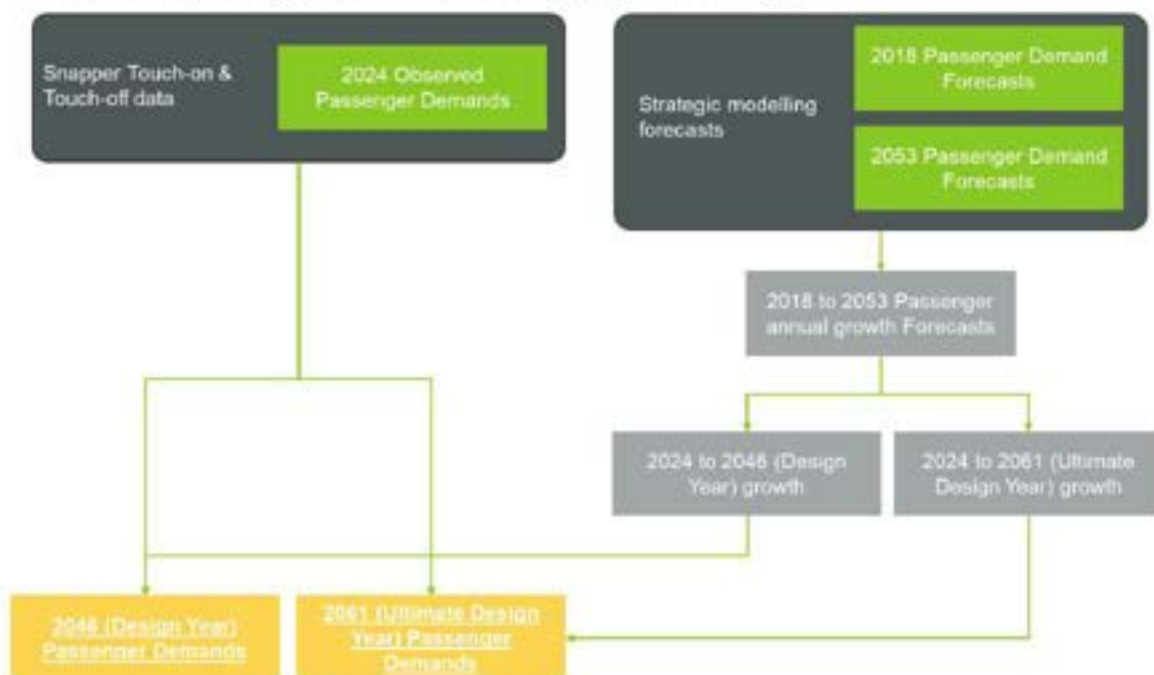


Figure 6-1 Passenger demand methodology overview

6.1.1 Design Year

Morning peak

Applying the existing passenger demand profiles to the adopted Design Year (2046) passenger demand forecasts shows the morning peak 15-minute period for the inbound platform to be 07:30 to 07:45, with a total of 445 passengers boarding and alighting train services (see Table 6.1).

Table 6.1 Design Year (2046) morning peak inbound passenger demands 15-minute intervals

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
06:00 – 06:15	25	3	0	0	25	3	28
06:15 – 06:30	156	5	0	0	156	5	161
06:30 – 06:45	114	3	0	0	114	3	117

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
06:45 – 07:00	156	0	0	0	156	0	157
07:00 – 07:15	185	14	0	0	185	14	199
07:15 – 07:30	275	10	67	3	342	13	355
07:30 – 07:45	430	15	0	0	430	15	445
07:45 – 08:00	216	11	143	16	359	27	386
08:00 – 08:15	354	40	0	10	355	50	405
08:15 – 08:30	252	72	20	5	272	77	349
08:30 – 08:45	131	11	2	0	133	11	144
08:45 – 09:00	70	14	0	4	70	17	88
Total	2364	198	232	38	2596	236	2833

The morning peak 15-minute period for the outbound platform is 08:15 to 08:30 with a total of 44 passengers boarding and alighting train services (see Table 6.2).

Table 6.2 Design Year (2046) morning peak outbound passenger demands 15-minute intervals

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
06:00 – 06:15	2	1	0	0	2	1	3
06:15 – 06:30	13	2	0	0	13	2	15
06:30 – 06:45	10	1	0	0	10	1	11
06:45 – 07:00	13	0	0	0	13	0	13
07:00 – 07:15	16	4	0	0	16	4	20
07:15 – 07:30	23	3	1	0	24	3	27
07:30 – 07:45	36	4	0	0	36	4	41
07:45 – 08:00	18	3	2	2	20	5	25
08:00 – 08:15	30	12	0	1	30	14	44
08:15 – 08:30	22	22	0	1	22	23	44
08:30 – 08:45	11	3	0	0	11	3	15
08:45 – 09:00	6	4	0	0	6	5	11
Total	200	61	3	5	203	66	268

Evening peak

Applying the existing passenger demand profiles to the adopted Design Year (2046) passenger demand forecasts shows the evening peak 15-minute period for the inbound platform to be 17:30 to 17:45, with a total of 45 passengers boarding and alighting train services (see Table 6.3).

Table 6.3 Design Year (2046) evening peak inbound passenger demands 15-minute intervals

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
15:00 – 15:15	24	4	0	0	24	4	28
15:15 – 15:30	11	5	0	0	11	5	17
15:30 – 15:45	16	4	0	0	16	4	20
15:45 – 16:00	13	17	0	0	13	17	29
16:00 – 16:15	7	15	0	0	7	15	22
16:15 – 16:30	10	2	0	0	10	2	12
16:30 – 16:45	11	19	0	0	11	19	30
16:45 – 17:00	12	17	0	0	12	17	30
17:00 – 17:15	9	24	0	0	9	24	34
17:15 – 17:30	8	5	0	0	8	5	13
17:30 – 17:45	7	38	0	0	7	38	45
17:45 – 18:00	5	11	0	0	5	11	16
Total	133	163	0	0	133	163	296

The evening peak 15-minute period for the outbound platform is 17:30 to 17:45 with a total of 445 passengers boarding and alighting train services (see Table 6.4).

Table 6.4 Design Year (2046) evening peak outbound passenger demands 15-minute intervals

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
15:00 – 15:15	38	50	0	0	38	50	88
15:15 – 15:30	18	63	0	0	18	63	81
15:30 – 15:45	26	50	0	0	26	50	76
15:45 – 16:00	20	193	1	0	21	193	214
16:00 – 16:15	11	180	1	0	12	180	192
16:15 – 16:30	17	24	4	0	21	24	45
16:30 – 16:45	18	225	13	0	31	225	256

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
16:45 – 17:00	20	203	1	72	21	275	296
17:00 – 17:15	15	285	0	0	15	285	299
17:15 – 17:30	13	59	2	0	15	59	74
17:30 – 17:45	10	433	1	0	12	433	445
17:45 – 18:00	7	127	4	71	12	198	209
Total	213	1892	29	142	242	2034	2276

6.1.2 Ultimate Design Year

Morning peak

Applying the existing passenger demand profiles to the adopted Ultimate Design Year (2061) passenger demand forecasts shows the morning peak 15-minute period for the inbound platform to be 07:30 to 07:45, with a total of 556 passengers boarding and alighting train services (see Table 6.5).

Table 6.5 Ultimate Design Year (2061) morning peak inbound passenger demands 15-minute intervals

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
06:00 – 06:15	31	4	0	0	31	4	35
06:15 – 06:30	195	7	0	0	195	7	202
06:30 – 06:45	143	4	0	0	143	4	147
06:45 – 07:00	196	0	0	0	196	0	196
07:00 – 07:15	231	19	1	0	231	19	251
07:15 – 07:30	344	13	84	4	427	17	445
07:30 – 07:45	538	19	0	0	538	19	556
07:45 – 08:00	270	14	179	22	449	36	484
08:00 – 08:15	443	54	1	13	444	66	510
08:15 – 08:30	316	96	25	7	340	102	442
08:30 – 08:45	164	15	2	0	167	15	181
08:45 – 09:00	88	18	0	5	88	23	111
Total	2957	263	291	50	3248	313	3561

The morning peak 15-minute period for the outbound platform is 08:15 to 08:30 with a total of 58 passengers boarding and alighting train services (see Table 6.6).

Table 6.6 Ultimate Design Year (2061) morning peak outbound passenger demands 15-minute intervals

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
06:00 – 06:15	3	1	0	0	3	1	4
06:15 – 06:30	17	2	0	0	17	2	19
06:30 – 06:45	12	1	0	0	12	1	13
06:45 – 07:00	17	0	0	0	17	0	17
07:00 – 07:15	20	6	0	0	20	6	25
07:15 – 07:30	29	4	1	1	30	5	35
07:30 – 07:45	45	6	0	0	45	6	51
07:45 – 08:00	23	4	2	3	25	7	32
08:00 – 08:15	37	17	0	2	37	18	56
08:15 – 08:30	27	30	0	1	27	31	58
08:30 – 08:45	14	5	0	0	14	5	19
08:45 – 09:00	7	6	0	1	7	6	14
Total	250	81	3	6	254	87	341

Evening peak

Applying the existing passenger demand profiles to the adopted Ultimate Design Year (2061) passenger demand forecasts shows the evening peak 15-minute period for the inbound platform to be 17:30 to 17:45, with a total of 55 passengers boarding and alighting train services (see Table 6.7).

Table 6.7 Ultimate Design Year (2061) evening peak inbound passenger demands 15-minute intervals

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
15:00 – 15:15	31	5	0	0	31	5	36
15:15 – 15:30	15	7	0	0	15	7	21
15:30 – 15:45	21	5	0	0	21	5	26
15:45 – 16:00	16	20	0	0	16	20	36
16:00 – 16:15	9	19	0	0	9	19	27
16:15 – 16:30	14	3	0	0	14	3	16
16:30 – 16:45	14	23	0	0	14	23	38
16:45 – 17:00	16	21	0	0	16	21	37

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
17:00 – 17:15	12	30	0	0	12	30	42
17:15 – 17:30	10	6	0	0	10	6	16
17:30 – 17:45	9	46	0	0	9	46	55
17:45 – 18:00	6	13	0	0	6	13	19
Total	173	197	0	0	173	197	370

The evening peak 15-minute period for the outbound platform is 17:30 to 17:45 with a total of 542 passengers boarding and alighting train services (see Table 6.8).

Table 6.8 Design Year (2046) evening peak outbound passenger demands 15-minute intervals

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
15:00 – 15:15	50	61	0	0	50	61	110
15:15 – 15:30	24	76	0	0	24	76	100
15:30 – 15:45	34	60	0	0	34	60	94
15:45 – 16:00	26	235	1	0	27	235	262
16:00 – 16:15	14	219	2	0	16	219	234
16:15 – 16:30	22	29	5	0	27	29	56
16:30 – 16:45	23	273	18	0	41	273	314
16:45 – 17:00	26	247	2	87	28	334	361
17:00 – 17:15	19	345	0	0	19	345	365
17:15 – 17:30	17	72	3	0	20	72	91
17:30 – 17:45	14	526	2	0	16	526	542
17:45 – 18:00	10	154	6	86	15	240	255
Total	277	2297	38	173	315	2470	2784

6.1.3 Passenger demand summary

The peak 15-minute demand was then converted into peak train service demand based on the train frequencies in Table 4.1. Peak minute boarding demand was calculated using the factors in Table 4.1 and the alighting peak minute was determined based on the HVL and WRL peak concentration percentages in Table 4.1. The resultant peak demands for sizing the station elements for the morning and evening peaks are shown in Table 6.9 and Table 6.10.

Table 6.9 Morning peak demand summary

	Design Year 2046				Ultimate Design Year 2061			
	Inbound		Outbound		Inbound		Outbound	
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
Peak 15-minutes	430	15	22	23	538	19	27	31
Peak train service	215	8	11	12	269	10	14	15
Peak minute	35	6	2	9	44	8	3	12

Table 6.10 Evening peak demand summary

	Design Year 2046				Ultimate Design Year 2061			
	Inbound		Outbound		Inbound		Outbound	
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
Peak 15-minutes	7	38	12	433	9	46	16	526
Peak train service	4	19	6	217	5	23	7	263
Peak minute	1	15	1	174	1	19	2	211

6.2 Assessment equations

The equations used to undertake the static pedestrian modelling assessment are detailed in Section 6.2.1 to Section 6.2.4.

6.2.1 Platform width

$$\text{Platform width} = \frac{\text{platform load per headway} \times \text{platform distribution [35\%]} \times \text{platform density [0.8m}^2/\text{person]}}{\text{platform length} \times 25\%} + \text{platform edge effect [1m]}$$

Equation 6-1 Platform width

6.2.2 Snapper card gates

$$\text{roundup} \frac{\text{peak minute boarding flow}}{\text{Snapper card gate flow rate [25 people / minute]}} + \text{roundup} \frac{\text{peak minute alighting flow}}{\text{Snapper card gate flow rate [25 people / minute]}}$$

Equation 6-2 Snapper card gates

6.2.3 Staircase width

$$\frac{\text{peak minute flow}}{\text{staircase flow rate [28 people / minute / metre]}}$$

Equation 6-3 Staircase width

6.2.4 Passageway width

$$\frac{\text{peak minute flow}}{\text{passageway flow rate [40 people / minute / metre]}} + \text{passageway edge effect [0.6m]}$$

Equation 6-4 Passageway width

7 Results

Based on the assumptions in Section 4.1 and methodology detailed in Section 5, the minimum station elements are provided in Table 7.1 for a side platform arrangement and illustrated in Figure 7-1 for the Design Year.

All widths are clear widths (i.e. width between handrails).

Section 7.1 to 7.3 provides details of the calculations used to determine the minimum provisions.

Table 7.1 Side platform arrangement minimum station elements provision

Station element	Minimum provision		Delta (Ultimate Design Year – Design Year)
	Design Year	Ultimate Design Year	
Inbound platform width	5.0 m	5.0 m	+0.0 m
Outbound platform width	5.0 m	5.0 m	+0.0 m
Inbound platform Snapper card gates	4 gates	4 gates	+0 gates
Outbound platform Snapper card gates	9 gates	11 gates	+2 gates
Overpass width	3.0 m	3.6 m	+0.6 m
Overpass staircase	3.4 m	4.2 m	+0.8 m
Oxford Terrace Station Forecourt staircase	6.1 m	7.5 m	+1.4 m
Cambridge Terrace Station Forecourt staircase	3.3 m	4.0 m	+0.7 m

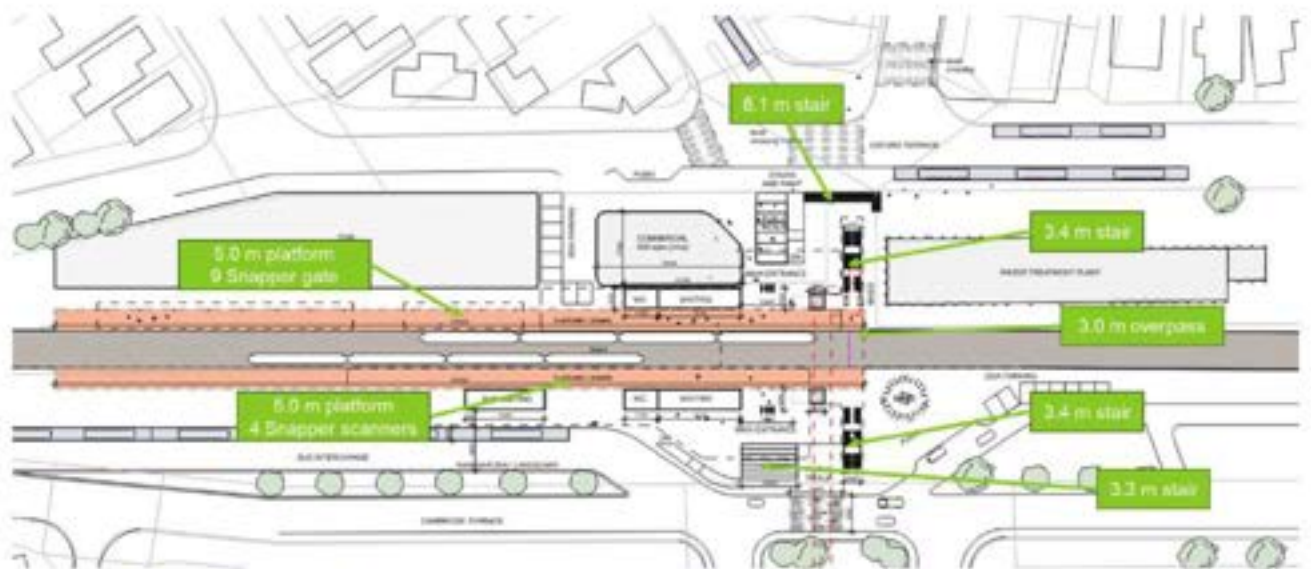


Figure 7-1 Waterloo Station Design Year (2046) minimum station elements provision

7.1 Platform width

Table 7.2 Design Year (2046) minimum platform width

Step		Morning peak				Evening peak			
		Inbound platform		Outbound platform		Inbound platform		Outbound platform	
		Value	Unit	Value	Unit	Value	Unit	Value	Unit
1	Peak train boarding demand	215	people	11	people	4	people	6	people
2	Peak train alighting demand	8	people	12	people	19	people	217	people
3	Platform load per headway (Step 1 plus Step 2)	223	people	23	people	23	people	223	people
4	Busiest platform quarter (Step 3 multiplied by 35%)	79	people	9	people	9	people	79	people
5	Platform area (Step 4 multiplied by 0.8)	63.2	m ²	7.2	m ²	7.2	m ²	63.2	m ²
6	Platform width (Step 5 divided by 190 multiplied by 25% plus 1m)	2.4	m	1.2	m	1.2	m	2.4	m
7	Minimum platform width (GWRC Minimum Requirements)	5.0	m	5.0	m	5.0	m	5.0	m

Table 7.3 Ultimate Design Year (2061) minimum platform width

Step		Morning peak				Evening peak			
		Inbound platform		Outbound platform		Inbound platform		Outbound platform	
		Value	Unit	Value	Unit	Value	Unit	Value	Unit
1	Peak train boarding demand	269	people	14	people	5	people	7	people
2	Peak train alighting demand	10	people	15	people	23	people	263	people
3	Platform load per headway (Step 1 plus Step 2)	279	people	29	people	28	people	270	people
4	Busiest platform quarter (Step 3 multiplied by 35%)	98	people	11	people	10	people	95	people
5	Platform area (Step 4 multiplied by 0.8)	78.4	m ²	8.8	m ²	8.0	m ²	76.0	m ²
6	Platform width (Step 5 divided by 190 multiplied by 25% plus 1m)	2.7	m	1.2	m	1.2	m	2.6	m
7	Minimum platform width (GWRC Minimum Requirements)	5.0	m	5.0	m	5.0	m	5.0	m

7.2 Snapper card gates

Table 7.4 Design Year (2046) minimum Snapper card gate provision

Step		Morning peak				Evening peak			
		Inbound platform		Outbound platform		Inbound platform		Outbound platform	
		Value	Unit	Value	Unit	Value	Unit	Value	Unit
1	Peak minute boarding demand	35	people	2	people	1	people	1	people
2	Peak minute alighting demand	6	people	9	people	15	people	174	people
3	Required boarding Snapper card gates (roundup Step 1 divided by 25)	2	gates	1	gates	1	gates	1	gates
4	Required Snapper card gates (roundup Step 2 divided by 25)	1	gates	1	gates	1	gates	7	gates
5	Snapper card gate redundancy provision	1	gates	1	gates	1	gates	1	gates
6	Total Snapper card gate provision (Step 3 plus Step 4 plus Step 5)	4	gates	3	gates	3	gates	9	gates
7	Minimum Snapper card gate provision	4	gates	3	gates	3	gates	9	gates

Table 7.5 Ultimate Design Year (2061) minimum Snapper card gate provision

Step		Morning peak				Evening peak			
		Inbound platform		Outbound platform		Inbound platform		Outbound platform	
		Value	Unit	Value	Unit	Value	Unit	Value	Unit
1	Peak minute boarding demand	44	people	3	people	1	people	2	people
2	Peak minute alighting demand	8	people	12	people	19	people	211	people
3	Required boarding Snapper card gates (roundup Step 1 divided by 25)	2	gates	1	gates	1	gates	1	gates
4	Required Snapper card gates (roundup Step 2 divided by 25)	1	gates	1	gates	1	gates	9	gates
5	Snapper card gate redundancy provision	1	gates	1	gates	1	gates	1	gates
6	Total Snapper card gate provision (Step 3 plus Step 4 plus Step 5)	4	gates	3	gates	3	gates	11	gates
7	Minimum Snapper card gate provision	4	gates	3	gates	3	gates	11	gates

7.3 Overpass width

Table 7.6 Design Year (2046) station overpass minimum width

Step		Morning peak		Evening peak	
		Value	Unit	Value	Unit
1	Inbound peak minute boarding demand	35	people	1	people
2	Inbound peak minute boarding demand from Oxford Terrace (Step 1 multiplied by 67%)	24	people	1	people
3	Inbound peak minute alighting demand	6	people	15	people
4	Inbound peak minute alighting demand to Oxford Terrace (Step 3 multiplied by 67%)	4	people	10	people
5	Outbound peak minute boarding demand	2	people	1	people
6	Outbound peak minute boarding demand from Cambridge Terrace (Step 5 multiplied by 34%)	2	people	1	people
7	Outbound peak minute alighting demand	9	people	174	people
8	Outbound peak minute alighting demand from Cambridge Terrace (Step 7 multiplied by 34%)	4	people	58	people
9	Peak minute demand (summation of Steps 2, 4, 6, and 8)	34	people	70	people

Step		Morning peak		Evening peak	
		Value	Unit	Value	Unit
10	Overpass width (Step 9 divided by 40 multiplied by 75% [entrance split uncertainty factor]) plus 0.6)	1.8	m	3.0	m
11	Minimum overpass width	1.8	m	3.0	m

Table 7.7 Ultimate Design Year (2061) station overpass minimum width

Step		Inbound platform			
		Morning peak		Evening peak	
		Value	Unit	Value	Unit
1	Peak minute inbound boarding demand	44	people	1	people
2	Inbound peak minute boarding demand from Oxford Terrace (Step 1 multiplied by 67%)	30	people	1	people
3	Peak minute inbound alighting demand	8	people	19	people
4	Inbound peak minute alighting demand to Oxford Terrace (Step 3 multiplied by 67%)	6	people	13	people
5	Peak minute outbound boarding demand	3	people	2	people
6	Outbound peak minute boarding demand from Cambridge Terrace (Step 5 multiplied by 34%)	2	people	2	people
7	Peak minute outbound alighting demand	12	people	211	people
8	Outbound peak minute alighting demand to Cambridge Terrace (Step 7 multiplied by 34%)	4	people	72	people
9	Peak minute demand (summation of Steps 2, 4, 6, and 8)	42	people	88	people
10	Overpass width (Step 9 divided by 40 multiplied by 75% [entrance split uncertainty factor]) plus 0.6)	2.0	m	3.6	m
11	Minimum overpass width	2.0	m	3.6	m

7.4 Overpass staircase widths

Table 7.8 Design Year (2046) overpass minimum staircase widths

Step		Inbound platform			
		Morning peak		Evening peak	
		Value	Unit	Value	Unit
1	Peak minute inbound boarding demand	35	people	1	people
2	Inbound peak minute boarding demand from Oxford Terrace (Step 1 multiplied by 67%)	24	people	1	people

Step		Inbound platform			
		Morning peak		Evening peak	
		Value	Unit	Value	Unit
3	Peak minute inbound alighting demand	6	people	15	people
4	Inbound peak minute alighting demand to Oxford Terrace (Step 3 multiplied by 67%)	4	people	10	people
5	Peak minute outbound boarding demand	2	people	2	people
6	Outbound peak minute boarding demand from Cambridge Terrace (Step 5 multiplied by 34%)	2	people	2	people
7	Peak minute outbound alighting demand	9	people	174	people
8	Outbound peak minute alighting demand to Cambridge Terrace (Step 7 multiplied by 34%)	2	people	58	people
9	Peak minute demand (summation of Steps 2, 4, 6, and 8)	34	people	71	people
10	Staircase width (Step 9 divided by 28 multiplied by 75% [entrance split uncertainty factor])	1.7	m	3.4	m
11	Minimum staircase width	1.7	m	3.4	m

Table 7.9 Design Year (2061) Inbound platform overpass minimum staircase width

Step		Morning peak		Evening peak	
		Value	Unit	Value	Unit
1	Peak minute inbound boarding demand	44	people	1	people
2	Inbound peak minute boarding demand from Oxford Terrace (Step 1 multiplied by 67%)	30	people	1	people
3	Peak minute inbound alighting demand	8	people	19	people
4	Inbound peak minute alighting demand to Oxford Terrace (Step 3 multiplied by 67%)	6	people	13	people
5	Peak minute outbound boarding demand	3	people	2	people
6	Outbound peak minute boarding demand from Cambridge Terrace (Step 5 multiplied by 34%)	2	people	2	people
7	Peak minute outbound alighting demand	12	people	211	people
8	Outbound peak minute alighting demand to Cambridge Terrace (Step 7 multiplied by 34%)	4	people	72	people
9	Peak minute demand (summation of Steps 2, 4, 6, and 8)	42	people	88	people
12	Staircase width (Step 9 divided by 28 multiplied by 75% [entrance split uncertainty factor])	2.0	m	4.2	m
13	Minimum staircase width	2.0	m	4.2	m

7.5 Oxford Terrace Station Forecourt staircase

Table 7.10 Design Year (2046) Oxford Terrace Station Forecourt minimum staircase width

Step		Oxford Terrace			
		Morning peak		Evening peak	
		Value	Unit	Value	Unit
1	Inbound peak minute boarding demand	35	people	1	people
2	Inbound peak minute boarding demand from Oxford Terrace (Step 1 multiplied by 67%)	24	people	1	people
3	Inbound peak minute alighting demand	6	people	15	people
4	Inbound peak minute alighting demand to Oxford Terrace (Step 3 multiplied by 67%)	4	people	10	people
5	Outbound peak minute boarding demand	2	people	1	people
6	Outbound peak minute boarding demand from Oxford Terrace (Step 5 multiplied by 67%)	2	people	1	people
7	Outbound peak minute alighting demand	9	people	174	people
8	Outbound peak minute alighting demand to Oxford Terrace (Step 7 multiplied by 67%)	6	people	116	people
9	Peak minute demand (summation of Steps 2, 4, 6, and 8)	36	people	128	people
10	Staircase width (Step 9 divided by 28 multiplied by 75% [entrance split uncertainty factor])	1.8	m	6.1	m
11	Minimum staircase width	1.8	m	6.1	m

Table 7.11 Ultimate Design Year (2061) Oxford Terrace Station Forecourt minimum staircase width

Step		Oxford Terrace			
		Morning peak		Evening peak	
		Value	Unit	Value	Unit
1	Inbound peak minute boarding demand	44	people	1	people
2	Inbound peak minute boarding demand from Oxford Terrace (Step 1 multiplied by 67%)	30	people	1	people
3	Inbound peak minute alighting demand	8	people	19	people
4	Inbound peak minute alighting demand to Oxford Terrace (Step 3 multiplied by 67%)	6	people	13	people
5	Outbound peak minute boarding demand	3	people	2	people
6	Outbound peak minute boarding demand from Oxford Terrace (Step 5 multiplied by 67%)	2	people	2	people
7	Outbound peak minute alighting demand	12	people	211	people

Step		Oxford Terrace			
		Morning peak		Evening peak	
		Value	Unit	Value	Unit
8	Outbound peak minute alighting demand to Oxford Terrace (Step 7 multiplied by 67%)	8	people	141	people
9	Peak minute demand (summation of Steps 2, 4, 6, and 8)	46	people	157	people
10	Staircase width (Step 9 divided by 28 multiplied by 75% [entrance split uncertainty factor])	2.2	m	7.5	m
11	Minimum staircase width	2.2	m	7.5	m

7.6 Cambridge Terrace Station Forecourt staircase

Table 7.12 Design Year (2046) Cambridge Terrace Station Forecourt minimum staircase width

Step		Cambridge Terrace			
		Morning peak		Evening peak	
		Value	Unit	Value	Unit
1	Inbound peak minute boarding demand	35	people	1	people
2	Inbound peak minute boarding demand from Cambridge Terrace (Step 1 multiplied by 34%)	12	people	1	people
3	Inbound peak minute alighting demand	6	people	15	people
4	Inbound peak minute alighting demand to Cambridge Terrace (Step 3 multiplied by 34%)	2	people	6	people
5	Outbound peak minute boarding demand	2	people	1	people
6	Outbound peak minute boarding demand from Cambridge Terrace (Step 5 multiplied by 34%)	2	people	1	people
7	Outbound peak minute alighting demand	9	people	174	people
8	Outbound peak minute alighting demand to Cambridge Terrace (Step 7 multiplied by 34%)	4	people	58	people
9	Peak minute demand (summation of Steps 2, 4, 6, and 8)	20	people	66	people
10	Staircase width (Step 9 divided by 28 multiplied by 75% [entrance split uncertainty factor])	1.0	m	3.3	m
11	Minimum staircase width	1.2	m	3.3	m

Table 7.13 Ultimate Design Year (2061) Cambridge Terrace Station Forecourt minimum staircase width

Step		Cambridge Terrace			
		Morning peak		Evening peak	
		Value	Unit	Value	Unit
1	Inbound peak minute boarding demand	44	people	1	people
2	Inbound peak minute boarding demand from Cambridge Terrace (Step 1 multiplied by 34%)	16	people	1	people
3	Inbound peak minute alighting demand	8	people	19	people
4	Inbound peak minute alighting demand to Cambridge Terrace (Step 3 multiplied by 34%)	4	people	8	people
5	Outbound peak minute boarding demand	3	people	2	people
6	Outbound peak minute boarding demand from Cambridge Terrace (Step 5 multiplied by 34%)	2	people	2	people
7	Outbound peak minute alighting demand	12	people	211	people
8	Outbound peak minute alighting demand to Cambridge Terrace (Step 7 multiplied by 34%)	4	people	72	people
9	Peak minute demand (summation of Steps 2, 4, 6, and 8)	26	people	83	people
10	Inbound peak minute boarding demand	1.3	m	4.0	m
11	Minimum staircase width	1.3	m	4.0	m

8 Option 17 station elements level of service performance

Station sizing assessment of Option 17 highlights the following:

- Platform circulation and vertical access elements provide sufficient space to meet LoS C during peak periods under normal operations and meet LoS D during delayed services in peak conditions for the years 2046 and 2061.
- Additional Snapper gates required on the outbound platform to cater to the alighting passenger demand in the evening peak (six additional gates required for year 2046, and a further three for 2061).
- Lack of alternative (or redundant) step-free access to and from the overpass in the event of a lift failure.

The provided provisions in Option 17 generally meet or exceed the minimum provisions required to meet the years 2046 and 2061 passenger demand forecasts, with the exception of the outbound platform Snapper card gate and the overpass staircase. The outbound platform would require an additional six gates to meet the year 2046 demand, with a further two gates to meet the year 2061 demands. There appears to be sufficient spatial provision for these additional gates to be added as the station passenger demand grows. The overpass staircase has a minor shortfall in width (0.2 m) by the year 2061 however, the width is still sufficient to meet LoS C (with a maximum flow rate of 29.3 people per minute per meter, which slightly exceeds the target flow rate of 28 people per minute per meter) and is deemed acceptable.

Table 8.1 Option 17 provided provision versus years 2046 and 2061 minimum provisions

Station Element	Option 17 provided provision	Year 2046 minimum provision	Year 2061 minimum provision
Inbound platform width	5.0 m	5.0 m	5.0 m
Outbound platform width	5.0 m	5.0 m	5.0 m
Inbound platform Snapper card gates	6 gates	4 gates	4 gates
Outbound platform Snapper card gates	3 gates	9 gates	11 gates
Overpass width	4.8 m	3.0 m	3.6 m
Overpass staircase	4.0 m	3.4 m	4.2 m
Oxford Terrace Station Forecourt staircase	18.0 m	6.1 m	7.5 m
Cambridge Terrace Station Forecourt staircase	13.0 m	3.3 m	4.0 m

The pedestrian level of service performance of the station elements over time (with the exception of platforms, which provide sufficient width for the 2061 design year) are provided in Figure 8-1 to Figure 8-4 based on the widths provided in Option 17.

The figures provide an indication of potential level of service performance from Rail Day One to the 2061 design year for both normal and degraded operations. In general, the figures show that the target level of service performance for normal and degraded operations can be met, with a slight exceedance at the overpass stairs for beyond the year 2058.

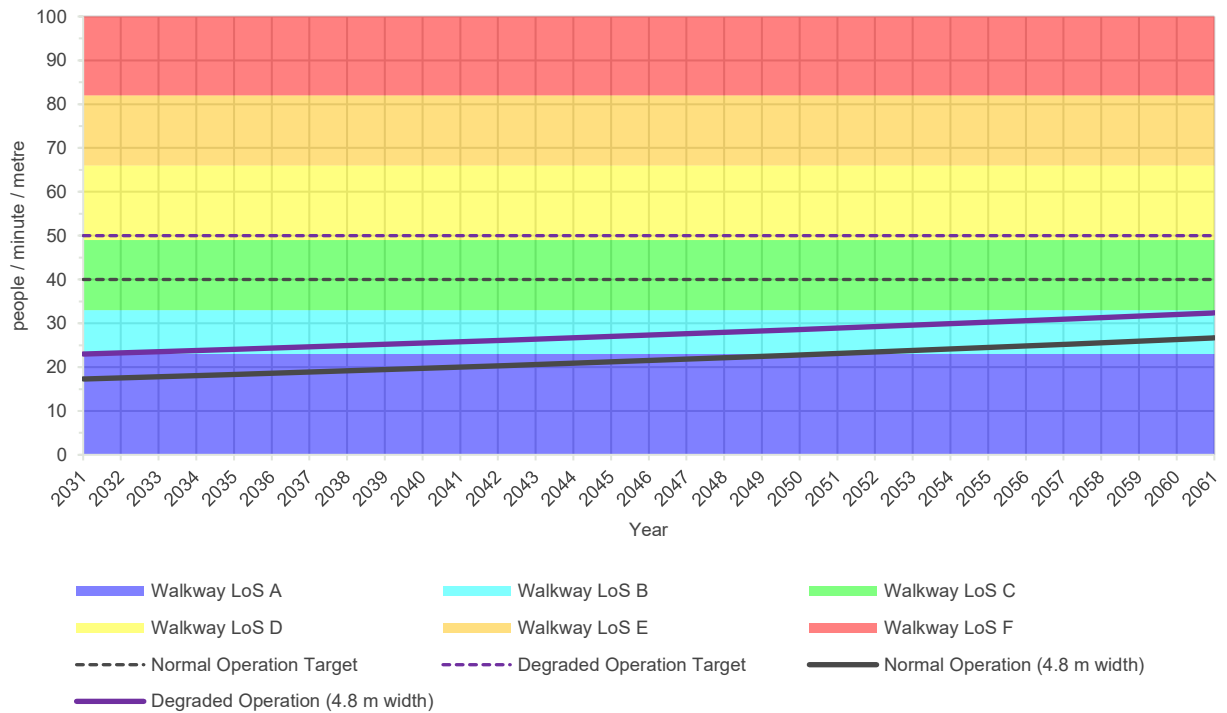


Figure 8-1 Overpass evening peak walkway Level of Service performance

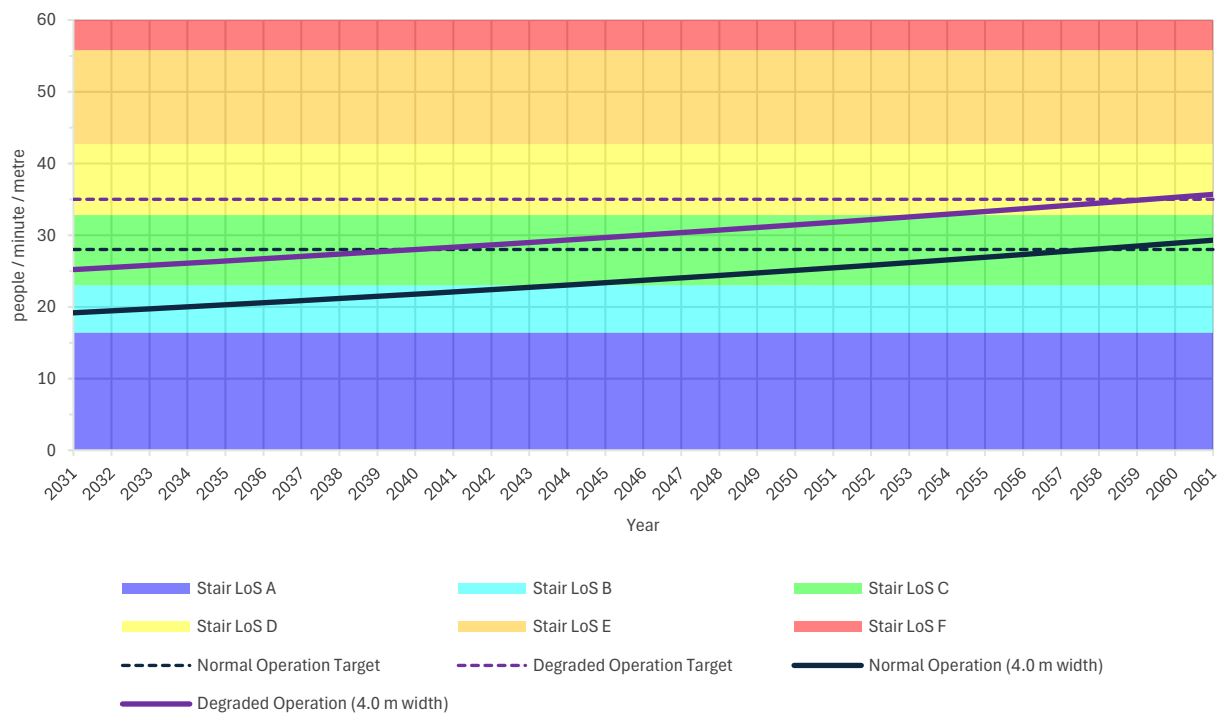


Figure 8-2 Overpass staircase evening peak stair Level of Service performance

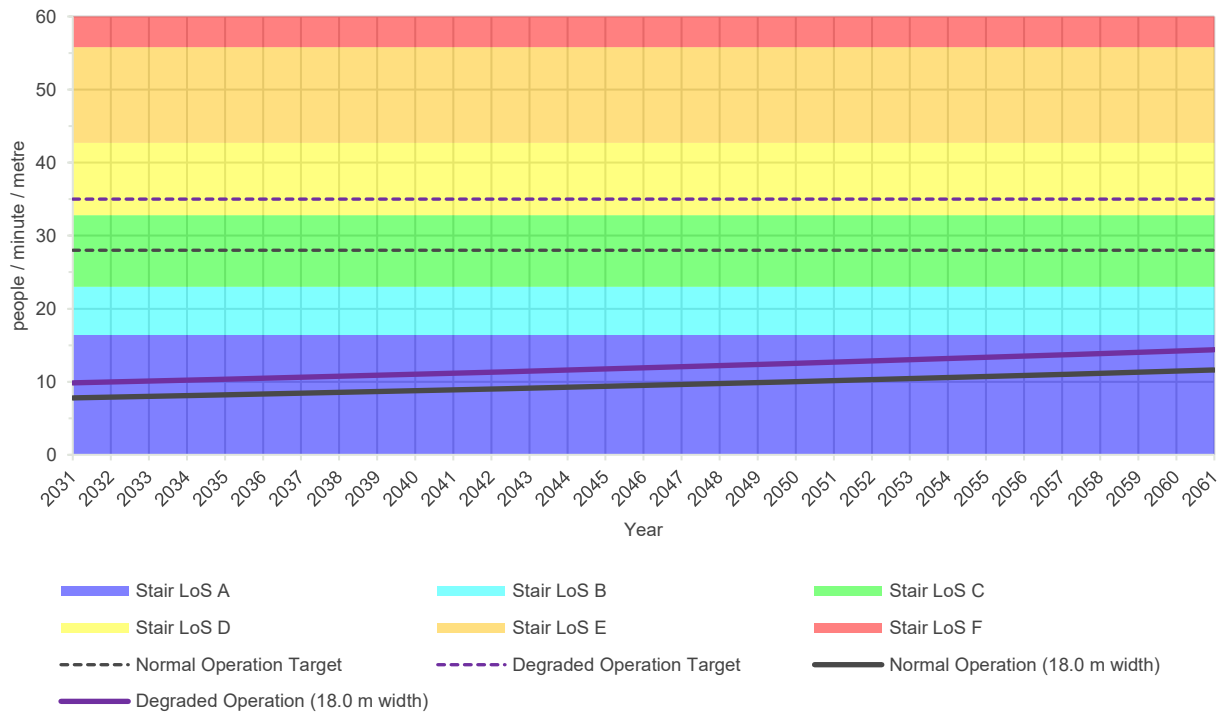


Figure 8-3 Oxford Terrace staircase evening peak stair Level of Service performance

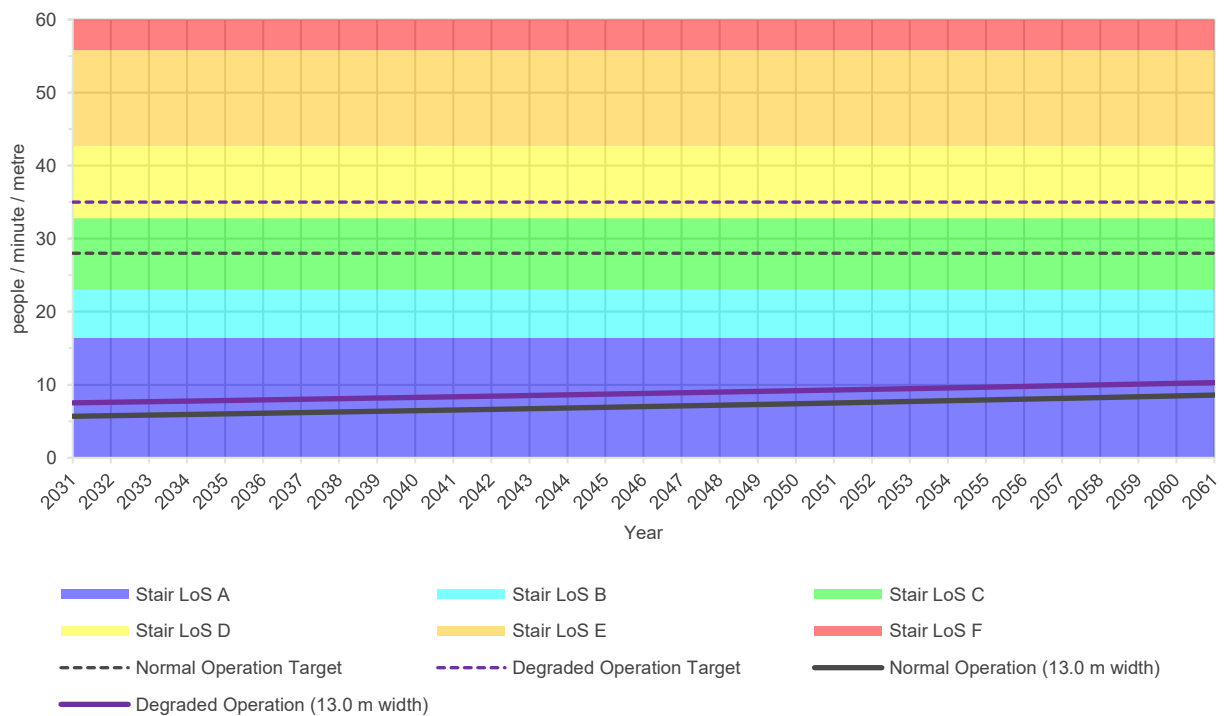


Figure 8-4 Cambridge Terrace staircase evening peak stair Level of Service performance

9 Sizing based on delayed service

In addition to the station element widths provided in Section 7, the required widths to achieve pedestrian Level of Service C for a delayed train service in the Design Year and the Ultimate Design Year are provided in Table 9.1 for information.

Table 9.1 Side platform arrangement minimum station elements provision not accounting for versus accounting for delayed service

Station element	2046 Design Year		2061 Ultimate Design Year	
	Not accounting for delayed service	Accounting for delayed service	Not accounting for delayed service	Accounting for delayed service
Inbound platform width	5.0 m	5.0 m (+0.0 m)	5.0 m (+0.0 m)	5.0 m (+0.0 m)
Outbound platform width	5.0 m	5.0 m (+0.0 m)	5.0 m (+0.0 m)	5.0 m (+0.0 m)
Inbound platform Snapper card gates	4 gates	4 scanners (+0 gates)	4 gates (+0 gates)	4 scanners (+0 gates)
Outbound platform Snapper card gates	9 gates	11 scanners (+2 scanners)	11 gates (+2 gates)	14 scanners (+5 gates)
Overpass width	3.0 m	3.6 m (+0.6 m)	3.6 m (+0.6 m)	4.2 m (+1.2 m)
Overpass staircase	3.4 m	4.3 m (+0.9 m)	4.2 m (+0.8 m)	5.1 m (+1.7 m)
Oxford Terrace Station Forecourt staircase	6.1 m	7.7 m (+1.6 m)	7.5 m (+1.4 m)	9.3 m (+3.2 m)
Cambridge Terrace Station Forecourt staircase	3.3 m	4.1 m (+0.8 m)	4.0 m (+0.7 m)	4.8 m (+1.5 m)

Appendix B

Waterloo Station – Pedestrian Crossings Design Note

Memorandum

To	s7(2)(a) – Boffa Miskell	From	s7(2)(a)
Copy	s7(2)(a)	Reference	P528886
Date	2025-07-16	Pages (including this page)	10
Subject	Waterloo Station – Pedestrian Crossings DRAFT Design Note		

1 Background

This memorandum is a discussion of existing and proposed pedestrian facilities immediately north and south of Waterloo Station in Lower Hutt for the Waterloo Station Feasibility Study and Reference Design.

The proposals being evaluated are:

North of Waterloo Station

1. Zebra crossings on Oxford Terrace, Pohutukawa Street and Birch Street – on single raised platforms or one raised platform for the intersection.

South of Waterloo Station

2. Pedestrian signals on Cambridge Terrace
3. Raised Safety Platforms on Trafalgar Square at Cambridge Terrace.

There are no pedestrian volumes available to use in the evaluation, however road volumes and characteristics are appended.

2 Recommendations

Retain the existing pedestrian facilities on the north side of the station in approximately the same locations as they best match pedestrian desire lines. Raise each one on a single platform to highlight the pedestrians to approaching traffic, provide traffic calming to lower speeds and create a traffic calmed precinct on the northern approach to the station to support the change in movement and place function.

Raising the entire intersection would provide speed reduction benefits at the edges of the platform and provide an easier transition through the intersection for heavy vehicles and emergency services, however it would not provide the maximum speed reduction benefit at the conflict points with pedestrians and would encourage pedestrians to cross the corridor away from the pedestrian crossing facilities.

Install a signalised pedestrian crossing on the southern side of the station on a raised platform to provide managed pedestrian priority in a higher volume, higher speed environment. Consider adding raised safety platforms on Telegraph Road as 'courtesy crossings' to provide a continuous accessible path of travel to the station from PUDO and bus stop areas and emphasise the change in priority to active modes access to the station. Where shoulder width is available and cycle routes are not affected, include side islands at crossing points to shorten crossing width and provide locations for poles and signs out of footpath areas.

2.1 General

- Future design stages should review crossing storage capacity and existing safety issues at crossing locations/desire lines to determine if any additional improvements should be made and finalise crossing widths.
- Future design stages should review cycle facilities provision and determine whether cycle facilities should be included in pedestrian crossings or if cycle lanes are included on street how they should be included in the crossings designs.
- Pedestrian crossings at intersections should be in a low speed environment – raised platforms will assist in lowering speeds at the conflict points.
- Pedestrian crossing markings should not be excessively wide as this affects limit line locations, intervisibility and extends queueing across adjacent intersections affecting pedestrian access and safety
- Pedestrian crossing lengths – for any road width greater than 10m a median island refuge is recommended to allow crossings to operate as 2 separate legal crossings and is required for widths 15m or greater. A single stage zebra or signalised crossing will require all traffic to stop for all pedestrians. Two stage crossings improve safety by limiting pedestrian exposure to traffic to one direction at a time, shorten the crossing distance and reduce congestion with each lane operating separately.
- Side islands – these are recommended where there are marked shoulders to provide additional protection kerbside and shorten the distance pedestrians are exposed to traffic. These are an obstruction for cyclists so are not recommended on a cycle route.
- Oxford Terrace Zebra Crossing – maintain a two stage pedestrian crossing. This can be via a wide central refuge with or without a stagger. The stagger is a safety measure to turn pedestrians towards oncoming traffic. If the stagger is retained, it should be reversed so pedestrians face oncoming traffic when walking in the median. Installation on a raised platform would reduce speeds at the conflict points.
- Consider emergency services access when designing raised platforms – Wellington Free Ambulance is immediately northeast of the station on Oxford Terrace

3 Design Proposals

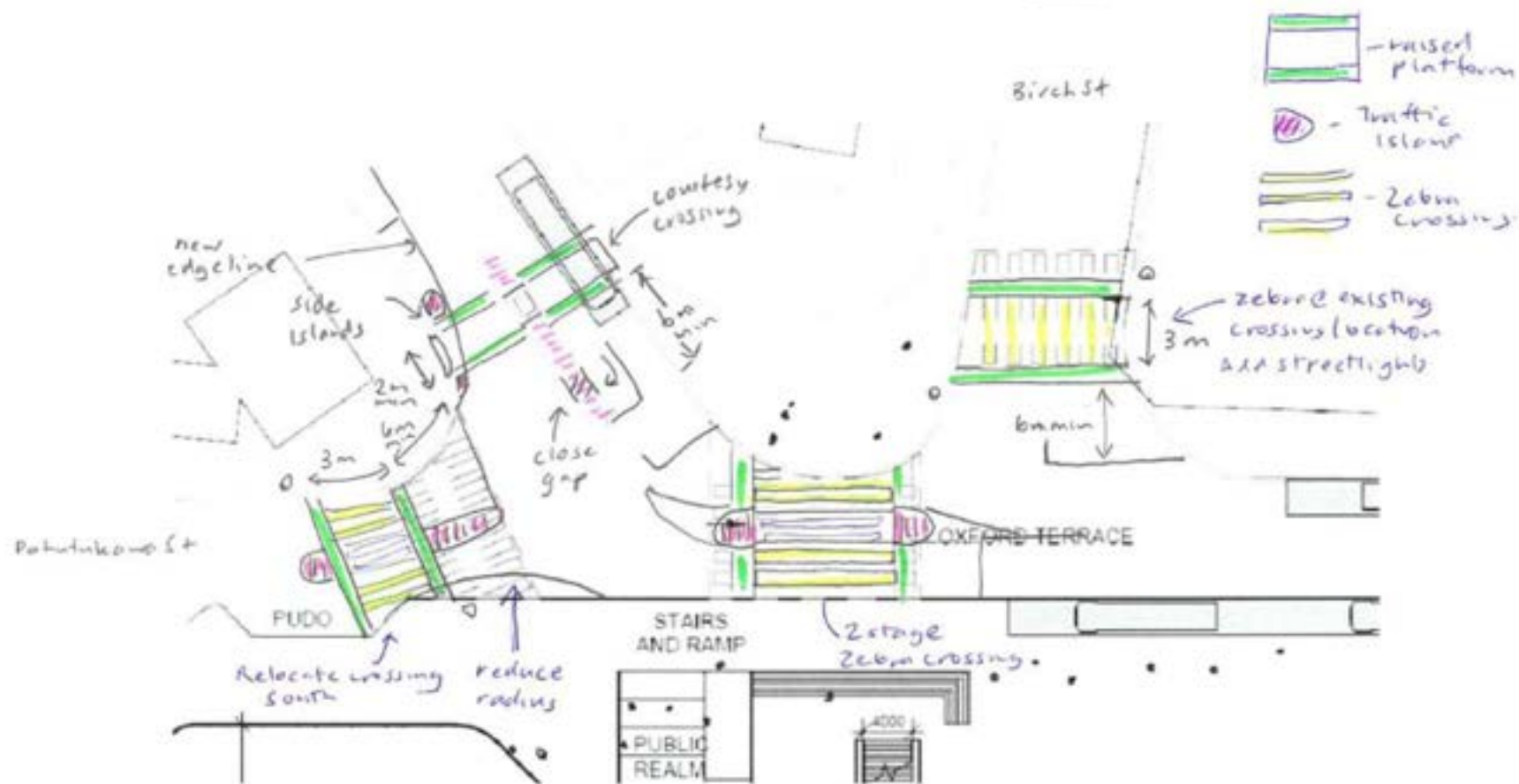


Figure No. 1: North of Waterloo Station

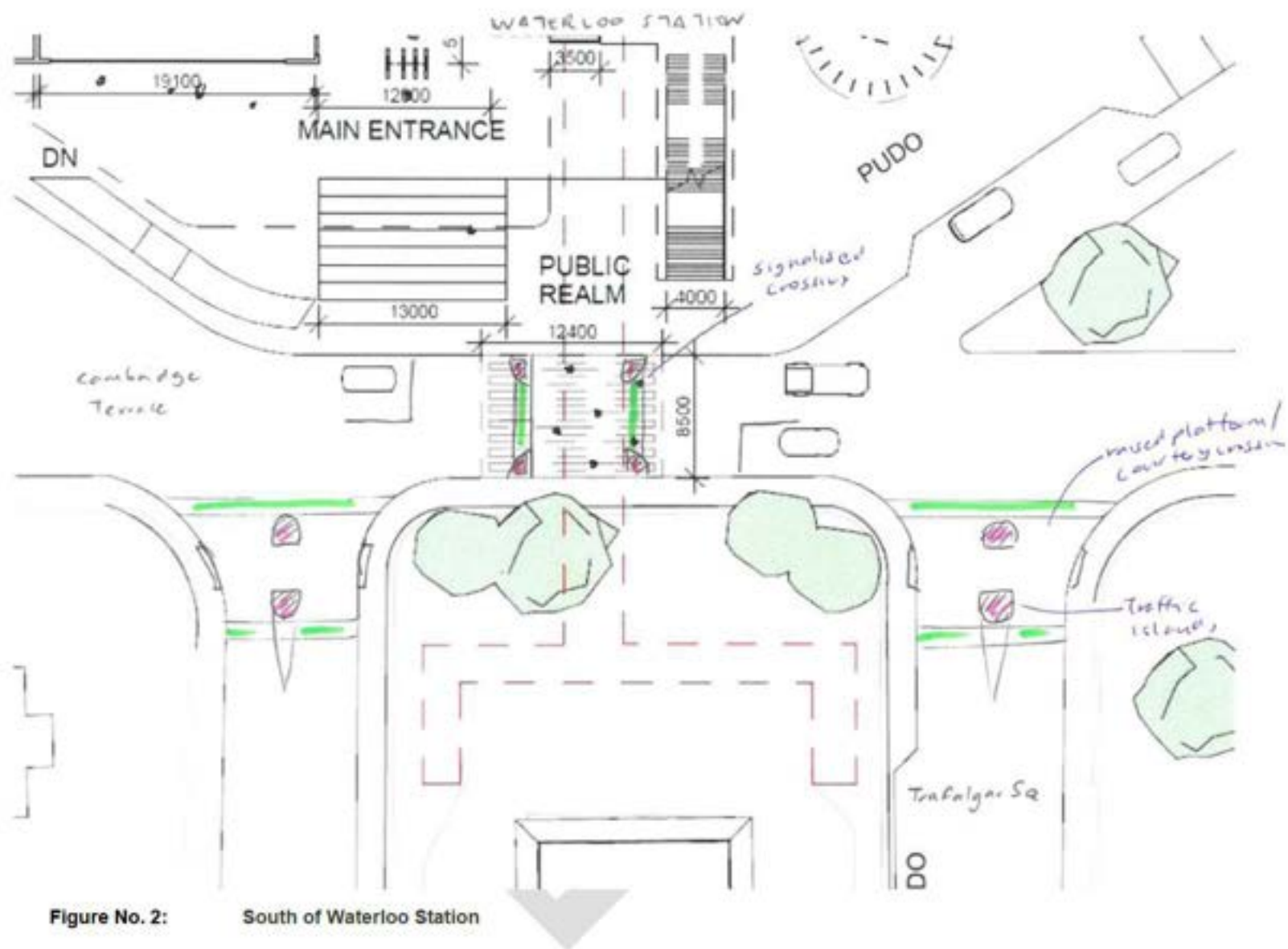


Figure No. 2: South of Waterloo Station

4 Options Evaluation

4.1 North of Waterloo Station



Figure No. 3:
Facilities

Existing Pedestrian



Figure No. 4:
Facilities

Proposed Pedestrian

4.1.1 Oxford Terrace

- Existing: at grade 2 stage staggered pedestrian zebra crossing with fenced median refuge (with red surfacing under the zebra bars) and streetlighting.
- Proposed: at grade 1 stage wide pedestrian zebra crossing

The existing pedestrian zebra crossing manages priority on each side of the carriageway separately as two separate legal pedestrian crossings. This means one side of the road can continue to operate while pedestrians are crossing on the other side. There is storage kerbside and in the median for pedestrians and the refuge fencing provides protection and channels pedestrians through the crossing. The total crossing distance is approximately 14 metres. For any distance over 10m a refuge is recommended and required at 15m width.

The existing stagger direction is the opposite recommended. It is more appropriate to have a right left stagger in the median so pedestrians enter then walk and look towards the direction traffic is approaching. The red markings under the zebra bars are not recommended as they do not provide sufficient contrast between the bars and the road surfacing for visually impaired road users. NZTA guidance is to apply red surfacing on the vehicle approaches.

The current proposal widens the crossing and shows it as a 1-stage crossing. This means all traffic has to stop for all pedestrians. The limit lines to show drivers where to stop are not shown but are required to be 5m in advance of the zebra stripes. Widening the crossing would also move the limit lines further from the existing crossing location and potentially affect sightlines between pedestrians and drivers. Depending on their location, the limit line position may affect the safety of pedestrians using the refuge island on Knights Road with traffic queueing back from the Oxford Terrace crossing. The proposal for a single stage crossing would reduce pedestrian safety, increase congestion at the intersection and affect the operation of the adjacent intersections.

Raising the crossing onto a platform would highlight pedestrians and reduce speeds at the point of conflict.

Raising the whole intersection on a platform would reduce speeds through the whole intersection and improve driver reaction time and reduce crash severity, however this would cover a large area and the immediate effect of the platform on speeds would be at the entry/exit points rather than at the conflict locations.

Recommendation:

- Zebra – maintain two stage pedestrian crossing in the same location. This can be a wide central refuge or if the stagger is retained, it can be reversed so pedestrians face oncoming traffic when walking in the median. Installation on a raised platform would reduce speeds at the conflict points. Staggered pedestrian crossings can stay as 4m wide zebra crossings or a total width of 8m subject to volume calculations for refuge storage if the sight distance for the current crossing layout meets requirements.



Figure No. 5: Example – zebra crossing on a raised platform with a central refuge

- An alternative is to signalise the two stage pedestrian crossing if volumes are sufficient to warrant this. The stagger is recommended to be retained in this situation to support crossing operation with a change to a right-left stagger. This would need to be modelled to evaluate the impact and confirm whether the whole intersection should be signalised. A signalised crossing would manage priority and create gaps in traffic for other crossing locations and for the side road intersections. A zebra crossing gives priority to pedestrians based on demand where with a signalised crossing you can share priority based on pedestrian and vehicle demand. If you are expecting high volumes of pedestrians or high volumes at specific times signals can better manage priority and congestion. This is subject to road and pedestrian volumes being sufficient.

4.1.2 Pohutukawa Street

- Existing: at grade 2 stage single pedestrian zebra crossing with median refuge island (with red surfacing under the zebra bars) safe hit posts to adjust the edgeline entry taper from Oxford Terrace, streetlighting.
- Proposed: at grade 1 stage pedestrian zebra crossing

The existing crossing is a 2-stage crossing as the road width at the intersection is approximately 15m. For any crossing distance over 10m a staged crossing is recommended (and required at 15m) to provide protection and a location for pedestrians to pause in the median. Single stage crossings increase congestion as drivers are required to stop for all pedestrians rather than for pedestrians crossing on their side of the road.

NZTA recommends crossings close to intersections are in low speed areas and the crossing is set back to provide space for a turning vehicle to yield to pedestrians out of the stream of through traffic.

Recommendation – change kerbline for entry (east) to reduce radius, move crossing south to provide storage space for 1 vehicle at the intersection. Raise crossing on a platform. Retain median refuge if crossing width exceeds 10m at new location.

4.1.3 Knights Road

- Existing: refuge island through Right Turn Bay with speed cushions on both west approach lanes
- Proposed: no change

The existing pedestrian refuge is within the head of the right turn bay. Pedestrians using the refuge would conflict with a vehicle waiting to turn. There is no kerb ramp on the southern side of the crossing and pedestrians cross into the Pohutukawa Street intersection where they are in conflict with left turning traffic. There are speed cushions immediately in advance of the crossing on the western approach. We can assume the zebra crossing on Oxford Terrace provides speed management for westbound traffic on occasion.

Recommend – move the median gap west to ensure it is at least 1 car width behind the right turn bay limit line and allows establishment of kerb ramps on both sides of the intersection. Raise the crossing on a platform and sign as a courtesy crossing. Relocation – may require parking space removal to provide sightlines. Add side islands to reduce crossing distance. Mark the edgeline from Pohutukawa Street west to the parking bays on Knights Road to guide turning traffic and provide space for the side islands.

4.1.4 Birch Street

- Existing: pram ramps
- Proposed: Wide pedestrian zebra crossing

There is an existing build-out on the eastern side of Birch Street which shortens the pedestrian crossing distance. The existing crossing point is approximately 8 metres from Oxford Terrace and should be retained as it is an existing desire line and meets safety guidance.

NZTA recommends crossings close to intersections are low speed areas and the crossing is set back to provide space for a turning vehicle to yield to pedestrians out of the stream of through traffic.

A wide zebra crossing is not recommended as it increases the sighting distance between drivers and pedestrians and encourages pedestrians to cross diagonally, reducing their visibility to traffic and safety.

Recommendation – use existing pram ramps location for the proposed zebra crossing, raise on a platform, add streetlighting. Shorten crossing length proposed.

4.2 South of Waterloo Station



Figure No. 6: Existing



Figure No. 7: Proposed

4.2.1 Cambridge Terrace:

- Existing: underpass
- Proposed: Signalised Pedestrian Crossing

Cambridge Terrace is <10m wide and carries over 12000 vpd. Pedestrian volumes have not been specified, however this will be a main entrance so a signalised pedestrian crossing is a suitable crossing type to manage safety and priority for pedestrians and traffic. To manage speeds, it is recommended the crossing be on a raised platform and side islands be included to reduce the distance pedestrians are exposed to traffic and provide locations for traffic signal poles out of the footpath if possible.

The crossing width should not be excessive as this increases the total crossing footprint, reduces intervisibility between pedestrians and drivers, potentially increases the distance pedestrians need to travel to access a pushbutton and affects the visibility of signal displays to approaching traffic.

4.2.2 Trafalgar Square

- Existing: Refuge islands and Give Way controls
- Proposed: Raised Safety Platform

Trafalgar Square has a 30km/h speed limit and a measured operating speed of 21km/h. The road widths are 13.3m which is a long distance for pedestrians to cross without support. At both intersections there is an existing refuge island to support pedestrians and Give Way markings.

To help define the pedestrian route to the station, raise the profile of pedestrians and support lower traffic speeds a raised safety platform or courtesy crossing is proposed at the intersection. This should include refuge islands to guide traffic and provide support for pedestrians. Side islands would

also support slower entry/exit speeds at the intersection and shorten the crossing distance. Ideally this should provide at least 6m of space between the Give Way limit line and the refuge to allow vehicles to enter and exit without blocking the pedestrian desire line.

Courtesy crossing	Pedestrian platform
	
Courtesy crossings are intended to facilitate eye contact between pedestrians and drivers resulting in a mutually negotiated position over who goes first.	On their own pedestrian platforms provide a focus for pedestrians to cross, however pedestrians must still give way to vehicles.

Figure No. 8: NZTA Pedestrian Network Guidance – non priority crossing aids

5 Background Data

Speeds from Mega Maps, ONF, width and volumes from Mobile Road

Table No. 1: Road Characteristics

Road	Posted Speed Limit (km/h)	Operating Speed (km/h)	ONF	Width (m)	Traffic Volume (vpd) 2025 estimate
Knights Road	50	46	Primary Collector	14.9	25531 2% HCV
Birch Street	50	30	Secondary Collector	13.3	1078, 0% HCV
Oxford Terrace	50	41	Primary Collector	8.6	7880, 5% HCV
Pohutukawa Street	50	42	Primary Collector	8.7	391 5% HCV
Cambridge Terrace	50	49	Primary Collector	10.7	12317 2% HCV
Trafalgar Square	30	21	Secondary Collector	13.3	3323 3% HCV

Figure No. 9: Crash History 2019-2023 (Mega Maps)

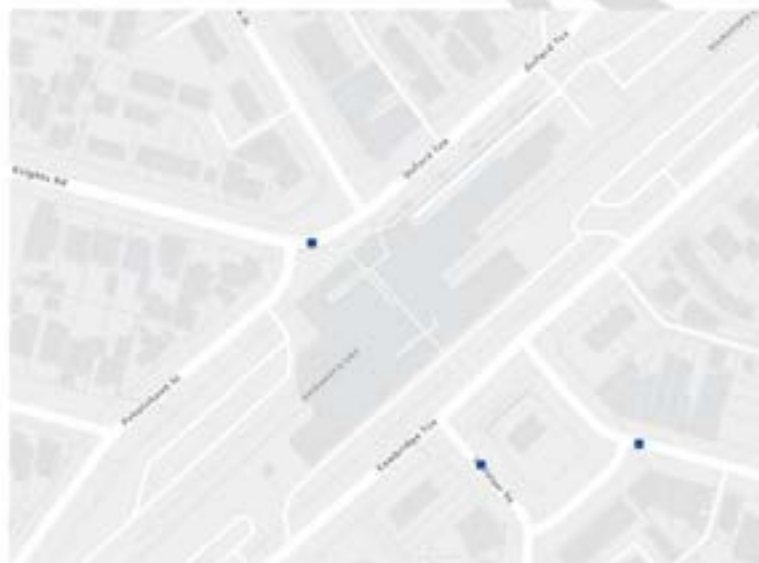


Table No. 2: Crash Details

Oxford Terrace

Rear End Crash, Minor Injury, Sept 2022
11:20am

Factors - alcohol test below limit, failed to notice vehicle slowing, stopping or stationary in front

Trafalgar Square

Manoeuvring Crash, Minor Injury, March 2023,
5:59pm

Factors - Drugs Suspected, Other inappropriate speed conditions, Intentional Collision

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8.4 STATIC MODELLING

Memorandum

To	s7(2)(a)	From	s7(2)(a)
Copy	Emmet McElhatton	Reference	528886
Date	2025-07-17	Pages (including this page)	37
Subject	Waterloo Station Pedestrian Modelling		

1 Introduction

To support the Waterloo Station feasibility study, static pedestrian modelling has been undertaken to inform initial station sizing and planning.

This memo details the sources of data, assumptions, limitations and exclusions, future year passenger demands development, the equations used, and the results of the static pedestrian modelling.

Static pedestrian modelling has been undertaken using passenger demand forecasts for a Design Year of 2046 (representing an indicative Rail Day One plus 15-years) and an Ultimate Design Year of 2061 (representing an indicative Rail Day One plus 30-years).

The memo includes an assessment of the preferred design option, Option 17, in terms of Level of Service performance of the proposed station element provisions over time (from Rail Day One to Rail Day One plus 30-years).

Note, numbers in this memo may not sum to the totals due to rounding.

2 Sources

Static pedestrian modelling has been informed by the reference documents and standards in Table 2.1.

Table 2.1 Reference documents

Document	Revision
Waterloo Transit Oriented Development – Public Transport Minimum Requirements	First Issue (10/04/2025)
Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure	Version 2
Design for Access and Mobility – Buildings and Associated Facilities	NZS 4121:2001
Metro Trains Melbourne – Stations and Public Precincts Standards – A1530	Version 5.0
Transport for New South Wales – Functional Spaces – Part 2 Stations – TS 04951.2.1.0	Version 1.0
Hong Kong MTR Corporation – New Works Design Standards Manual – Section 5 – Architecture and Station Planning	Revision A9
Waterloo B&A.xlsx	Version 1
Waterloo-Station-TOTO-15min_2024-03-11-to-2024-03-17 FIXED.xlsx	Version 2

3 Station layout

While the station layout has not been finalised, for the purpose of static pedestrian modelling a side platform arrangement has been assessed, with an indicative arrangement shown in Figure 3-1.

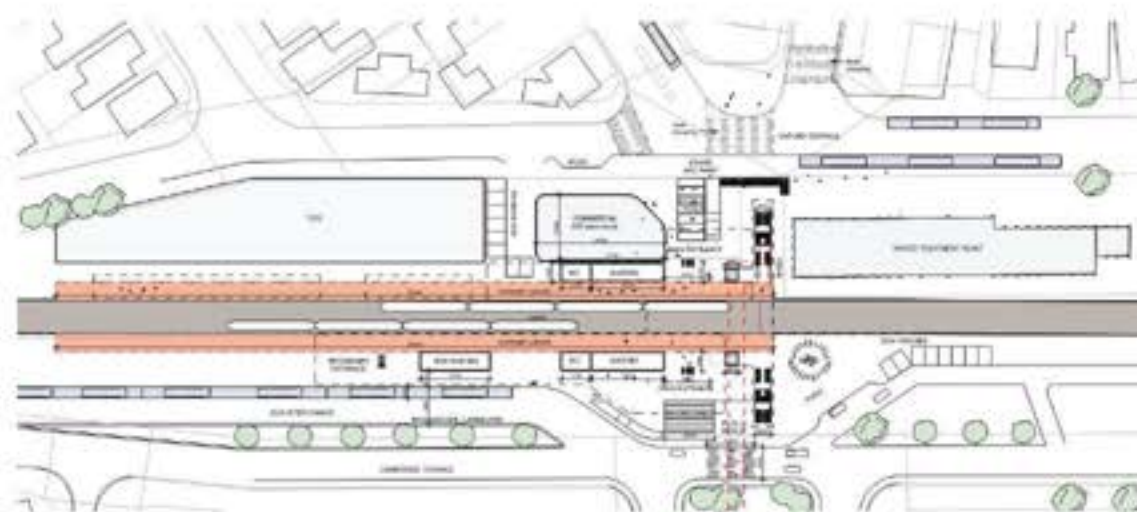


Figure 3-1 Indicative Waterloo Station side platform arrangement (Option 17)

4 Assumptions and data inputs

4.1 Assumptions

Assumptions adopted to undertake the static pedestrian modelling are provided in Table 4.1.

Table 4.1 Assumptions

Assumption	Value	Unit	Source
Peak 5-minute factor	0.4		Section 13 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Peak minute boarding factor	0.2		Section 2.2 - Waterloo Transit Oriented Development – Public Transport Minimum Requirements
Morning peak hour Hutt Valley Line train services	8	trains / hour / direction	Waterloo B&A
	7.5	minutes	
Morning peak hour Wairarapa Line train services	2	trains / hour / direction	Waterloo B&A
	30	minutes	
Evening peak hour Hutt Valley Line train services	8	trains / hour / direction	Waterloo B&A
	7.5	minutes	
	2	trains / hour / direction	Waterloo B&A

Assumption	Value	Unit	Source
Evening peak hour Wairarapa Line train services	30	minutes	
Hutt Valley Line alighting peak concentration	80	per cent	Section 2.2 - Waterloo Transit Oriented Development – Public Transport Minimum Requirements
Wairarapa Line alighting peak concentration	60	per cent	Section 2.2 - Waterloo Transit Oriented Development – Public Transport Minimum Requirements
Delayed service factor ¹	125	per cent	Section 2.2 - Waterloo Transit Oriented Development – Public Transport Minimum Requirements
Normal operation staircase flow rate	28	people / minute / metre	Table 15 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Degraded operation staircase flow rate	35	people / minute / metre	Table 15 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Staircase minimum clear width	1.2	m	Table 5 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Normal operation passageway flow rate	40	people / minute / metre	Table 15 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Degraded operation passageway flow rate	50	people / minute / metre	Table 15 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Passageway minimum clear width	1.8	m	Figure D10 – Design for Access and Mobility – Buildings and Associated Facilities – NZS 4121:2001
Snapper card gate flow rate	25	people / minute / scanner	Table 9 - Metro Trains Melbourne – Stations and Public Precincts Standards – A1530 Section 6.2.5 - Transport for New South Wales – Functional Spaces – Part 2 Stations – TS 04951 2:1.0
Snapper card gate redundancy	1	scanner (if less equal to or less than ten gates)	Section 14 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
	2	scanner (if greater than ten gates)	
Minimum Snapper card gate provision	3	Gates (per access point to the paid area)	Section 14 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Normal operation platform density	0.8	m ² / person	Table 15 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Degraded operation platform density	0.45	m ² / person	Table 15 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure

Assumption	Value	Unit	Source
Platform length	190	m	Section 2.6 - Waterloo Transit Oriented Development – Public Transport Minimum Requirements
Minimum platform width	5.0	m	Section 2.6 - Waterloo Transit Oriented Development – Public Transport Minimum Requirements
Platform distribution (Busiest quarter of platform)	35	per cent	Section 13 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Platform edge effect	1.0	m	Section 13 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Passageway edge effect	0.6	m	Section 14 - Auckland Transport – Transport Design Manual – Engineering Design Code – Public Transport – Rail Infrastructure
Cambridge Terrace (inbound) Station Forecourt Entrance split	17	per cent	Assumption
Cambridge Terrace (inbound) Entrance split	17	per cent	Assumption
Oxford Terrace (outbound) Entrance split	67	per cent	Assumption
Station entrance split uncertainty design factor	75	per cent	Clause 5.1.4.2 Hong Kong MTR Corporation – New Works Design Standards Manual – Section 5 – Architecture and Station Planning
1. The station elements have been designed to achieve the target flows rates for normal operation (i.e. achieving pedestrian level of service C) which does not account for a delayed service. The delayed services has been assessed based on the resultant widths for normal operation and checked against flow rates for degraded operation (i.e. achieving pedestrian level of service D).			

The station entrance split assumptions from Table 4.1 are show illustratively in Figure 4-1.

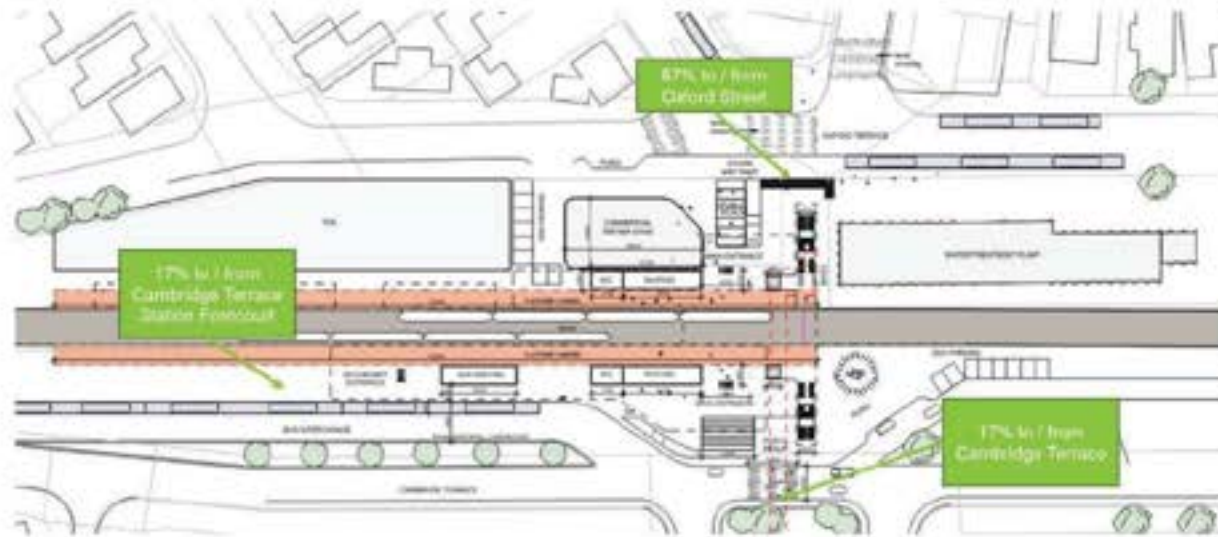


Figure 4-1 Waterloo Station assumed entrance splits

4.2 Existing passenger demand

Snapper data for 11 March to 17 March 2024 was analysed for the morning peak (06:00 to 09:00) and evening peak (15:00 to 18:00) to understand existing rail passenger demands and arrival / departure profiles for Waterloo Station.

March was adopted for the assessment as it represents the 'busy' month as shown in Figure 4-2 and is the month commonly used for Metlink service and investment planning

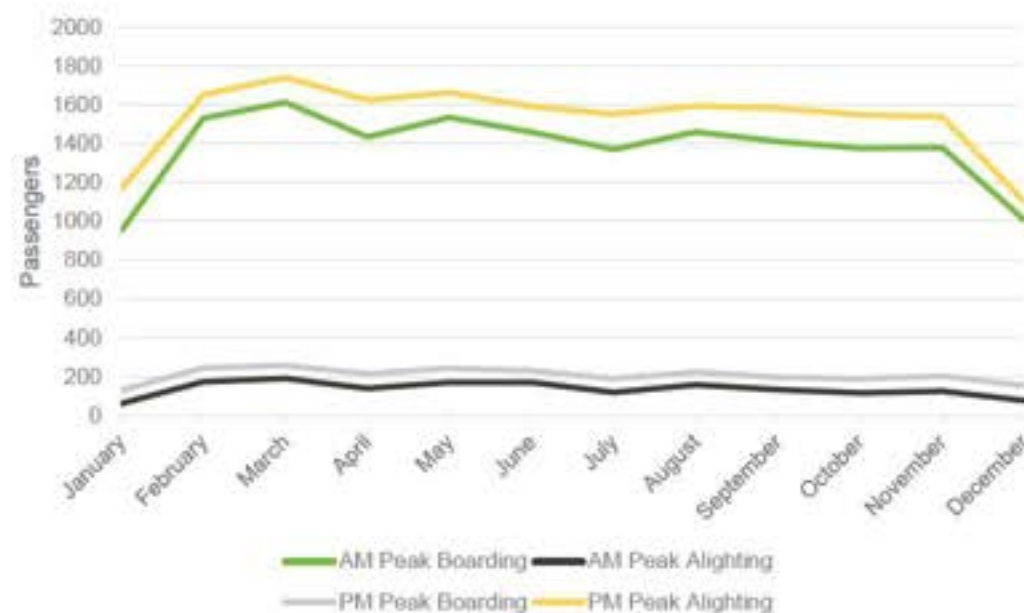


Figure 4-2 Waterloo Station year 2024 weekday daily average boarding and alighting volumes per month

Due to work from home behaviours, data for Monday and Friday was excluded from the assessment as the passenger demands were notably lower than other weekdays. In addition, weekend data was also excluded from the assessment due to lower passengers demands.

The average passenger boarding and alighting demands were therefore based on the data for Tuesday, Wednesday, and Thursday and separated by the Hutt Valley Line (HVL) and Wairarapa Line (WRL).

Passenger demands for the HVL are shown in Figure 4-3 and Figure 4-4, and passenger demands for the WRL are shown in Figure 4-5 and Figure 4-6. The data shows tidal passenger flows, with high inbound (towards Wellington CBD) in the morning and high outbound flows (away from Wellington CBD) in the evening. In addition, with the higher train frequency of the HVL (versus the WRL), the HVL receives most of the passenger demand.

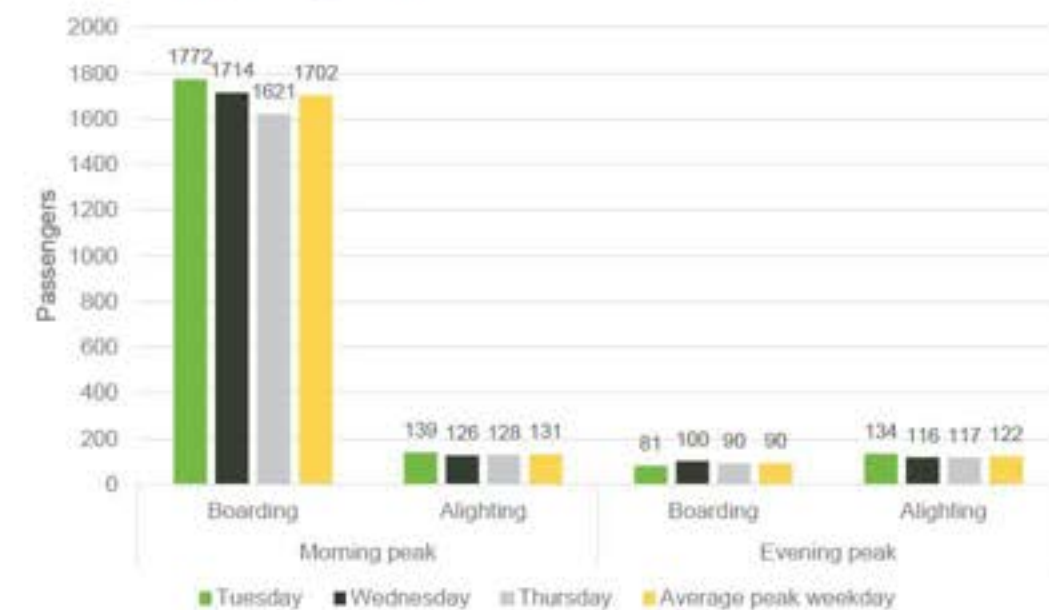


Figure 4-3 Hutt Valley Line (inbound) existing morning and evening 3-hour peak passenger demands

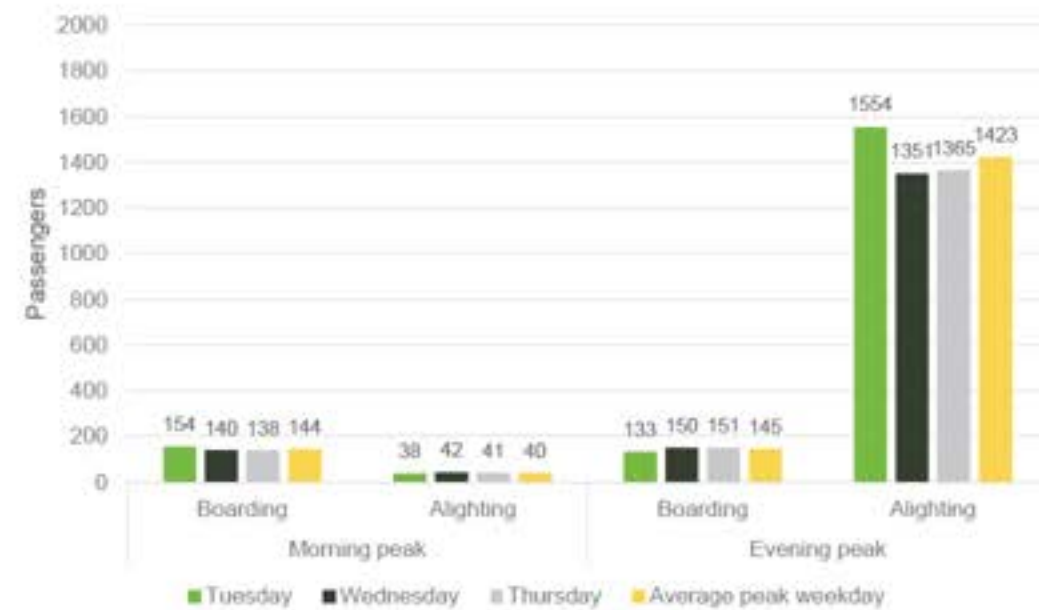


Figure 4-4 Hutt Valley Line (outbound) existing morning and evening 3-hour peak passenger demands

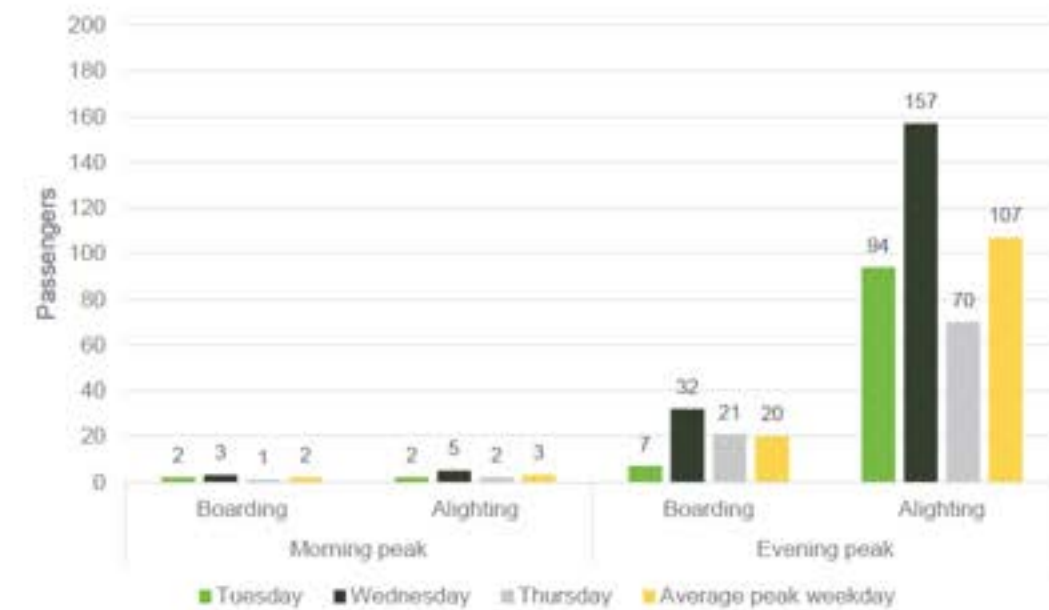


Figure 4-6 Wairarapa Line (outbound) existing morning and evening 3-hour peak passenger demands

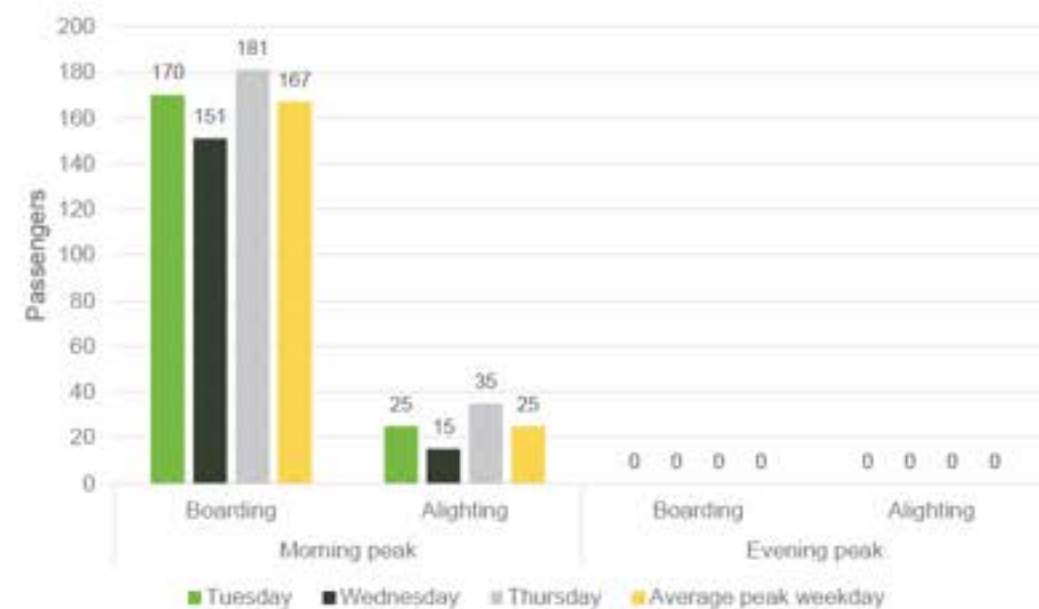


Figure 4-5 Wairarapa Line (inbound) existing morning and evening 3-hour peak passenger demands

4.2.1 Passenger demand distributions

The existing passenger demand distributions between the HVL and WRL for inbound and outbound services are shown in Table 4.2 and Table 4.3 for the morning and evening peaks respectively. The results show the majority of boarding and alighting in the morning peak to be to/from HVL inbound services. While for the evening peak the majority of boarding and alighting is to/from HVL outbound services.

These existing distributions were applied to the future passengers demands (see Section 4.2.2) due to the observed data being more suitable than using the modelled splits.

Table 4.2 Morning 3-hour peak passenger demand distributions

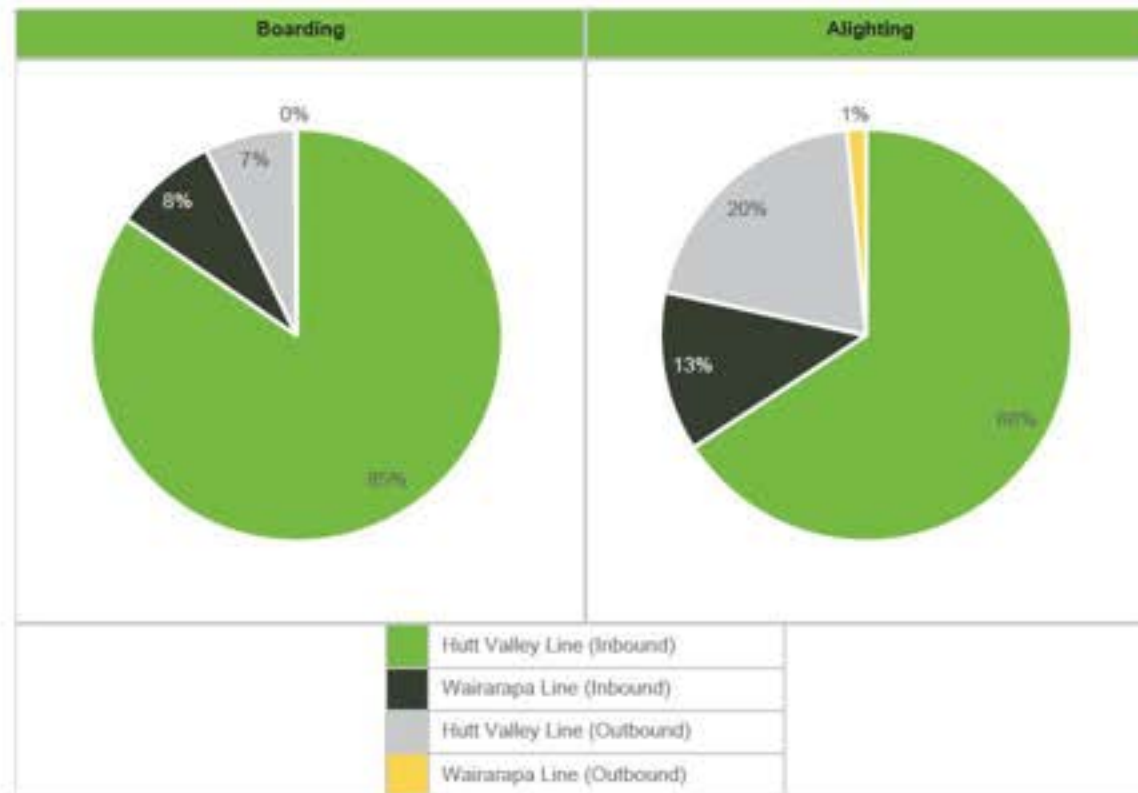
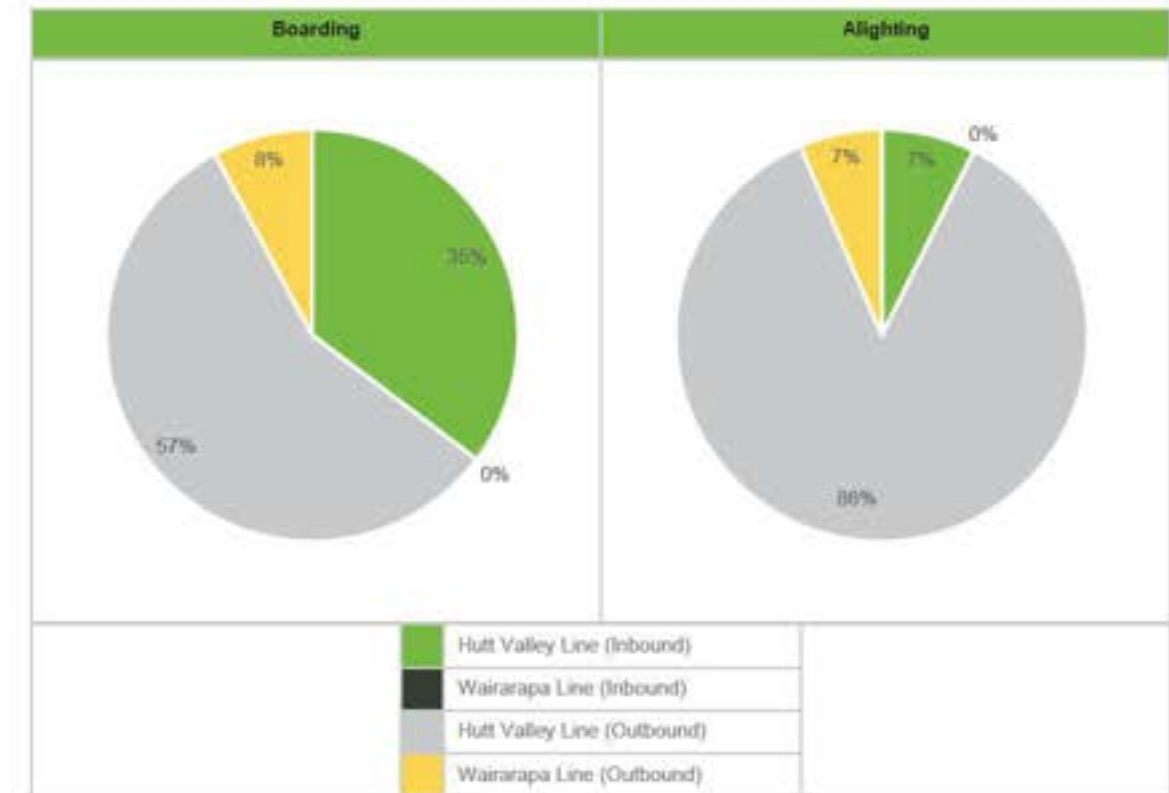


Table 4.3 Evening 3-hour peak passenger demand distributions



4.2.2 Passenger demand profiles

Passenger demand profiles were obtained from the existing Snapper data to understand the proportion of passengers across the morning and evening 3-hour time periods boarding and alighting train services in 15-minute intervals.

The existing profile was then applied to the future year data to identify the peak 15-minute boarding and alighting demands to undertake the static pedestrian modelling.

Hutt Valley Line

The HVL shows relatively even distribution of boarding demand throughout the morning and evening 3-hour periods with the typical peak 15-minute boarding demand representing approximately 18 per cent of the total 3-hour demand (see Figure 4-7 and Figure 4-9).

For alighting passenger profile, both the morning and evening peaks show clear spikes, likely correlating with the train timetable. The morning peak 15-minutes represents 36 per cent of the 3-hour alighting demand and the evening peak 15-minutes represents 23 per cent (see Figure 4-8 and Figure 4-10).

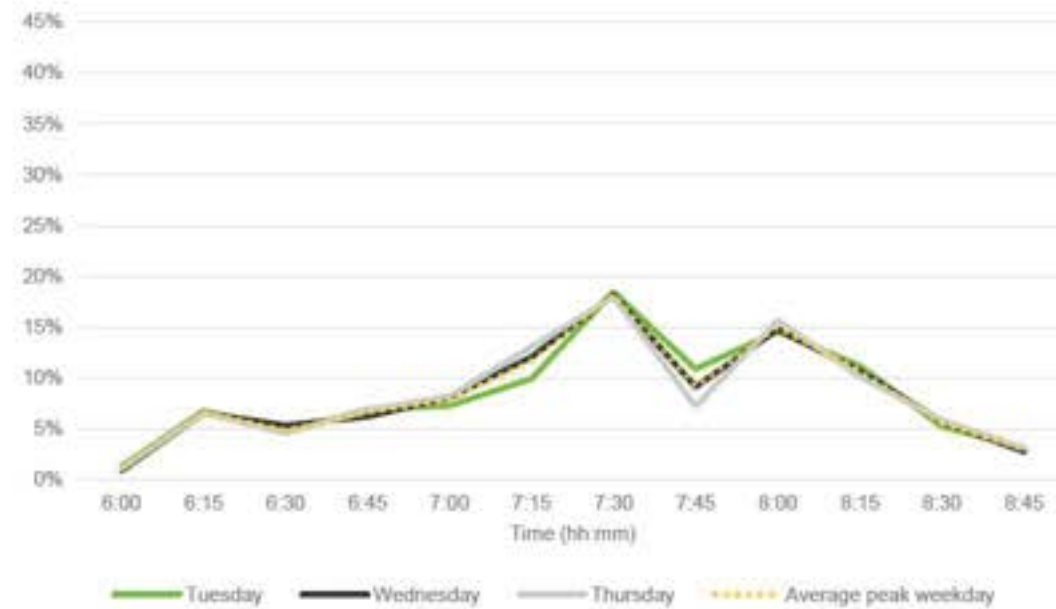


Figure 4-7 Hutt Valley Line morning peak passenger boarding profile

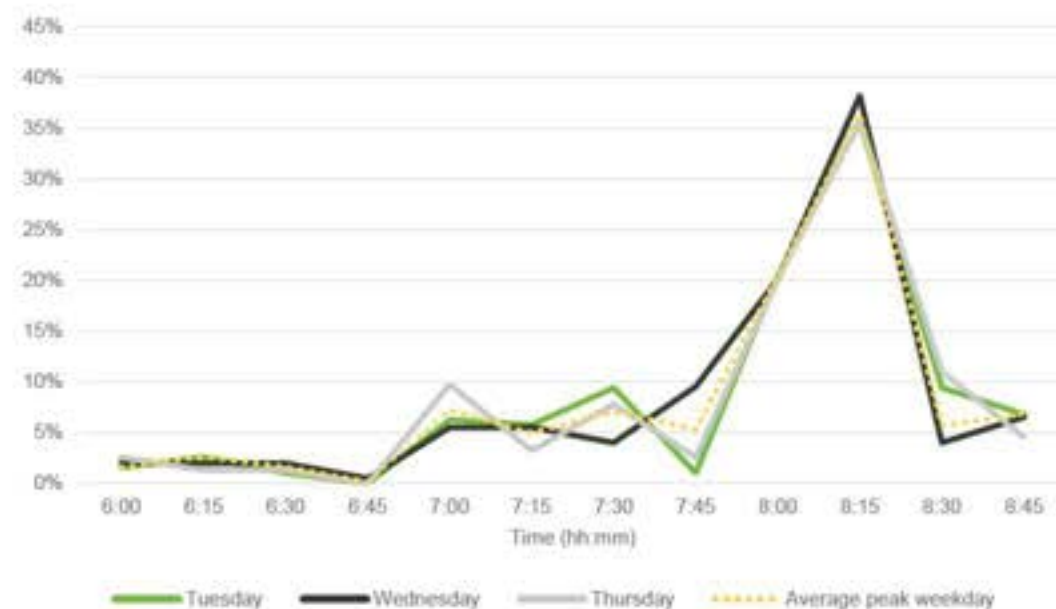


Figure 4-8 Hutt Valley Line morning peak passenger alighting profile

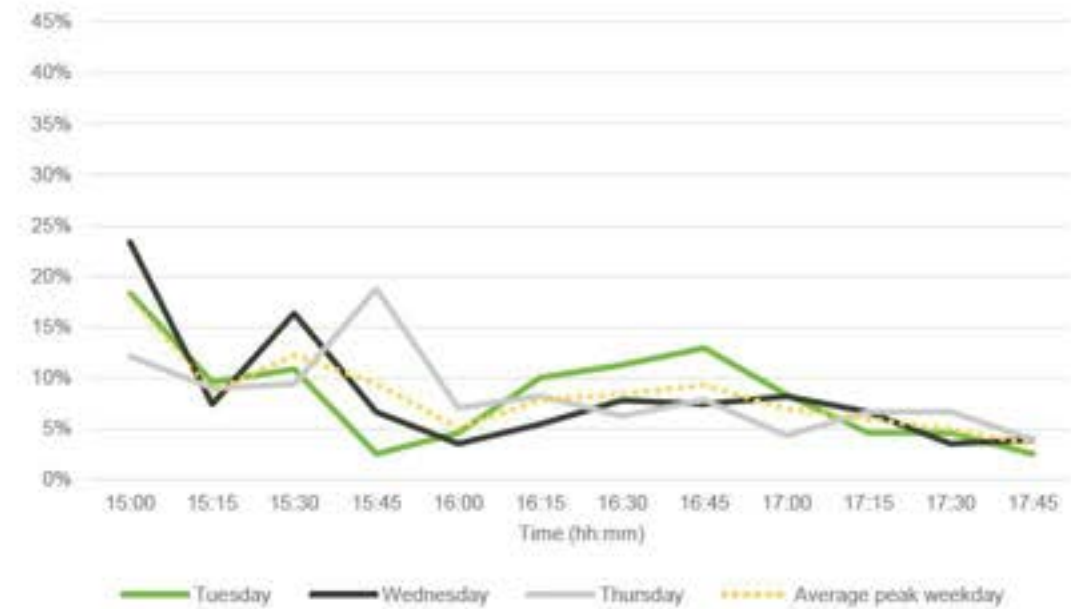


Figure 4-9 Hutt Valley Line evening peak passenger boarding profile

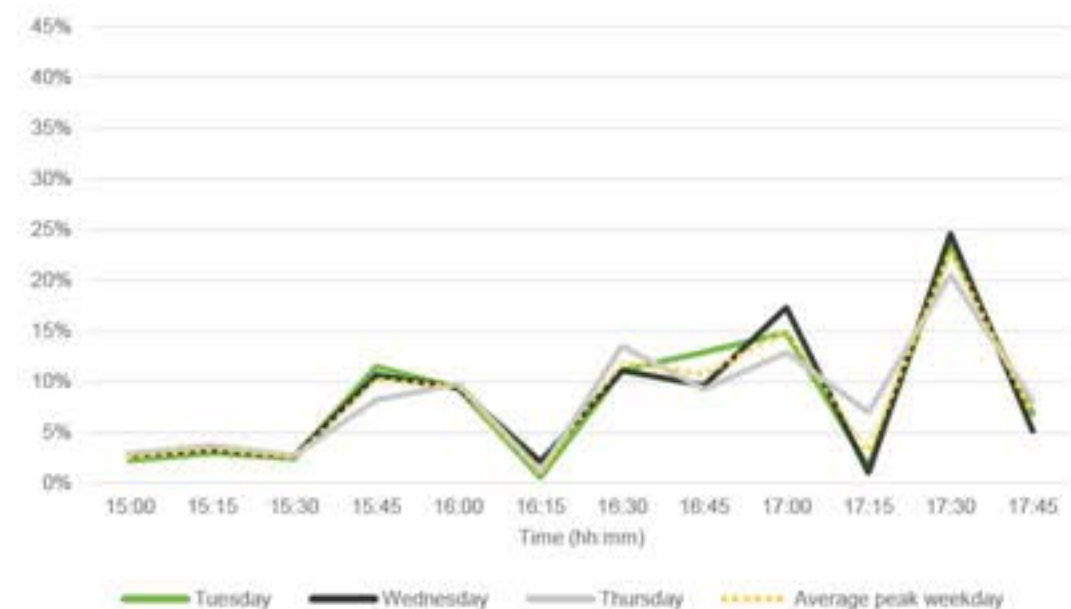


Figure 4-10 Hutt Valley Line evening peak passenger alighting profile

Wairarapa Line

The WRL shows peaks in boarding demand likely coinciding with timetabled train arrivals (with trains approximately every 30 minutes). The morning peak 15-minutes represents 62 per cent of the 3-hour alighting demand and the evening peak 15-minutes represents 46 per cent (see Figure 4-11 and Figure 4-13).

The alighting passenger profile also shows clear spikes, likely correlating with the train timetable. The morning peak 15-minutes represents 43 per cent of the 3-hour alighting demand and the evening peak 15-minutes represents 50 per cent (see Figure 4-12 and Figure 4-14).

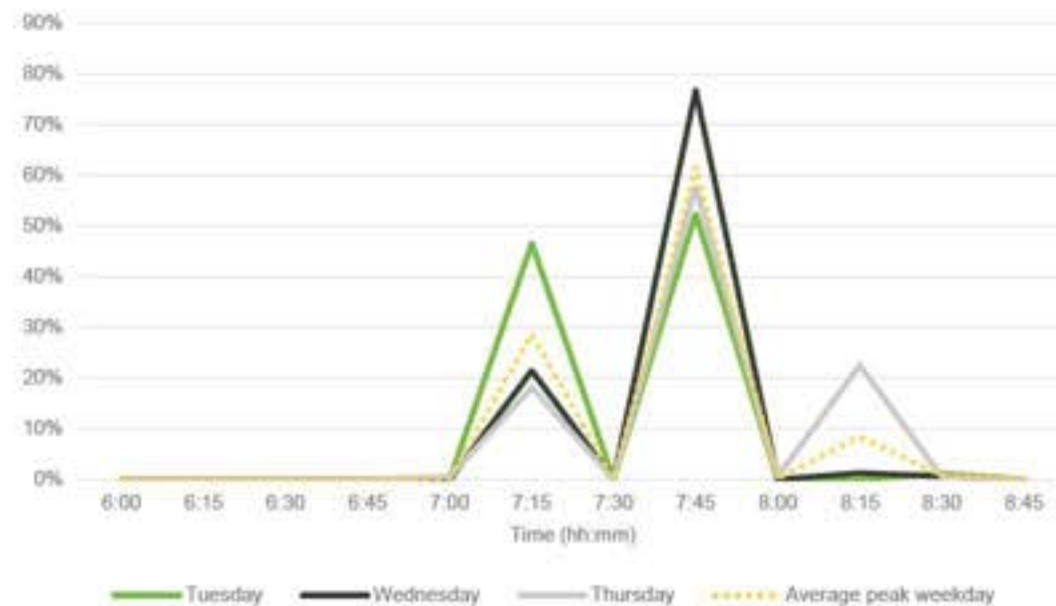


Figure 4-11 Wairarapa Line morning peak passenger boarding profile

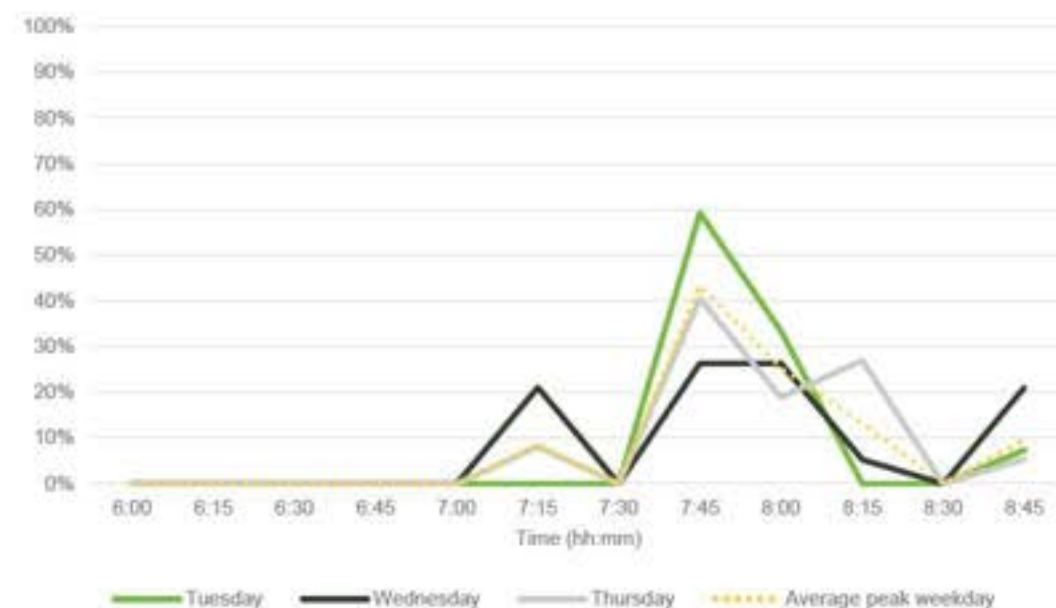


Figure 4-12 Wairarapa Line morning peak passenger alighting profile

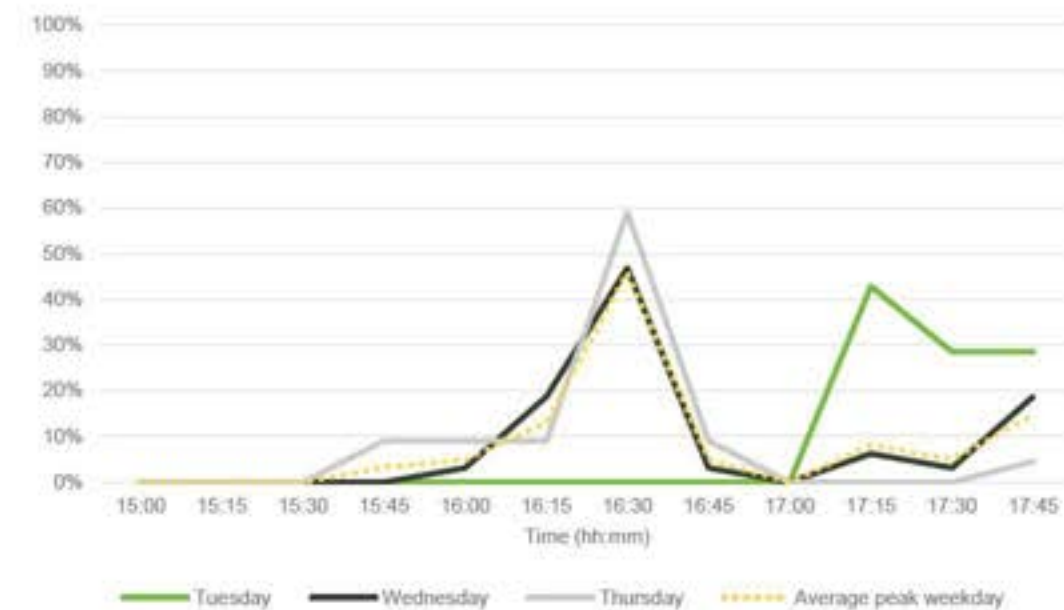


Figure 4-13 Wairarapa Line evening peak passenger boarding profile

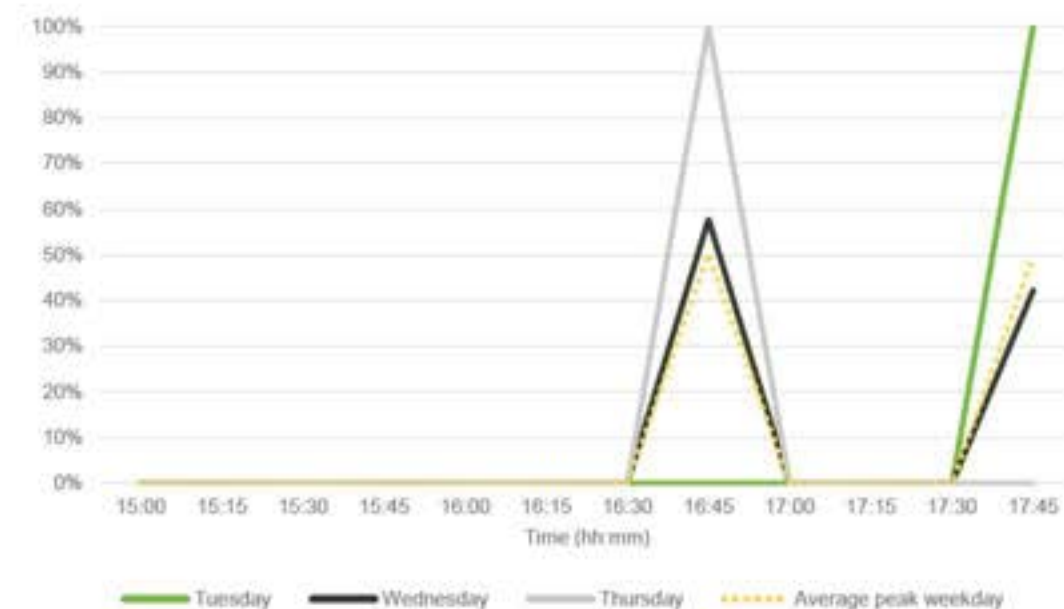


Figure 4-14 Wairarapa Line evening peak passenger alighting profile

4.3 Future passenger demand

Future passenger demand forecasts for the year 2053 were obtained from the Wellington Strategic Demand Model based on population and employment growth rates developed by Sense Partners. The demand forecasts for the morning and evening 3-hour peaks are shown in Table 4.4.

Table 4.4 Modelled morning and evening 3-hour peak passenger demands

Peak	2018		2053		Per annum growth rate (2018 to 2053)	
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
Morning	2073	431	3495	834	1.50%	1.90%
Evening	609	2019	1124	3175	1.77%	1.30%

The morning and evening 3-hour peak demands were distributed by line and direction based on the existing demand distributions shown in Table 4.2 and the outputs are shown in Table 4.5 and Table 4.6.

Table 4.5 Modelled morning 3-hour peak passenger demands by line and direction

Line	2018		2053	
	Boarding	Alighting	Boarding	Alighting
HVL (Inbound)	1751	283	2952	548
WRL (Inbound)	172	54	290	105
Inbound Total	1923	337	3242	653
HVL (Outbound)	148	87	250	169
WRL (Outbound)	2	6	3	13
Outbound Total	150	94	253	181

Table 4.6 Modelled evening 3-hour peak passenger demands by line and direction

Line	2018		2053	
	Boarding	Alighting	Boarding	Alighting
HVL (Inbound)	216	149	398	235
WRL (Inbound)	0	0	0	0
Inbound Total	216	149	398	235
HVL (Outbound)	345	1739	638	2734
WRL (Outbound)	48	131	88	206
Outbound Total	393	1870	726	2940

To account for travel behaviour changes between 2018 and 2024, due to covid and increased work-from-home, rather than using passenger demand numbers from the Wellington Strategic Demand Model, growth rates were obtained from the model which were then applied to the existing 2024 Snapper data. Therefore, better reflecting existing rail passenger demands which are anticipated to continue into the future.

The per annum growth rates from Table 4.5 and Table 4.6 were used to interpolate the growth for the 2046 Design Year and extrapolate the 2061 Ultimate Design Year. As growth rates for the modelled data were applied to the existing Snapper data, growth was re-based to the year 2024 rather than the 2018 model base year.

The resultant growth rates are shown in Figure 4-15 and Table 4.7, and show the highest growth rates for alighting in the morning peak and boarding in the evening peak which correlate with the aspiration of Waterloo becoming a growing destination.

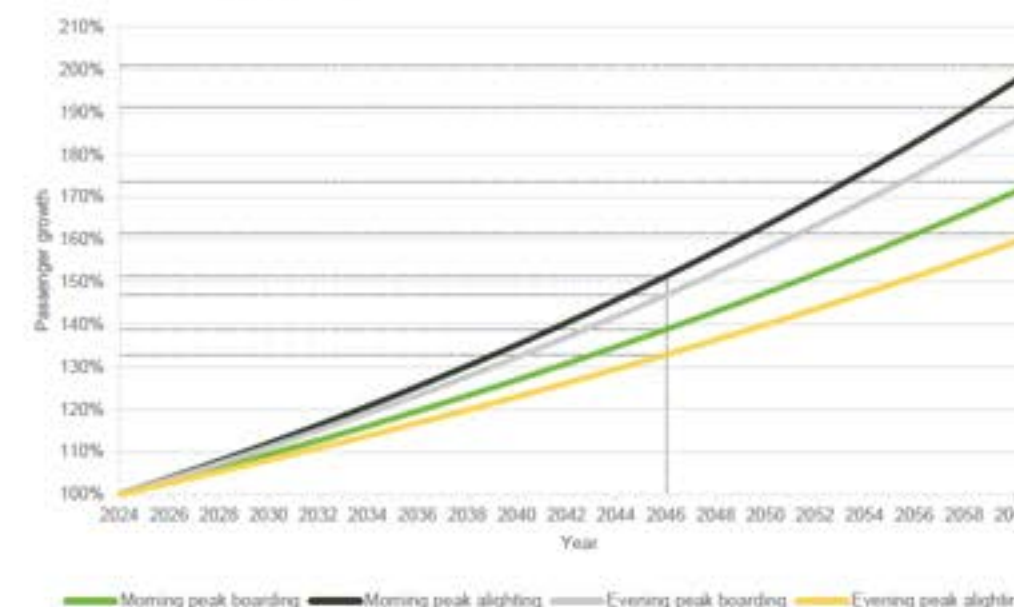


Figure 4-15 Waterloo Station passenger growth rates

Table 4.7 Waterloo Station passenger growth rates from the year 2024

Peak	2046		2061	
	Boarding	Alighting	Boarding	Alighting
Morning	139%	151%	174%	201%
Evening	147%	133%	191%	161%

Applying the growth rates from Table 4.7 and the passenger demand distributions from Table 4.2 and Table 4.3 to the existing Snapper data for the average peak weekday, results in the Design Year and Ultimate Design Year passenger demands in Table 4.8 and Table 4.9.

Table 4.8 Design Year and Ultimate Design Year morning 3-hour peak passenger demands by line and direction

Line	2024		2046		2061	
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
HVL (Inbound)	1702	131	2384	198	2957	263

Line	2024		2046		2061	
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
WRL (Inbound)	167	25	232	38	291	50
Inbound Total	1869	156	2596	236	3248	313
HVL (Outbound)	144	40	200	61	250	81
WRL (Outbound)	2	3	3	5	3	6
Outbound Total	146	43	203	66	253	87

Table 4.9 Design Year and Ultimate Design Year evening 3-hour peak passenger demands by line and direction

Line	2024		2046		2061	
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
HVL (Inbound)	90	122	133	163	173	197
WRL (Inbound)	0	0	0	0	0	0
Inbound Total	90	122	133	163	179	197
HVL (Outbound)	145	1423	213	1892	277	2297
WRL (Outbound)	20	107	29	142	38	173
Outbound Total	165	1530	242	2034	315	2470

5 Limitations and exclusions

The static pedestrian modelling included in this memo includes the following limitations:

- Detailed station entry and exit split information was unavailable and therefore to de-risk elements of the station impacted by the adopted assumptions a 75% reduction in flow rates was applied to station elements at station entrances (as per Hong Kong MTRC approach [see Table 4.1]).
- Passenger demand forecasts were produced for the year 2053, the Ultimate Design Year (2061) forecasts are based on extrapolation with assumes continuation of the modelled annual growth between 2018 and 2053.

The static pedestrian modelling included in this memo excludes the following items:

- Non-rail passengers' usage of the station (e.g. the usage of the proposed overpass to travel between Oxford Terrace and Cambridge Terrace)
- Emergency egress performance
- Back of House areas
- Public toilets
- Usage of ticket offices
- Public precinct

6 Methodology

6.1 Passenger demand

Passenger demand forecasts from Section 4.3 were used to develop peak train boarding and alighting volumes and peak minute volumes for the purposes of determining the minimum provision of passenger station elements. The process to develop these volumes generally followed the process outlined in Section 2.2 of the Waterloo Transit Oriented Development – Public Transport Minimum Requirements, with the exception of the application of the 125% uplift to account for a delayed service (see Table 4.1 for further details).

An overview of passenger demand methodology is provided in Figure 6-1.

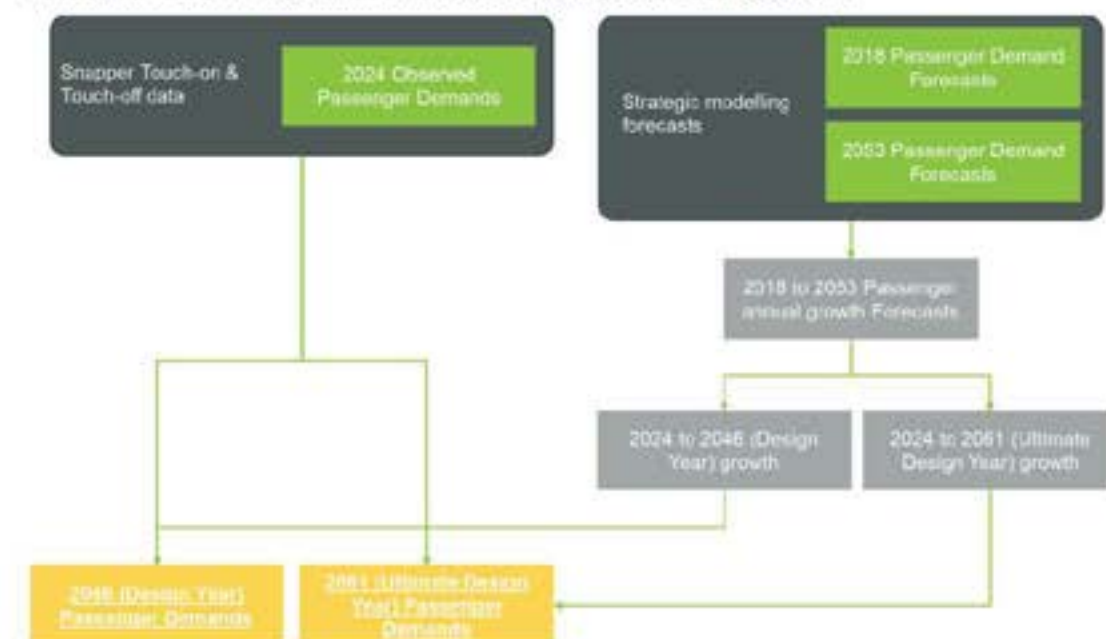


Figure 6-1 Passenger demand methodology overview

6.1.1 Design Year

Morning peak

Applying the existing passenger demand profiles to the adopted Design Year (2046) passenger demand forecasts shows the morning peak 15-minute period for the inbound platform to be 07:30 to 07:45, with a total of 445 passengers boarding and alighting train services (see Table 6.1).

Table 6.1 Design Year (2046) morning peak inbound passenger demands 15-minute intervals

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
06:00 – 06:15	25	3	0	0	25	3	28
06:15 – 06:30	156	5	0	0	156	5	161
06:30 – 06:45	114	3	0	0	114	3	117

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
06:45 – 07:00	156	0	0	0	156	0	157
07:00 – 07:15	185	14	0	0	185	14	199
07:15 – 07:30	275	10	67	3	342	13	355
07:30 – 07:45	430	15	0	0	430	15	445
07:45 – 08:00	216	11	143	16	359	27	386
08:00 – 08:15	354	40	0	10	355	50	405
08:15 – 08:30	252	72	20	5	272	77	349
08:30 – 08:45	131	11	2	0	133	11	144
08:45 – 09:00	70	14	0	4	70	17	88
Total	2364	198	232	38	2596	236	2833

The morning peak 15-minute period for the outbound platform is 08:15 to 08:30 with a total of 44 passengers boarding and alighting train services (see Table 6.2).

Table 6.2 Design Year (2046) morning peak outbound passenger demands 15-minute intervals

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
06:00 – 06:15	2	1	0	0	2	1	3
06:15 – 06:30	13	2	0	0	13	2	15
06:30 – 06:45	10	1	0	0	10	1	11
06:45 – 07:00	13	0	0	0	13	0	13
07:00 – 07:15	16	4	0	0	16	4	20
07:15 – 07:30	23	3	1	0	24	3	27
07:30 – 07:45	36	4	0	0	36	4	41
07:45 – 08:00	18	3	2	2	20	5	25
08:00 – 08:15	30	12	0	1	30	14	44
08:15 – 08:30	22	22	0	1	22	23	44
08:30 – 08:45	11	3	0	0	11	3	15
08:45 – 09:00	6	4	0	0	6	5	11
Total	200	61	3	5	203	66	268

Evening peak

Applying the existing passenger demand profiles to the adopted Design Year (2046) passenger demand forecasts shows the evening peak 15-minute period for the inbound platform to be 17:30 to 17:45, with a total of 45 passengers boarding and alighting train services (see Table 6.3).

Table 6.3 Design Year (2046) evening peak inbound passenger demands 15-minute intervals

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
15:00 – 15:15	24	4	0	0	24	4	28
15:15 – 15:30	11	5	0	0	11	5	17
15:30 – 15:45	16	4	0	0	16	4	20
15:45 – 16:00	13	17	0	0	13	17	29
16:00 – 16:15	7	15	0	0	7	15	22
16:15 – 16:30	10	2	0	0	10	2	12
16:30 – 16:45	11	19	0	0	11	19	30
16:45 – 17:00	12	17	0	0	12	17	30
17:00 – 17:15	9	24	0	0	9	24	34
17:15 – 17:30	8	5	0	0	8	5	13
17:30 – 17:45	7	38	0	0	7	38	45
17:45 – 18:00	5	11	0	0	5	11	16
Total	133	163	0	0	133	163	295

The evening peak 15-minute period for the outbound platform is 17:30 to 17:45 with a total of 44 passengers boarding and alighting train services (see Table 6.4).

Table 6.4 Design Year (2046) evening peak outbound passenger demands 15-minute intervals

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
15:00 – 15:15	38	50	0	0	38	50	88
15:15 – 15:30	18	63	0	0	18	63	81
15:30 – 15:45	26	50	0	0	26	50	76
15:45 – 16:00	20	193	1	0	21	193	214
16:00 – 16:15	11	180	1	0	12	180	192
16:15 – 16:30	17	24	4	0	21	24	45
16:30 – 16:45	18	225	13	0	31	225	256

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
16:45 – 17:00	20	203	1	72	21	275	296
17:00 – 17:15	15	285	0	0	15	285	299
17:15 – 17:30	13	59	2	0	15	59	74
17:30 – 17:45	10	433	1	0	12	433	445
17:45 – 18:00	7	127	4	71	12	198	209
Total	213	1892	29	142	242	2034	2276

6.1.2 Ultimate Design Year

Morning peak

Applying the existing passenger demand profiles to the adopted Ultimate Design Year (2061) passenger demand forecasts shows the morning peak 15-minute period for the inbound platform to be 07:30 to 07:45, with a total of 556 passengers boarding and alighting train services (see Table 6.5).

Table 6.5 Ultimate Design Year (2061) morning peak inbound passenger demands 15-minute intervals

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
06:00 – 06:15	31	4	0	0	31	4	35
06:15 – 06:30	195	7	0	0	195	7	202
06:30 – 06:45	143	4	0	0	143	4	147
06:45 – 07:00	196	0	0	0	196	0	196
07:00 – 07:15	231	19	1	0	231	19	251
07:15 – 07:30	344	13	84	4	427	17	445
07:30 – 07:45	538	19	0	0	538	19	556
07:45 – 08:00	270	14	179	22	449	36	484
08:00 – 08:15	443	54	1	13	444	66	510
08:15 – 08:30	316	96	25	7	340	102	442
08:30 – 08:45	164	15	2	0	167	15	181
08:45 – 09:00	88	18	0	5	88	23	111
Total	2957	263	291	50	3248	313	3561

The morning peak 15-minute period for the outbound platform is 08:15 to 08:30 with a total of 58 passengers boarding and alighting train services (see Table 6.6).

Table 6.6 Ultimate Design Year (2061) morning peak outbound passenger demands 15-minute intervals

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
06:00 – 06:15	3	1	0	0	3	1	4
06:15 – 06:30	17	2	0	0	17	2	19
06:30 – 06:45	12	1	0	0	12	1	13
06:45 – 07:00	17	0	0	0	17	0	17
07:00 – 07:15	20	6	0	0	20	6	25
07:15 – 07:30	29	4	1	1	30	5	35
07:30 – 07:45	45	6	0	0	45	6	51
07:45 – 08:00	23	4	2	3	25	7	32
08:00 – 08:15	37	17	0	2	37	18	56
08:15 – 08:30	27	30	0	1	27	31	58
08:30 – 08:45	14	5	0	0	14	5	19
08:45 – 09:00	7	6	0	1	7	6	14
Total	250	81	3	6	254	87	341

Evening peak

Applying the existing passenger demand profiles to the adopted Ultimate Design Year (2061) passenger demand forecasts shows the evening peak 15-minute period for the inbound platform to be 17:30 to 17:45, with a total of 55 passengers boarding and alighting train services (see Table 6.7).

Table 6.7 Ultimate Design Year (2061) evening peak inbound passenger demands 15-minute intervals

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
15:00 – 15:15	31	5	0	0	31	5	36
15:15 – 15:30	15	7	0	0	15	7	21
15:30 – 15:45	21	5	0	0	21	5	26
15:45 – 16:00	16	20	0	0	16	20	36
16:00 – 16:15	9	19	0	0	9	19	27
16:15 – 16:30	14	3	0	0	14	3	16
16:30 – 16:45	14	23	0	0	14	23	38
16:45 – 17:00	16	21	0	0	16	21	37

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
17:00 – 17:15	12	30	0	0	12	30	42
17:15 – 17:30	10	6	0	0	10	6	16
17:30 – 17:45	9	46	0	0	9	46	55
17:45 – 18:00	6	13	0	0	6	13	19
Total	173	197	0	0	173	197	370

The evening peak 15-minute period for the outbound platform is 17:30 to 17:45 with a total of 542 passengers boarding and alighting train services (see Table 6.8).

Table 6.8 Design Year (2046) evening peak outbound passenger demands 15-minute intervals

Time period	Hutt Valley Line		Wairarapa Line		Total		
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Total
15:00 – 15:15	50	61	0	0	50	61	110
15:15 – 15:30	24	76	0	0	24	76	100
15:30 – 15:45	34	60	0	0	34	60	94
15:45 – 16:00	26	235	1	0	27	235	262
16:00 – 16:15	14	219	2	0	16	219	234
16:15 – 16:30	22	29	5	0	27	29	56
16:30 – 16:45	23	273	18	0	41	273	314
16:45 – 17:00	26	247	2	87	28	334	361
17:00 – 17:15	19	345	0	0	19	345	365
17:15 – 17:30	17	72	3	0	20	72	91
17:30 – 17:45	14	526	2	0	16	526	542
17:45 – 18:00	10	154	6	86	15	240	255
Total	277	2297	38	173	315	2470	2784

6.1.3 Passenger demand summary

The peak 15-minute demand was then converted into peak train service demand based on the train frequencies in Table 4.1. Peak minute boarding demand was calculated using the factors in Table 4.1 and the alighting peak minute was determined based on the HVL and WRL peak concentration percentages in Table 4.1. The resultant peak demands for sizing the station elements for the morning and evening peaks are shown in Table 6.9 and Table 6.10.

Table 6.9 Morning peak demand summary

	Design Year 2046				Ultimate Design Year 2061			
	Inbound		Outbound		Inbound		Outbound	
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
Peak 15-minutes	430	15	22	23	538	19	27	31
Peak train service	215	8	11	12	269	10	14	15
Peak minute	35	6	2	9	44	8	3	12

Table 6.10 Evening peak demand summary

	Design Year 2046				Ultimate Design Year 2061			
	Inbound		Outbound		Inbound		Outbound	
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
Peak 15-minutes	7	38	12	433	9	46	16	526
Peak train service	4	19	6	217	5	23	7	263
Peak minute	1	15	1	174	1	19	2	211

6.2 Assessment equations

The equations used to undertake the static pedestrian modelling assessment are detailed in Section 6.2.1 to Section 6.2.4.

6.2.1 Platform width

$$\text{Platform width} = \frac{\text{platform load per headway} \times \text{platform distribution [35\%]} \times \text{platform density [0.8m}^2/\text{person]}}{\text{platform length} \times 25\%} + \text{platform edge effect [1m]}$$

Equation 6-1 Platform width

6.2.2 Snapper card gates

$$\text{roundup} \frac{\text{peak minute boarding flow}}{\text{snapper card gate flow rate [15 people / minute]}} + \text{roundup} \frac{\text{peak minute alighting flow}}{\text{snapper card gate flow rate [15 people / minute]}}$$

Equation 6-2 Snapper card gates

6.2.3 Staircase width

$$\frac{\text{peak minute flow}}{\text{staircase flow rate [28 people / minute / metre]}}$$

Equation 6-3 Staircase width

6.2.4 Passageway width

$$\frac{\text{peak minute flow}}{\text{passageway flow rate [40 people / minute / metre]}} + \text{passageway edge effect [0.6m]}$$

Equation 6-4 Passageway width

7 Results

Based on the assumptions in Section 4.1 and methodology detailed in Section 5, the minimum station elements are provided in Table 7.1 for a side platform arrangement and illustrated in Figure 7-1 for the Design Year.

All widths are clear widths (i.e. width between handrails).

Section 7.1 to 7.3 provides details of the calculations used to determine the minimum provisions.

Table 7.1 Side platform arrangement minimum station elements provision

Station element	Minimum provision		Delta (Ultimate Design Year – Design Year)
	Design Year	Ultimate Design Year	
Inbound platform width	5.0 m	5.0 m	+0.0 m
Outbound platform width	5.0 m	5.0 m	+0.0 m
Inbound platform Snapper card gates	4 gates	4 gates	+0 gates
Outbound platform Snapper card gates	9 gates	11 gates	+2 gates
Overpass width	3.0 m	3.6 m	+0.6 m
Overpass staircase	3.4 m	4.2 m	+0.8 m
Oxford Terrace Station Forecourt staircase	6.1 m	7.5 m	+1.4 m
Cambridge Terrace Station Forecourt staircase	3.3 m	4.0 m	+0.7 m



Figure 7-1 Waterloo Station Design Year (2046) minimum station elements provision

7.1 Platform width

Table 7.2 Design Year (2046) minimum platform width

Step		Morning peak				Evening peak			
		Inbound platform		Outbound platform		Inbound platform		Outbound platform	
		Value	Unit	Value	Unit	Value	Unit	Value	Unit
1	Peak train boarding demand	215	people	11	people	4	people	6	people
2	Peak train alighting demand	8	people	12	people	19	people	217	people
3	Platform load per headway (Step 1 plus Step 2)	223	people	23	people	23	people	223	people
4	Busiest platform quarter (Step 3 multiplied by 35%)	79	people	9	people	9	people	79	people
5	Platform area (Step 4 multiplied by 0.8)	63.2	m ²	7.2	m ²	7.2	m ²	63.2	m ²
6	Platform width (Step 5 divided by 190 multiplied by 25% plus 1m)	2.4	m	1.2	m	1.2	m	2.4	m
7	Minimum platform width (GWRC Minimum Requirements)	5.0	m	5.0	m	5.0	m	5.0	m

Table 7.3 Ultimate Design Year (2061) minimum platform width

Step		Morning peak				Evening peak			
		Inbound platform		Outbound platform		Inbound platform		Outbound platform	
		Value	Unit	Value	Unit	Value	Unit	Value	Unit
1	Peak train boarding demand	269	people	14	people	5	people	7	people
2	Peak train alighting demand	10	people	15	people	23	people	263	people
3	Platform load per headway (Step 1 plus Step 2)	279	people	29	people	28	people	270	people
4	Busiest platform quarter (Step 3 multiplied by 35%)	98	people	11	people	10	people	95	people
5	Platform area (Step 4 multiplied by 0.8)	78.4	m ²	8.8	m ²	8.0	m ²	76.0	m ²
6	Platform width (Step 5 divided by 190 multiplied by 25% plus 1m)	2.7	m	1.2	m	1.2	m	2.6	m
7	Minimum platform width (GWRC Minimum Requirements)	5.0	m	5.0	m	5.0	m	5.0	m

7.2 Snapper card gates

Table 7.4 Design Year (2046) minimum Snapper card gate provision

Step		Morning peak				Evening peak			
		Inbound platform		Outbound platform		Inbound platform		Outbound platform	
		Value	Unit	Value	Unit	Value	Unit	Value	Unit
1	Peak minute boarding demand	35	people	2	people	1	people	1	people
2	Peak minute alighting demand	6	people	9	people	15	people	174	people
3	Required boarding Snapper card gates (roundup Step 1 divided by 25)	2	gates	1	gates	1	gates	1	gates
4	Required Snapper card gates (roundup Step 2 divided by 25)	1	gates	1	gates	1	gates	7	gates
5	Snapper card gate redundancy provision	1	gates	1	gates	1	gates	1	gates
6	Total Snapper card gate provision (Step 3 plus Step 4 plus Step 5)	4	gates	3	gates	3	gates	9	gates
7	Minimum Snapper card gate provision	4	gates	3	gates	3	gates	9	gates

Table 7.5 Ultimate Design Year (2061) minimum Snapper card gate provision

Step		Morning peak				Evening peak			
		Inbound platform		Outbound platform		Inbound platform		Outbound platform	
		Value	Unit	Value	Unit	Value	Unit	Value	Unit
1	Peak minute boarding demand	44	people	3	people	1	people	2	people
2	Peak minute alighting demand	8	people	12	people	19	people	211	people
3	Required boarding Snapper card gates (roundup Step 1 divided by 25)	2	gates	1	gates	1	gates	1	gates
4	Required Snapper card gates (roundup Step 2 divided by 25)	1	gates	1	gates	1	gates	9	gates
5	Snapper card gate redundancy provision	1	gates	1	gates	1	gates	1	gates
6	Total Snapper card gate provision (Step 3 plus Step 4 plus Step 5)	4	gates	3	gates	3	gates	11	gates
7	Minimum Snapper card gate provision	4	gates	3	gates	3	gates	11	gates

7.3 Overpass width

Table 7.6 Design Year (2046) station overpass minimum width

Step		Morning peak		Evening peak	
		Value	Unit	Value	Unit
1	Inbound peak minute boarding demand	35	people	1	people
2	Inbound peak minute boarding demand from Oxford Terrace (Step 1 multiplied by 67%)	24	people	1	people
3	Inbound peak minute alighting demand	6	people	15	people
4	Inbound peak minute alighting demand to Oxford Terrace (Step 3 multiplied by 67%)	4	people	10	people
5	Outbound peak minute boarding demand	2	people	1	people
6	Outbound peak minute boarding demand from Cambridge Terrace (Step 5 multiplied by 34%)	2	people	1	people
7	Outbound peak minute alighting demand	9	people	174	people
8	Outbound peak minute alighting demand from Cambridge Terrace (Step 7 multiplied by 34%)	4	people	58	people
9	Peak minute demand (summation of Steps 2, 4, 6, and 8)	34	people	70	people

Step		Morning peak		Evening peak	
		Value	Unit	Value	Unit
10	Overpass width (Step 9 divided by 40 multiplied by 75% [entrance split uncertainty factor]) plus 0.6)	1.8	m	3.0	m
11	Minimum overpass width	1.8	m	3.0	m

Table 7.7 Ultimate Design Year (2061) station overpass minimum width

Step		Inbound platform			
		Morning peak		Evening peak	
		Value	Unit	Value	Unit
1	Peak minute inbound boarding demand	44	people	1	people
2	Inbound peak minute boarding demand from Oxford Terrace (Step 1 multiplied by 67%)	30	people	1	people
3	Peak minute inbound alighting demand	8	people	19	people
4	Inbound peak minute alighting demand to Oxford Terrace (Step 3 multiplied by 67%)	6	people	13	people
5	Peak minute outbound boarding demand	3	people	2	people
6	Outbound peak minute boarding demand from Cambridge Terrace (Step 5 multiplied by 34%)	2	people	2	people
7	Peak minute outbound alighting demand	12	people	211	people
8	Outbound peak minute alighting demand to Cambridge Terrace (Step 7 multiplied by 34%)	4	people	72	people
9	Peak minute demand (summation of Steps 2, 4, 6, and 8)	42	people	88	people
10	Overpass width (Step 9 divided by 40 multiplied by 75% [entrance split uncertainty factor]) plus 0.6)	2.0	m	3.6	m
11	Minimum overpass width	2.0	m	3.6	m

7.4 Overpass staircase widths

Table 7.8 Design Year (2046) overpass minimum staircase widths

Step		Inbound platform			
		Morning peak		Evening peak	
		Value	Unit	Value	Unit
1	Peak minute inbound boarding demand	35	people	1	people
2	Inbound peak minute boarding demand from Oxford Terrace (Step 1 multiplied by 67%)	24	people	1	people

Step		Inbound platform			
		Morning peak		Evening peak	
		Value	Unit	Value	Unit
3	Peak minute inbound alighting demand	6	people	15	people
4	Inbound peak minute alighting demand to Oxford Terrace (Step 3 multiplied by 67%)	4	people	10	people
5	Peak minute outbound boarding demand	2	people	2	people
6	Outbound peak minute boarding demand from Cambridge Terrace (Step 5 multiplied by 34%)	2	people	2	people
7	Peak minute outbound alighting demand	9	people	174	people
8	Outbound peak minute alighting demand to Cambridge Terrace (Step 7 multiplied by 34%)	2	people	58	people
9	Peak minute demand (summation of Steps 2, 4, 6, and 8)	34	people	71	people
10	Staircase width (Step 9 divided by 28 multiplied by 75% [entrance split uncertainty factor])	1.7	m	3.4	m
11	Minimum staircase width	1.7	m	3.4	m

Table 7.9 Design Year (2061) inbound platform overpass minimum staircase width

Step		Morning peak		Evening peak	
		Value	Unit	Value	Unit
1	Peak minute inbound boarding demand	44	people	1	people
2	Inbound peak minute boarding demand from Oxford Terrace (Step 1 multiplied by 67%)	30	people	1	people
3	Peak minute inbound alighting demand	8	people	19	people
4	Inbound peak minute alighting demand to Oxford Terrace (Step 3 multiplied by 67%)	6	people	13	people
5	Peak minute outbound boarding demand	3	people	2	people
6	Outbound peak minute boarding demand from Cambridge Terrace (Step 5 multiplied by 34%)	2	people	2	people
7	Peak minute outbound alighting demand	12	people	211	people
8	Outbound peak minute alighting demand to Cambridge Terrace (Step 7 multiplied by 34%)	4	people	72	people
9	Peak minute demand (summation of Steps 2, 4, 6, and 8)	42	people	88	people
12	Staircase width (Step 9 divided by 28 multiplied by 75% [entrance split uncertainty factor])	2.0	m	4.2	m
13	Minimum staircase width	2.0	m	4.2	m

7.5 Oxford Terrace Station Forecourt staircase

Table 7.10 Design Year (2046) Oxford Terrace Station Forecourt minimum staircase width

Step		Oxford Terrace			
		Morning peak		Evening peak	
		Value	Unit	Value	Unit
1	Inbound peak minute boarding demand	35	people	1	people
2	Inbound peak minute boarding demand from Oxford Terrace (Step 1 multiplied by 67%)	24	people	1	people
3	Inbound peak minute alighting demand	6	people	15	people
4	Inbound peak minute alighting demand to Oxford Terrace (Step 3 multiplied by 67%)	4	people	10	people
5	Outbound peak minute boarding demand	2	people	1	people
6	Outbound peak minute boarding demand from Oxford Terrace (Step 5 multiplied by 67%)	2	people	1	people
7	Outbound peak minute alighting demand	9	people	174	people
8	Outbound peak minute alighting demand to Oxford Terrace (Step 7 multiplied by 67%)	6	people	116	people
9	Peak minute demand (summation of Steps 2, 4, 6, and 8)	36	people	128	people
10	Staircase width (Step 9 divided by 28 multiplied by 75% [entrance split uncertainty factor])	1.8	m	6.1	m
11	Minimum staircase width	1.8	m	6.1	m

Table 7.11 Ultimate Design Year (2061) Oxford Terrace Station Forecourt minimum staircase width

Step		Oxford Terrace			
		Morning peak		Evening peak	
		Value	Unit	Value	Unit
1	Inbound peak minute boarding demand	44	people	1	people
2	Inbound peak minute boarding demand from Oxford Terrace (Step 1 multiplied by 67%)	30	people	1	people
3	Inbound peak minute alighting demand	8	people	19	people
4	Inbound peak minute alighting demand to Oxford Terrace (Step 3 multiplied by 67%)	6	people	13	people
5	Outbound peak minute boarding demand	3	people	2	people
6	Outbound peak minute boarding demand from Oxford Terrace (Step 5 multiplied by 67%)	2	people	2	people
7	Outbound peak minute alighting demand	12	people	211	people

Step		Oxford Terrace			
		Morning peak		Evening peak	
		Value	Unit	Value	Unit
8	Outbound peak minute alighting demand to Oxford Terrace (Step 7 multiplied by 67%)	8	people	141	people
9	Peak minute demand (summation of Steps 2, 4, 6, and 8)	46	people	157	people
10	Staircase width (Step 9 divided by 28 multiplied by 75% [entrance split uncertainty factor])	2.2	m	7.5	m
11	Minimum staircase width	2.2	m	7.5	m

7.6 Cambridge Terrace Station Forecourt staircase

Table 7.12 Design Year (2046) Cambridge Terrace Station Forecourt minimum staircase width

Step		Cambridge Terrace			
		Morning peak		Evening peak	
		Value	Unit	Value	Unit
1	Inbound peak minute boarding demand	35	people	1	people
2	Inbound peak minute boarding demand from Cambridge Terrace (Step 1 multiplied by 34%)	12	people	1	people
3	Inbound peak minute alighting demand	6	people	15	people
4	Inbound peak minute alighting demand to Cambridge Terrace (Step 3 multiplied by 34%)	2	people	6	people
5	Outbound peak minute boarding demand	2	people	1	people
6	Outbound peak minute boarding demand from Cambridge Terrace (Step 5 multiplied by 34%)	2	people	1	people
7	Outbound peak minute alighting demand	9	people	174	people
8	Outbound peak minute alighting demand to Cambridge Terrace (Step 7 multiplied by 34%)	4	people	58	people
9	Peak minute demand (summation of Steps 2, 4, 6, and 8)	20	people	66	people
10	Staircase width (Step 9 divided by 28 multiplied by 75% [entrance split uncertainty factor])	1.0	m	3.3	m
11	Minimum staircase width	1.2	m	3.3	m

Table 7.13 Ultimate Design Year (2061) Cambridge Terrace Station Forecourt minimum staircase width

Step		Cambridge Terrace			
		Morning peak		Evening peak	
		Value	Unit	Value	Unit
1	Inbound peak minute boarding demand	44	people	1	people
2	Inbound peak minute boarding demand from Cambridge Terrace (Step 1 multiplied by 34%)	16	people	1	people
3	Inbound peak minute alighting demand	8	people	19	people
4	Inbound peak minute alighting demand to Cambridge Terrace (Step 3 multiplied by 34%)	4	people	8	people
5	Outbound peak minute boarding demand	3	people	2	people
6	Outbound peak minute boarding demand from Cambridge Terrace (Step 5 multiplied by 34%)	2	people	2	people
7	Outbound peak minute alighting demand	12	people	211	people
8	Outbound peak minute alighting demand to Cambridge Terrace (Step 7 multiplied by 34%)	4	people	72	people
9	Peak minute demand (summation of Steps 2, 4, 6, and 8)	26	people	83	people
10	Inbound peak minute boarding demand	1.3	m	4.0	m
11	Minimum staircase width	1.3	m	4.0	m

8 Option 17 station elements level of service performance

Station sizing assessment of Option 17 highlights the following:

- Platform circulation and vertical access elements provide sufficient space to meet LoS C during peak periods under normal operations and meet LoS D during delayed services in peak conditions for the years 2046 and 2061.
- Additional Snapper gates required on the outbound platform to cater to the alighting passenger demand in the evening peak (six additional gates required for year 2046, and a further three for 2061).
- Lack of alternative (or redundant) step-free access to and from the overpass in the event of a lift failure.

The provided provisions in Option 17 generally meet or exceed the minimum provisions required to meet the years 2046 and 2061 passenger demand forecasts, with the exception of the outbound platform Snapper card gate and the overpass staircase. The outbound platform would require an additional six gates to meet the year 2046 demand, with a further two gates to meet the year 2061 demands. There appears to be sufficient spatial provision for these additional gates to be added as the station passenger demand grows. The overpass staircase has a minor shortfall in width (0.2 m) by the year 2061 however, the width is still sufficient to meet LoS C (with a maximum flow rate of 29.3 people per minute per meter, which slightly exceeds the target flow rate of 28 people per minute per meter) and is deemed acceptable.

Table 8.1 Option 17 provided provision versus years 2046 and 2061 minimum provisions

Station Element	Option 17 provided provision	Year 2046 minimum provision	Year 2061 minimum provision
Inbound platform width	5.0 m	5.0 m	5.0 m
Outbound platform width	5.0 m	5.0 m	5.0 m
Inbound platform Snapper card gates	6 gates	4 gates	4 gates
Outbound platform Snapper card gates	3 gates	9 gates	11 gates
Overpass width	4.8 m	3.0 m	3.6 m
Overpass staircase	4.0 m	3.4 m	4.2 m
Oxford Terrace Station Forecourt staircase	18.0 m	6.1 m	7.5 m
Cambridge Terrace Station Forecourt staircase	13.0 m	3.3 m	4.0 m

The pedestrian level of service performance of the station elements over time (with the exception of platforms, which provide sufficient width for the 2061 design year) are provided in Figure 8-1 to Figure 8-4 based on the widths provided in Option 17.

The figures provide an indication of potential level of service performance from Rail Day One to the 2061 design year for both normal and degraded operations. In general, the figures show that the target level of service performance for normal and degraded operations can be met, with a slight exceedance at the overpass stairs for beyond the year 2058.

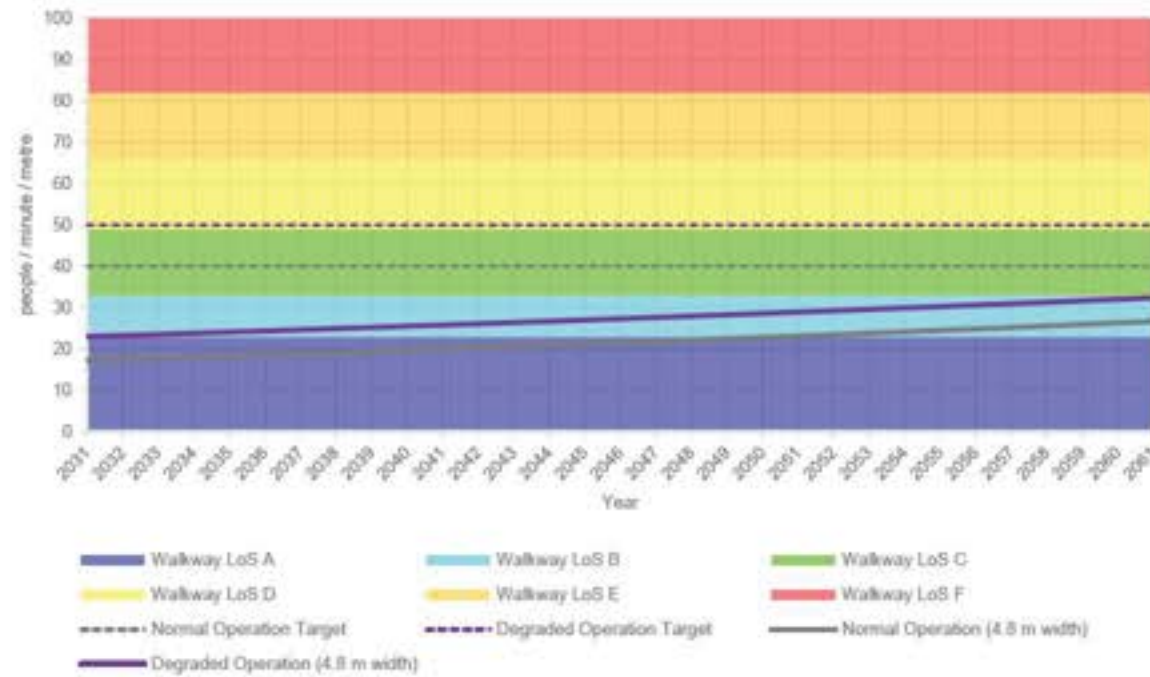


Figure 8-1 Overpass evening peak walkway Level of Service performance

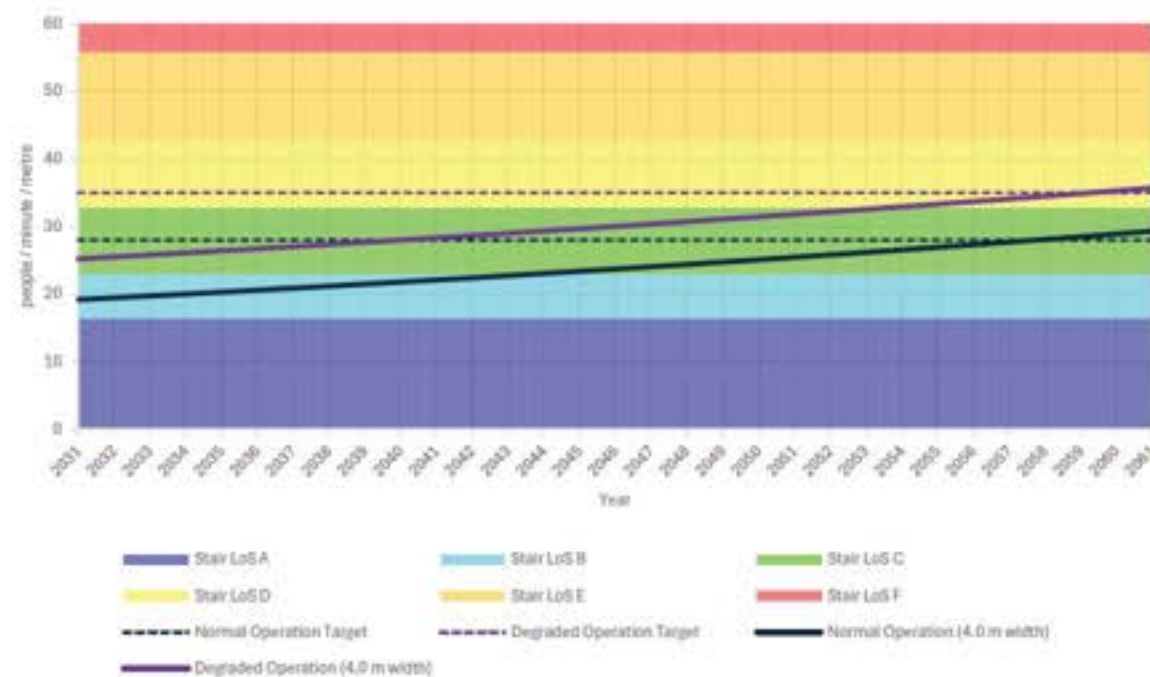


Figure 8-2 Overpass staircase evening peak stair Level of Service performance

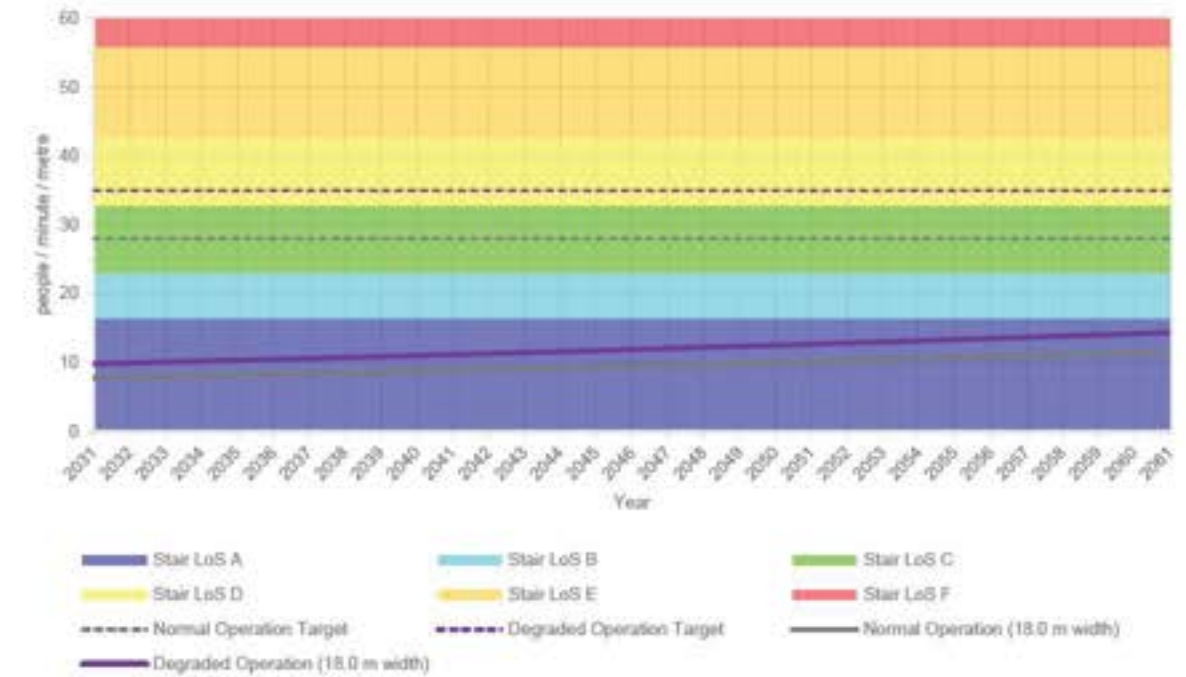


Figure 8-3 Oxford Terrace staircase evening peak stair Level of Service performance

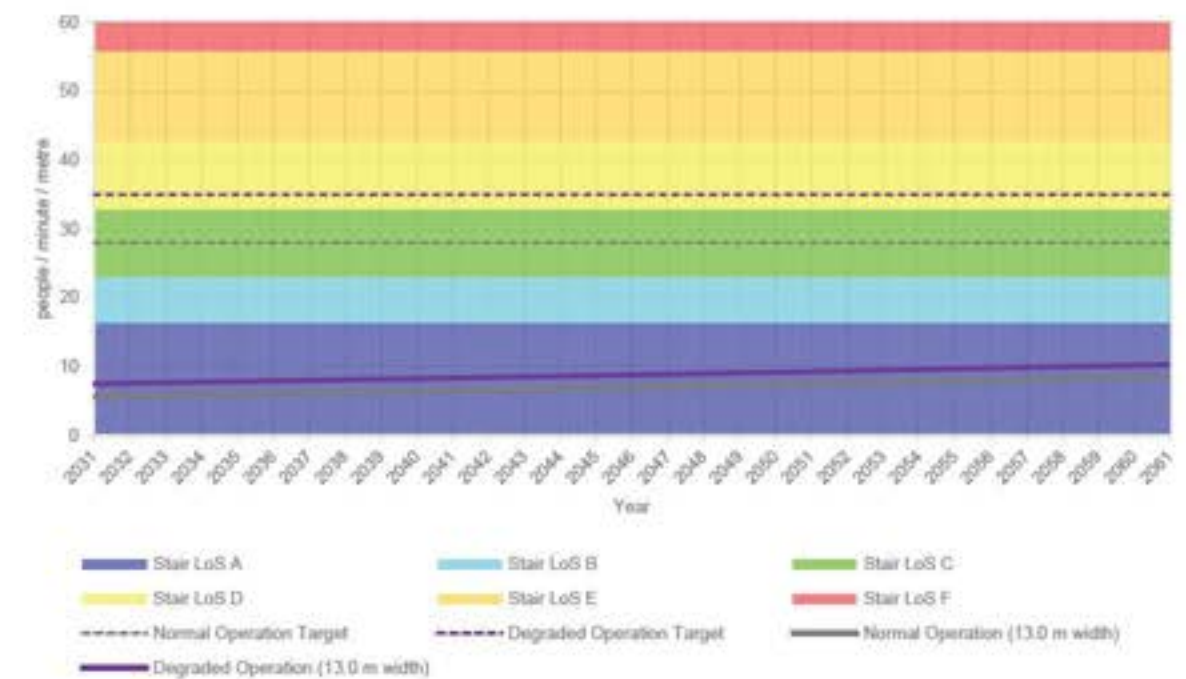


Figure 8-4 Cambridge Terrace staircase evening peak stair Level of Service performance

9 Sizing based on delayed service

In addition to the station element widths provided in Section 7, the required widths to achieve pedestrian Level of Service C for a delayed train service in the Design Year and the Ultimate Design Year are provided in Table 9.1 for information.

Table 9.1 Side platform arrangement minimum station elements provision not accounting for versus accounting for delayed service

Station element	2046 Design Year		2061 Ultimate Design Year	
	Not accounting for delayed service	Accounting for delayed service	Not accounting for delayed service	Accounting for delayed service
Inbound platform width	5.0 m	5.0 m (+0.0 m)	5.0 m (+0.0 m)	5.0 m (+0.0 m)
Outbound platform width	5.0 m	5.0 m (+0.0 m)	5.0 m (+0.0 m)	5.0 m (+0.0 m)
Inbound platform Snapper card gates	4 gates	4 scanners (+0 gates)	4 gates (+0 gates)	4 scanners (+0 gates)
Outbound platform Snapper card gates	9 gates	11 scanners (+2 scanners)	11 gates (+2 gates)	14 scanners (+5 gates)
Overpass width	3.0 m	3.6 m (+0.6 m)	3.6 m (+0.6 m)	4.2 m (+1.2 m)
Overpass staircase	3.4 m	4.3 m (+0.9 m)	4.2 m (+0.8 m)	5.1 m (+1.7 m)
Oxford Terrace Station Forecourt staircase	6.1 m	7.7 m (+1.6 m)	7.5 m (+1.4 m)	9.3 m (+3.2 m)
Cambridge Terrace Station Forecourt staircase	3.3 m	4.1 m (+0.8 m)	4.0 m (+0.7 m)	4.8 m (+1.5 m)

8.5 URBAN & LANDSCAPE DESIGN

DRAFT

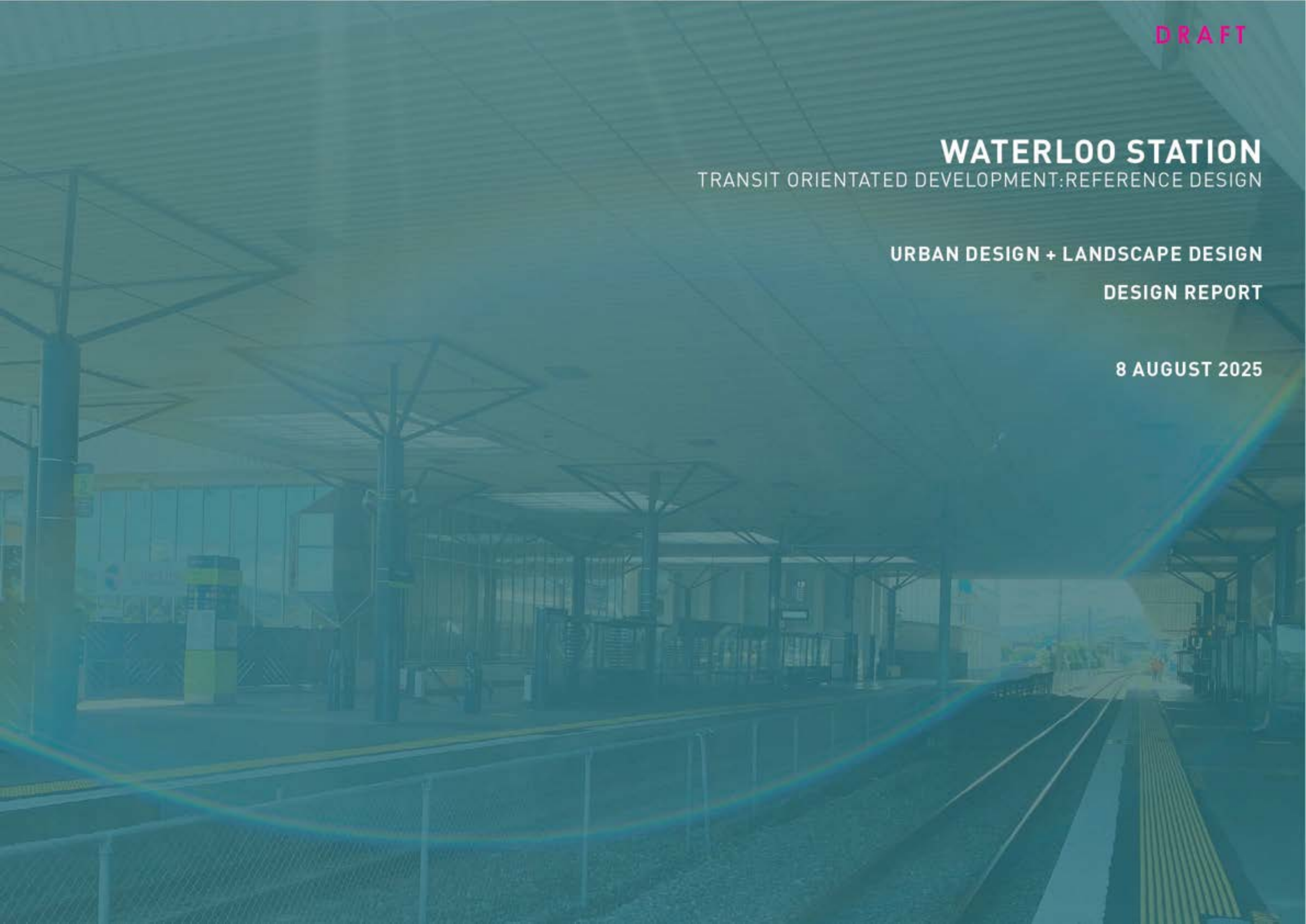
WATERLOO STATION

TRANSIT ORIENTATED DEVELOPMENT:REFERENCE DESIGN

URBAN DESIGN + LANDSCAPE DESIGN

DESIGN REPORT

8 AUGUST 2025





Boffa Miskell is proudly a
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INTRODUCTION

This Waterloo Station TOD Reference Design Urban and Landscape Design Report has been prepared by Boffa Miskell Ltd.

It is intended as a Technical Report to support the overall project Design Report led by Grimshaw Architects.

The project purpose, background, objectives and process (including optioneering and evaluations) are provided for in the overall Reference Design Report and Feasibility Report.



1. URBAN DEVELOPMENT CONTEXT

Prior to colonisation the valley has long been a significant place for Māori with Te Awa Kairangi (Hutt River) providing movement routes, and resources such as food and materials¹.

Post European settlement, the Hutt Valley, part of the Te Whanganui A Tara Wellington region, has long been a purposefully ‘planned’ urban area.

The process of urbanisation purposefully included a rail link to create land value uplift and the motivate a market response to deliver residential. as well as commercial development. This was to provide employment as well as services to support people living in the area.

The central government of the day had purchased land in advance of the rail investment in order to provide for the public benefits in land value uplift this delivered.

As shown in Figure 1, the planned street network is generally ‘block based’ and orthogonal. Key nodes including local centres with parks and stations sit along the rail and road corridors.

In 1927 the rail line reached Waterloo, which at that time was a terminal. Before it was developed, the open fields were part of a fertile horticultural economy. The advent of the rail line came with the street pattern and urban form still largely present today.

Government investment in housing and the infrastructure to support this continues to this day. Key investments include in:

- flood protection infrastructure, such as RiverLink, which includes Melling Station as part of a series of transport improvements
- water infrastructure (aquifer protection and linkages to storage - Pipe Bridge
- housing intensification (Kainga Ora) as well as private investments - Hutt Valley and Wainuiomata
- road infrastructure (Highways and potential Cross Valley Link RONS).



Figure 1: Urbanisation of the Hutt Valley has occurred following a deliberate public investment in public infrastructure and gaining public benefit from land value uplift



Figure 2: Waterloo Station was developed in 1927 (photo 1939) and was accompanied by new street layouts and new housing. The station was a single track terminal at that time. Access to the station was at grade (there was no underpass).



Figure 3: Waterloo Station (photo 1950) was at one time single sided (there is a suggestion of a previous over pass leading from the right corner of the photograph).

¹ Note that GWRC have been responsible for engagement with mana whenua partners - the authors of this report have encouraged early participation of mana whenua in the design process.

2. URBAN AND LANDSCAPE CONTEXT INFLUENCES

2.1. RESIDENTIAL INTENSIFICATION

There is and will be an increasing population of people living in the Hutt Valley and in the area around Waterloo. This is evidenced by contemporary change (refer to Figure 4). The Hutt City District Plan has recently introduced a 22m (approx 6 storey) height limit for the area to encourage increase utilisation of the existing urban footprint. Proximity to quality public transport is a known market factor in residential development investment decision making.

Intensification brings an increased reliance on public open spaces and reduced on site provision for car parking.

Transport accessibility and mode choice is fundamental to enabling people to move between where they live to participate in work, education, recreation and cultural activities efficiently and effectively. The role of Waterloo as an interchange where the bus network and rail network support movement choice is an important consideration.

Key urban design and landscape considerations:

- Increased use of station which means providing for more people and its role as a part of the public realm network.
- Increased density and scale of built context which means height and larger building forms will change the character of the area over time.
- Increased utilisation of the station as an interchange as intensification occurs in the wider area, including Wainuiomata.

2.2. COMMERCIAL (AND TOD)

The predominant new urban development in the subject area is residential townhouses and apartments of two-to-three storeys. There is unrealised opportunity for larger commercial and transit orientated development (TOD) in the context of the station, including on existing surface car parking areas.

It is anticipated that the redevelopment of the station with higher amenity, more effective trip transfer (bus/train) and better customer experience, would enable the opportunity for a broader range and scales of redevelopment.

As noted in Waterloo Renewal: Greater Wellington Transport Orientated Development (2023)¹ 'TOD, and in particular the station node itself provides the opportunity to create a genuine catalysts for the improved ongoing development of the broader precinct in which it serves. Integrating mixed mode transportations, enhancing pedestrian connectivity and amenity, proving ready access to essential services and prioritising pedestrian environment will in-turn provide more enjoyable urban spaces to occupy and successful urban precincts will help development importunities to be realised'.

¹ Willis Bord (2023) Waterloo Renewal, Greater Wellington Transport Orientated Development, Prepared for Metlink



Figure 4: Urban intensification is underway in the context of Waterloo as evidenced by recent Kainga Ora and private developments



Figure 6: Land ownership Waterloo context (source: Waterloo Renewal: Greater Wellington Transport Orientated Development Report (2023))



Figure 5: Urban intensification at a larger scale site in Lower Hutt - Epuni. Note that where there are larger sites (which could include land at Waterloo Station), there are compositional opportunities for TOD (dependant on market feasibility) that includes a mix of uses, scale and amenity (such as open space)

The market for any form of urban development is muted and the above mentioned report notes the current significant risk in the ability of the market to absorb a large scale commercial/residential development of the Waterloo Station.

Key urban design and landscape considerations:

- Recognise that there is no specific development proposed for the station land (identified in Appendix 1), but to show a potential footprint on the GWRC controlled area (refer to Figure 6). Ensure that servicing, platform relationships and public realm responses are recognised and provided for in the reference design so future commercial/residential development can be realised when market conditions better allow.
- Recognise that in the hierarchy of priority for modes enabled at the station/interchange that PT (train, bus) is the most important to provide for and that vehicle parking is the lower priority. On this basis emphasise improving the quality of the public realm, walking/cycle infrastructure to and through the Station, and the bus interchange arrangements.
- Recognise that future TOD opportunities (in addition to that on the GWRC land already noted) on the parking land to the north east may be enabled by its depth and relationship to the higher amenity east side existing centre.
- Identify that both the parking areas to north west (adjacent to the Water Plant) and to the south east (south of the bus interchange on Cambridge Terrace) have a lesser attraction to urban development.

2.3. SCHOOLS

The urban context of the station includes multiple schools. The public transport provided via the Station, bus interchange and its network supports access from homes to the schools from around city and region.

As shown on Figure 7, most of the area's schools are located to the west of the Station. The Station (primarily the through-station underpass link), plays a significant role in accessibility to schools given the severance caused by the railway line and busy Cambridge and Oxford Terraces. Observations in Appendix 1 provide evidence of this significance. The next closest crossing point to the south (underpass) is 600m away and to the north is by way of the Waterloo Road over-bridge, which requires complex pedestrian movements to access given convergence of roads.

Key urban design and landscape considerations:

- High level of significance of the through-station connection for access from east to west for people accessing schools and centres (refer Figure 7 and Figure 8).

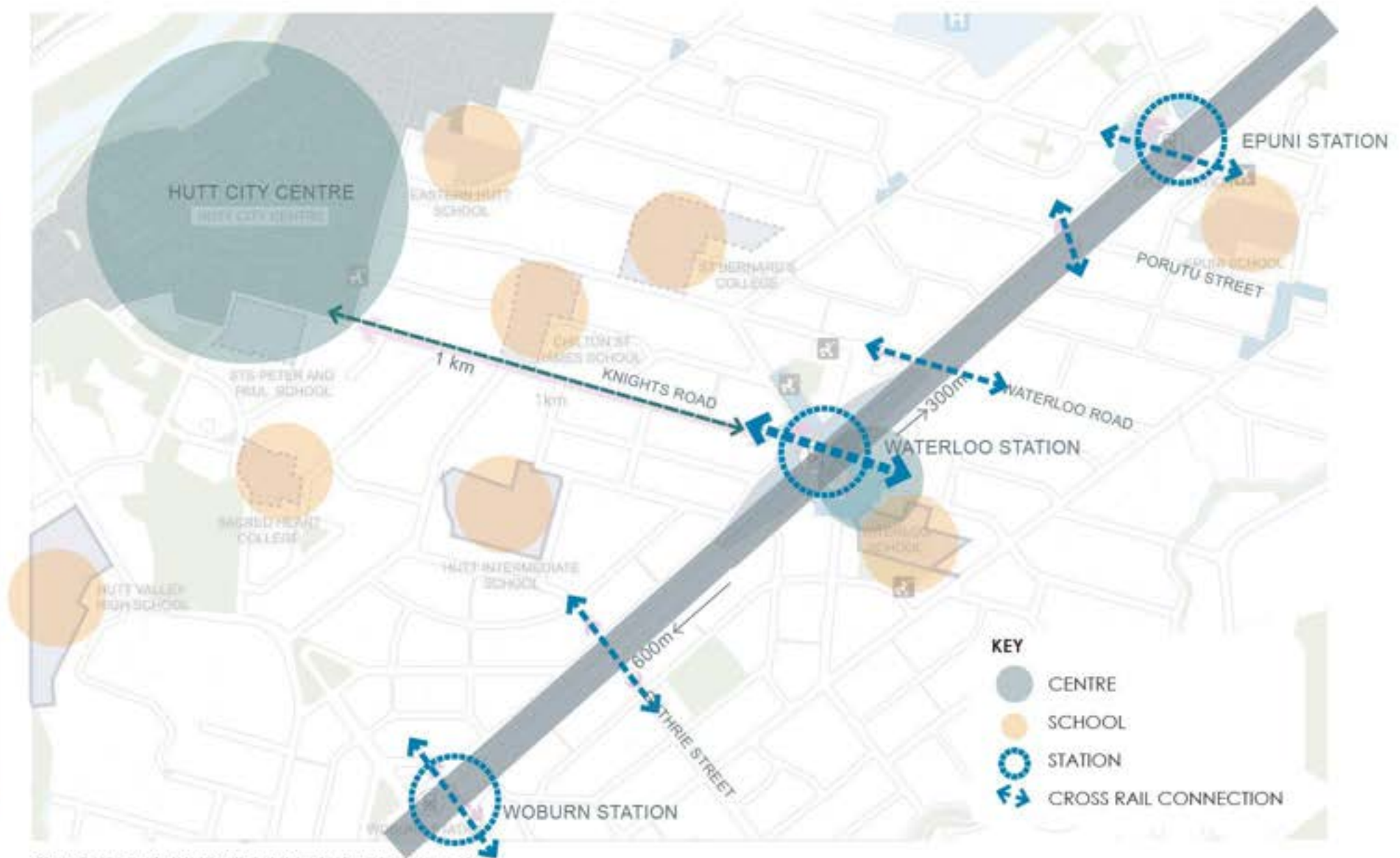


Figure 7: Urban context showing Station relative location to centres and schools

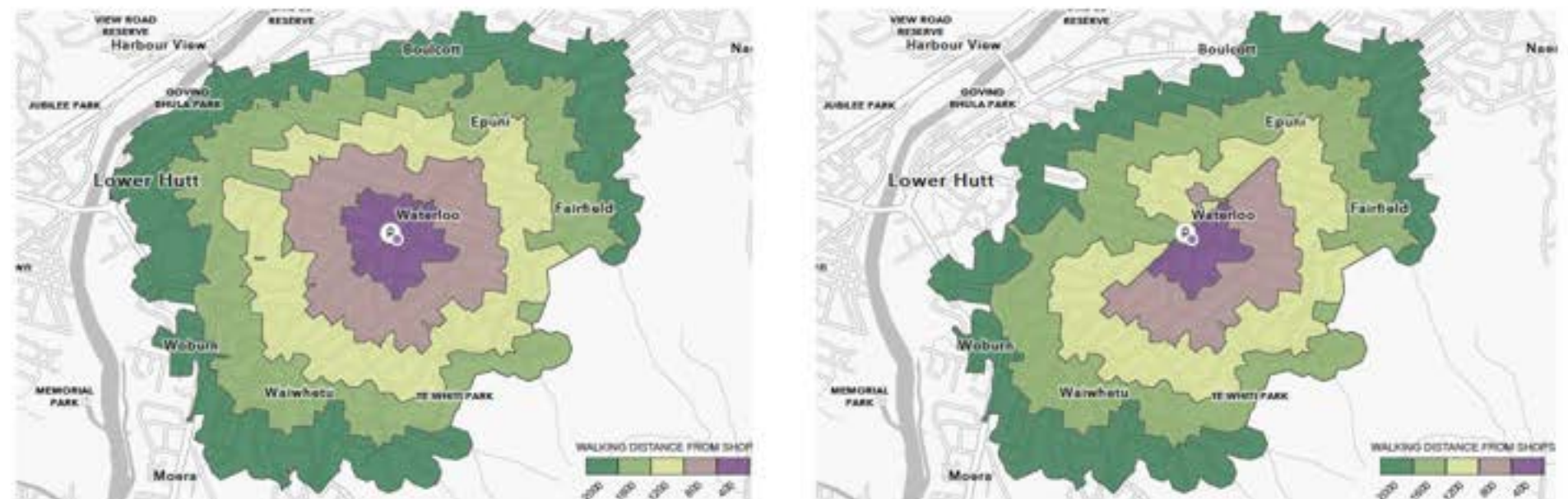


Figure 8: Walking accessibility with (left image) and without (right image) a through Station connection east west

2. 4. CENTRES

The Waterloo local centre is immediately adjacent on the east side of the Station. It has a formal layout of shops arrayed around a green square (Trafalgar Square). The centre is of a small, local scale with such offerings as cafés, takeaways and a bookstore a, and appears to be commercially viable. The Square supports a public building (Plunket Rooms) and small playground. Cambridge Terrace is a busy street and severs the centre and station. An underpass connects the two (further commentary in Local Influences below). Large trees also severe a visual connection from Waterloo centre to the Station.

The west side of the station also supports a few small retail premises which sit on the streets that ‘fan’ off Oxford Street. Hutt City Centre begins 1km from the station, linked by Knights Road.

Key urban design and landscape considerations:

- Immediacy of eastern side centre with its square and formal shops that frame this space generates the primary opportunity for gaining public realm integration benefits
- The western link towards the Hutt City centre should be maintained (accessibility from centre to Waterloo can be enhanced with investment in cycle infrastructure) given the bus link to city centre bus hub (outside Queensgate). The enhanced access and increased utilisation of the Waterloo interchange can offset some of the loss of service during the reconstruction of the Melling Line associated with RiverLink.



Figure 9: Looking south-west from Waterloo Station to Hutt City in the distance



Figure 10: Early image of Te Awa Kairangi (Hutt River) which shows meandering form and vegetated islands



Figure 11: Map of the multiple river channels and meandering nature.

2. 5. WATER AND VALLEY FORM

The aquifer under the valley is a high value regional water supply resource and the Treatment Plan adjacent to the station is an important component that cannot be put at risk. The building is a large block which sits abruptly in the urban context and has some functional requirements for services access. There are various geotechnical/structural constraints to consider in regards to the Waterloo Station development above the aquifer addressed by other technical reports.

Te Awa Kairangi (Hutt River) and Waiwhetu Stream have been a fundamental shaper of the valley and is integral to the character and cultural values of the area (refer Figure 10 and Figure 11).

Key urban design and landscape considerations:

- Recognition of significance of water for Māori and representation in design of the station and place.
- Understanding of the river’s more braided form with banks and vegetated islands shaped by flooding and deposition.
- Recognition that with the need to cross multiple waterways (and latterly over rail and roads) that bridges are a common structure in the landscape.
- Potential for flood hazards and the groundwater influence to the viability of below ground infrastructure such as underpass (refer Figure 12).
- Responsible use and improving quality of water disposed of from the site.
- Mitigating the scale of the Treatment Plant building and its edges on the quality of the station public realm.



Figure 12: Source HCC GIS Flood Risk

3. URBAN AND LANDSCAPE & LOCAL INFLUENCES

3.1. FORM

1. The local street layout intersects with the railway line and two parallel roads (Oxford Terrace on the west side and Cambridge Terrace on the east)
2. The streets immediately radiate out on the Oxford Terrace side of the station. On the Cambridge Terrace side there is a focus in towards Trafalgar Square.
3. Oxford Terrace and Cambridge Terrace are relatively busy and with the station in the middle with its railway line through the centre, the current PT network is effectively an island.
4. The area directly around the station is car dominated with large parcels of land dedicated to park and ride.
5. The underpass that connects Oxford Terrace and Cambridge Terrace to the platform provides a critical role in supporting passenger movements. Many of these movements across the rail line are not related to the station, but are through east-west movements (such as to schools and centres as noted previously). The closest alternative connections over the rail lines are a considerable distance away.
6. The urban form is made up of wider streets, where the rail line intersects the grid street pattern triangular blocks are formed. Buildings are generally one and two storey (commercial and residential), albeit the scale of the existing station and Water Treatment Plan are larger and District Plan provisions allow new building heights up to 22m. Any 'greenness' is sporadic - buffer to rail, 'formal' parks, school grounds and scattered street trees. There is little public realm amenity in general (see below).

3.2. LANDSCAPE

7. Oxford and Cambridge Terrace street trees buffer/screen the rail infrastructure from the local roads/residential areas and Trafalgar Square. This generates a visual disconnect between the east side local centre and the station.
8. Trafalgar Square is a formal public space around which are arrayed small retail shops and services. There is a clearer local centre identity and public realm amenity on this east side than on the west.
9. The square and frontage to Cambridge Terrace is blocked by the underpass infrastructure and pohutukawa trees, severing a clear sight-line to the Station.
10. Pohutukawa trees (not endemic or indigenous here) are the predominant tree species. Te Awa Kairangi/river valley and also the hills would have supported kahikitea, totara, raupo and other trees as part of the indigenous landscape.
11. There is minimal amenity or green infrastructure within the public realm. Greening is used for screening rather than incorporating amenity into public space.

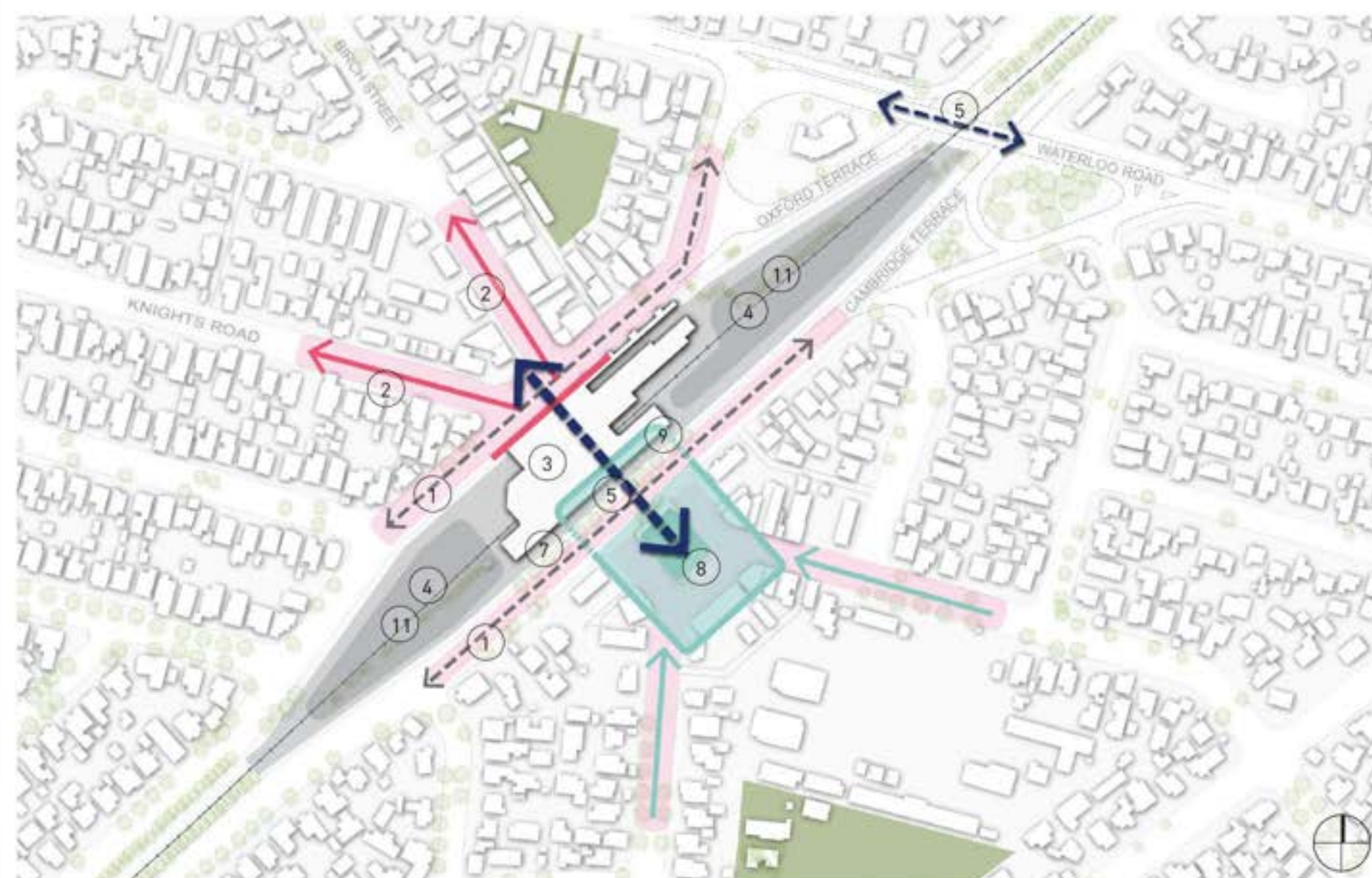


Figure 13: Diagrammatic plan of consolidated urban and landscape design influences



3. 3. USEAGE AND PUBLIC LIFE

Observations (refer to Appendix 1 for more information) of station users identified that (key summary points):

- At morning peak times users were both making rapid changes from bus or car to train, as well as more slower-paced arrival and waiting for train.
- There were multiple school age users going through the station underpass - including primary aged-children (refer Figure 16). Many were on scooters.
- The relevant immediacy of bus stop C and D and the platform was observed to allow for quick and efficient transfers.
- Trafalgar Square car parks were used for drop-offs to avoid the busier road on the northern side, or going through the station drop off point.
- At evening peak people were observed waiting for train arrivals to meet passengers.
- At Trafalgar Square there was observed use of sitting beneath trees and use of the central Plunket Building. The building is used for other community groups. The square and the east side has a pleasant public realm amenity (refer Figure 15).
- There is otherwise generally a poor pedestrian/public environment in the immediate vicinity of the station and local streets that connect with it (refer Figure 17 and Figure 18).

3. 4. CLIMATE

- The east side of the station (the station side that trains travelling into the city arrive and depart from) receives the morning/rising sun and the west (the station side that trains travelling out from the city arrive and depart from) receives the evening sun.
- Temperature ranges are typically moderate, but in winter can be uncomfortable cold in combination with southerly winds (which blow under canopies and into platforms).
- Hotter temperatures are more occasional than predominant, but the valley can have elevated heat compared with the more coastal locations.



Figure 15: Trafalgar Square - seating and reasonable quality of public realm



Figure 16: Photograph of underpass use - morning school pupil use



Figure 17: Photograph - Knights Rd - poor pedestrian and bus user infrastructure



Figure 18: Photograph - Cambridge Terrace - poor pedestrian environment - also shows contemporary urban redevelopment opposite station parking area

4. URBAN AND LANDSCAPE DESIGN RESPONSES

1. Develop (signalised) at-grade crossing (same level as footpaths) across Cambridge Terrace to enable direct movements to station from east and to overpass - also allows more direct desire lines (than underpass) to the two different entry points. Co-design with HCC.
2. Replace the existing underpass with an overpass that continues to provide community east west link and for all active modes to connect onto platforms. Outlook to valley. Has adjacency to offset scale of Water Plant.
3. Replace underpass on Trafalgar Square with reinstated open space that visually links square to the front of the station - this conceptually makes a new station frontage on the east-facing side of the open space square. Replace play space in co-design with HCC and community.
4. Improve crossings at Oxford Terrace, Knights Road, Birch Street, Pohutakawa Streets as at-grade (same level as footpaths) to better link to bus stops.
5. Develop public realm with a series of "pause points" that provide for sitting/waiting outside the station canopy. The pause points sit in the flow of the steps and movement routes and respond to stone/islands in a river current. The 'pulsing' nature of the station use is recognised in the range of levels and sitting opportunities that cater to heavy and light use - not too congested or feeling 'empty' at slow times.
6. Co-design with mana whenua ground plane, vertical elements, tree types, water design and facing/articulation of overpass structure.
7. Develop raised table crossing points on side streets to Trafalgar Square (not pedestrian crossings).
8. Provide ramps to provide access onto Cambridge Terrace and Oxford Terrace for wheeled users and people with reduced mobility.
9. Provide visible, secure bike parking on the east and west sides in proximity to ramps.
10. Develop rain gardens along side the main roads to take stormwater runoff and improve water quality prior to discharge. These also reduce (on Cambridge Terrace) people risking crossing the street away from signalised crossing point.
11. Provide for the desire lines for people arriving to the station entry from PUDO and disabled parking on the north east area by passage under the overpass. Ensure passage is attractive and designed with CPTED considerations.
12. Push the car parking away from the immediate adjacency to the station entry and public realm to reduce conflicts and elevate the priority for people on foot and using PT interchange. This also allows for future TOD on parking areas and larger scale buildings to not dominate station public realm.





1. karaka tree
2. rewa rewa tree
3. titoki tree
4. lancewood tree
5. kowhai tree
6. rewa rewa tree flower
7. kowhai flower with tui
8. rain garden grasses
9. raupo/rain garden plant
10. integrated steps and seating
11. informal seating
12. paving pattern (etched concrete - Wellington Thorndon Quay example)



12



11



10



9

APPENDIX 1

OBSERVATIONS

CONNECTIVITY

LANDSCAPE / IDENTITY / CULTURE / CLIMATE

URBAN DEVELOPMENT

OBSERVATIONS

MORNING COMMUTE

The following observations were recorded between 7am and 8.30am on Wednesday 2nd April 2025. Weather was 16°, mist/fog clearing into blue skies once sun was fully risen. It was dark on arrival, sunrise was at 7.38am.

METHODOLOGY

I sat in one location for 5 minutes and recorded people's movements through the station. I did this in four locations, recording both movements through the station and how people were arriving to the station. These locations are marked on the maps.

Station movements: Observed at both platforms - both at the western (city side) entrance and eastern (Waterloo shops) inside the station,

Arrival movements: Observed outside the station entrances at Oxford Street (western side) and Trafalgar Square (eastern side), to get a better understanding of where those not using the park and ride facilities were arriving from.

LIMITATIONS

Due to the layout, it was not always clear to distinguish whether people were using the station for travel or as a east-west connection. Even observing movements from the underpass, the western side exits at the platform, so it cannot be determined whether users walking the entire length of the underpass are coming/going the western platform or beyond.

Even observing from outside the station, it was not easy to know whether passengers had arrived from park and ride, particularly on the western side from the Greater Wellington car-park to the north.

OBSERVATIONS	BASE MAP
★ OBSERVATION LOCATION	▽ STATION ENTRANCES
— PEOPLE MOVEMENT (SKETCH)	Ⓢ BUS STOPS
..... BIKE MOVEMENTS (SKETCH)	⬢ PARK AND RIDE
	--- UNDERPASS



EASTERN ENTRANCE - 7.04AM - 7.09AM



WESTERN ENTRANCE - 7.15AM - 7.20AM



OXFORD ST - 7.53AM - 7.58AM / TRAFALGAR SQ - 8.00AM - 8.05AM

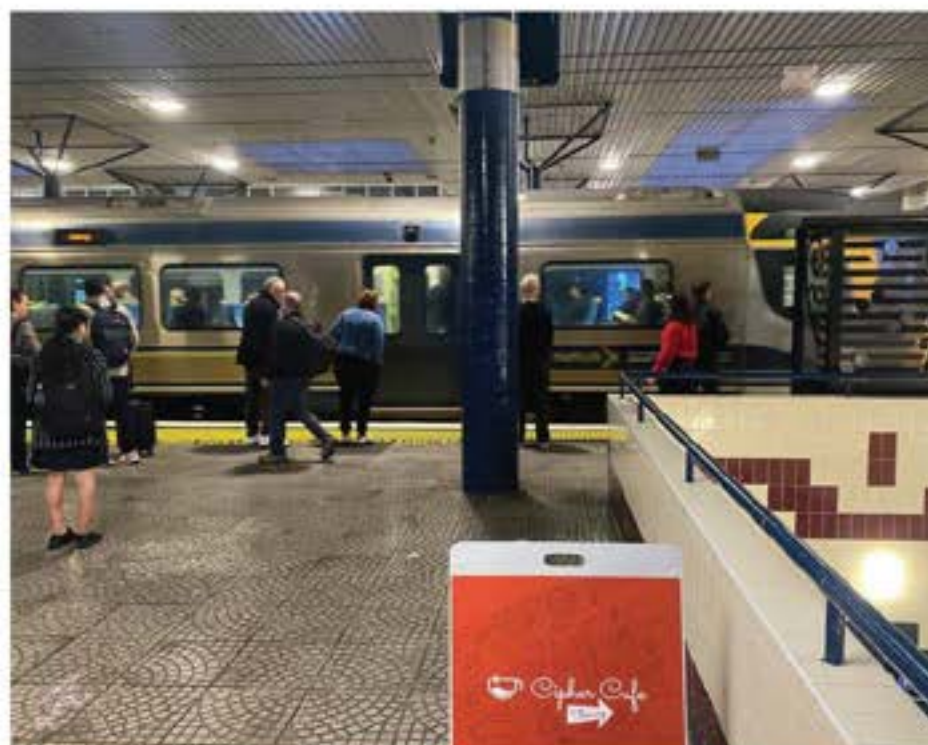


ALL OBSERVATIONS OVERLAID



GENERAL OBSERVATIONS - MORNING

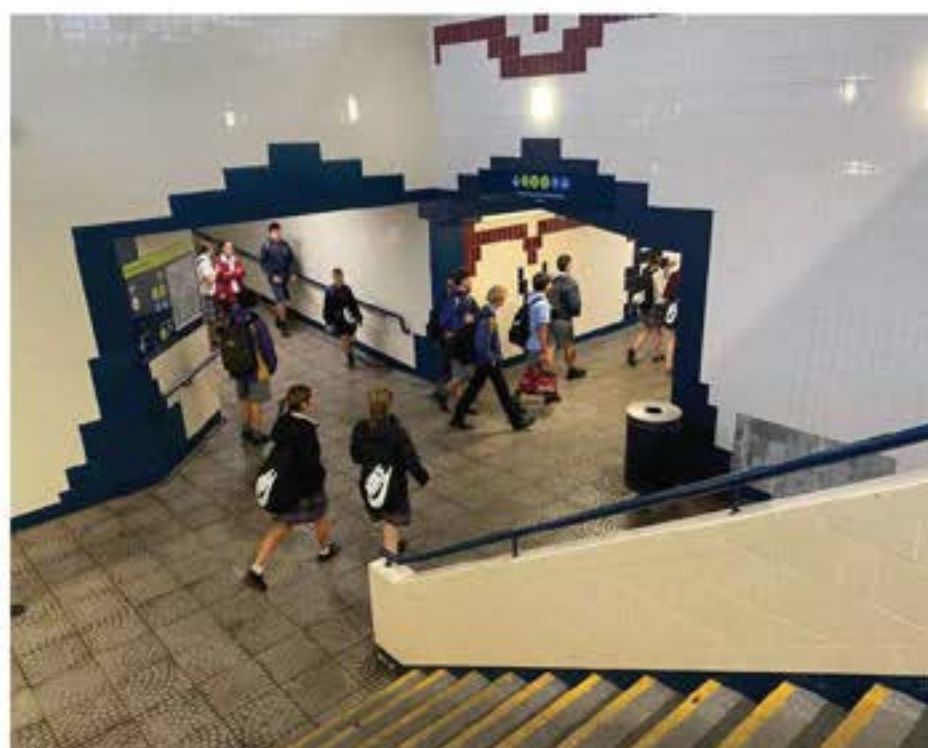
- Prior to 8am passengers were predominantly adults and heading into Wellington City
- Between 8-8.15am there was a surge in teenagers present. Many of them were arriving at the station.
- Most users going through the station underpass were primary aged-children. Many were on scooters.
- Trains arrived frequently enough that passengers trickle in, there is not a major influx before a train.
- 3 users used the station as part of their dog walk.
- While most underpass users used the stair cases, a large number used the ramps.
- Bus loads arriving to the station were small. I observed 3 buses arrive which had between 5-8 passengers transferring to the train.
- Passengers alighting from a bus at C were able to transfer immediately to a train (running) which arrived at the same time. This proximity worked well.
- Observed 3 cyclists arrive. Each parked their bike on the (northern) side they arrived, despite using the underpass to reach their train on the other side which had better cycle parking. Implying a preference of convenience for cycling parking to be close to the entrance points over the platform.
- Trafalgar Square car parks were used for drop-offs to avoid the busier road on the northern side, or going through the station drop off point.
- While not observing it the entire time, only observed 3 people get a coffee from the coffee shop.
- Urgency of passengers arriving at the same time as a train was split. About half would run for a train, and about half would walk and wait for the next one.



BUSY PLATFORM AS TRAIN ARRIVES. PEOPLE SPREAD OUT.



PASSENGER RUNNING FOR TRAIN (LOWER RIGHT), AND PASSENGER CHOOSING TO WALK (LOWER LEFT)



8.27AM - STATION FILLS WITH STUDENTS ARRIVING



8.30AM - SOME PARK & RIDE SPACES AVAILABLE IN GREATER WELLINGTON PARK

EVENING COMMUTE

The following observations were recorded between 5pm and 6.30pm on Thursday 3rd April 2025. Weather was 21°, and overcast.

METHODOLOGY

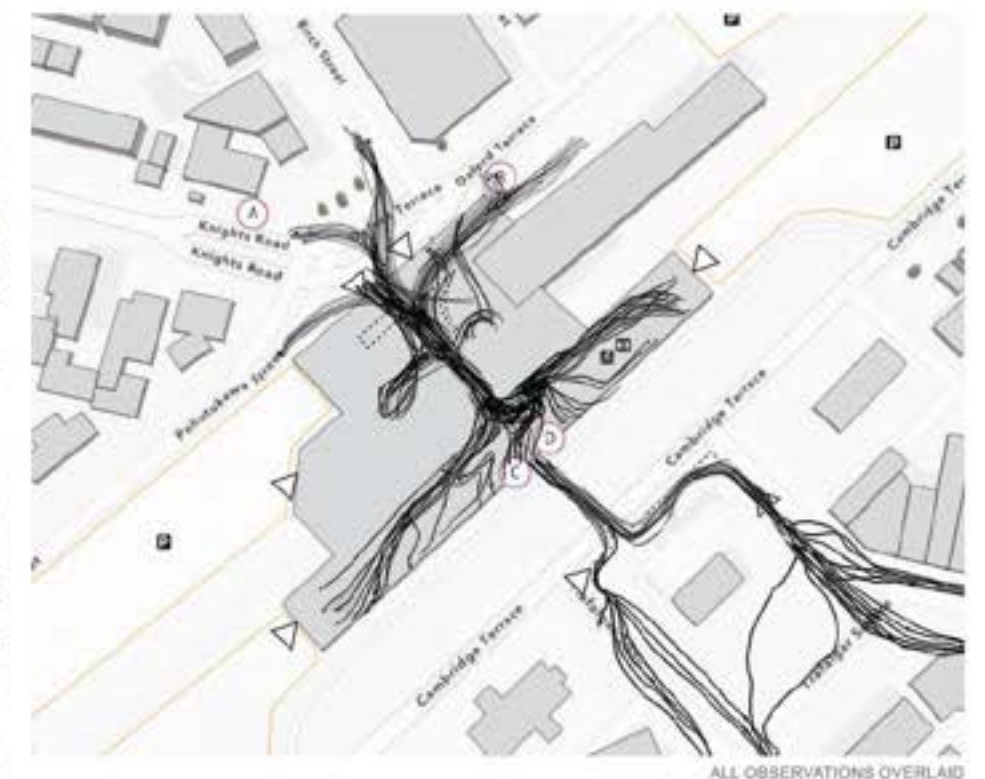
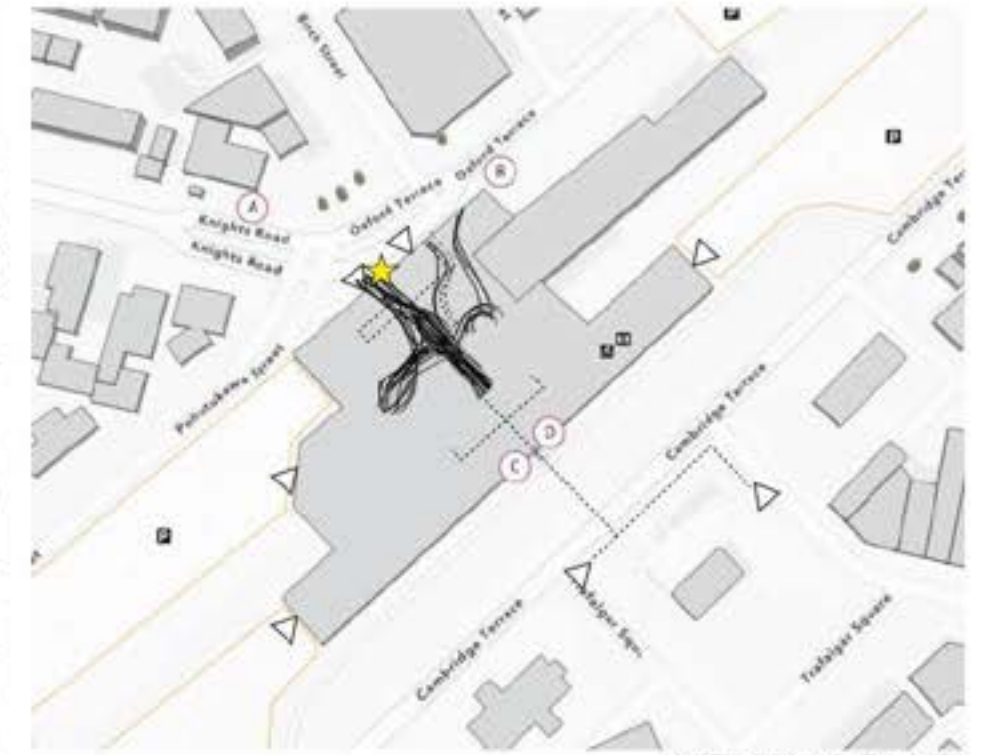
I sat in one location for 5 minutes

LIMITATIONS

Due to the layout, it was not always clear to distinguish whether people were using the station for travel or as a connection. As passengers exit the station, the viewpoint limited ability to see whether passengers (on the Oxford Terrace side in particular) were walking home or walking to the park and ride.

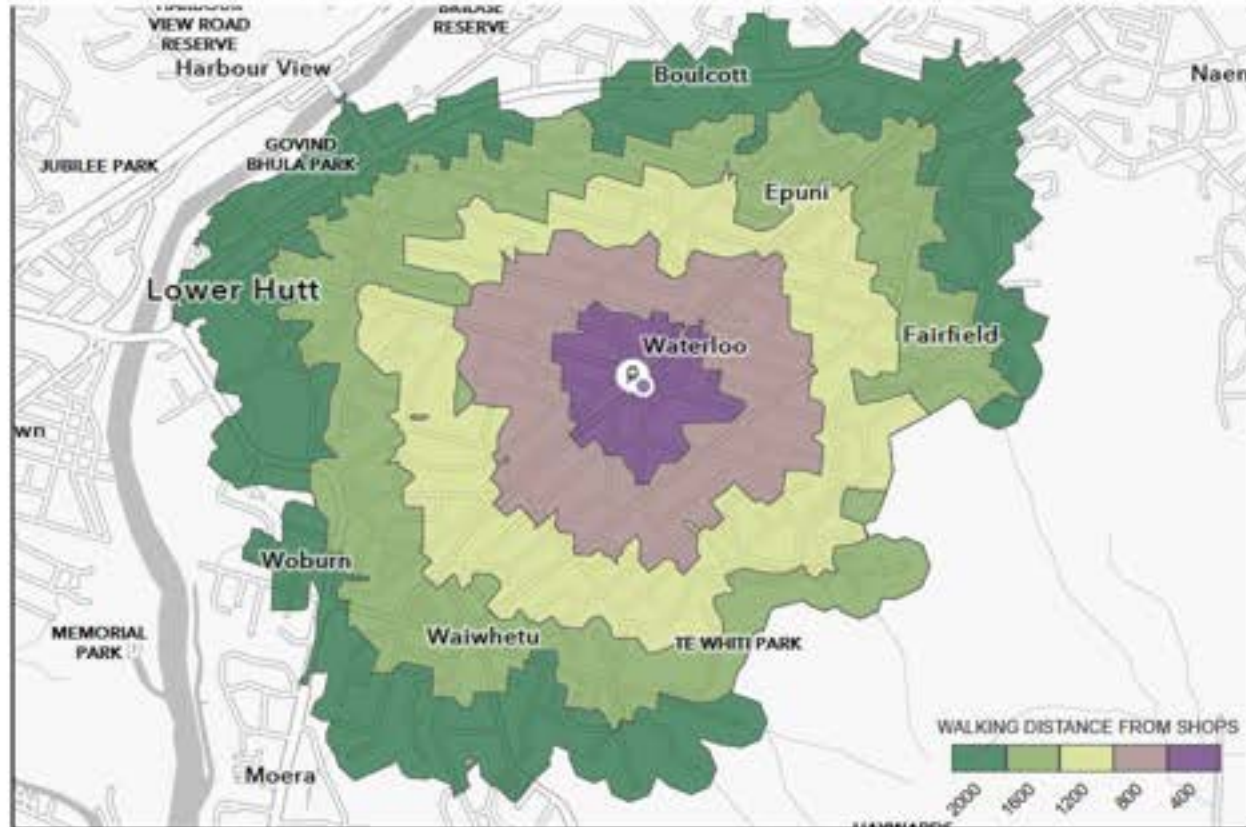
GENERAL OBSERVATIONS - EVENING

- Peak period is longer than morning peak (begins from 3pm), the 3pm period was not observed.
- A handful of people would arrive on foot prior to the arrival of the north-bound train to collect arrivals, some with children and / or dogs
- After the train arrives and passengers spill out, the train station empties immediately in all directions. This is the key difference in passenger movement patterns from the morning, which builds slowly then empties. Therefore the Station is emptier for longer in the evenings.
- Passengers leaving exited in all directions, on foot down the connecting streets, but predominantly to the car parks.
- No arriving passengers were observed going to the shops after arrival (eg. to takeaways or the dairy)
- Some passengers were picked up from Trafalgar Square.
- There were fewer than 10 observed passengers getting on the north-bound train, suggesting it is not well-used as a commuter connection from Hutt City. A similar number of departing passengers were travelling South.
- Very few numbers of high-school-aged children were seen in the evening peak. No primary school-aged were seen in this period.
- No cyclists arrived at, departed from or travelled through the station underpass at this time.
- A handful of passengers transferred to bus stops C and D. It was unclear whether any passengers used bus stops A and B.
- At the Trafalgar Square exit, people exit the underpass according to the direction they are heading (direct exit from the access is preferred, rather than using the stairs then crossing the Square). This provides limited activation through the park.

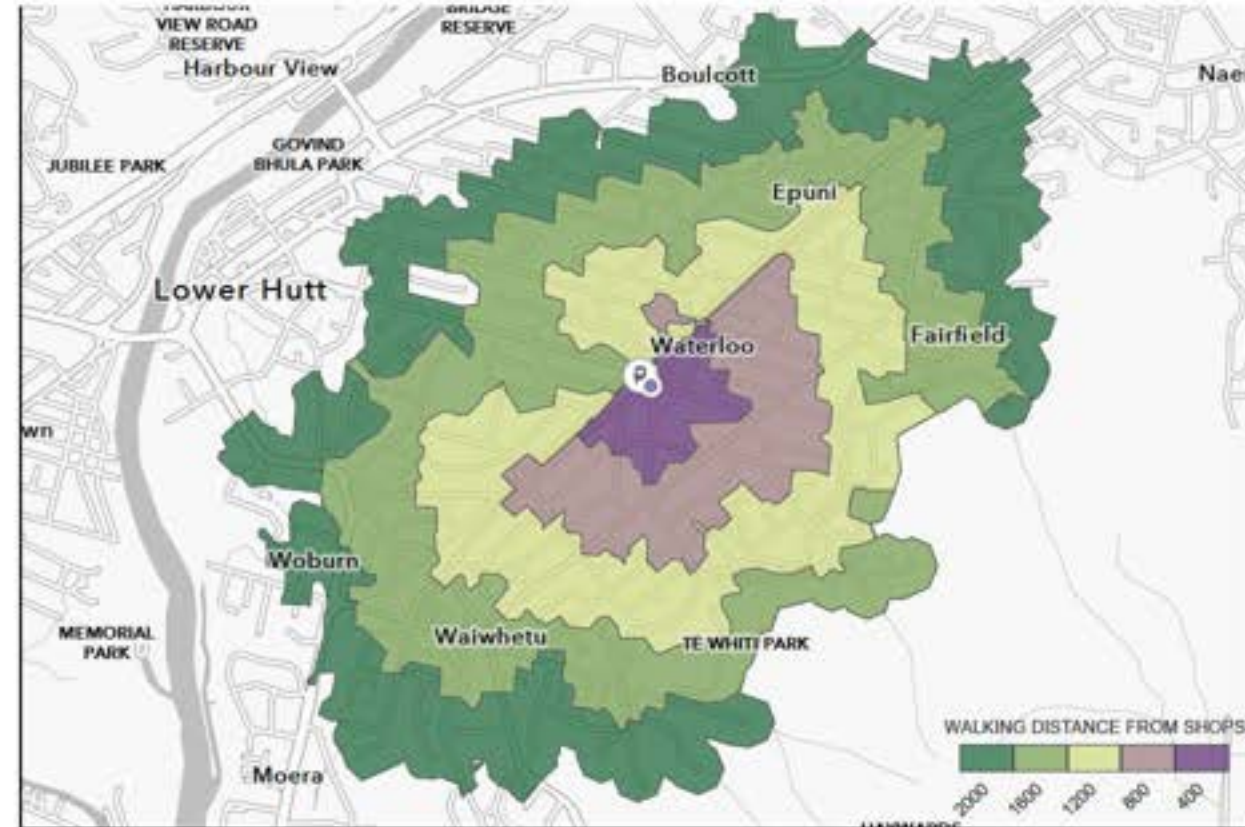


CONNECTIVITY

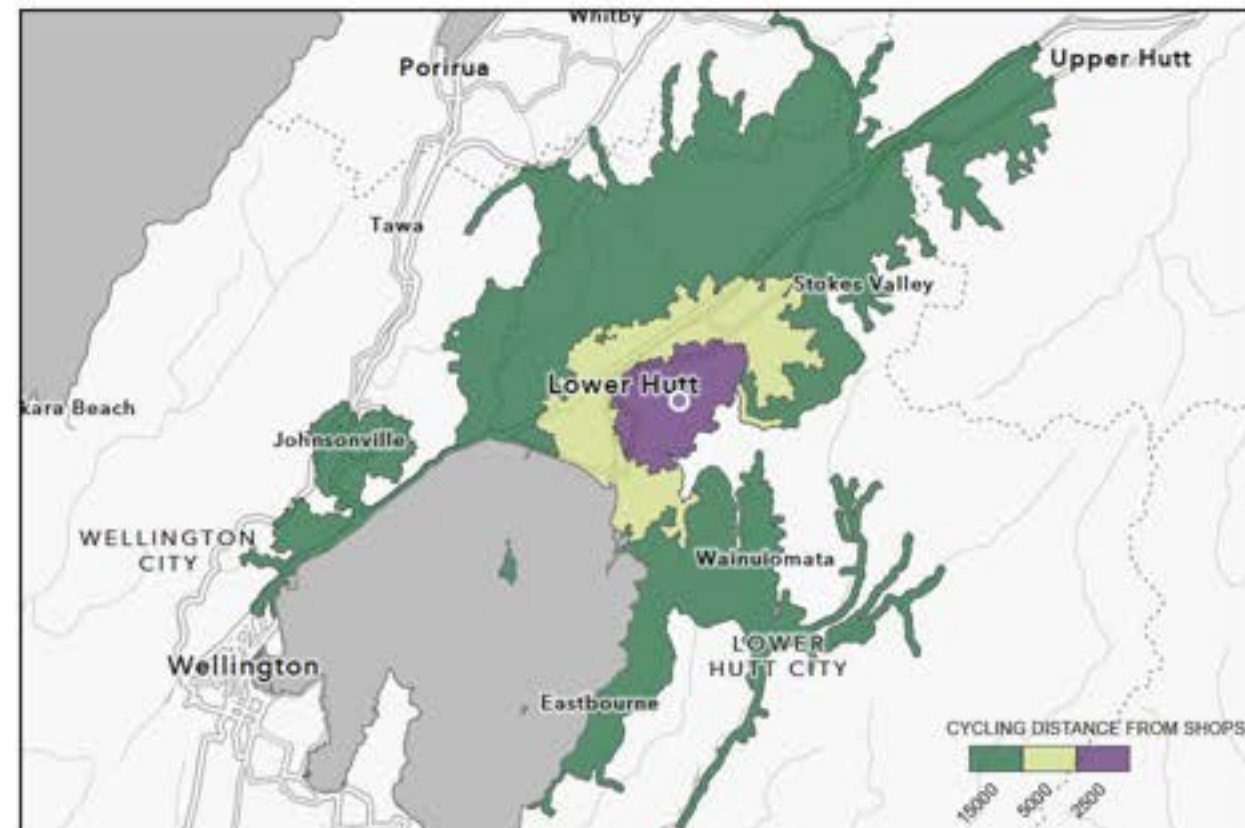
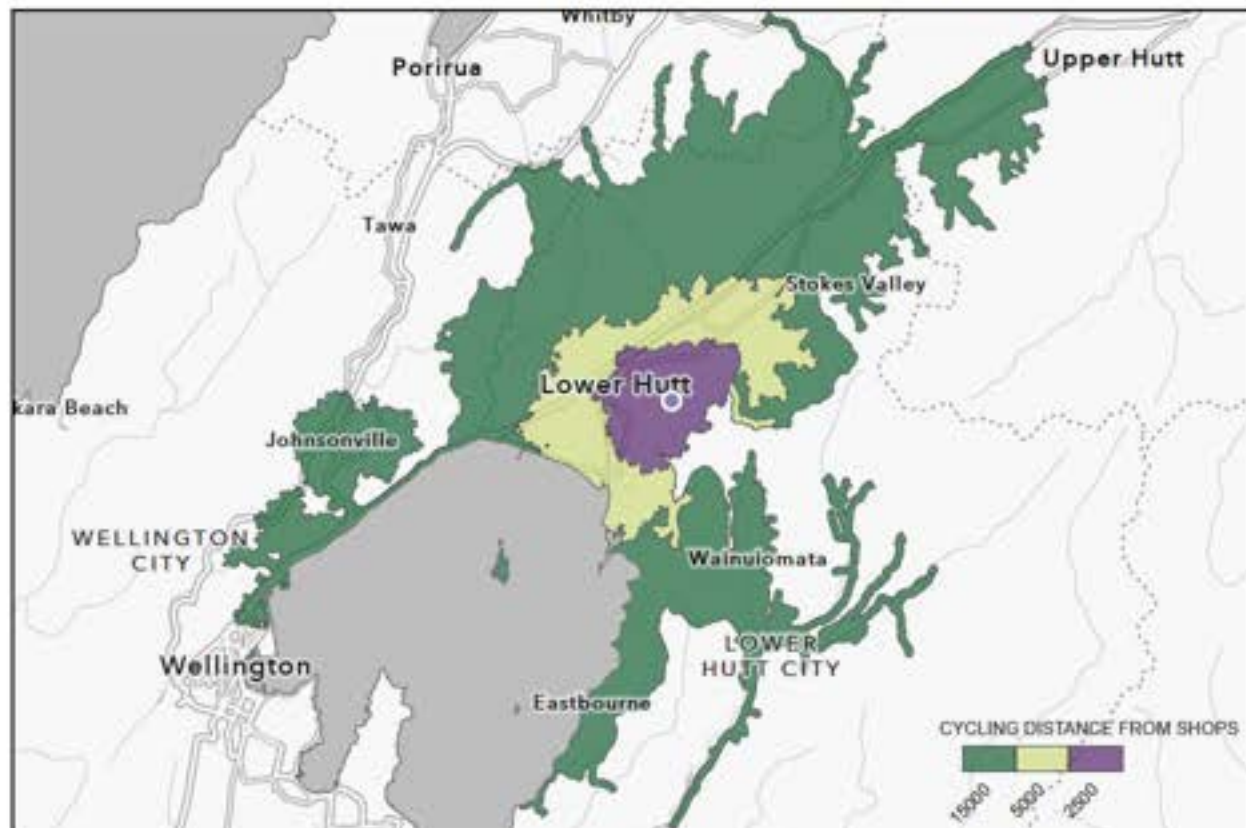
WALKING AND CYCLING ACCESS TO THE WATERLOO SHOPS



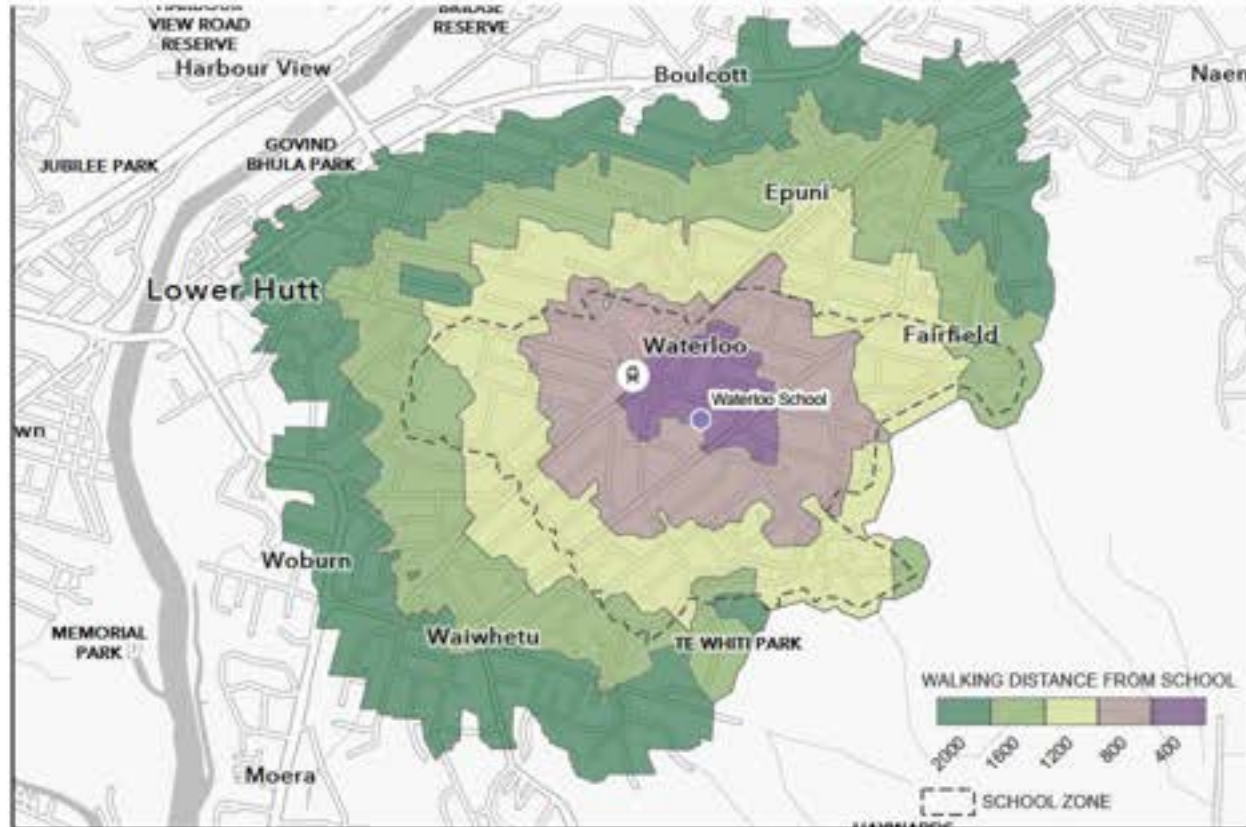
WITH ACCESS THROUGH WATERLOO STATION



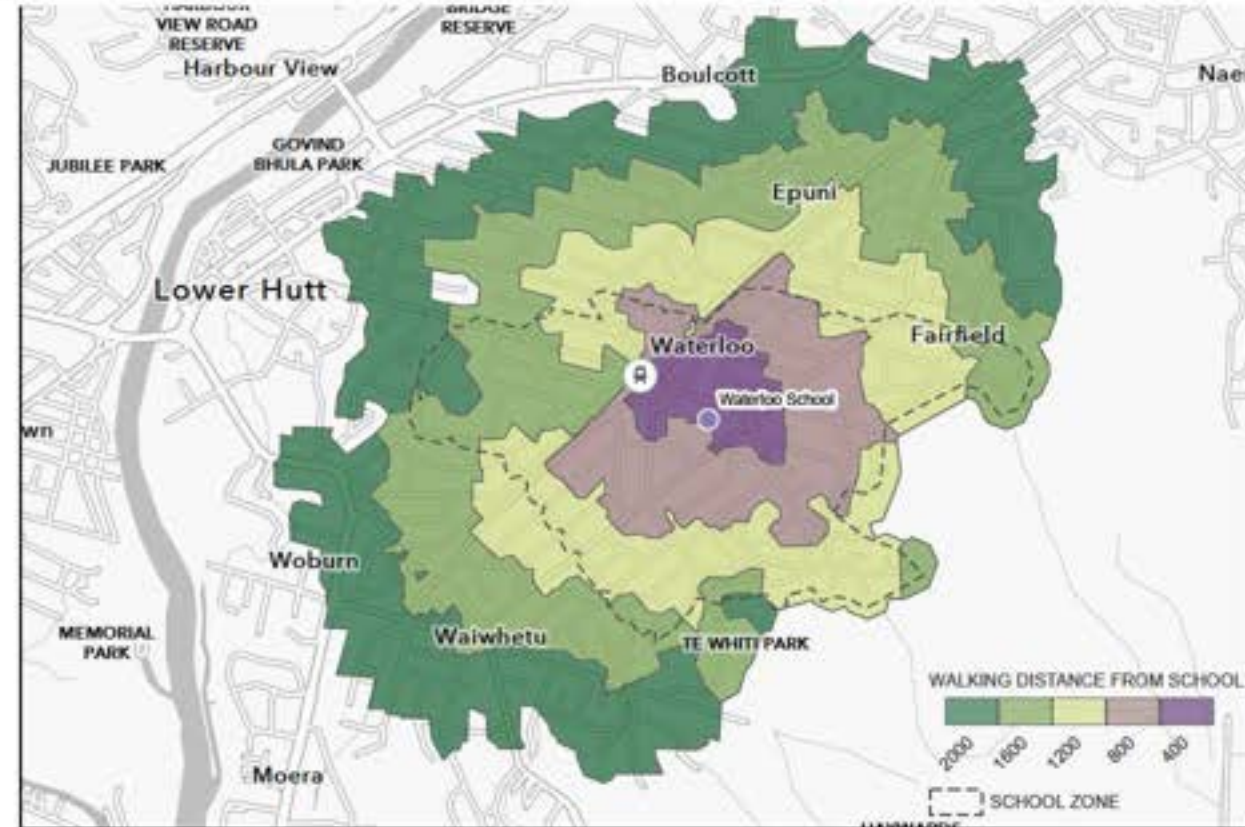
WITHOUT ACCESS THROUGH WATERLOO STATION



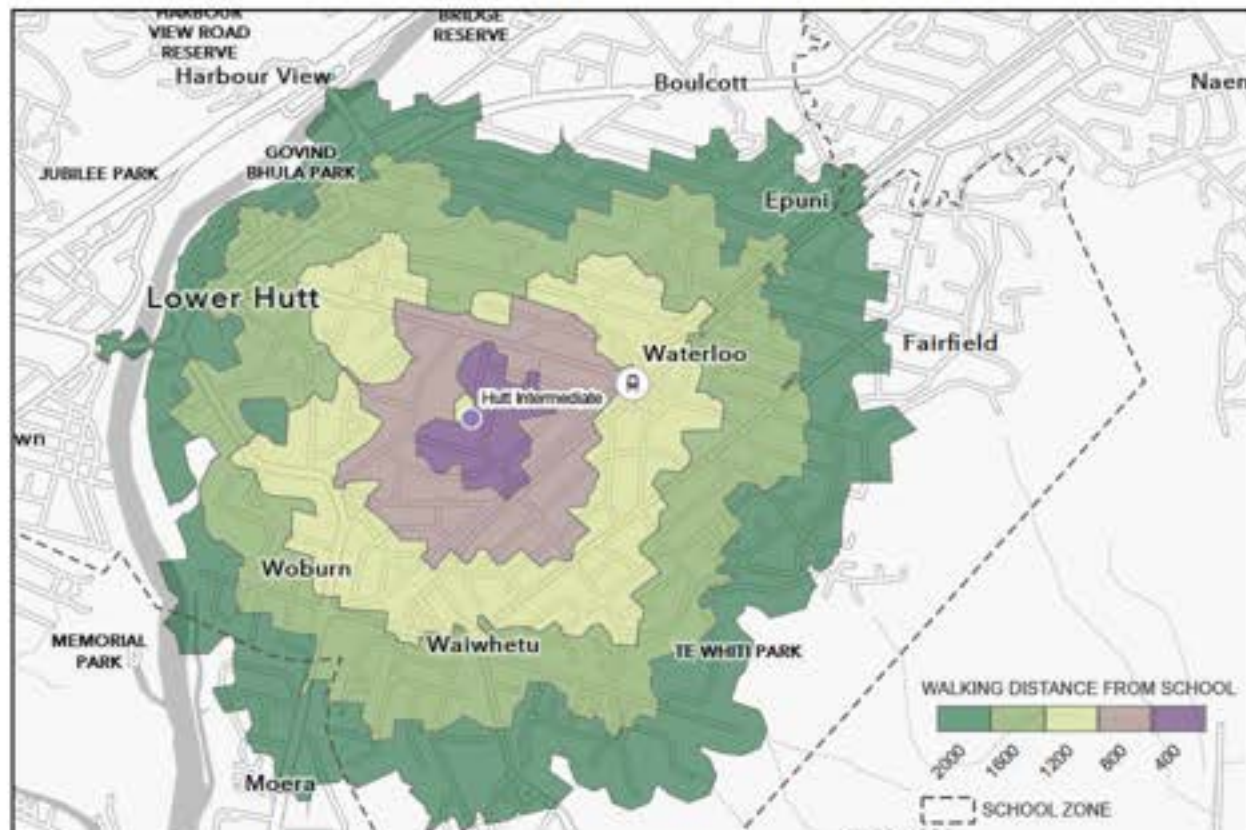
WALKING ACCESS TO SCHOOLS AND RELATIONSHIP TO SCHOOL ZONES



WITH ACCESS THROUGH WATERLOO STATION



WITHOUT ACCESS THROUGH WATERLOO STATION



CYCLING



WATERLOO TO CITY CENTRE - EAST WEST LINK - PROPOSED AND PUT ON HOLD AND FUNDING FOR FUTURE AS PART OF 2024-2027 LTP.



SHELTERED AND SEMI-SECURE BICYCLE PARKING PROVIDED ON THE EASTERN SIDE OF THE PLATFORM

CYCLING CONDITIONS

- There is a well-used protected cycleway to the north of Waterloo Station but cycling is likely not an attractive option to access the station due to poor east-west access to Hutt City Centre, and south from the station.
- A standard Metlink two-level bicycle park is provided on the eastern side of the platform. It is poor visibility as it is tucked between the bathrooms and the kiosk so may be under-utilised due to security risk.



- Protected Cycle Lane
- Quiet Route (no infrastructure)
- Future East-West Cycleway (2024-2027 LTP)

- Future plans to provide an east-west cycle lane on Knights Road (funded in LTP) would improve safe cycling options to the Station.
- The Waterloo overbridge over the train tracks is a hostile road environment so many cyclists making the east-west connection prefer to use the underpass.

DRIVING

<u>Petone</u>	448 parks	Fare zone 4
<u>Ava</u>	limited on-street parking	Fare zone 4
<u>Woburn</u>	159 parks	Fare zone 4
<u>Waterloo</u>	788 parks	Fare zone 4
<u>Eponi</u>	limited on-street parking	Fare zone 5
<u>Naenae</u>	24 parks	Fare zone 5
<u>Wingate</u>	limited on-street parking	Fare zone 5
<u>Taita</u>	120 parks	Fare zone 5
<u>Pomare</u>	77 parks	Fare zone 5



DRIVING CONDITIONS

- Waterloo has the most available park and ride car parks on the Hutt Valley line.
- Waterloo is the first Zone 4 station to the north
- Parking is provided up to (and on) the platform and drop off zones next to the platform
- Road conditions are hostile particularly on the eastern side (Cambridge Terrace) with busy, wide urban connectors feeding the station



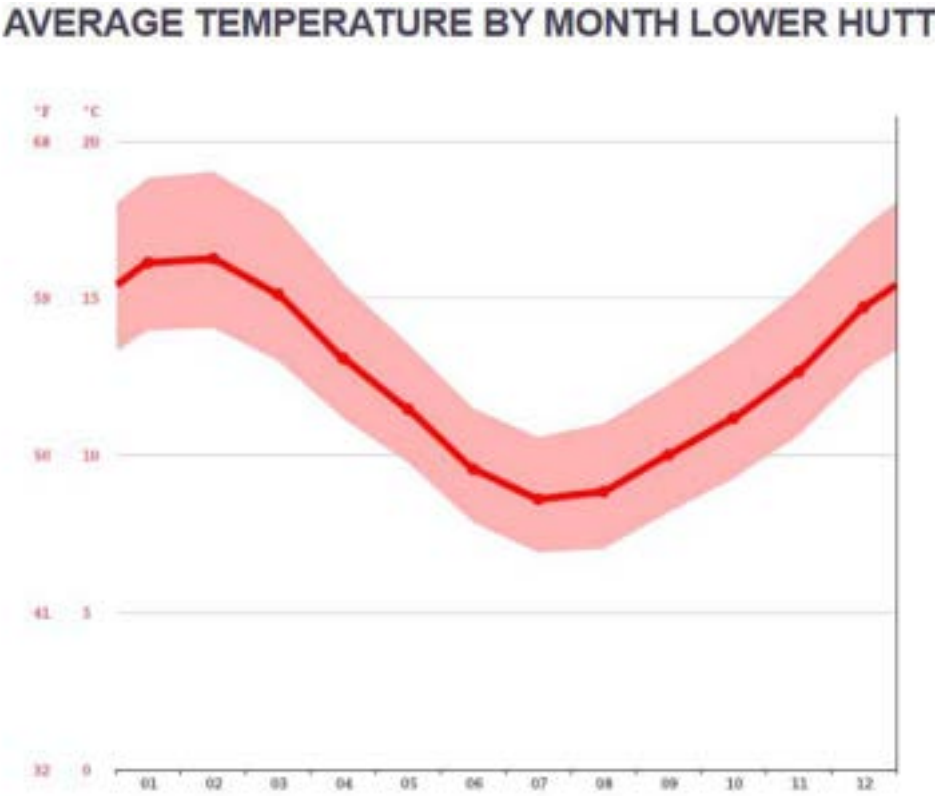
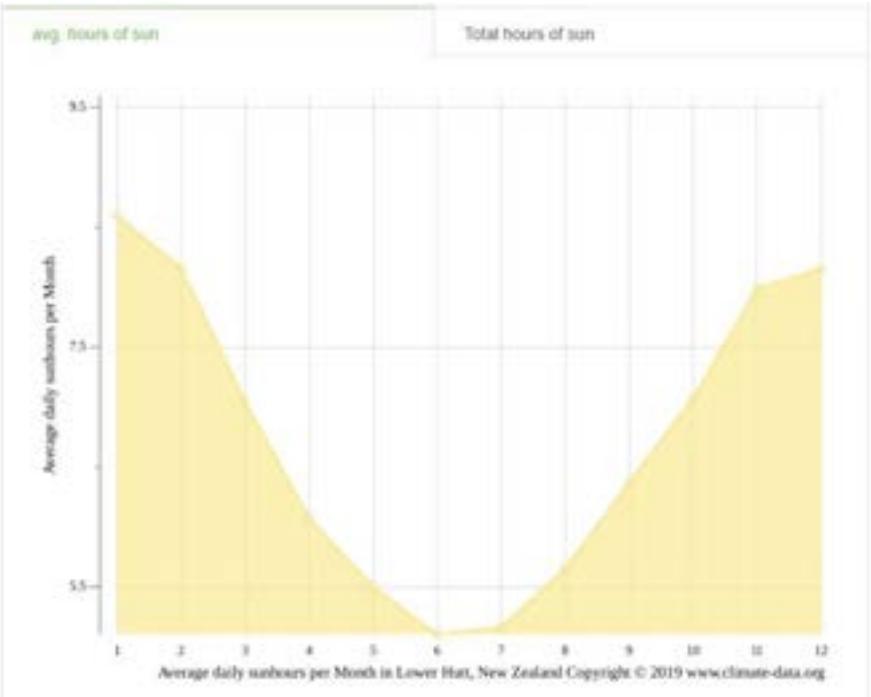
- Driving is the easiest and safest way to access Waterloo Station, encouraging driver travel even from close distances
- Commuters who may live walkable distances to stations further north are encouraged to drive to Waterloo for cheaper zone fares, especially as parking is free
- It is easier to access the eastern side of the station by car

Urban Connectors
Activity Streets
Local Streets



LANDSCAPE / IDENTITY / CULTURE / CLIMATE

- There are significant values of Te Awa Kairangi for mana whenua – mana whenua will need to guide this narrative.
- River plain – braided river, flowing water – key theme in landscape identity – and remnants in places – braids/islands of large swamp podocarp trees – kahikatea, tōtara with raupō and vines.
- Flood risks and urbanisation – bridges and stopbanks are part of today’s landscape – along and across movements.
- Hutt Valley was established as a garden city. This design was incorporated within the urbanisation of the area in building model worker dwellings, but has lost its identity over time with increased hardscape and loss of vegetation. This is a colonial concept that while not a contemporary aspiration, has created a need for greening of the area.
- Formal park spaces and centre space are provided by Trafalgar Square on Cambridge Street side. Oxford Terrace there is a more abrupt transition between Station and Street.
- There is a clearer centre identity on east side – Plunket rooms, trees, play, space formed by built edges. A strong sense of community scale that has no relationship to the Station frontage.
- The Station sits in the middle of the valley with views to hills (regional parks). Has potential to provide a strong sense of place that is not maximised with outlook opportunities from the station. There is no sense of arrival on the platforms.
- There are strong climatic influences due to the surrounding hills, including low sunshine hours in winter. Station could provide better comfort for waiting in cold temperatures.
- Station orientation: north/east–south/west – morning sun on east side – evening sun on west side.
- Canopy overhead prevents sunlight access, although height aids light penetration – large light wells to underpass are positive.



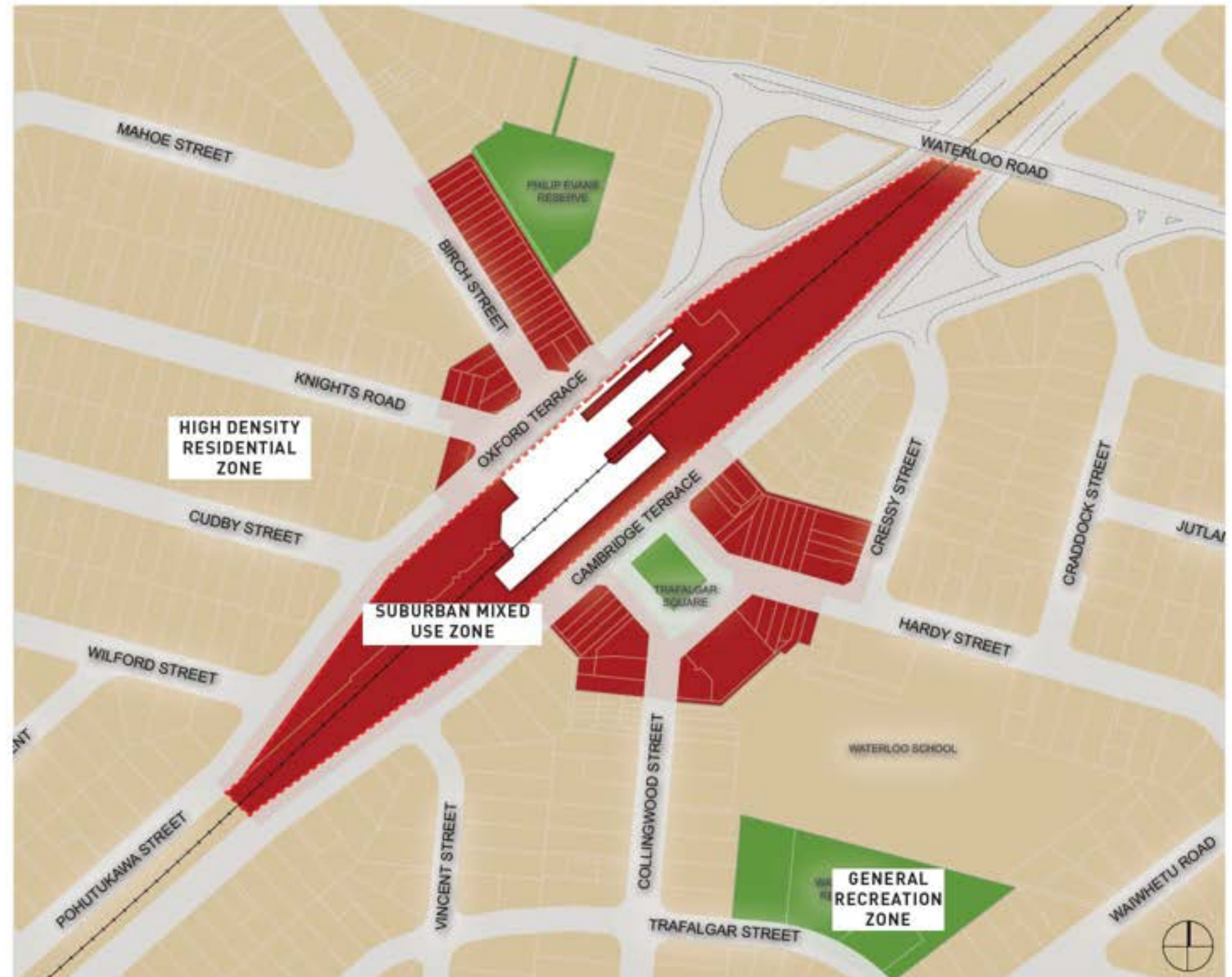
VIEWS OUT TO HILLS (EAST FROM CAMBRIDGE STREET) NOT VISIBLE FROM INSIDE STATION. LIMITED SENSE OF PLACE.



STATION RECEIVES GREAT SUNLIGHT IN SUMMER. STATION DOES NOT PROVIDE OPPORTUNITY TO ENJOY SUNSHINE, NOR WELCOMING SPACES TO SEEK SHADE.

URBAN DEVELOPMENT

- The built form surrounding Waterloo Station is changing. Planning rules allow for the predominantly detached-residential dwellings to be replaced with multiple dwellings on one site, up to 22m (where meeting other standards such as height in relation to boundary).
- Developments are predominantly taking place in the form of multi-unit terraced houses, with some apartments.
- Many of these homes have either no carpark or fewer than one carpark per dwelling. This is both increasing the density of the population around Waterloo Station but also encouraging people to move around in different ways other than private vehicle, as on-road car parking becomes more strained.
- The Waterloo Station land parcel takes up most of the land zoned Suburban Mixed Use (46% of the entire zone).
- The area of Suburban Mixed Use Zone services a large area of High Density Residential, as this develops to increased density, the Mixed Use Zone will need to offer a greater variety of services, retail and hospitality. Outside of the Waterloo Station land, there is very limited land to develop.



8.6 BUILDING SERVICES

Waterloo Train Station

Reference Design Report Building
Services

Greater Wellington Regional Council

Reference: 528886

Revision: B

2025-08-21



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Figure 1: Waterloo Station and 800m Radius

Figure 2: Reference Design for Waterloo Station TOD

1 Introduction

1.1 Overview

This report has been prepared for the Greater Wellington Regional Council to support the creation of a Reference Design for the new Waterloo Train Station, a pivotal element within the broader Waterloo Station Transit-Oriented Development (TOD) Project.

Serving as a central hub, this transportation hub is designed to efficiently integrate with the wider urban environment, fostering connectivity and accessibility.

Separate from the commercial developments that form part of the larger TOD, this report focuses specifically on the building services reference design for the transportation hub itself. The design brief encapsulates the outcomes from three critical phases of the project—Define and Discover, Feasibility Study, and the Waterloo Station Reference Design.

By addressing the essential building services considerations within this reference design, the report aims to guide the delivery of a functional, sustainable, and user-friendly transport hub, aligned with the region's strategic goals for urban development and public transport enhancement.

1.2 Background

The following background is a condensed version of the excerpt that originally appeared in the Services RFP.

The current Waterloo Railway Station was constructed in 1988. In recent years the roof structure has suffered from ongoing maintenance issues and is past its end-of-life. This has provided the opportunity for the station infrastructure and surrounding urban catchment to be reconfigured in a way that supports transport orientated developments.

A transit-oriented development (TOD) is a mixed-use urban area within walking distance of a transit stop and core commercial and/or residential areas.

Waterloo Station was selected by Wellington Regional Council Leadership as the first local TOD due to:

- A need to address major and end-of-life infrastructure issues in the Waterloo Station.
- The availability of prime commercially developable land in the wider precinct
- Waterloo station and the precinct's strategic location in the Hutt Valley and larger footprint (~18,865m² of developable land).

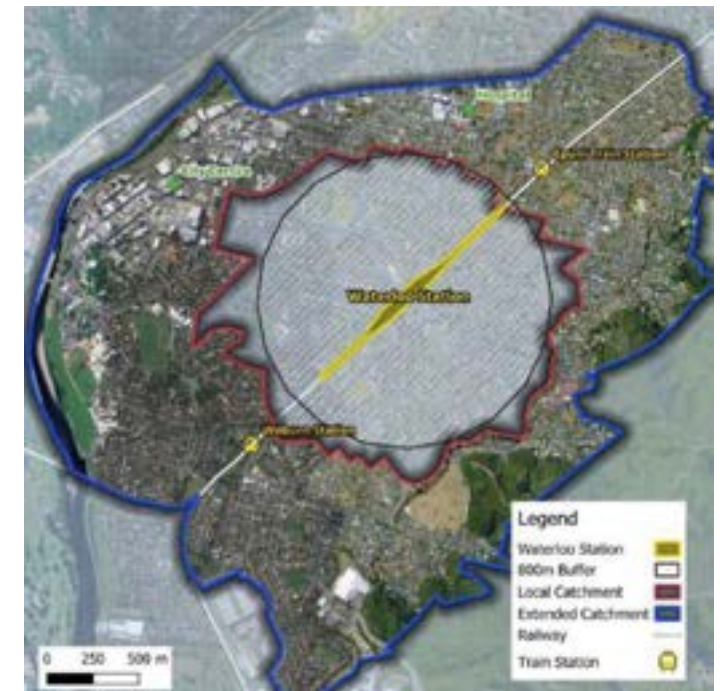


Figure 1: Waterloo Station and 800m Radius

- The potential of the Waterloo Station precinct to facilitate urban intensification, contribute to realising the Wellington Regional Growth Framework, and contribute of other positive social and health outcomes.

The project constitutes a major redevelopment of the existing Waterloo Station. The design team has progressed to the creation/development of a concept reference station design to facilitate further development of the Waterloo Station precinct.

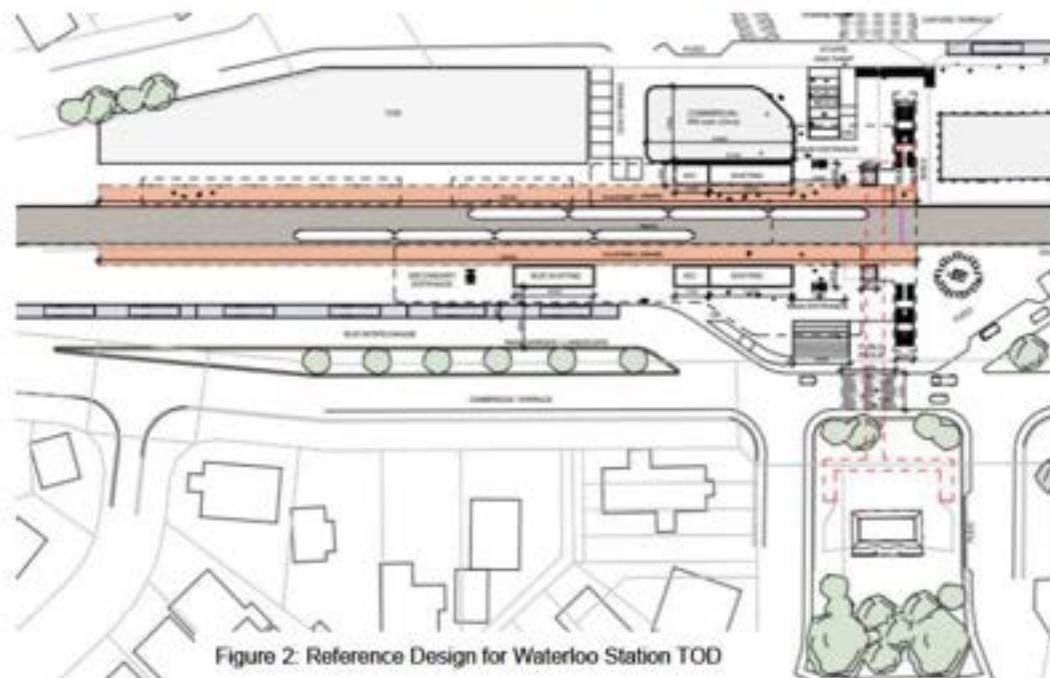


Figure 2: Reference Design for Waterloo Station TOD

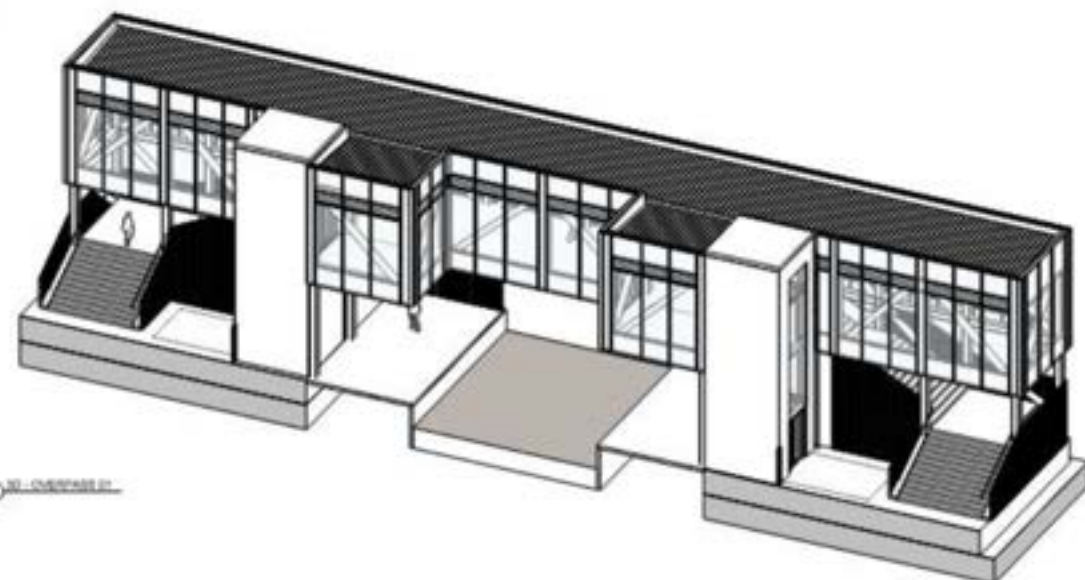


Figure 3: Waterloo Station Overpass

2 Mechanical Services

2.1 General Requirements

The mechanical services have been designed to comply with the rules and regulations of the following:

- New Zealand Building Code
- New Zealand and/or Australian Standards, as applicable
- The relevant aspects of the Fire Safety report (once received)

2.2 Mechanical Design Criteria

The mechanical systems are designed on the basis of the following design criteria:

■ Ambient Conditions	Summer	26.3°C DB / 21.1°C WB	(based on Wallaceville 1 percent design day)
	Winter	-1.4°C DB	
■ Temperature Setpoint	Cooling	23.0 ± 1.5°C	(enclosed air-conditioned spaces only)
	Heating	22 ± 1.5°C	
■ Internal Heat Gains	People	80 W/person sensible, 60 W/person latent	
	Equipment	15 W/m²	
	Lighting	10 W/m² lighting	
■ Toilet Exhaust & Adjacent Utility spaces.	25 L/s/fixture OR 10 L/s/m²		AS 1668.2 - 2002
■ Plant Rooms (Final Location TBD)	5 L/s/m²		AS 1668.2 - 2002
■ MSB	Passive Ventilation to MSB		NZBC G4
■ Comms Room Ventilation	Split System Heat Pumps sized to meet final client ICT and Security requirements		

- Waiting Spaces
 - Passive Ventilation
 - Heating and Cooling N/A based on current design
- Overpass
 - Passive Ventilation
 - Heating and Cooling N/A based on current design
- Noise Levels
 - The maximum building services internal noise levels will be as follows:
 - General Offices L_{eq} 40 - 45 dBA
 - Bathrooms L_{eq} 50 - 55 dBA
 - Railway and Bus Terminals L_{eq} 45 - 55 dBA
 - Staff Room L_{eq} 40 - 50 dBA
 - All areas will be designed to achieve design levels provided by the acoustic engineer and consent conditions.

2.3 Station Design Philosophy

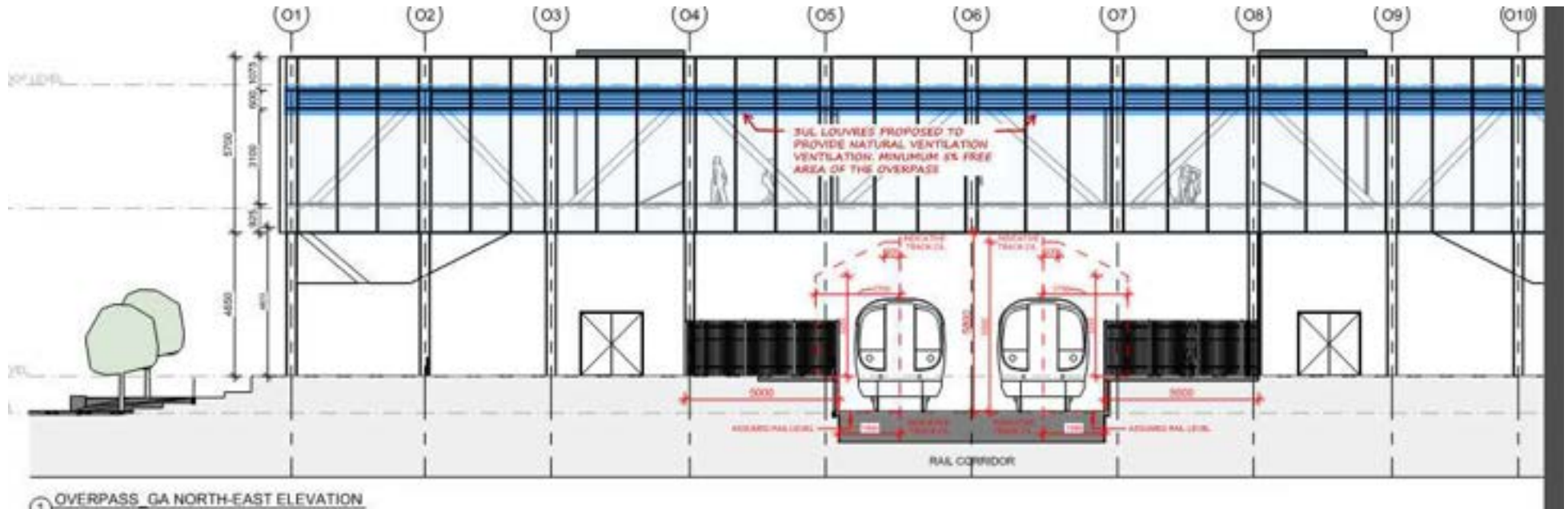
2.3.1 Bus Interchange

The bus drop-off / pick-up is external to the station with no mechanical service requirements.

2.3.2 Overpass

The pedestrian concourse bridge (overpass) will have the following design features:

- It is proposed to be naturally ventilated.
- Fixed louvres are proposed to avoid maintenance associated with operable openings. Louvres to be carefully selected to avoid water ingress.
- Internal surface finishes will need to be suitable for naturally ventilated space.



2.3.3 Public Toilets

The public toilets will utilise mechanical exhaust systems.

These systems will discharge air through roof mounted fans located above the adjacent utility area. These fans will be located to ensure appropriate separation from occupied areas.

Air will be drawn into toilets through door undercuts, door grilles or high-level louvers.

2.3.4 Train Waiting Areas

The covered train waiting areas are predominantly open on the rail side. As such these will be treated as external area and naturally ventilated with no mechanical requirements. The natural ventilation will be in accordance with the NZBC G4 VM1 and AS1 requirements. G4 requires a natural ventilation opening equivalent to at least 5% of the floor area.

2.3.5 Lifts

Lift ventilation requirements to be advised by lift supplier. Typically, the supplier's require ventilation with a free area of approximately 0.1 m².

This ventilation would be provided using either a weather louver or roof mounted cowl at the top of each lift shaft.

2.3.6 Communications Room

It is proposed to locate a communication room below the overpass. This room will likely contain the ICT, audio visual and security infrastructure.

The mechanical services for this space would likely include:

- Mechanical outside air ventilation. This system would include a fan drawing outside air through a filter, from an external louver. Outside air will then discharge directly into the space through a supply diffuser. This fan would be controlled by a timeclock
- Air conditioning using a DX split system complete with outdoor condensing unit and indoor hi-wall unit. A suitable location for the outdoor condensing unit will need to be determined that provides access for maintenance.
- If a UPS is located within this space a suitable mechanical extract may be required.

2.3.7 MSB Room

It is proposed to locate a Main Switchboard (MSB) room below the overpass. This room will likely contain the electrical infrastructure for the station, bus interchange and associated external lighting.

The mechanical services for this space would likely include:

- Passive ventilation through door mounted weather louvres.
- If a UPS is located within this space a suitable mechanical extract may be required.

Once a more detailed assessment is made of this space it is possible mechanical ventilation or cooling may be required.

2.3.8 Controls

It is proposed all plant will operate on independent standalone controls. These will include:

- Air conditioning systems are controlled via a single proprietary control wall mounted controller within the dedicated space served to control temperature.
- Toilet exhaust fans, outside air ventilation fans and general exhaust fans will run using programmable digital timeclocks or local occupancy sensor.
- The mechanical control system will be able to issue alarms if overheating ($> 30^{\circ}\text{C}$) occurs in either the ICT Room or the MSB Room.

2.3.9 Electrical for Mechanical

The power supplies for mechanical plant and equipment will be supplied from local electrical switchboards.

2.4 Commercial Area

The commercial area, which is indicated as part of the station proposal, has been documented for the purpose of the reference design as a 3-storey building (GF, L1, L2). The building has a footprint of 550sqm, with a total GFA of 1650 sqm over 3 floors. We would anticipate the mechanical services of this space would include:

- VRF/HVRF air conditioning system.
- Heat recovery ventilation
- Toilet exhaust system
- Mechanical control system
- Dedicated exhaust systems as required
- Cooling allowances for a dedicated small comms/server room

This building is subject to further development in the next phase once GWRC requirements are known.

2.5 Seismic Restraint

Mechanical services are to be seismically restrained in accordance with the requirements of NZS 4219.

3 Electrical Services

3.1 General Requirements

The electrical services will be designed in accordance with the NZ Building Code, Kiwi Rail requirements, safety in design legislation and in accordance with the following standards:

- AS/NZS 3000 Australian/New Zealand wiring rules.
- AS/NZS 3008.1 Cables for alternating voltages up to and including 0.6/1kV
- AS/NZS 3013 Electrical installations – Classification of the fire and mechanical performance of wiring systems.
- AS/NZS 2293 Emergency evacuation lighting for buildings.
- AS/NZS 61439 Low voltage switchgear and control gear assemblies - type tested and partially type-tested assemblies.
- NZS 4219 Seismic performance of engineering systems in buildings

Note: this list is not exhaustive, other AS/NZS standards may be used as required.

3.2 Incoming Supply

The station is currently supplied from the Wellington Electricity sub-station located to the north of the station at the eastern end of Knights Road. The LV supply to the station runs in an underground duct which passes under Knights Road and Oxford Terrace. It is known that there is limited spare capacity in both the supply cable and the sub-station. During the preliminary design phase, the future station load and the proposed commercial building load will be assessed as requirements become known. The suitability of the existing underground duct will also be assessed.

The current intention is that the station and the commercial building are supplied from the sub-station alleviating the need to house a transformer in the station complex. The spare capacity of the sub-station will be discussed with Wellington Electricity and investigated in the next design phase. The tariff meters will be located in the main switchboards of the station and commercial building.

3.3 Main Switchboards

A new main switchboard (MSB) will be housed in a new main switchroom located under the overpass at the northern end. The MSB will be kept to 3 metres or less in length so that a second means of egress from the main switchroom is not required.

In the preliminary design phase, the IP rating of the MSB will be finalised once it is confirmed whether the main switchroom is to be sprinklered or not. The form rating will also be determined.

The MSB will contain spare outgoing ways, surge protection, tariff metering, a power quality meter, CTs for the proposed photovoltaic installation on the platform roofs, connection point for a temporary generator, a lift safety section of busbar, and anti-condensation heaters. All MCCBs within the MSB will be electronic type.

It is currently intended to temporarily retain the existing MSB so that the station can remain operational during the station upgrade. The methodology of transferring power from the existing MSB to the new will be explored in the next design phase. The requirement for check meters for possible NABERSNZ or Greenstar rating will be investigated in the preliminary design phase.

3.4 Power Factor Correction

Power factor correction (PFC) will not be provided initially as it may not be required. The need for PFC will be determined during the first 12 months of operation when the worst-case power factor is known. This will be assessed from the lowest recorded PF by the power quality meter in the MSB. Space provision for a future PFC unit will be allocated in the main switchroom and a spare MCCB breaker allowed for in the MSB.

3.5 Generator

It is not proposed to incorporate a permanent generator for the station unless specifically asked for. Instead, a connection point for a temporary generator will be provided. The actual location will be determined during the preliminary design investigation.

3.6 Redundant Services

All redundant electrical services in the station complex including the underpass will be decommissioned, removed and safely disposed of. The full extent of this will be identified in future design phases.

3.7 Cable & Cable Management

During the preliminary design phase, the extent of the existing platform underground ducts will be determined. These will be re-used where practical.

All main and sub-main cable will be low smoke and zero halogen (LSZH). The main incoming cable and cables supplying life safety systems will additionally be fire rated.

Where possible cables will be hidden from view and run in ceiling voids, walls, underground ducts and within service ways built into the platform canopy. It is also proposed that cable ducts for power and ICT services will be built into the new overpass.

The following is proposed for the cable management for the main, sub-main and final circuit wiring:

- The existing platform underground ducts to be re-used, where possible.
- Cable tray/basket – for distribution of sub-main cables and final circuits.
- Cable tray/basket – provided for ICT services.
- Conduits – for final circuits that cannot be hidden from view.
- Underground ducts – for external power, lighting and ICT.
- Ducts provided below the screed in the concourse for power, lighting and ICT.
- Catenary wires – for final circuits that are run in ceiling voids.

3.8 Distribution Boards & Small Power

Distribution boards will house miniature circuit breakers (MCBs) and residual current devices (RCDs) for the following:

- ICT distribution boards supplied via uninterruptable power supply (UPS) units.
- External lighting distribution boards
- Platform lighting and power distribution boards

The mechanical and hydraulic services will be supplied from local distribution boards. This includes air conditioning, pumps, fans, hot water cylinders etc.

Automatic doors will be supplied from local distribution boards.

Socket outlets will be provided on the platforms. All internal socket outlets will be flush mounted where possible. Externally mounted socket outlets will be IP65 rated and of an industrial design.

In general, all socket outlets will be RCD protected except those supplying ICT racks.

Power will also be supplied to the following: -

- Ticket barrier gates
- Passenger information displays (PIDs)
- Master clock system
- Passenger help points
- Ticket vending machines
- Bus stops

3.9 Lighting

Lighting will be designed to the recommendations of AS/NZS 1680, AS/NZS 1158, CIBSE guidelines where not covered by AS/NZS 1680, the requirements of any Crime Prevention Through Environmental Design (CPTED) assessment, and requirements of GI/RT7016 produced by the Rail Safety and Standards Board in the UK.

New lighting will be provided to the station, platforms, bus interchange, and external areas leading to the station.

The roof of the station is the single most dominant architectural feature of the new development. The lighting design and the luminaires chosen will be carried out in consultation with the architect to enhance this key architectural feature. To be energy efficient we will be advising the architect to specify light surface finishes with a high reflective index to reduce the quantity and electrical load of the luminaires.

All luminaires will be LED with a minimum efficacy of 100 lumens/Watt.

Platform lighting and areas of the station open to external influences will be IP65 rated.

All recessed mounted luminaires will be fed via a plug and socket to facilitate easy and safe replacement.

The external lighting will be designed to meet the requirements of AS/NZS 1158, and to minimise the spill light onto adjacent properties in accordance with the Hutt City Council Unitary Plan.

The external lighting within the station complex will be supplied from the station power supply so that it is part of the combined station and traction earthing system, this will be subject to whether the station earthing, and traction earthing systems are combined or not.

A DALI compliant scene setting control system will provide the following control functions:

- Control the public areas of the station and platforms to come on and off at prescribed times and provide dimming up and down subject to the external lighting levels.
- Control the lighting to the public toilets to come on and off at prescribed times.
- The carpark lighting to go on at dusk and off at dawn, the actual lighting level of the dawn and dusk settings will be adjustable.

3.10 Emergency Lighting

Emergency lighting will be designed in accordance with the Fire Engineering Report and the New Zealand Building Code with AS/NZS 2293 being adopted as the acceptable solution.

It is proposed to use self-contained emergency luminaires to form a decentralised intelligent system. This is as opposed to a centralised system for the following reasons: -

- There is no single point of failure, a centralised system is far more prone to fail under a seismic event leaving no emergency lighting.
- The latest battery technology only requires replacement every 10+ years and is cost effective.

- Monitoring of the status of each individual luminaire is constant.
- Testing can be carried out automatically, remotely, and outside of operational hours.
- A central system needs 6 monthly inspections, testing and maintenance.
- No need for fire rated cupboard to house a centralised system and mechanical cooling.
- No requirement for expensive fire rated cables.
- No lost space.
- The central system is made up of multiple parts from different manufactures, with no one overarching warranty.

3.11 Earthing

The station earthing and bonding system will be designed in accordance with AS/NZS 3000 and in conjunction with the requirements of the traction earthing systems. These earthing systems may need to be separated or combined subject to separation distances. The actual requirement will be determined in the next design phase.

3.12 Photovoltaic (PV) Panels

Photovoltaic (PV) solar panels located on top of the platform canopies and commercial space are intended to be incorporated into the electrical design. The quantity and scope will be investigated in the next design phase, when it will also be agreed as to whether this will be a D&B package for a specialist PV contractor.

3.13 Lightning Protection

A lightning protection risk assessment will be carried out in accordance with AS/NZS 1768 during the next design phase to determine risk factors and whether a lightning protection system is recommended.

3.14 Sustainability

- The single biggest impact that the electrical design has upon sustainability is the use of highly efficient LED lighting.
- A lighting control system capable of dimming and switching is also proposed to reduce energy consumption.
- PVC insulated cables will be excluded from the design thereby eliminating a product that is toxic to produce and toxic to dispose of.

- Photovoltaic (PV) solar panels to be included into the electrical design of the station complex.
- Provision for electric car, bicycle and scooter charging will be investigated in the next design phase.

3.15 Commercial Area

The commercial area, which is indicated as part of the station proposal, has been documented for the purpose of the reference design as a 3-storey building (GF, L1, L2). The building has a footprint of 550sqm, with a total GFA of 1650 sqm over 3 floors. We would anticipate the electrical services of this space would include:

- New local distribution boards (db)
- Lighting
- Small power
- PV allowances

This building is subject to further development in the next phase once GWRC requirements are known. Also refer to the requirements above regarding the implementation of shared design principles (PV, ESD, etc.).

3.16 Seismic Restraint

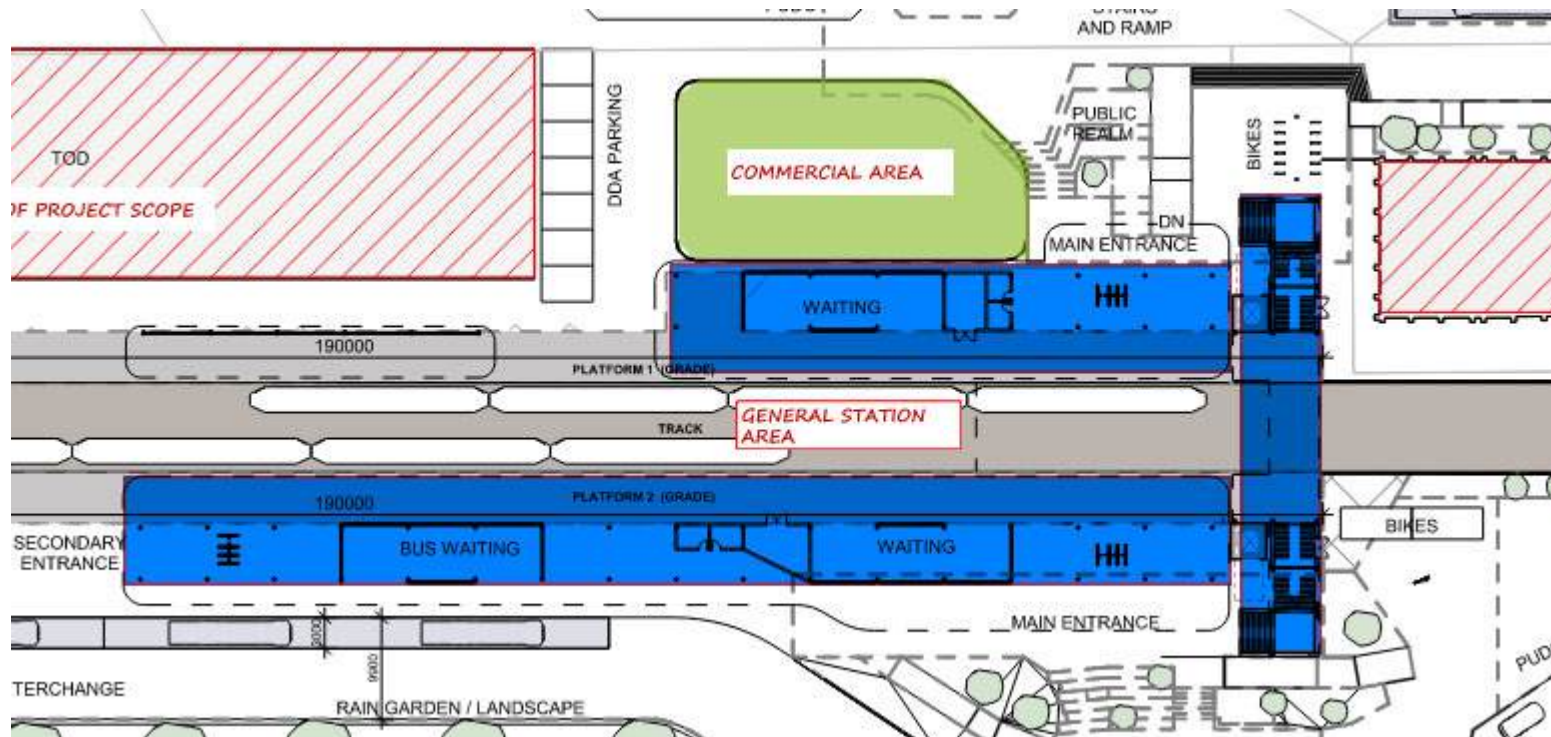
Electrical services are to be seismically restrained in accordance with the requirements of NZS 4219.

4

4.1

The Fire Engineer has indicated, for the station, that fire protection systems will not be required for NZBC life safety compliance. However, GWRC will need to consider if they would like to include fire protection systems for property protection purposes.

The Commercial will require a suitable fire protection system, and this will need to be confirmed by the Fire Engineer.



4.2

The types of systems that could be considered for the station include audible alarms, combined with:

- Manual call points.
- Fire sprinklers or heat detectors within enclosed areas (over pass, MSB room etc).

4.3 Commercial Area

The commercial area, which is indicated as part of the station proposal, has been documented for the purpose of the reference design as a 3-storey building (GF, L1, L2). The building has a footprint of 550sqm, with a total GFA of 1650 sqm over 3 floors. We would anticipate the commercial area fire protection systems could include a combination of some of the following types of systems:

- Manual fire alarm system (manual call points)
- Heat detection system
- Smoke detection system
- Fire Sprinkler System

A fire alarm panel and a fire service attendance point will likely be required for this building. This commercial building is subject to further development in the next phase once GWRC requirements are known a fire report specific to the commercial area is provided.

4.4 Seismic Restraint

Electrical services are to be seismically restrained in accordance with the requirements of NZS 4219.

5 Hydraulic Services

5.1 General Requirements

The hydraulic services have been designed to comply with the rules and regulations of the following:

- New Zealand Building Code
- New Zealand and/or Australian Standards, as applicable
- Requirements of Wellington Water for the public sewer and water network
- Requirements of Hutt City Council

5.1.1 Hydraulic Services Design Criteria Table

Table 5-1: Hydraulic Services Design Table

Item	Proposed Design Parameters
Design Standards	AS/NZS 3500:2018
Sanitary Drainage	Pipes sized to flow 0.7 proportional depth, minimum self-cleansing velocity of 0.75m/s.
Fixture Units for Sanitary Drainage	From AS/NZS 3500 Part 2, Table 6.3(A) WHB 1 Sink 3 WC Cistern 4
Hot & Cold Water including non-potable cold water	Pipes sizes based on velocity. Maximum velocity in cold water pipework 1.2 m/s. Maximum velocity hot water pipework 0.9m/s.
Fixture Loading units for Hot & Cold-water services	From IOP Guide 2-Hot and Cold Water, Table 15 (Medium Frequency of Use) WHB 1 Sink 5 WC Cistern 2

5.2 Design Philosophy

5.2.1 Sanitary Drainage

Sanitary drainage is provided to serve the proposed commercial space, 2 x WC and plant areas, and 2 x lift pit sump pumps.

Sanitary drainage is to be gravity discharge and connects to the sitewide sanitary drainage provided under the Civil scope.

Sanitary drainage includes soil, waste, vent to all fixtures indicated on the architectural drawings and condensate drainage from air conditioning systems where required.

Floor waste gullies are provided in the west and east concourse pods, located in the cleaner's cupboard, first aid room and each of the toilets. These are connected to the main sanitary wastewater drains.

Rodding/inspection points are provided to stacks and graded drains with access points.

A moisture sensor attached to a local alarm is provided within each of the two lift pit sumps.

Each lift pit sump is pumped to an external overflow relief gully trap, adjacent to the WC/Plant areas.



Figure 5-1: Lift Sump Pump (example only)

Power supplies for the sump pumps and moisture sensors are derived from the local electrical switchboards. The moisture sensor alarms, and status/run/fault lights are located within the plant rooms.

All 100mm sewer branches are to be laid at a minimum gradient of 1 in 60. Pipe gradients for sewers within the buildings will comply with the minimum requirements of AS/NZS 3500.2. Pipes will have sufficient fall to be self-cleansing, whilst complying with AS/NZS 3500.

Sanitary drainage pipe materials are to be uPVC (both internal and external to the building).

5.2.2 Stormwater

Roof water drainage is designed to a stormwater event being an average rainfall intensity of 10-minute intervals over 100 years, which results in 123 mm/hr. Refer to NIWA HIRDS website (<https://hirds.niwa.co.nz/>) for the Waterloo Interchange location in Lower Hutt.

Downpipes discharge at the building line to a gravity discharge system and connects to the sitewide stormwater drainage provided under the Civil scope.

For roof gutter design with regards to accelerated water flows and sump design refer to Architectural documentation.

Downpipes are to be sized and provided based on architectural roof and gutter design.

Stormwater drainage pipe materials are uPVC.

5.2.3 Potable (Domestic) Hot & Cold-Water Services

Potable cold-water supply is taken from a (metered) connection to the Wellington Water main provided under Civil scope of works.

Potable cold water is reticulated within the site to serve the proposed commercial space, 2 x WC and plant areas, and various hose taps.

Hot water to 2 x WC areas is provided by local electric hot water cylinders (HWC), located in the adjoining plant rooms.

HWC's to be 45L capacity (to be confirmed).

Thermostatic Mixing Valves are provided to all limit maximum supply temperature to 45°C for the public wash hand basins.

All hot and cold-water pipes are built into walls, concealed in ducts, and pass through risers and ceiling spaces where applicable.

Backflow prevention devices are provided in accordance with AS/NZS 3500, to be provided under the Civil scope.

All reticulation will be pressure tested to a hydrostatic pressure equal to 1500 kPa for a period of 30 minutes and generally kept charged with water thereafter.

Pipe materials are to be either PEX or Copper (Class B) above ground and HDPE (High Density Polyethylene) below ground.

5.3 Commercial Area

The commercial area, which is indicated as part of the station proposal, has been documented for the purpose of the reference design as a 3-storey building (GF, L1, L2). The building has a footprint of 550sqm, with a total GFA of 1650 sqm over 3 floors. We would anticipate that dedicated Hydraulic services of this space would include connection of the following services into the site civil infrastructure:

- Storm water
- Potable Water
- Sanitary drainage

We would also anticipate the following dedicated hydraulic systems:

- Electric hot water reticulation system
- Back flow prevention systems
- Condensate as required by mechanical systems

This building is subject to further development in the next phase once GWRC requirements are known.

5.4 Seismic Restraint

Hydraulic services are to be seismically restrained in accordance with the requirements of NZS 4219.

6 Information & Communications Technology (ICT)

IT and Data systems will be provided to enable passengers, staff and operational systems to efficiently communicate and to provide an interfacing link to existing rail services and the wider area communications network.

The following ICT services will be provided at Waterloo Railway station

- Structured Cabling System (SCS)
- Building Backbone Optical Network
- Infrastructure for Public and Staff Wi-Fi
- Infrastructure for Passenger Information Displays (PIDs)
- Infrastructure for Passenger Help Points (PHPs)
- Infrastructure for Ticket Vending and Snapper top up machines
- Access Control and Intruder Detection (ACID) System
- Closed Circuit Television (CCTV) Systems
- Infrastructure for Master Clock System
- Public Address system (PA)
- Ticket barrier gates

6.1 Structured Cabling System (SCS)

The Structure Cabling System (SCS) will be provided throughout the platform. The Structured Cabling System will be Category 6A / Class EA (shielded) and support all approved applications including but not limited to analogue and digital voice applications, data, local area network, wireless, video, PHP, VRDS, PIDS and low voltage devices for building control and management on a common cabling platform to fully support the ICT requirements as laid out in this design report.

6.2 Building Backbone Optical Network

An Optical Fibre Network will be provided to link all the communications and control systems around the station. Optical fibre from the Communication Equipment Rooms will connect to the existing Rail network.

6.3 Communications Equipment Room (CER)

A Communications Equipment Room will be provided at platform level with a room size of approximately 5x4 m, housing 3no full size 1200x800 equipment racks. The racks will be seismically certified (Seismically tested to the latest Telcordia® GR-63-CORE: Zone 4). The Communications Equipment Room will have double doors with a minimum 900mm leaf for equipment access. The CER may have gas suppression subject to confirmation from the fire engineer and discussion with Metlink.

6.4 Public and staff Wi-Fi

The SCS will make allowance for data outlets and wireless access points in public and non- public areas of the station for the provision of station Wi-Fi.

6.5 Passenger Information Displays (PIDs)

The PiDs design is to provide real-time information to passengers at key decision points throughout the station. PIDs will be provided with an integrated clock. The SCS will make allowance for data outlets at PIDs locations as identified at the later stage.



Figure 6-1: Typical Passenger Information Display

6.6 Passenger Help Points (PhP)

PHPs provide passengers with the facility to make information or emergency calls to staff in the station control room. The SCS will make allowance for data outlets at PHP locations as identified at the later design phase.



Figure 6-2: Typical PHP used in Metro/Railway environments

6.7 Access Control and Intruder detection

The access control system will make specific areas of the station secure allowing access to authorised persons only. The access control field devices will be connected to a local interface which communicate via the station LAN. Access devices will include:

- Card readers
- Keypad
- Intercom
- Electronic door locks
- Reed switches

Access Control at the station will typically be provided in specific areas as listed below:

- Corridors including after-hours staff access
- Plant rooms
- switch rooms including UPS room
- Plant rooms

The intruder detection system will detect unauthorised entry into the station and activate alarms and notify staff and monitoring company. The intruder detection field devices will be connected to a local interface panel which communicates via the station LAN. Intruder detection field devices will include:

- Presence detectors
- Audible and visual alarms
- Door reed switches
- Duress alarms.

Intruder detection will be provided on all doors with electronic access control, all external doors and high-risk areas.

Specified areas listed below:

- Corridors
- Public concourse
- Switchroom
- Platform End Fire Egress routes

6.8 CCTV System

CCTV cameras will be provided throughout the platform, entrances and the bike storage area. Cameras will be a mixture of fixed and dome cameras. Cameras on the platform will be connected for monitoring and recording. All Security Systems equipment will be powered from the station 230V AC UPS. The required autonomy will be investigated during the preliminary design phase.

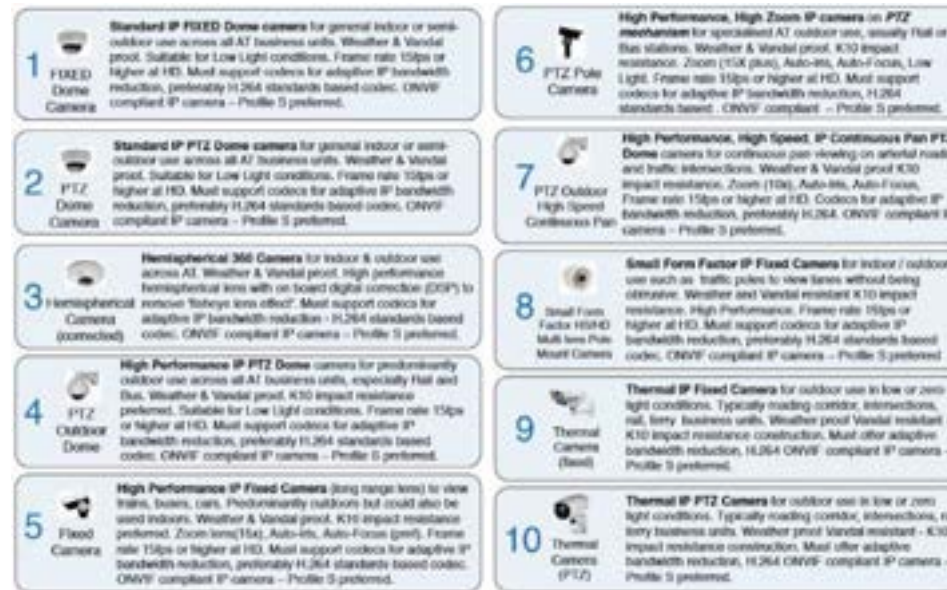


Figure 6-3: Camera types

It is proposed that a security workshop be held during the preliminary design phase to establish and agree requirements.

6.9 Master Clock System

The Master Clock System provides an IP based synchronised timestamp across the station. Clock displays may be integrated into the Platform Information Displays (PIDs). The SCS will make allowance for data outlets at Clock locations as identified at the later design phase.

6.10 Public Address System (PA)

The PA system provides the facility the ability to broadcast audio announcements to passengers and staff. The PA system will be zoned for broadcasting different audio messages in areas of the station and priority levels will be programmed to allow high priority messages to override those which are less important. The headend amplifier and audio control equipment will be located in the communications room.

6.11 Exclusion

No allowance has been made for mobile, radio network and fixed telephone due to the station being at surface level. Railway Communication and signalling is not included in scope. Active network equipment UPS and Network switches are not included in the scope of work

6.12 Existing Infrastructure

The existing infrastructure will be investigated during the preliminary design phase to establish what systems can be kept, extended and connected into.

6.13 Commercial Area

The commercial area, which is indicated as part of the station proposal, has been documented for the purpose of the reference design as a 3-storey building (GF, L1, L2). The building has a footprint of 550sqm, with a total GFA of 1650 sqm over 3 floors. We would anticipate the ICT/security services of this space would include:

- Data structural cabling,
- Data cabinets,
- PA systems,
- Wifi,
- Security system

This building is subject to further development in the next phase once GWRC requirements are known. Also refer to the requirements above regarding the implementation of shared design principles

6.14 Seismic Restraint

Hydraulic services are to be seismically restrained in accordance with the requirements of NZS 4219.

7 Earthing and Bonding

7.1 General

The Earthing and Bonding section of this report describes the earthing and bonding arrangements necessary for the proper working of the services, rail and the safety of all concerned in Waterloo Station.

7.2 Regulations, Standards, Codes, and Specifications

The regulations, standards, codes, and specifications listed in the table are relevant documents for the earthing and bonding design.

Table 7-1: E&B Specific Codes and Standards

Document No	Rev / Issue	Title
SR 2010/36	2010 incorporating latest revisions (reprinted as of 4 April 2016)	New Zealand Electricity (Safety) Regulations 2010
NZEC 34	2001	New Zealand Electrical Code of Practice for Electrical Safe Distances
NZEC 35	1993	New Zealand Electrical Code of Practice for Power Systems Earthing
EN 50122-1	2011	Railway Applications - Fixed Installations – Electrical Safety, Earthing and the Return Circuit – Part 1: Protective Provisions Against Electric Shock
IEC 62128-1	2013	Railway Applications - Fixed Installations – Electrical Safety, Earthing and the Return Circuit – Part 1: Protective Provisions Against Electric Shock
AS/NZS 3000	2007 incl. A2	Electrical Installation (known as the Australian/New Zealand Wiring Rules)
E1332	1	AEP Traction Rail Bonding Installation Specification
ENA EG1	2006	Energy Networks Association – Substation Earthing Guide
IEEE Std 80	2000	IEEE Guide for Safety in AC Substation Grounding

7.3 Traction and Station Earthing Systems

During the next design phase, it will be determined as to whether the traction and station earthing systems are to be separate systems or combined. This will be based on the separation distances of the two systems.

7.3.1 Earthing and Bonding Areas

Traction and equipotential bonding are required throughout the Waterloo Station complex, the following items will be connected to earthing and bonding system.

- Zone 1
 - Canopies
 - Metallic structures
 - Fences and discrete air gaps for discontinuity
 - Metalwork
 - Overbridges: walkways and roads
 - Concourse
- Zone 2
 - Traction Overhead Line Equipment (OHLE) comprises the support masts & foundations, catenary wires, contact wires and traction earth wires, together with the associated feeder and cross span wiring, isolation, support arms, associated fittings and other attachments that traction overhead wirings are suspended and registered in position.

7.3.2 Low Voltage Electrical Supplies

The electrical services design which includes the distribution of the Multiple Earthed Neutral (MEN) and communication earth systems as per AS/NZS 3000 is covered in the electrical services section of this report.

7.4 New Primary Earth Terminal (PET) Cabinet

The requirement for a new Primary Earth Terminal (PET) cabinet will be determined as the design progresses. The PET is a critical electrical item of the traction system earthing infrastructure and provides the main point of connection for traction and equipotential bonding for the station.

7.4.1 Equipotential Bonding

The following normally non-current carrying conductive structures and equipment installed close to the Overhead Contact Line Zone (OCLZ) will be connected to the Primary Earth Terminal (PET) equipotential earth bars:

- Canopy structure
- Dual bond to the Station Main Earth Bar (SMEB)

7.4.2 Traction Bonding

The following normally non-current carrying conductive structures and equipment installed within the Overhead Contact Line Zone (OCLZ) and Current Collector Zone (CCZ) along the platforms will be connected to the Primary Earth Terminal (PET) traction earth bars:

- Dual bond to rail tracks
- Fences

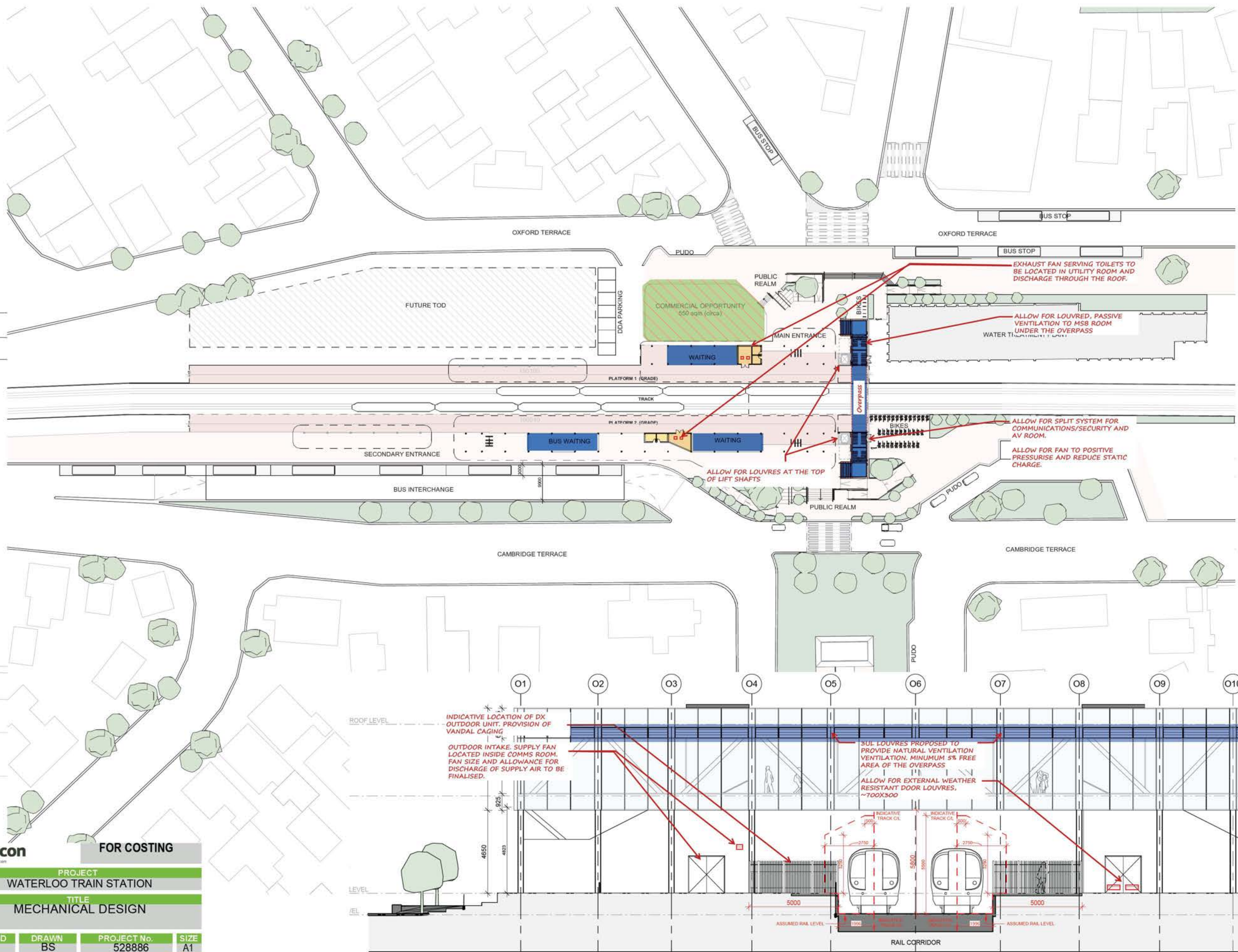
7.5 Substation Earthing System

The 11 kV HV MEN supply feeding the new station transformer can contribute to the Earth Potential Rise (EPR) at the station under fault conditions, this will result EPR at the substation and transferring potentials to other parts of the interchange facility via the connected earthing and bonding system.

ERP results analysis shows that the touch potential levels are very close to acceptable levels indicated in the AS60479 standard.

It is recommended that Wellington Electricity design the earthing system of the substation to ensure the touch and step potentials levels are below the acceptable levels.

Appendix A – Building Services Sketches



COLOURS LEGEND

- EXHAUST AIR (EA)
- KITCHEN EXHAUST (KE)
- OUTSIDE AIR (OA)
- RETURN AIR (RA)
- SUPPLY AIR (SA)
- TOILET EXHAUST (TE)

Recommended VRF/HVRF Air conditioned spaces with tempered outdoor air, general exhaust and toilet exhaust.

Exhaust air discharged through roof cowl

Passive ventilation, no conditioning

Space not directly conditioned

- GENERAL NOTES**
- ELECTRICAL INFRASTRUCTURE WILL REQUIRE STAGING REGARDING INSATLLATION OF NEW, TRANSITIONING THE OLD OVER TO THE NEW, WHILE MAINTAINING FULL OPERATIONS DURING CONSTRUCTION.
 - ALLOWANCE FOR 12 SNAPPER CARD READERS, 2 X SNAPPER TOP UP MACHINES, 6 X REAL TIME INFORMATION (RTI) DISPLAYS ON THE PLATFORMS AND 2 X RTI DISPLAYS AT STATION ENTRANCES.
 - NO ALLOWANCE HAS BEEN MADE FOR THE FUTURE TOD SPACE.
 - A NEW COMMUNICATIONS SPACE WILL BE REQUIRED FOR STATION ICT, SECURITY AND AV SERVICES. A DEDICATED COOLING SYSTEM SHOULD BE ALLOWED FOR THIS SPACE.
 - OFFICE SPACE AND OTHER ENCLOSED SPACES WILL REQUIRE FIRE SYSTEMS.
 - ALLOW FOR HEATING AND COOLING SYSTEMS, OUTDOOR AIR, GENERAL AND BATHROOM EXTRACTS FOR THE COMMERCIAL AREA.
 - UPGRADE PLATFORM FACILITIES AND SERVICES, INCL LIGHTING, DATA CONNECTION, WIFI, PA AND SECURITY SYSTEMS.
 - INSTALLATION OF THE NEW LIFTS WILL REQUIRE NEW POWER AND DATA SUPPLIES.
 - NEW LIGHTING AND EMERGENCY LIGHTING FOR THE STAIRS.
 - PV PANELS CAN BE MOUNTED ON THE PLATFORM CANOPIES' ROOF AND THE COMMERCIAL BUILDINGS' ROOF. BATTERY AND INVERTERS FOR THE PV SYSTEM TBC. POTENTIAL LOCATIONS CAN BE ON THE ROOFTOP OR IN A SEPARATE PV ROOM ON THE GROUND FLOOR.
 - ALL UNDERPASS ELECTRICAL SERVICES ARE DECOMMISSIONED AND REMOVED FROM SITE.
 - TWO SEPARATE LOCATIONS IDENTIFIED FOR A SINGLE LIFT INSTALLATION.
 - SERVICES SERVING PUBLIC TOILETS TO BE LOCATED IN ADJACENT UTILITY ROOM.

aurecon **FOR COSTING**

PROJECT
WATERLOO TRAIN STATION

TITLE
MECHANICAL DESIGN

DESIGNED BS	DRAWN BS	PROJECT No. 528886	SIZE A1
SCALE NTS	DATE 08/08/2025	SKETCH No. SK-BM-0001	REV A

OVERPASS, GA NORTH-EAST ELEVATION

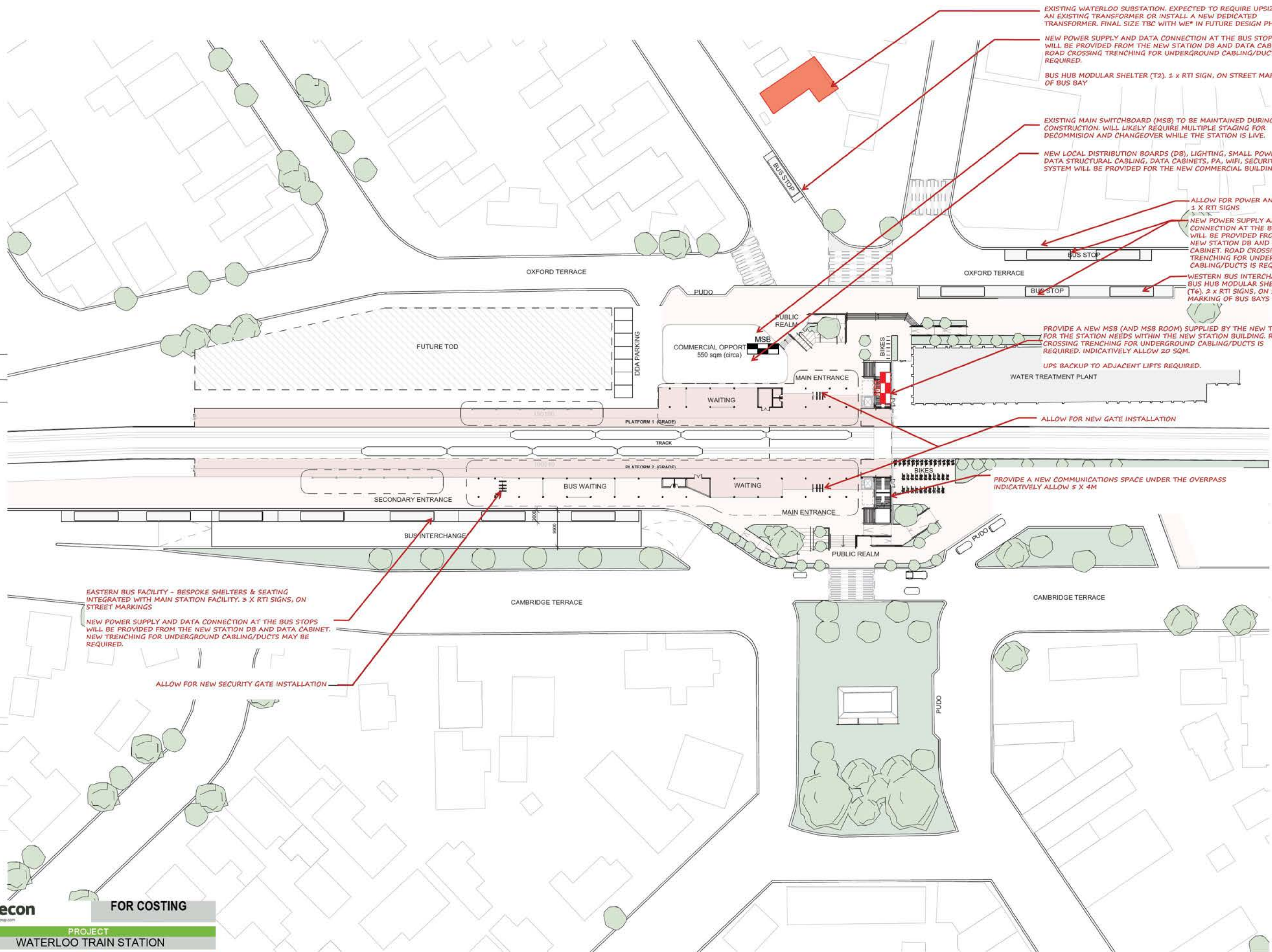
LEVEL GROUND - PROPOSED SITE PLAN

SCALE 1:500 @A1

STATUS For Information

DRW CH APPR DRW DATE REV
MC BP MH 2025.08.08 P06

DRAWING NO:
A02 2001



GENERAL NOTES

1. ELECTRICAL INFRASTRUCTURE WILL REQUIRE STAGING REGARDING THE INSTALLATION OF NEW A NEW MSB, AND TRANSITIONING FROM THE OLD MSB WHILE MAINTAINING FULL OPERATIONS DURING CONSTRUCTION.
2. ALLOWANCE FOR 12 SNAPPER CARD READERS, 2 X SNAPPER TOP UP MACHINES, 6 X REAL TIME INFORMATION (RTI) DISPLAYS ON THE PLATFORMS AND 2 X RTI DISPLAYS AT STATION ENTRANCES.
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6. ALLOW FOR HEATING AND COOLING SYSTEMS, OUTDOOR AIR, GENERAL AND TOILET EXTRACTS FOR THE COMMERCIAL AREA.
7. UPGRADE PLATFORM FACILITIES AND SERVICES, INCL LIGHTING, DATA CONNECTION, WIFI, PA AND SECURITY SYSTEMS.
8. INSTALLATION OF THE NEW LIFTS WILL REQUIRE NEW POWER AND DATA SUPPLIES.
9. NEW LIGHTING AND EMERGENCY LIGHTING THROUGHOUT THE STATION.
10. PV PANELS CAN BE MOUNTED ON THE PLATFORM CANOPIES' ROOF AND THE COMMERCIAL BUILDINGS' ROOF. BATTERY AND INVERTERS FOR THE PV SYSTEM TBC. POTENTIAL LOCATIONS CAN BE ON THE ROOFTOP OR IN A SEPARATE PV ROOM ON THE GROUND FLOOR.
11. ALL UNDERPASS ELECTRICAL SERVICES ARE TO BE DECOMMISSIONED AND REMOVED FROM SITE.
12. TWO SEPARATE LOCATIONS IDENTIFIED FOR A SINGLE LIFT INSTALLATION.
13. SERVICES SERVING PUBLIC TOILETS TO BE LOCATED IN ADJACENT UTILITY ROOM.

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PROJECT			
WATERLOO TRAIN STATION			
TITLE			
ELECTRICAL/ SECURITY AND ICT GROUND PLAN			
DESIGNED	DRAWN	PROJECT No.	SIZE
PA	PA	528886	A1
SCALE	DATE	SKETCH No.	REV
NTS	08/08/2025	SK-BE-0001	A

NORTH				
METRES @ 1:100				
DRAWING TITLE				
LEVEL GROUND - PROPOSED SITE PLAN				
SCALE			STATUS	
1 : 500 @A1			For Information	
DRW	CH	APPR	DRW DATE	REV
MC	BP	MH	2025.08.08	P06
DRAWING NO:				
A02 2001				

GENERAL NOTES

1. ELECTRICAL INFRASTRUCTURE WILL REQUIRE STAGING REGARDING THE INSATLLATION OF NEW A NEW MSB, AND TRANSITIONING FROM THE OLD MSB WHILE MAINTAINING FULL OPERATIONS DURING CONSTRUCTION.

2. ALLOWANCE FOR 12 SNAPPER CARD READERS; 2 X SNAPPER TOP UP MACHINES; 6 X REAL TIME INFORMATION (RTI) DISPLAYS ON THE PLATFORMS AND 2 X RTI DISPLAYS AT STATION ENTRANCES.

3. NO ALLOWANCE HAS BEEN MADE FOR THE FUTURE TOD SPACE.

4. A NEW COMMUNICATIONS SPACE WILL BE REQUIRED FOR STATION ICT, SECURITY AND AV SERVICES. A DEDICATED COOLING SYSTEM SHOULD BE ALLOWED FOR THIS SPACE.

5. OFFICE SPACE AND OTHER ENCLOSED SPACES WILL REQUIRE FIRE SYSTEMS.

6. ALLOW FOR HEATING AND COOLING SYSTEMS, OUTDOOR AIR, GENERAL AND BATHROOM EXTRACTS FOR THE COMMERCIAL AREA.

7. UPGRADE PLATFORM FACILITIES AND SERVICES, INCL LIGHTING, DATA CONNECTION, WIFI, PA AND SECURITY SYSTEMS.

8. INSTALLATION OF THE NEW LIFTS WILL REQUIRE NEW POWER AND DATA SUPPLIES.

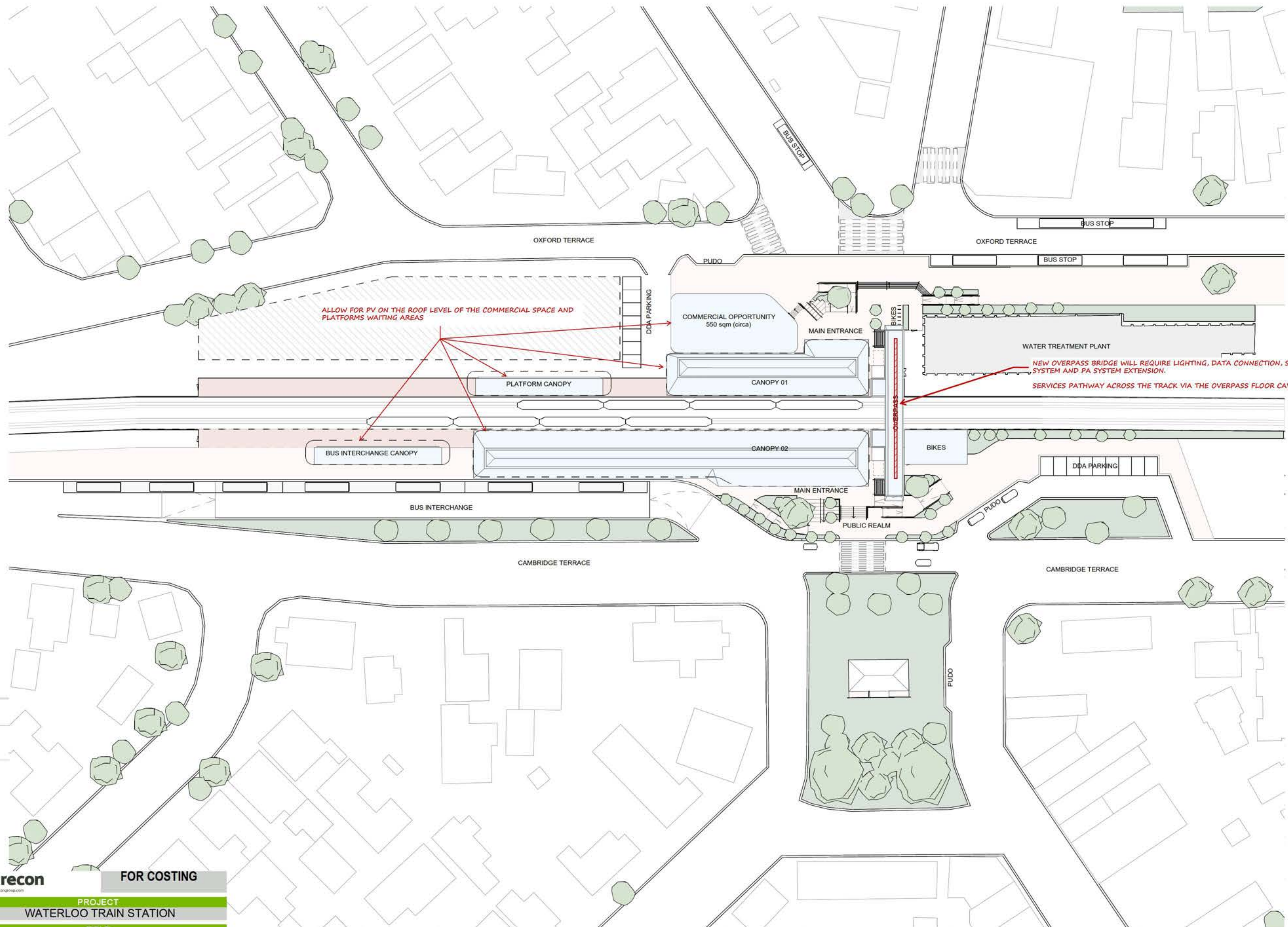
9. NEW LIGHTING AND EMERGENCY LIGHTING THROUGHOUT THE STATION.

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12. TWO SEPERATE LOCATIONS IDENTIFIED FOR A SINGLE LIFT INSTALLATION.

13. SERVICES SERVING PUBLIC TOILETS TO BE LOCATED IN ADJACENT UTILITY ROOM.



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FOR COSTING

PROJECT			
WATERLOO TRAIN STATION			
TITLE			
ELECTRICAL/ SECURITY AND ICT ROOF PLAN			
DESIGNED	DRAWN	PROJECT No.	SIZE
PA	PA	528886	A1
SCALE	DATE	SKETCH No.	REV
NTS	08/08/2025	SK-BE-0002	A



DRAWING TITLE				
LEVEL OVERPASS ROOF - PROPOSED SITE PLAN				
SCALE			STATUS	
1 : 500 @A1			For Information	
DRW	CH	APPR	DRW DATE	REV
MC	BP	MH	2025.08.08	P06
DRAWING NO. A02 2002				

COLOURS LEGEND

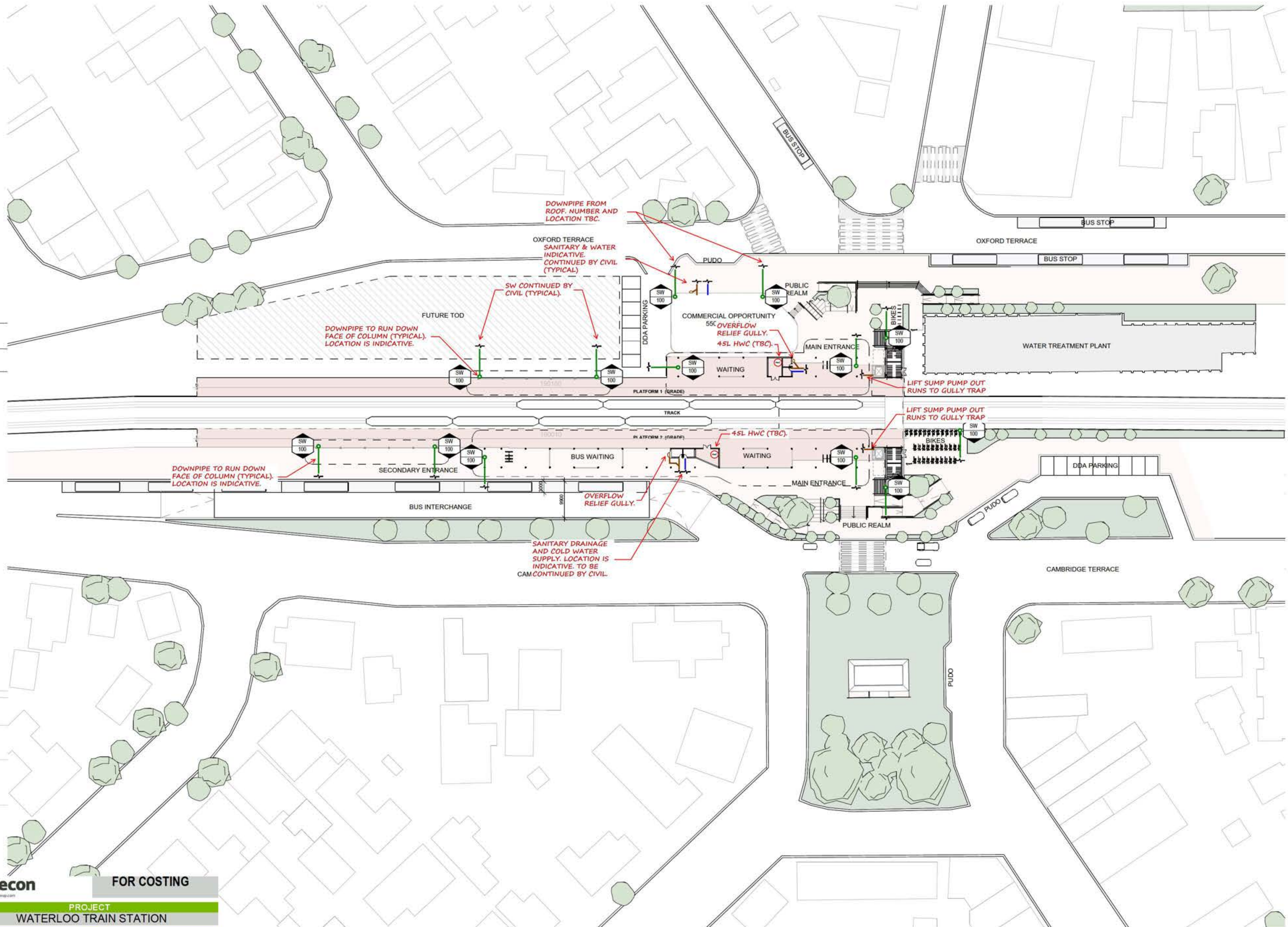
- SANITARY DRAINAGE
- STORMWATER DRAINAGE
- DOWNPIPES
- COLD WATER SUPPLY

SHEET SPECIFIC NOTES

1. COLD WATER SUPPLY COMPLETE WITH IN-GROUND TOBY AND BACKFLOW PREVENTION.
2. ALL PIPE SIZES TO BE CONFIRMED.
3. DOMESTIC HOT WATER PLANT WILL BE REQUIRED FOR THE COMMERCIAL BUILDING.
4. HOSE TAP LOCATIONS ARE NOT SHOWN.
5. LIFT PIT SUMP PUMPS TO BE PUMPED TO OVERFLOW RELIEF GULLY TRAPS ADJACENT TO WC/PLANT AREAS.
6. DOWNPIPE LOCATIONS AND NUMBERS ARE INDICATIVE AND TO BE CONFIRMED.

GENERAL NOTES

1. ELECTRICAL INFRASTRUCTURE WILL REQUIRE STAGING REGARDING THE INSTALLATION OF NEW A NEW MSB, AND TRANSITIONING FROM THE OLD MSB WHILE MAINTAINING FULL OPERATIONS DURING CONSTRUCTION.
2. ALLOWANCE FOR 12 SNAPPER CARD READERS; 2 X SNAPPER TOP UP MACHINES, 6 X REAL TIME INFORMATION (RTI) DISPLAYS ON THE PLATFORMS AND 2 X RTI DISPLAYS AT STATION ENTRANCES.
3. NO ALLOWANCE HAS BEEN MADE FOR THE FUTURE TOD SPACE.
4. A NEW COMMUNICATIONS SPACE WILL BE REQUIRED FOR STATION ICT, SECURITY AND AV SERVICES. A DEDICATED COOLING SYSTEM SHOULD BE ALLOWED FOR THIS SPACE.
5. OFFICE SPACE AND OTHER ENCLOSED SPACES WILL REQUIRE FIRE SYSTEMS.
6. ALLOW FOR HEATING AND COOLING SYSTEMS, OUTDOOR AIR, GENERAL AND BATHROOM EXTRACTS FOR THE COMMERCIAL AREA.
7. UPGRADE PLATFORM FACILITIES AND SERVICES, INCL LIGHTING, DATA CONNECTION, WIFI, PA AND SECURITY SYSTEMS.
8. INSTALLATION OF THE NEW LIFTS WILL REQUIRE NEW POWER AND DATA SUPPLIES.
9. NEW LIGHTING AND EMERGENCY LIGHTING THROUGHOUT THE STATION.
10. PV PANELS CAN BE MOUNTED ON THE PLATFORM CANOPIES' ROOF AND THE COMMERCIAL BUILDINGS' ROOF. BATTERY AND INVERTERS FOR THE PV SYSTEM TBC. POTENTIAL LOCATIONS CAN BE ON THE ROOFTOP OR IN A SEPARATE PV ROOM ON THE GROUND FLOOR.
11. ALL UNDERPASS ELECTRICAL SERVICES ARE DECOMMISSIONED AND REMOVED FROM SITE.
12. TWO SEPERATE LOCATIONS IDENTIFIED FOR A SINGLE LIFT INSTALLATION.
13. SERVICES SERVING PUBLIC TOILETS TO BE LOCATED IN ADJACENT UTILITY ROOM.



COLOURS LEGEND

- SANITARY DRAINAGE
- STORMWATER DRAINAGE
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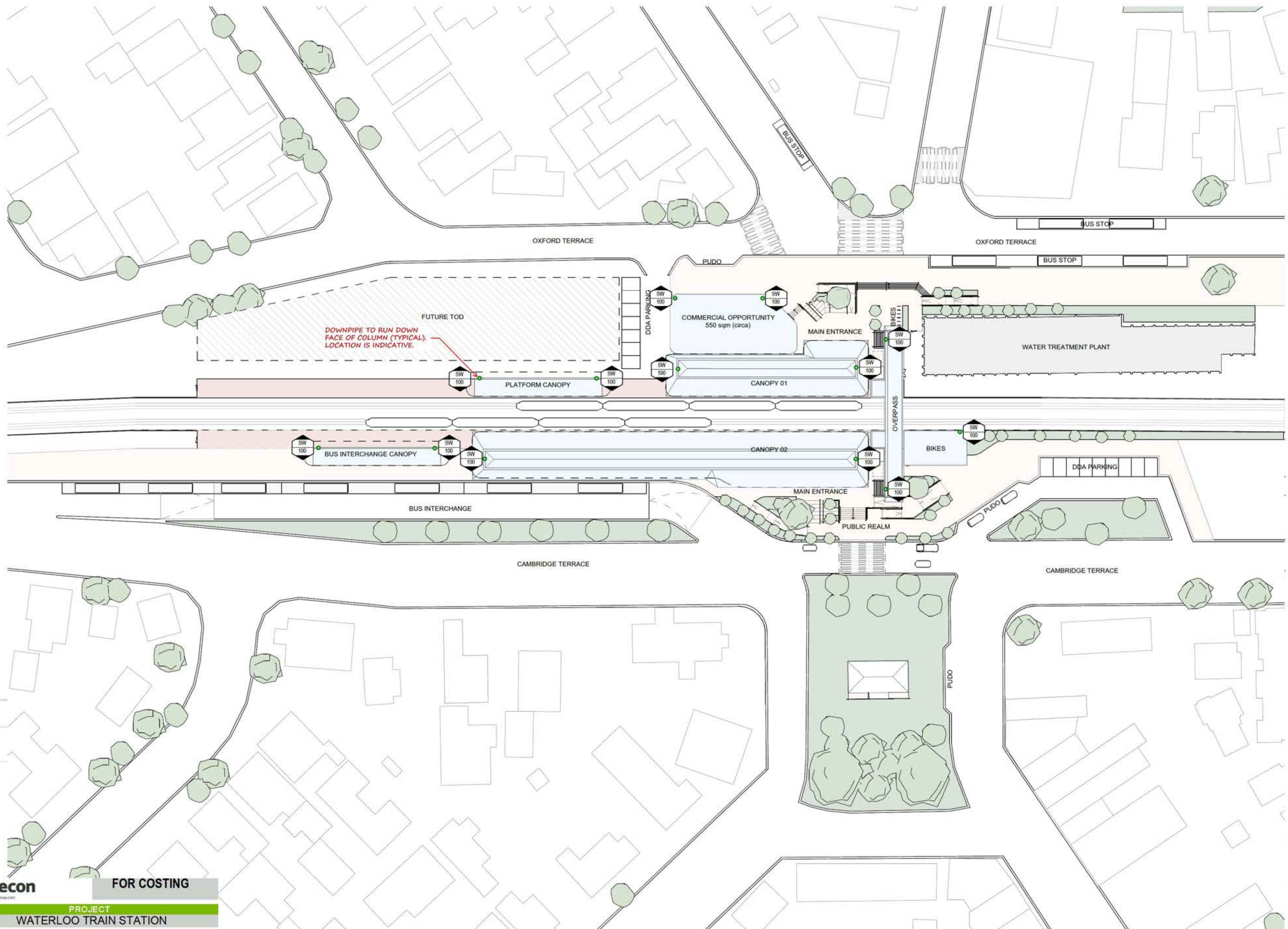
DRAWING TITLE
LEVEL OVERPASS ROOF -
PROPOSED SITE PLAN

SCALE
1 : 500 @A1

STATUS
For Information

DRW CH APPR DRW DATE REV
MC BP MH 2025.08.08 P06

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A02 2002



aurecon

FOR COSTING

PROJECT
WATERLOO TRAIN STATION

TITLE
HYDRAULICS
ROOF PLAN

DESIGNED PA	DRAWN PA	PROJECT No. 528886	SIZE A1
SCALE NTS	DATE 08/08/2025	SKETCH No. SK-BY-0002	REV A

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8.7 CIVIL

Waterloo Train Station

Reference Design Report Civil Services

Greater Wellington Regional Council

Reference: 528886

Revision: B

2025-08-21



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1 Introduction

1.1 Overview

This report has been prepared for the Greater Wellington Regional Council (GWRC) to support the creation of a Reference Design for the new Waterloo Train Station, a pivotal element within the broader Waterloo Station Transit-Oriented Development (TOD) Project.

Serving as a central hub, this transportation hub is designed to efficiently integrate with the wider urban environment, fostering connectivity and accessibility.

Separate from the commercial developments that form part of the larger TOD, this report focuses specifically on the Civil Engineering Services reference design for the transportation hub itself. The design brief encapsulates the outcomes from three critical phases of the project—Define and Discover, Feasibility Study, and the Waterloo Station Reference Design.

By addressing the civil engineering services considerations within this reference design, the report aims to guide the delivery of a functional, sustainable, and user-friendly transport hub, aligned with the region's strategic goals for urban development and public transport enhancement.

1.2 Background

Waterloo Station is a key node in the Wellington Region's public transport network. Located on the Hutt Valley and Wairarapa Lines, it serves as the primary interchange for Naenae, Wainuiomata, Seaview, and Kelson, and connects into regional services linking Upper Hutt, Wellington City, and the Wairarapa. With over 14,000 rail boardings weekly and functioning as a key bus-rail transfer point, the station is strategically positioned to enable mode shift, reduce transport emissions, and unlock urban development within Lower Hutt City.

The current Waterloo Station Railway Station was constructed in 1988. In recent years the roof structure has suffered from ongoing maintenance issues and is past its end-of-life. This has provided the opportunity for the station infrastructure and surrounding urban catchment to be reconfigured in a way that supports transport orientated developments. Waterloo Station was selected by Wellington Regional Leadership as a potential TOD due to:

- A need to address major and end-of-life infrastructure issues in the Waterloo Station.
- The availability of prime commercially developable land in the wider precinct
- Waterloo station and the precinct's strategic location in the Hutt Valley and larger footprint (~18,865m² of developable land).

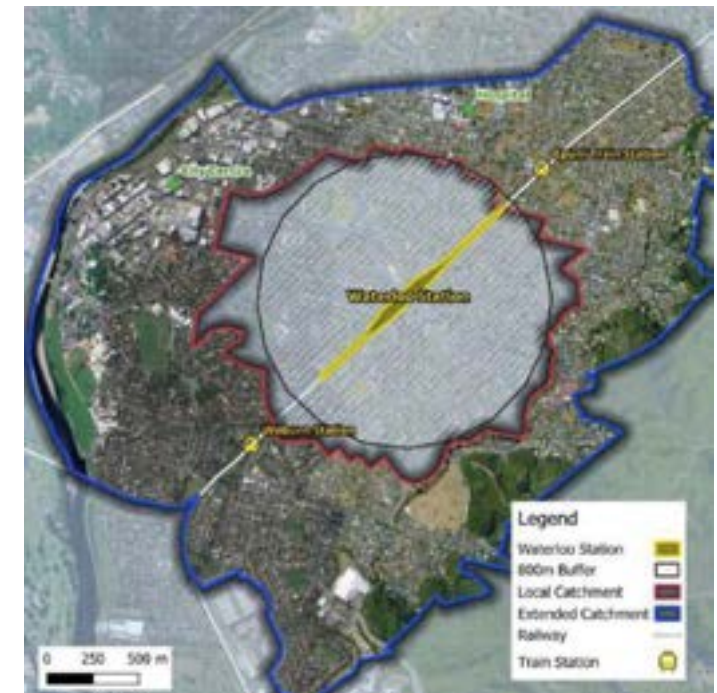


Figure 1 Waterloo Station and 800m radius

2 Existing Site

Waterloo Station is located within a largely existing residential housing area with some light commercial businesses on both the eastern and western side of the station with an established road network and car parking system. The railway line intersects the site into two separate catchments, from a civil services perspective.

The site is reasonably flat with the high point of the site contours located at the Waterloo station building and gently sloping to the north and the south. There is a small concrete crib retaining wall along the eastern edge of the car park on Cambridge Terrace.

The existing Station building is immediately adjacent to the Waterloo Water Treatment Plant (refer to Figure 3). The Plant is a critical piece of infrastructure, supplying the Wellington region with 40% of its annual water supply. Associated with the Water Treatment Plant is large diameter water transmission mains and associated valving work running parallel to Waterloo Station. This includes:

- 750mm diameter concrete lined steel transmission main, installed in 1981
- 525mm diameter concrete lined steel transmission main, installed in 1945

The treatment plant and associated infrastructure are constraints to the future development of Waterloo Station and need to be considered in all future design stages.

There are existing utilities located within the site extents. These are considered in further detail in the following sections.



Figure 3 Waterloo Water Treatment Plant (source: WWL)

3 Stormwater

3.1 Existing Network

The railway tracks split the site into two independent catchments to the east and the west. Stormwater runoff from the buildings is currently managed by downpipe collection which is directed to the public network located on Oxford Terrace and Cambridge Terrace. Overland flow from the hardstand areas in the surrounding carpark is directed to kerb and channel into a series of sumps around the perimeter of the site, which also drains to the public network. There are no known stormwater treatment devices i.e. raingardens, swales etc. on the site.

The stormwater drainage for the adjacent WWL Water Treatment Plant is also directed through Waterloo Station via a public 225 diameter concrete gravity pipe. The existing network can be seen in Figure 4 below.



Figure 4 Existing Stormwater Network

No consultation with Wellington Water has been undertaken to understand the condition or capacity of the existing network. The network on the western side of the station (Oxford Terrace) and the car park on the eastern side (Cambridge Terrace) consists of concrete pipe installed in the 1990's. The drain that runs along Cambridge Terrace is a concrete pipe installed in the 1940's. This pipe will be approaching the end of life over the next 10 - 20 years.

3.1.1 Site Flooding Risk

According to Hutt City Council GIS (see Figure 5 below), the Station and the associated car parks sit above the 100 year Average Recurrence Interval (ARI) flood zone. The exception is to car park north of the WWL Water Treatment Plant. There are no overland flow paths traversing Waterloo Station. It is noted that the adjacent road network and the car park to the north of the Treatment Plant is located within the flood zone.



Figure 5 100 year flooding zone, accounting for climate change

3.2 Design Criteria

The following section outlines the design criteria pertaining to the stormwater design.

3.2.1 Relevant Standards and Design Guidance

The following design criteria has been used for design of the proposed stormwater drainage system:

- Wellington Water– Water Sensitive Design for Stormwater: Treatment Device Design Guideline (2019).
- Acceptable Solutions and Verification Methods for New Zealand Building Code Clause E1 Surface Water (1st Edition, Amendment 10).
- Wellington Water – Regional Standard for Water Services (Dec 2024).
- Wellington Water – Regional Specification for Water Services (Dec 2024).
- AS/NZS 2890.1:2004 Parking Facilities - Part 1: Off-street car parking.

3.2.2 Design Flows

Stormwater flow calculations have been undertaken in accordance with the Regional Standard for Water Services (December 2024) using the rational method for hydrological design, suitable for catchments less than 100ha. The primary drainage system has been designed to convey a 10% AEP (1 in 10-year) rainfall event, which with an allowance for climate change increase (RCP 8.5; 2081-2100), resulting in 10-minute and 20-minute design rainfall intensities of 95.4 and 65.9 mm/hour, respectively (retrieved from HIRDS, accessed 08 August 2025)

The runoff coefficient (C) used for the design flows are in accordance with NZ Building Code E1 and are summarised below:

- C = 0.95 for building rooves and hardstand pavement areas.
- C = 0.35 for landscape areas, green spaces and parks.

The total eastern catchment area is approximately 475 sqm, with 13.7% being pervious surfaces. The expected 10-year 10-minute flow for this catchment has been calculated at 10.87 L/s, while the 10-year 20-minute flow is estimated at 7.51 L/s. Similarly, the total western catchment covers approximately 540 sqm, of which about 3.4% is pervious. The expected 10-year 10-minute flow for the west catchment is 13.30 L/s, with the 10-year 20-minute flow calculated at 9.18 L/s.

Table 1 Stormwater design flows for Waterloo Station

Catchment Size	10% AEP 10 min	10% AEP 20 min
Eastern Catchment ~475	10.87 L/s	7.51 L/s
Western Catchment ~540	13.30 L/s	9.18 L/s

3.3 Proposed Stormwater Systems

The overall stormwater philosophy will largely remain unchanged for the site. Overland flow will continue to be directed to channel drains, kerb and channel and a series of sumps around the site. Where practicable, the reuse of existing infrastructure has been considered. In order to ensure compliance with Wellington Water and Greater Wellington Regional Council requirements, the use of water sensitive devices is proposed in the form of raingardens. This is further discussed in the sections below.

3.3.1 Stormwater Connections

New stormwater connections will be required for the Station buildings, commercial building, platform canopies and over bridge structure with 150mm and 225mm diameter uPVC pipes proposed to link into the existing stormwater network at the locations indicated in Figure 6 below. At this stage, consultation with Wellington Water has not been undertaken to confirm the suitability or capacity of these connections.



Figure 6 Stormwater Connection points (WWL GIS)

In addition to connections for the built structures, additional stormwater connections will be required for strip drains located at the top of stairs and ramps and repositioned or additional sumps in the carpark and entrance areas. Where practicable overland flow will be directed to a series of raingardens to treat the runoff prior to being discharged to the existing network. The full extent of the stormwater infrastructure can be found in the drawing provided in Appendix A.

3.3.2 Rain Gardens

In addition to meeting compliance requirements in regard to stormwater quality, GWRC has expressed aspiration to improve sustainability outcomes for the project. The use of water sensitive devices has hence been reviewed for suitability, to improve the water quality outcomes and reduce adverse effects on the receiving environment through treatment of areas such as pavements. The suitability of water sensitive devices is dependent on-site constraints such as space availability and ground conditions. In general, space availability is limited to smaller devices given the transport requirements for the site.

On this basis, the following devices were considered but not deemed practical for the development:

- Permeable pavements – Permeable pavements are constructed hard surfaces that allow water to pass through to the underlying soil layers. This helps to reduce site run off and provide some water quality treatment. However, due to pavement requirements for buses, there were concerns around pavement longevity and maintenance, permeable pavements were not considered appropriate or effective for the site.
- Soakage – The option to return stormwater to the ground through soakage was not considered practical for this development.
- Vegetated swales, constructed wetlands and ponds – Swales, wetlands and ponds have been considered unsuitable due to space availability.

The one additional device that was considered appropriate for the site was the use of raingardens. Rain gardens slow down and capture stormwater at the source, reducing runoff velocity and volume, thereby minimizing flooding and erosion risks. These use plants and soil to naturally filter pollutants from stormwater, improving water quality. Rain gardens contribute visually appealing green spaces in urban areas.

Raingardens have been incorporated into the urban form and have been designed in accordance with Water Sensitive Design for Stormwater: Treatment Design Guideline (Wellington Water, 2019). They have been sized to capture 2% of the impervious area in a 1% AEP 20-min storm event.

3.3.3 Attenuation

There are no significant changes to the impervious area post development, therefore, attenuation is likely not required for the station redevelopment. However, the TOD development will likely trigger some more onerous requirements such as attenuation and water reuse. This has not been considered as part of this reference design.

4 Wastewater

4.1 Existing Network

The existing wastewater network surrounding the project site is illustrated in Figure 7 below. The existing wastewater network is to be maintained and protected, unless mentioned to be abandoned or relocated on the civil drawings found in Appendix A. There is an existing 900mm trunk main, that runs parallel to the site on Cambridge Terrace. This is a critical asset within the network however, it will not be directly affected by the construction works. It is to be protected and maintained during proposed construction works. There is no known wastewater treatment or attenuation on site.

No consultation with Wellington Water has been undertaken to understand the condition or capacity of the existing network.



Figure 7 Existing Wastewater network (WWL GIS)

4.2 Design Criteria

The wastewater network will be designed to comply with the following standards and codes:

- Acceptable Solutions and Verification Methods for New Zealand Building Code Clause G13 Foul Water (2nd Edition, Amendment 9).
- Wellington Water – Regional Standard for Water Services (Dec 2024).
- Wellington Water – Regional Specification for Water Services (Dec 2024).

The following design criteria shall be used for design of the proposed wastewater drainage system:

- Minimum pipe gradients to comply with Wellington Water Standards.
- Minimum self-cleansing velocity of 0.75m/s in Average Dry Weather Flow (ADWF).
- Peak velocity of 3m/s in Peak Wet Weather Flow (PWWF).

4.3 Proposed Wastewater Network

The wastewater system will collect sanitary sewer from the station buildings and commercial area via proposed 150mm diameter uPVC wastewater connections to the existing network via existing manholes.

No consultation has been undertaken with Wellington Water to confirm connection points or network capacity. With the addition of a significant commercial area on the site, there is a possibility that wastewater attenuation may be required if there is inadequate capacity in the downstream network.

While not considered as part of this reference design, it is likely that the TOD will likely trigger downstream capacity upgrades or onsite wastewater attenuation requirements.



Figure 8 Proposed Wastewater connection points (WWL GIS)

5 Proposed Water Supply

5.1 Existing Network

As previously mentioned, the site is adjacent to Waterloo water treatment plant and the associated underground infrastructure. Within Oxford Street there is a 525mm diameter transmission main installed in the 1940's and a 750mm diameter transmission main, installed in the 1980s. In addition, there is potable water infrastructure located to the east and the west which provide connection opportunities. All existing infrastructure to be maintained and protected during construction works.



Figure 9 Existing bulk and potable water network (WWL GIS)

5.2 Design Criteria

The potable water network has been designed to comply with the following standards and codes:

- Acceptable Solutions and Verification Methods for New Zealand Building Code Clause G12 Water Supplies (3rd Edition, Amendment 12).
- Wellington Water – Regional Standard for Water Services (Dec 2024).
- Wellington Water – Regional Specification for Water Services (Dec 2024).

The following design criteria shall be used for the design of the proposed potable water supply and fire sprinkler mains:

- Fire services to be concrete lined steel (STCL) pipe in accordance with acceptable materials for fire services as per Wellington Water Regional Specification.
- Allowable pipeline losses on principal mains. ≤ 5 m/km for 110OD PE100 SDR11 potable water pipe (Wellington Water Regional Standard, 6.3.1.5 Allowable pipeline losses).
 - Darcy Weisbach method outlined in Wellington Water Regional Standard for calculating pipeline losses.
- As per SNZ PAS 4509:2010, all structures with a sprinkler system installed to an approved standard are classified by FW2 with minimum of two fire hydrants to provide flow.
- Sprinkler requirements for water supply as per NZS 4541:2020.

5.3 Proposed Water Supply Network

A proposed 50mm diameter potable water connection from the existing network on the eastern side and a proposed 100mm diameter potable water connection from the existing network on the western side will supply water to the buildings. These proposed connections are indicated in Figure 10 below. No consultation has been undertaken with Wellington Water to confirm connection points or network capacity.



Figure 10 Proposed Water connection points (WWL GIS)

6 Utilities

6.1.1 Communication

According to resources sent via beforeUdig by EonFibre, 2degrees and Chorus there is existing communication infrastructure adjacent to or are existing cable connection in the project site, all of which must be protected during works. Of particular note is a Chorus duct bank consisting of 6 x 100 diameter duct within a 450 diameter concrete pipe that runs under the railway, as shown in Figure 11 below. With the extension of the platforms and the proposed commercial areas on site, this duct bank will likely require relocation. This will need to be determined in consultation with the NUO.

There is a communications cable that runs through the station from east to west that may require relocation as it currently runs under the proposed stairs. Any relocation will need to be undertaken with Chorus.

Additional communication connections are likely to be required for the redevelopment. As mentioned above, there is existing infrastructure in both Oxford and Cambridge Terraces to enable these connections.

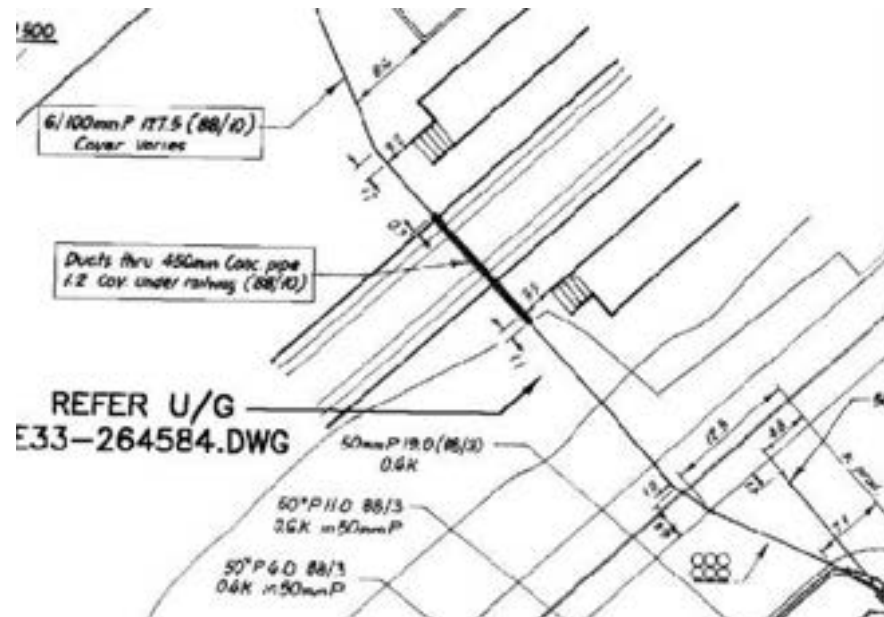


Figure 11 Existing Chorus duct bank

6.1.2 Power

Based on the Wellington Electricity plans have indicated that there is 33kV cables, 11kV cables, 400V cables, Auxiliary cables, public light, distribution station in and around the site (see Figure 12). It is recommended that the power cables within the platform of the station are precisely located, prior to commencement of works and protected as necessary. There is an electrical cable that runs through the station from east to west that may require relocation as it currently runs under the proposed stairs. Any relocation will need to be undertaken with the relevant Network Utility Operator.

The installation of new lifts will require the provision of new power and data supplies to support their operation. Additionally, new lighting and emergency lighting will be installed for the stair. Services for the public toilets will be located in an adjacent utility room for easy access and maintenance. The new overpass bridge will necessitate the installation of lighting. The electrical infrastructure installation will require careful staging to transition from the old system to the new one seamlessly. This process must be managed in phases to ensure that full operational capacity is maintained throughout construction. Proper planning and execution will be essential to avoid service interruptions while upgrading the electrical systems.



Figure 12 Wellington Electricity infrastructure

6.1.3 LINZ Survey

There are several survey markers within or adjacent to the site that will require protection and / or removal and replacement after construction. Refer to Figure 13 below.

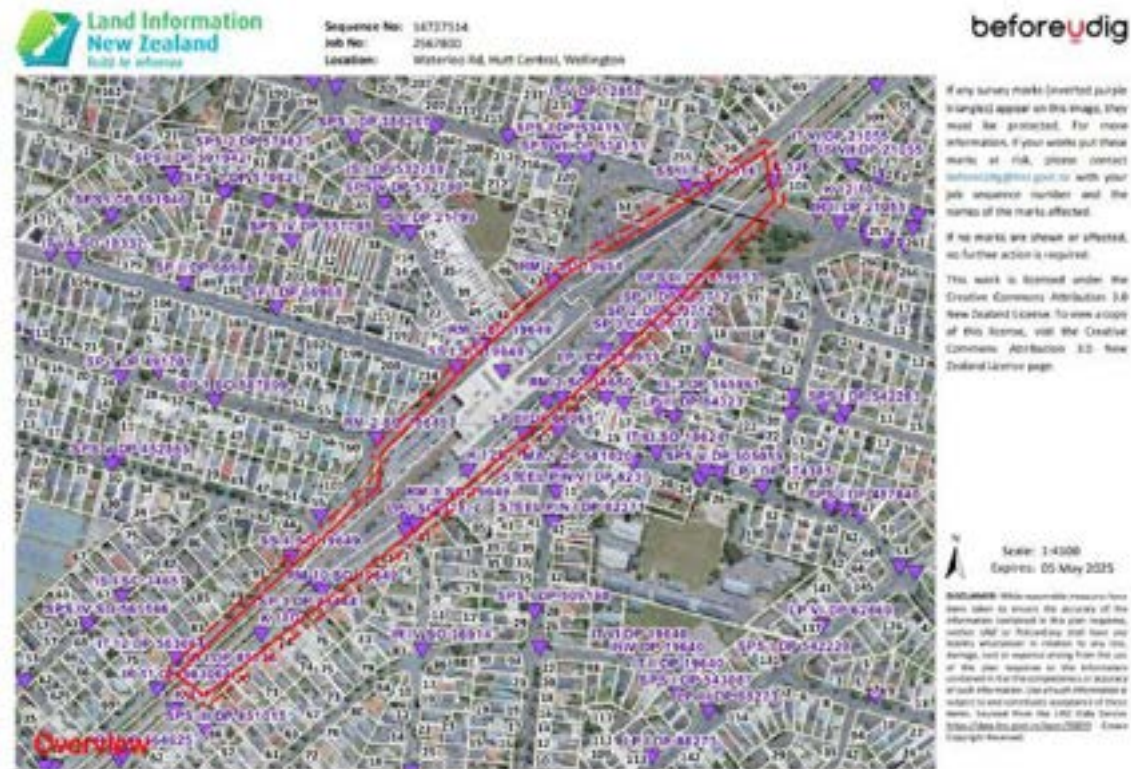


Figure 13 Linz survey marks

Appendix A

Civil Drawing

Civil Drawing

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8.8 STRUCTURAL & TUNNEL LIQ RELIEF

Memorandum

Title	Concept-lite Design Memo
Job Number	8962
To/Attn	GWRC c/- RCP
From	S7(2)(a)
Date	7/08/2025

The following memorandum provides background to the structure proposed for the favoured shortlisted option (Short Overbridge) as well as touching on future risks and opportunities.

1 Outline

Dunning Thornton have provided structural input to Grimshaw's "Issue for Coordination" drawings dated 28th July 2025. These markups include structural materiality, likely zones for bracing elements and gravity structure.

Main elements requiring structural input are:-

- New overbridge spanning track only
- New Canopy structures
 - Two main types- double cantilever (Main Canopy #1) and side column (Platform Canopy)

There is also potential for a stage 1 commercial building to be developed as part of the station re-development. This is currently shown as a two storey building in the massing model. For costing purposes, this can be assumed to be traditional steel framed building, with 8x8m grid, with piles and pile caps at column locations, with concrete foundation beams between. Assume insitu concrete floors on trapezoidal steel tray with secondary beams, and light gauge purlin roof with plywood diaphragm. There may be an option for incorporating timber elements, such as a timber roof, and/or floors which can be explored in later design phases.

The main structural driver is to limit foundation loads in order to minimise piles required. All structures need to be supported on piles, founded in gravel layer ~8m below ground, and avoid the aquifer. Refer to Tonkin and Taylor geotechnical memo for further details.

1.1 New Overbridge

Form of the overbridge, with offset lift and stair, has resulted in a more complex bridge design than in the previous phase, due to the need to hang one corner – the lift "lobby" - off the main span. An SHS trussed frame is proposed, with diagonal members to the elevations, as well as the roof and floor. Placement of diagonals is driven by circulation constraints with two braced bays per side per end on the longitudinal elevation. These differ on each elevation of the bridge due to position of stair flight exiting one side of the bridge.

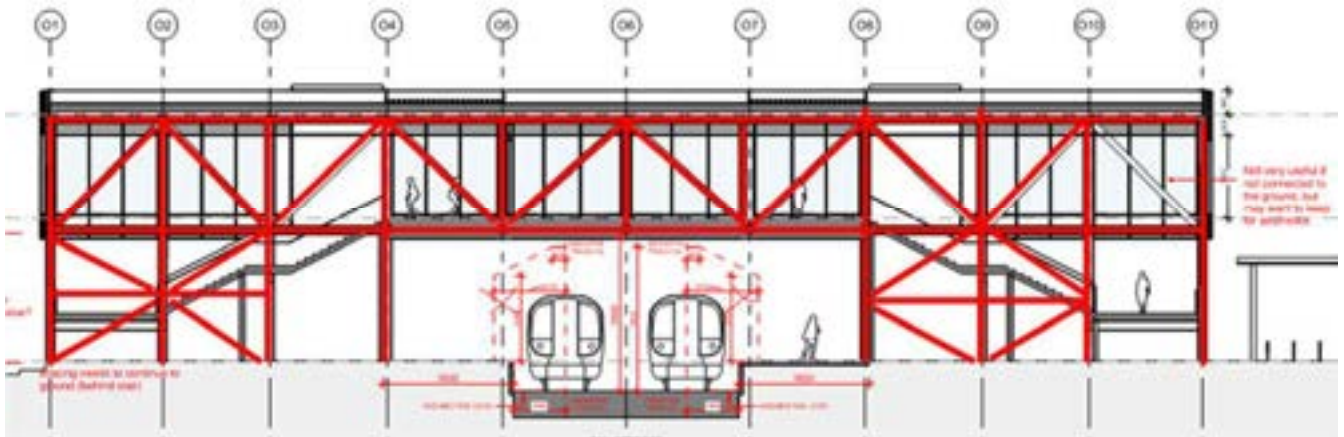


Figure 1 – Elevation of Bridge Showing Proposed Truss Arrangement

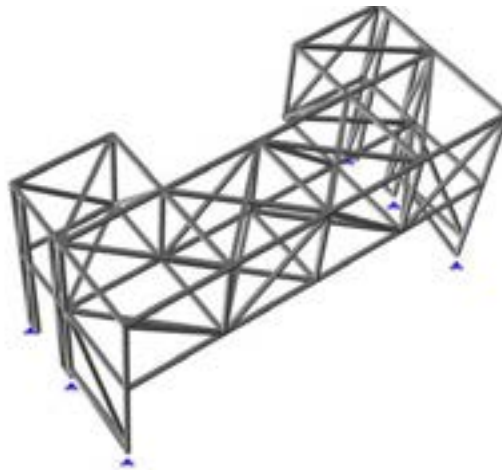


Figure 2 – Excerpt Structural Model of Bridge Spanning Portion Only

It is proposed that the floor and roof of the overbridge are CLT panels, with 80mm lightweight screed to the floor panels for wear/weathering purposes. These would sit on the top of the steel structure.

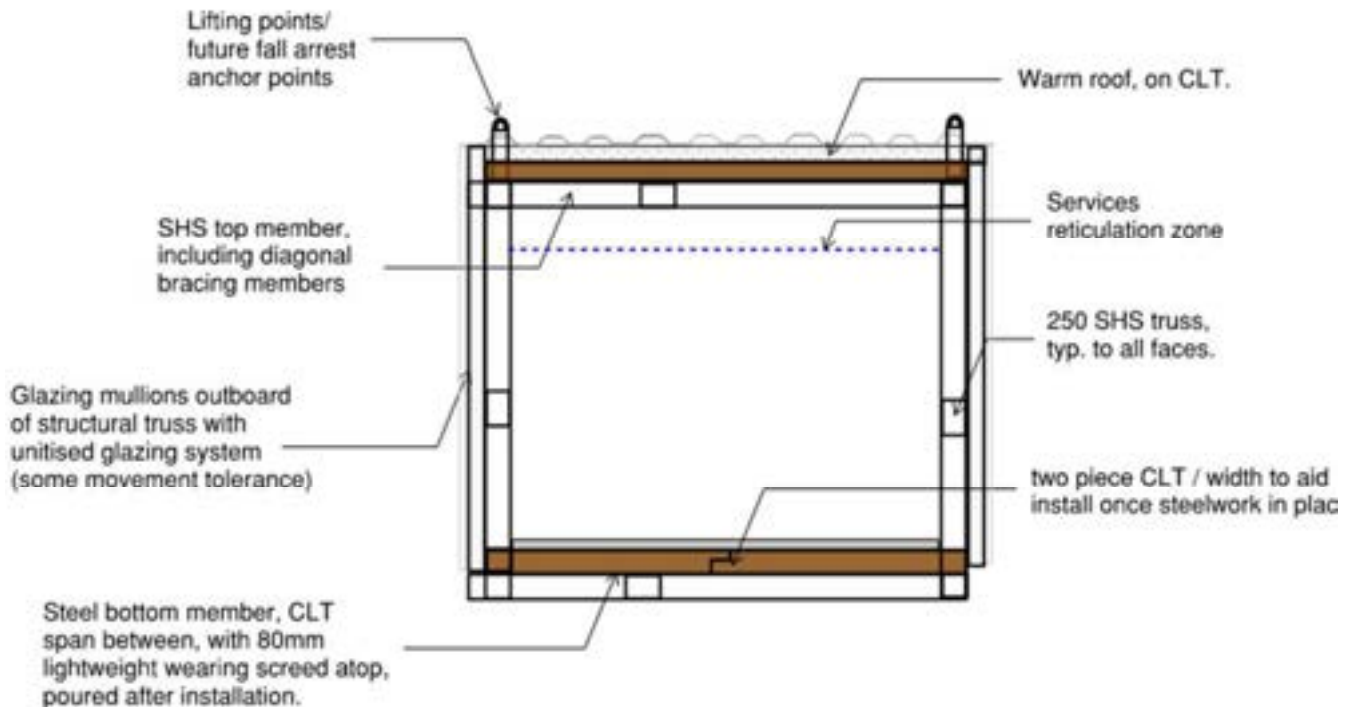


Figure 3 – Cross Section Through Bridge

Given the complexity of the trussing, it is proposed that the bridge is functionally a single element, rather than incorporating seismic movement joints. This will impact constructability of the bridge, it is currently proposed to fabricate as one element. Allowance for Category 4 piloted transport should be made.

Stairs are proposed to be steel plate on steel stringers generally, with steel plate landings. The first short flights at 90 degrees to the main bridge are proposed to be insitu concrete over void former.

It is assumed that the bridge structure will be subject to fire rating requirements – this will include protection to the roof steel elements. If specific fire assessment is done, this may be able to be omitted.

1.2 Canopies

Two different canopies are proposed, larger ~15m structures which form part of the roof of large semi-permeable shelters and smaller single span canopies over sections of the platform. It is proposed that canopies are formed of steel columns and beams, with structural cassette rooves (SIPS or pre-sheathed frames panels, overlaid in architectural lining to the soffit (if not part of the cassette)) and metal roofing. Additional framing will be required to achieve the canopy envelope shape.

It is assumed that the canopy structures will not need to be fire rated.

Canopy steelwork beams will be set out to avoid being penetrated by internal gutter – this is likely to drive the position/depth of steelwork.

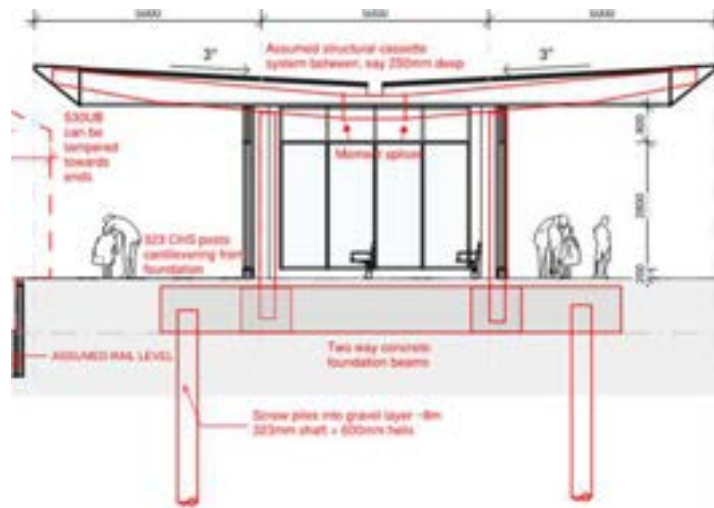


Figure 4 – Cross Section Through Double Column Canopy

Allowances for thermal movement and any differential movement will be considered in later design phases through detailing. A conservative allowance would be movement joints every 40-50m

1.3 Other Structural Items for Discussion

At the time of writing, extend of glazing to shelters is still to be determined. It is likely that secondary structural steel will be required to support the glazing.

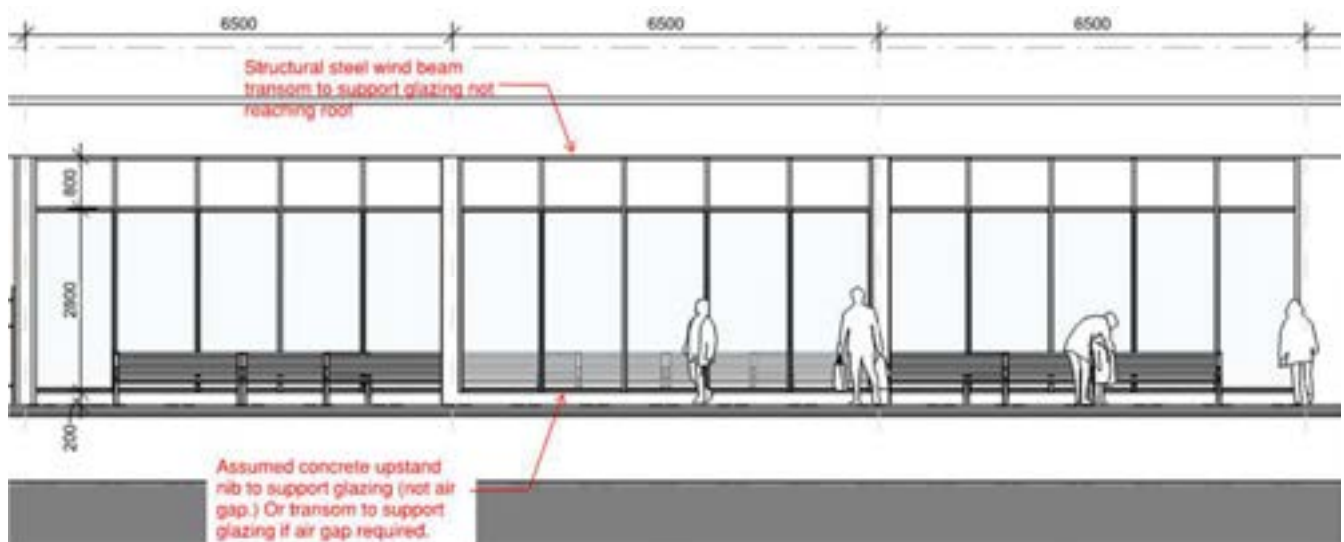


Figure 5 – Example of Glazing

Single storey standalone structures, such as plant and toilet block could either be lightweight timber structures (stick frame or CLT) with timber framed ceiling or alternatively blockwork with concrete lid. Structural solution and required ceiling height will

influence integration with canopy structure.

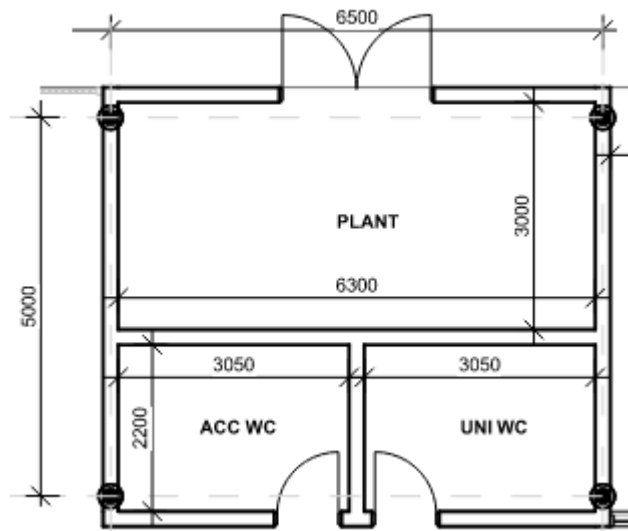


Figure 6 – Excerpt Architectural – Plant & Toilet Block

2 Key decisions to date

The architecture form of both the bridge and canopies lend themselves to primarily structural steel solutions rather than timber due to proposed spans. Similarly, the foundation constraints preclude large scale use of concrete, in order to minimise imposed loads on the foundations.

Providing medium depth piled foundations also helps to isolate the structure from effects of potential differential settlement of the ground locally. This is particularly important for the overbridge if constructed as a single unit.

3 Future Risks

The current lift position has been set out to be offset from the existing subway, to allow continued use of the subway during construction. The suitability and practicality of this will need to be examined more closely in later phases, to ensure sufficient offset has been provided. Excavation adjacent will need to consider water control risk (refer sketches).

The status of the existing subway is currently unknown at time of writing from both a durability perspective and a liquefaction susceptibility perspective. This is subject to forthcoming testing (durability) and analysis (once liquefaction trigger level is established following ground investigation.)

Importance level of the station is still subject to discussion. Current structures have been sized assuming IL2 levels of shaking. The loadings code does not require higher levels of resilience than this (unless classed as principal railway station with capacity greater than 250 people): options to add “above code” resilience for either life-safety or damage mitigation can be had during Preliminary Design along with the cost/benefits.

4 Future Opportunities

There is a future phase of work to consider station construction staging and possibility of ‘hybrid’ option of continuing to use

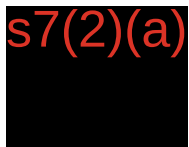
existing subway prior to installation of new overbridge. This will be dependent on results of both the durability assessment of the subway and liquefaction susceptibility of the subway.

In future design stages, relative resilience of structures verses platforms should be considered. It is currently noted that platforms are formed on a gravel raft over void former, as a mid range solution between slab on grade (likely subject to liquefaction induced settlement) and fully piled solution, but this should be interrogated considering amount of bulk excavation vs post seismic remediation required once liquefaction trigger level is known.

Future design phases can consider potential for pedestrian pass through under the bridge, through alternative bracing configurations/layouts. Similarly in preliminary design, form of bracing to lift fronts can be explored to minimise structural bracing zone as much as possible.

Infill/removal of the existing subway and options for this will also be considered in future stages.

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Associate



Waterloo Station
Dunning Thornton Consultants Ltd
DOCUMENT REGISTER
Job No. 8962



Issue Date							
17.06.25	25.07.25	28.07.25	06.08.25				
AGC	AGC	AGC	AGC				

verified by

Sketch Number																			
9862	Sk-01	Tunnel Watertightness Plate		A															
9862	Sk-P-1-9	Shortlist Options WIP	A																
9862	Sk-P-10-15	Short Overbridge Option - For Costing			B														
9862	Sk-P-16	Liquefaction Relief Concept				A													

Report Register																			
9862	M02	Concept-lite Memo				A													

Liquefaction Relief Concept

Note that liquefaction trigger level is not yet known



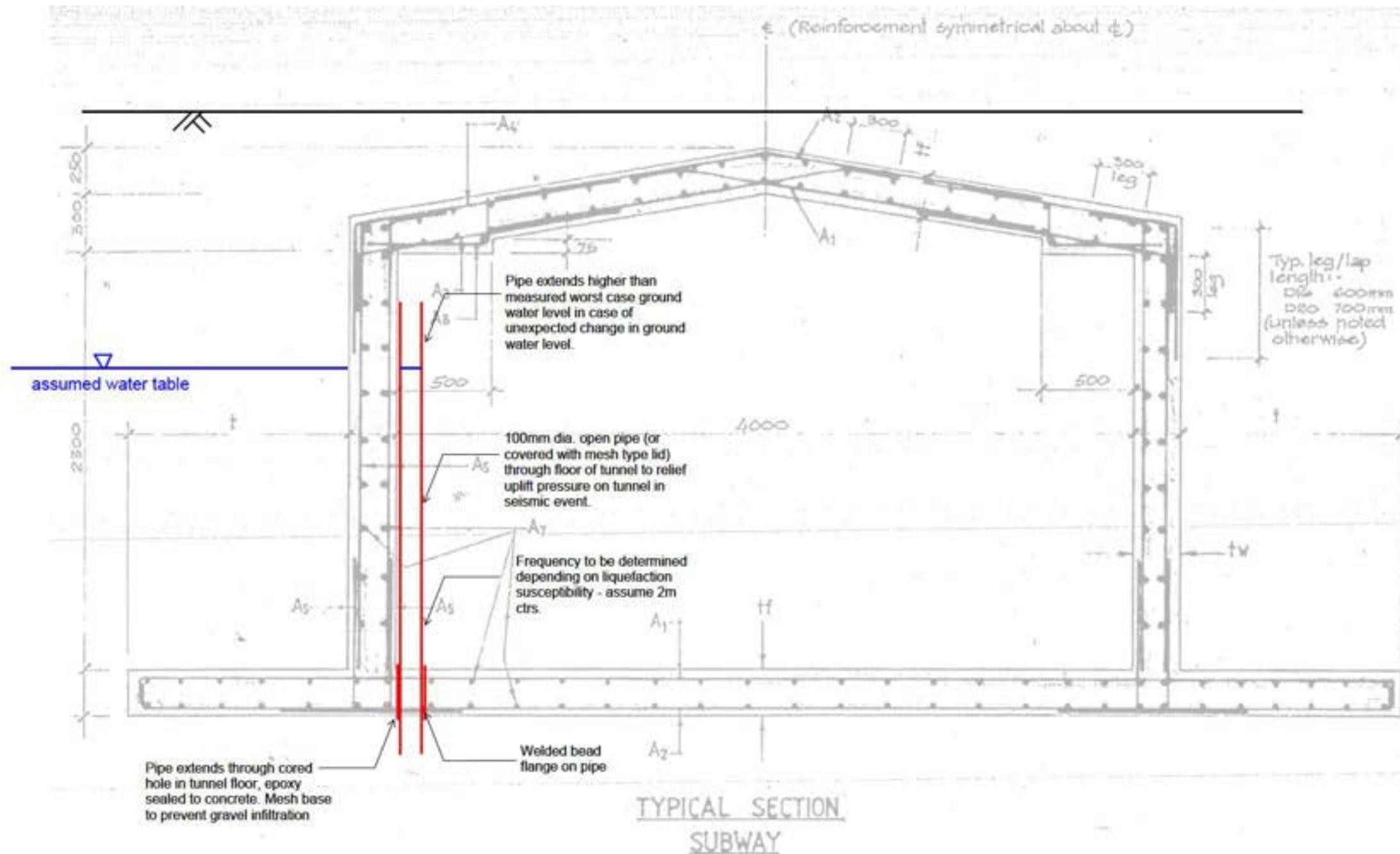
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Revision : A

SKETCH

JOB NAME:	Waterloo Station		
JOB NO:	DRAWN BY:	DATE:	SKT NO:
8962	NKV	31/07/25	Sk-P-16



8.9 GEOTECHNICAL

7 August 2025
Job No: 1098196.0000

Greater Wellington Regional Council
100 Cuba St
Te Aro
Wellington 6011
c/- RCP

Attention: s7(2)(a)

Dear s7(2)(a)

Waterloo Station Redevelopment Geotechnical Report - Concept-lite Design Stage

1 Introduction

This report presents a desktop geotechnical report for the Concept-lite design stage of the proposed Waterloo Station Redevelopment.

The study was undertaken by Tonkin & Taylor Ltd (T+T) at the request of Greater Wellington Regional Council in accordance with our letter of engagement dated 30 April 2025 (T+T ref. 1098196.0000 v1).

This report presents a summary of:

- Inferred ground and groundwater conditions at the site.
- Ground shaking hazard.
- Identified geotechnical issues.
- Foundation options for the proposed station.
- Geotechnical considerations for the existing subway.
- Identified geotechnical risks.
- Further work.

2 Site Description

Conclusion	Information reviewed
• Refer Figure A1 (site plan), in Appendix A. • The site is located at the existing Waterloo Station and carpark, Hutt Central, Lower Hutt, 5011. • The existing station comprises a piled canopy structure, an amenities building (piled), a subway (shallow founded box structure) which runs under the railway lines and Cambridge Tce, a carpark and a bus/taxi lane. The Hutt Valley and Wairarapa Lines run through the station.	• LINZ aerial imagery. • Hutt City 2021 LiDAR in NZVD2106 datum.

- It is understood that the existing station platforms and slab under the canopy structure are shallow founded / on grade.
- The Waterloo Water Treatment Plant is to the north. Oxford Terrace and Pohutukawa Street is to the west. Cambridge Terrace is to the east.
- The station platforms are around RL+7m. The carpark to the south and surrounding area is around RL+6m. The subway is around RL+2m to +3m.
- The site is in Source Protection Zone 2 (SPZ2). SPZ2 is intended to protect against microbiological contamination of the water supply.¹

3 Proposed Development

A long list of options were considered by the project team as part of this design stage. The favoured shortlisted option includes a short overbridge over the railway lines (SHS trussed frame structure), and a new canopy structure formed of steel columns and beams with structural cassette rooves and metal roofing. The station platforms are proposed to be lengthened and extend south from the existing station. A proposed layout sketch is provided as Figure 3.1 below.

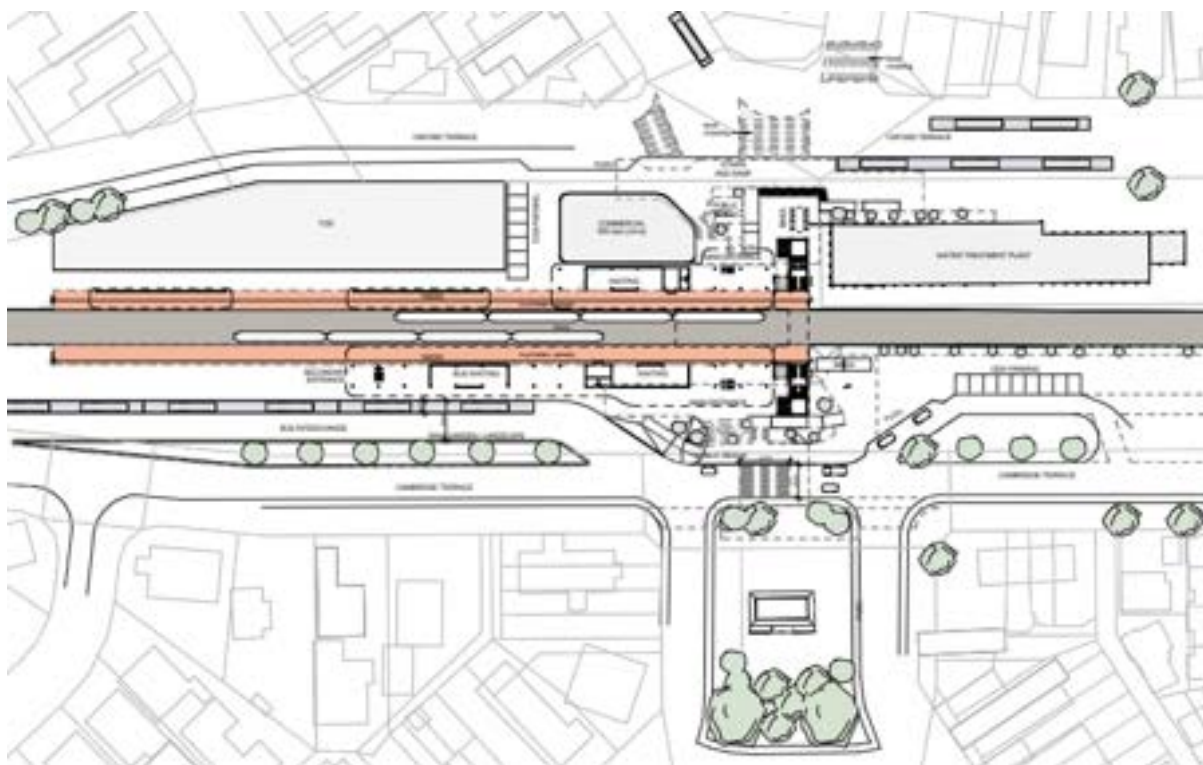


Figure 3.1: Proposed Reference Design Layout Plan (Extract from Grimshaw Architects Drawings)

4 Ground and groundwater conditions

Conclusion	Information reviewed
• Refer Figure A1 for a Site Investigation Plan (Appendix A). • There is no available geotechnical information within the site area. • Geotechnical information (boreholes and CPTs) within the vicinity of the site (as shown on Figure A1) has been used in the assessment.	• New Zealand Geotechnical Database

¹ Wellington Water (22 March 2023) Waiwhetu Aquifer – Source water risk management implications. Version 1.0.

- The inferred soil profile is summarised in Table 4.1 and shown in cross section in Figures A2 and A3 in Appendix A.
- Groundwater monitoring at Water Treatment Plant indicated groundwater ranged between RL+4.8 and RL+5.2. Groundwater level observed in a vacuum excavation pit carried out on Cambridge Tce, adjacent the subway, on 4 August 2025, was observed to be 1.3mbgl (~RL+4.2m). At this stage, a groundwater level of RL+5.0m has been adopted in this assessment.

Table 4.1: Summary of inferred soil profile

Layer No	Soil Layer	Description	Top of layer RL (m)	Depth to Top of layer (m)	Range of thickness (m)
1	Fill	Likely to be a variable mixture of granular and cohesive material. Parts of the site likely to comprise uncontrolled fill; other parts may have engineered fill. May also comprise organics and construction debris.	+6 to +7	0	1 to 2
2	Upper Taita Alluvium	Typically, very loose SAND and very soft SILT. Medium dense gravel/sand in places.	+5	1 to 2	3.5
3	Lower Taita Alluvium ⁽¹⁾	Typically, dense SAND/GRAVEL.	+1.5	4.5 to 5.5	3
4a	Petone Marine Deposits	Loose to very dense SAND/ GRAVEL and SILT with shells.	-1.5	7.5 to 8.5	12.5
4b	Aquitard (present as a layer within the Petone Marine Deposits)	Predominantly overlapping discontinuous beds of CLAY/SILT.	-8	14 to 15	3
5	Waiwhetu Gravel (aquifer)	Dense to very dense silty GRAVEL.	-14	20 to 21	89 to 110
6	Bedrock ⁽²⁾	Greywacke sandstone and siltstone.	-103 to -114	110 to 120	N/A

Note 1: Typically, a competent founding layer but could be too thin or absent in places.

Note 2: Depth to bedrock estimated based on Map 1 (Depth to bedrock) from Boon et al (2010)²

5 Earthquake Shaking Hazard

5.1 Seismic site subsoil class

Conclusion	Information reviewed
• Site subsoil class is assessed to be Class D - Deep or soft soil site; based on depth to rock and available geotechnical data. • Level of certainty in the above assessment is moderate to high. Further investigations are not expected to change this assessment.	• Refer Section 4. • NZS1170.5:2004 • "NZS1170.5:2004 Site Subsoil Classification of

² Boon, D.P., Perrin, N.D., Dellow, G.D. and Lukovic, B., 2010. It's Our Fault: Geological and geotechnical characterisation and site class revision of the Lower Hutt Valley. GNS Science Consultancy Report, 163, p.56.

- We note that the site is located within a zone identified as potentially containing Class E (Very soft soil site) sites (Boon et al, 2011). Based on the inferred soil profile, we have assessed that the site is unlikely to be Class E.

Lower Hutt". (Boon, D et al, 2011).

5.2 Active faults

Conclusion	Information reviewed
• The Wellington Fault lies approximately 1.7km northwest of the site. • The Wellington Fault is included in Table 3.6 of NZS 1170.5:2004 as a major fault requiring near fault factors when assessing structural design actions. • Other faults include: Whitemans Valley Fault (6 km southeast) and the Moonshine Fault (6.5 km northwest).	• GNS Online database of active faults • NZS1170.5: 2004 Section 3.1.3 and Table 3.6

5.3 Ground shaking hazard

In accordance with guidance published on the MBIE website ([Module 1: Overview of the geotechnical guidelines | Building Performance](#)), the ground shaking hazard to be considered in the geotechnical design of new structures is to be based on Module 1³ (Version 1, 2021). Table 5.1 presents peak ground acceleration (PGA) and magnitude (M) for the ultimate limit state (ULS) and serviceability limit state (SLS) earthquakes, for both importance level 2 (IL2) and importance level 3 (IL3) structures.

In October 2022, GNS Science released the revised National Seismic Hazard Model (NSHM)⁴. This represents the latest scientific knowledge of earthquake hazard in New Zealand and is an important factor for understanding and managing earthquake risk in the built environment.

Updates to Building Code compliance documents for design of new structures (including update of Module 1³(Version 1, 2021)) are expected to be released in the future. Those updates will be informed by the NSHM. Table 5.1 includes the probability of the respective earthquakes in the next 50 years as indicated by the NSHM⁴. This is provided to inform an understanding of seismic risk.

Table 5.1: Shaking hazard for geotechnical design

Design Case	PGA (g)	Magnitude, M	Approximate probability of exceedance in next 50 years based on NSHM ⁽³⁾
SLS ^(1, 2)	0.13	6.5	95%
ULS (IL2) ^(1, 2)	0.68	7.7	15%
ULS (IL3) ^(1, 2)	0.91	7.7	8%

Note 1: Assumes a building design life of 50 years.

Note 2: Parameters for SLS, ULS(IL2) and ULS(IL3) are based on the shaking hazard for a 25-year, 500-year and 1000-year return period earthquake as set out in Module 1 respectively. The importance level for the proposed structure has not been determined at this stage.

Note 3: Assumes a V_{s30} of 250 m/s based on inferred soil profile (refer Section Error! Reference source not found.), and Foster et al (2019)⁵.

³ MBIE/NZGS. Earthquake Geotechnical Engineering Practise, Module 1 (Version 1, 2021): Overview of the Guidelines, Section 5, Method 1.

⁴ <https://nshm.gns.cri.nz/>

⁵ Foster, K.M., Bradley, B.A., McGann, C.R. and Wotherspoon, L.M., 2019. AVS 30 map for New Zealand based on geologic and terrain proxy variables and field measurements. Earthquake Spectra, 35(4), pp.1865-1897.

6 Liquefaction assessment

Site specific geotechnical data is not available. Therefore, a qualitative assessment of liquefaction risk has been carried out based on adjacent site's information and past experience of sites with similar ground conditions in the Lower Hutt area.

Widespread liquefaction of the Upper Taita Alluvium is possible in >0.2g M7.7 shaking. Pockets of liquefaction within the Petone Marine Deposits is possible in >0.25g M7.7 shaking.

Liquefaction consequences include:

- Reduced bearing capacity and settlement of foundations founded on or immediately above liquefied soils.
- Loss of shaft friction for deep foundations adequately founded on non-liquefiable soils.
- Liquefaction induced uplift pressure on structures founded within liquefiable ground.
- Cyclic displacement imposing kinematic loads on foundations or buried structures extending through the Upper Taita Alluvium.
- Negative skin friction (NSF) on foundations or buried structures extending through the Upper Taita Alluvium.
- Differential settlement between a building (particularly those founded on deep foundations) and adjacent services / hardstanding / landscaping is to be considered.
- Free field settlement resulting in total and differential settlement of buildings, pavements and slabs on grade.
- Sand boils (ejecta) at ground surface.

7 Geotechnical challenges

The identified geotechnical challenges issues are listed in Table 7.1.

Table 7.1: Geotechnical issues identified

ID	Issue	Comments
1	Founding conditions	<u>Fill and Upper Taita Alluvium</u> • Due to the variable nature and / or low strength and / or susceptibility to liquefaction of these strata, they are not considered reliable founding strata without some ground intervention, e.g. shallow ground improvement. <u>Lower Taita Alluvium</u> • Typically comprises dense GRAVEL and SAND, and in <u>sufficient thickness</u> considered a reliable founding stratum. • Risk exists of this layer containing localised weaker soil layers / lenses susceptible to liquefaction. This needs to be investigated and considered in future design stages. • Risk exists of this layer being locally too thin as a founding layer, or not present at all over all or part of the site. This needs to be investigated and considered in future design stages. <u>Petone Marine Deposits (including aquitard)</u> • Due to the variable nature and / or low strength and / or susceptibility to liquefaction of typically the upper part of this stratum, it is generally not considered a reliable founding layer. • The lower part may be suitable for founding but is likely to be below the aquitard i.e. artesian and therefore <u>significant consenting risk</u>. In this case, it

ID	Issue	Comments
		may be preferable to found in the Waiwhetu Gravel which is likely to be more reliable (see below). <u>Waiwhetu Gravel (aquifer)</u> - Typically comprises very dense GRAVEL. A favourable founding stratum. The Hutt Aquifer is within this layer. - Founding in this gravel layer requires piles to extend through the Petone Marine Deposit layer, which contains the aquitard. Risk of leakage through the aquitard by any penetration. <u>Significant consenting risk</u>. - Leakage of the aquitard could lead to contamination (downward water flow) during the dry months and heavy water extraction. The leakage risk must be critically considered if founding in this layer.
2	Presence of soft ground	Shallow foundations must consider the settlement of soft ground within the Upper Taita Alluvium.
3	Liquefaction	Refer Section 6.
4	Proximity to sensitive structure	Water treatment plant and railway tracks are in close proximity which may limit certain foundation techniques and or when foundation works can be undertaken (e.g. only during block of line of the tracks).
5	Soil contamination	The Fill soils could contain contaminants requiring management during any excavation and offsite disposal. Associated high cost of disposing off contaminated soils in Wellington.

8 Canopy structure and pedestrian bridge foundations

At this stage, considering the identified geotechnical challenges, a foundation option for the station canopy structure could be screw piles founding in the Lower Taita Alluvium. However, the following are required to confirm the suitability of screw piles:

- Site specific investigations to assess:
 - Presence, thickness and density of the Lower Taita Alluvium across the site.
 - Thickness of the Upper Taita Alluvium and its susceptibility to liquefaction.
- Design development and soil-structure interaction analyses in conjunction with the structural engineer.

If the Lower Taita Alluvium is not present over part of the site or is too thin, local ground improvement (e.g. jet-grouting targeted layer) could be considered.

The suitability of other foundation options should be considered in future design stages following completion of site investigations and considering the site constraints such as working close to railway line or water treatment plant. Vibration induced settlement and noise (e.g. driven options), high groundwater and other temporary stability issues should be considered in developing alternative foundation options.

9 Station platform foundations

The station platform foundations have not been specifically considered as part of this study but the foundation techniques described in Section 8 above could be suitable. If shallowly founded the likely settlement of the soft ground and seismic performance should be considered. This will likely require interaction with KiwiRail and adopting KiwiRail standards.

10 Further work

The following further work is required as part of the station development:

- Site investigations to inform ground and groundwater conditions across the site.
- Design development of canopy and bridge structures.
- Geotechnical design of station platforms.

11 Applicability

This report has been prepared for the exclusive use of our client Greater Wellington Regional Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Recommendations and opinions in this report are based on data from discrete investigation locations. The nature and continuity of subsoil away from these locations are inferred but it must be appreciated that actual conditions could vary from the assumed model.

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Appendix A Figures

- Figure A1: Site investigation plan
- Figure A2: Cross Section 1
- Figure A3: Cross Section 2



NOTES:

CRS: NZGD 2000 New Zealand Transverse Mercator Credits: Tonkin & Taylor Group, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, Foursquare, METRASA, USGS, Earthstar Geographics, Maxar, LINZ, Stats NZ, Esri, TomTom, Garmin, Foursquare, METRASA, USGS



PROJECT No. 1098196

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DRAWN	-WEB-	FEB 25
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CLIENT GREATER WELLINGTON REGIONAL COUNCIL

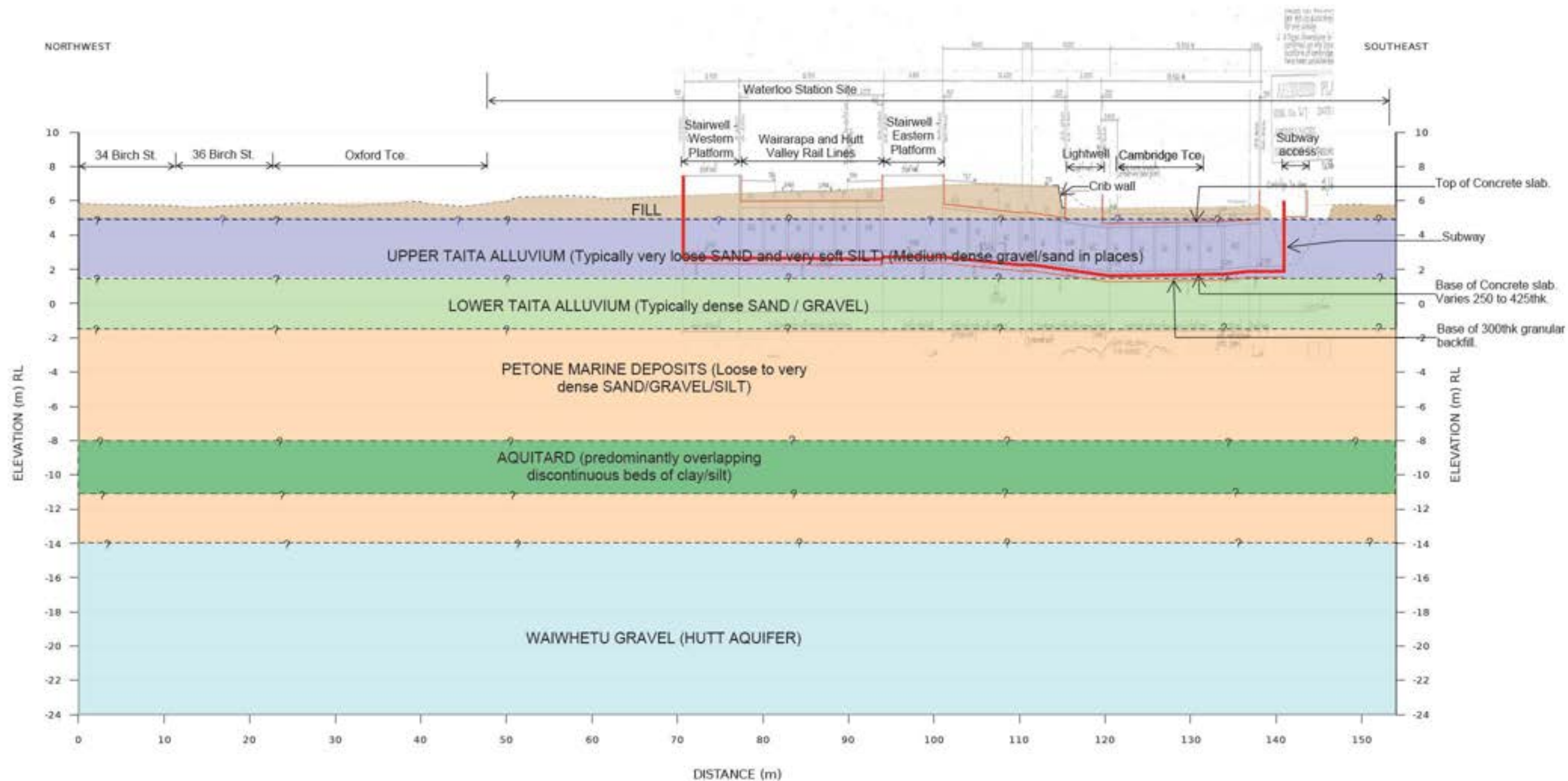
PROJECT WATERLOO STATION

TITLE SITE INVESTIGATION PLAN

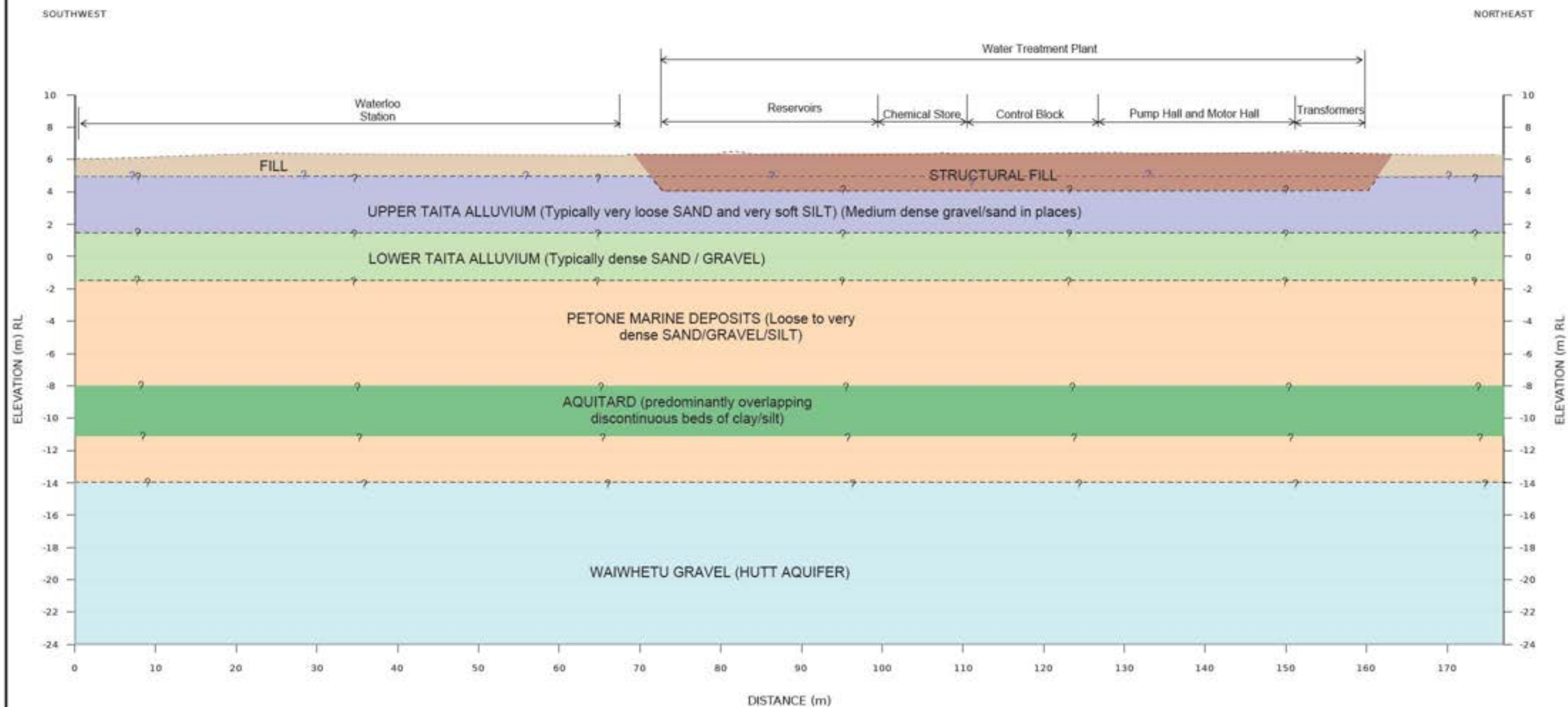
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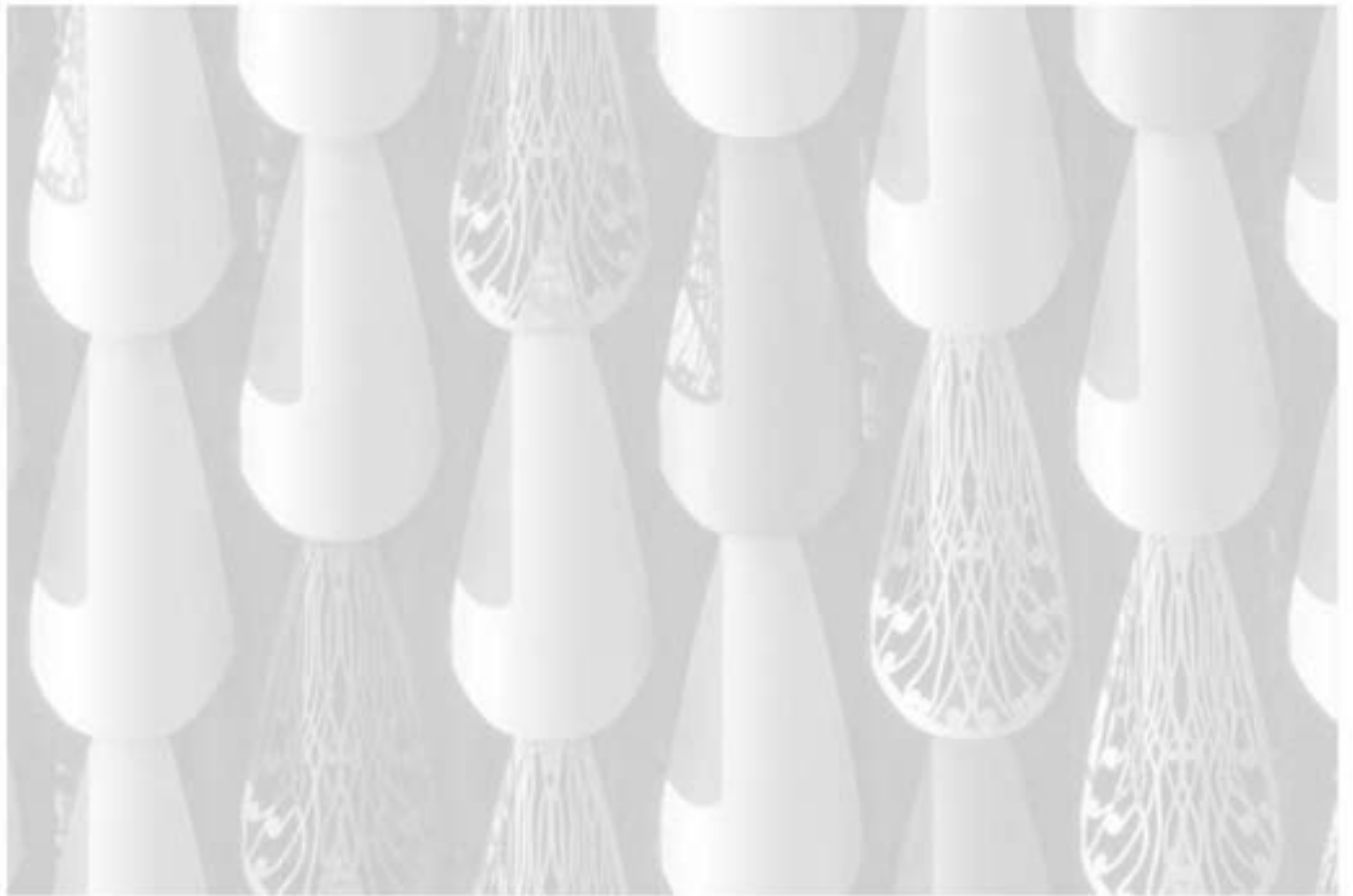
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8.10 PRECONSTRUCTION

Waterloo Station

Pre-Construction Report

Reference Design



Prepared for:

Greater Wellington Regional Council

Version 2

18 / 08 / 2025

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1. Introduction

Waterloo Station is a principal rail station for the Lower Hutt Area and serves a catchment extending from the Lower Hutt City CBD to Wainuiomata. Train services on the Hutt Valley Line and Wairarapa Line both stop at the Station, and multiple bus stops are located on both sides of the station. An underpass below the Station links Trafalgar Square on the west with Oxford Terrace, providing a key east-west pedestrian connection, while also offering cross-track access to both Station platforms.

As part of its broader Regional Transport Plan, Greater Wellington Regional Council [GWRC] intend to upgrade Waterloo Station, replacing aging infrastructure while also including commercial and community spaces, delivering the wider outcomes of GWRC's Transport-Oriented Development strategy.

Various schemes and designs have been considered as part of the ongoing Reference Design phase. An optioneering and multi-criteria analysis has been completed to determine the preferred option for the Reference Design. The Reference Design includes the following features:

- Upgrade the existing rail platforms and shift and align the southbound platform to be opposite the northbound platform
- New bus interchange on the eastern side of the station
- New canopies and shelters for bus and rail passengers
- New commercial building to replace the existing small commercial building on the site
- A new overpass to provide a connection across the rail line
- New pedestrian crossing point on Cambridge Terrace
- Decommissioning of the existing underpass
- Demolition of the existing canopy and commercial building

This report assesses and identifies downstream programme and constructability challenges, detailing those to be addressed and confirmed during subsequent design stages.

2. Construction Staging

Staging Overview

The staging has been arranged to maintain the operational serviceability of the station. This includes working in distinct work zones away from members of the public and transit passengers. There are several options to deliver the works, the drivers of which will be assessed and verified as the design develops. The current construction project focuses on upgrading platforms and canopies, as well as reorienting the bus interchange.

The commercial development, overpass and TOD following the platform upgrade are sequenced to occur in the later stages, allowing the greatest flexibility as to when GWRC may wish to carry out these works. Stages 4, 5 & 6 can be delivered at a later point and are not essential for the successful delivery of Stages 1, 2 & 3.

Sequencing

Stage 1 – Temporary Platform Construction, Platform Upgrade & Bus Interchange

- 1) Site Establishment, including the repurposing of part of the public carpark on Oxford Terrace for a construction laydown and access point. The existing platforms are temporarily reduced in length by approximately 30%.
- 2) The SW end of the existing platforms on both sides of the rail tracks is lifted and widened. Additionally, temporary platforms are constructed to the southwest of the existing platforms. This will provide the minimum platform length in the next stage. The new platform canopies are constructed.
- 3) A smaller section of the existing platform extending from the SW to the existing underpass ramp is also upgraded. This construction site is set back from the platform edge, enabling passengers to continue to utilise the platform.
- 4) The public carpark on Cambridge Terrace is closed, and construction of approximately half of the bus interchange is completed. This work occurs simultaneously with items (2) and (3) above.

Stage 2 – Platform Construction, Demolition & Cambridge Terrace Entrance Construction

- 1) After the completion of Stage 1, the active platform location is shifted SW to the recently constructed permanent and temporary platforms. Access from the underpass ramps to the revised platform remains open.
- 2) The Bus Interchange is relocated to the SW, and the permanent Bus Interchange is opened in a temporary arrangement. This interchange is used by both buses and public vehicles, albeit in distinct and separate drop-off/pick-up areas. A section of the carpark on Cambridge Terrace is closed and utilised as a construction laydown.
- 3) The remaining half of the Oxford Terrace carpark is closed and construction laydown is expanded. This is required to support the demolition of the existing structures.
- 4) Demolition of the existing commercial building and of the existing canopy occurs. The large existing canopy would be dismantled during a 'Block of Line'.
- 5) The NE of the existing platforms are lifted and widened to suit the permanent design. Sections of the new canopy have been constructed, although modifications are required to permit the continued operation of the underpass access ramps.
- 6) Simultaneously with step 5, construction continues the remaining half of the bus interchange, along with the main entrance to the station from Cambridge Terrace. During this time, access to the southbound platform is via the SW end of the platform or via the underpass.
- 7) Once demolition of the existing commercial building is completed, a temporary entrance to the station from Oxford Terrace is constructed. This is required for the next stage.

Stage 3 – Oxford Terrace Station Entrance and Commencement of Overpass Construction

- 1) After the completion of Stage 2, the active platform is shifted to the permanent design location and opened to full length. The temporary platforms are removed.
- 2) The Bus Interchange area is opened to full length, however, remaining in a temporary configuration, shared by both public vehicles and buses.
- 3) The station entrance from Cambridge Terrace is opened.
- 4) The station entry from Oxford Terrace is constructed. The underpass stairs to be closed. Access to the Northbound platform and Oxford Terrace remains open via the underpass ramp.
- 5) The foundation works for the rail overpass are installed on the Oxford Terrace side. This will involve installing piles adjacent to the operational underpass. In addition, the underpass stairs are demolished, and the lift is installed along with the supporting structure for the overpass. Work over the rail line does not occur at this stage.

Stage 4 – Overpass and Commercial Building Construction

- 1) The Permanent Station entrance from Oxford Terrace is opened. The underpass remains open and access from Oxford Terrace continues via the ramps.
- 2) The temporary station access is demolished and the Commercial Building is constructed.
- 3) The underpass stairs on the Cambridge Terrace side are closed and work commences on constructing the overpass foundations, substructure and lift.
- 4) Once the substructure is complete, the overpass structural truss is lifted into place in a pre-fabricated section. This work would occur during a 'Block of Line'. The overpass stairs are installed and lifts commissioned.

Stage 5 – Underpass decommissioning & TOD Construction

- 5) The overpass is opened and the underpass is closed at the beginning of this stage.
- 6) Following the successful trial and verification of the overpass, the underpass is backfilled or decommissioned.
- 7) The underpass access ramps are backfilled and the remaining platform canopies are constructed. On both platforms, these work sites are 'islands' within the operational platforms. It is proposed that large materials deliveries occur at night. Pumping of low-strength backfill could occur via an elevated platform that does not restrict operational use of the platforms.
- 8) The construction laydown off Oxford Terrace is demobilised and opportunity is available for the TOD construction.

Stage 6 – Station Construction Demobilisation & Public PUDO

- 9) Once the underpass decommissioning is complete, the construction laydown off Cambridge Terrace is removed and the public PUDO is constructed, along with the final elements of the station entry.
- 10) The public PUDO zone is relocated to the final design location and the Bus Interchange is opened in the final design configuration.
- 11) TOD construction would be ongoing; however, this would not affect the station operation.

3. Buildability Challenges

We have identified several constructability challenges that will need to be addressed as design development progresses. The key challenges are listed below, with further details provided thereafter.

Key Constructability Challenges

The project will require significant construction and staging efforts to minimise impacts to the operation of the station while not impacting construction productivity. The following key challenges and details will need to be considered:

- **Level of Service for Station Operation During Construction.** Details have yet to be finalised on the level of service required during construction. Details such as minimum platform lengths to remain open, passenger facilities, access requirements, and other operational requirements need to be confirmed in the next design phase. The requirements must be developed with construction considerations in mind, noting that if the requirements become too onerous on construction, then additional costs and an extended construction duration could likely occur.
- **Engagement with KiwiRail.** KiwiRail are a key stakeholder and is the landowner for a substantial portion of the project footprint. KiwiRail has specific requirements for working within the rail corridor and for approving the construction of third-party assets in the rail corridor. Early engagement with KiwiRail is essential to ensure the successful delivery of the project.
- **Overpass Design Location Relative to the Underpass.** Maintaining a safe rail crossing point through construction is a project objective and minimum requirement. Currently, the underpass provides a safe pedestrian crossing through the rail corridor. The Reference Design outlines the intention to replace the underpass with an overpass, which is situated in close proximity to, or partially overlaps with, the existing underpass. It will be essential that further design development ensures that there is sufficient separation to enable simultaneous operation of the underpass and construction of the overpass.
- **Construction Laydowns and Access.** Waterloo Station presents a highly confined construction environment, with limited space available for equipment storage, material laydown, and site access. The station's central urban location and continuous operational demands necessitate that construction activities be carefully coordinated to minimise disruptions to passenger flow and station services. Access routes are constrained, and suitable areas for staging construction equipment are scarce should a percentage of public parking remain. Striking a balance between maintaining station operability and achieving efficient, timely construction will be imperative.

Maintaining Station Operations and Rail Corridor Crossing

Station Operations

Maintaining station operations during construction presents a key construction challenge and programming constraints. Keeping access routes available for users to access the platforms and the bus stops, as well as providing sufficient length of platforms and bus stops in operation to achieve the required level of service, will impact construction.

At this stage, the level of service required for station operations is not confirmed. For the proposed construction sequencing, it has been assumed that one-third of each platform can be closed at any given time and that safe access to the platforms can be provided through the construction areas.

Obviously, the highest construction productivity could be achieved on site if there were no constraints on areas that could be made available for construction; however, this would require the station to be closed. Conversely, placing large restrictions on areas and times when construction could take place will reduce the impact on station operations. Striking a balance between the two will be key, and this will be developed further in combination with cost and stakeholder engagement in future design phases.

Rail Corridor Crossing (Underpass)

The existing underpass serves as a vital connection for the local community, offering a safe crossing point over the rail line and forming a key pedestrian and cycling route between the Hutt City CBD and the eastern suburbs. It also supports station operations by facilitating essential access between platforms and across the rail corridor.

Greater Wellington Regional Council has stipulated that a crossing must remain available to all users throughout the construction period. To meet this requirement, a continuous route must be maintained through the live construction site. The most practical solution is to first construct the new overpass, including access lifts and the

pedestrian crossing across Cambridge Terrace. Once these elements are in place, pedestrian and station users can be safely diverted to the new route, allowing the existing underpass to be closed. This requirement introduces a significant staging risk, as the location of the underpass and associated voids for stairs and ramps, along with the decommissioning activities, directly impact the construction of the overpass and operational use of the platforms.

Location of Existing Underpass and Design Overpass

To maintain a full level of service, either the underpass or an overpass must remain fully accessible for all users to maintain a safe grade-separated crossing of the rail line. Access to the overpass will be via stairs and lifts located on either side of the rail line. A potential conflict exists as the location of the lift partially overlaps the location of the underpass, refer to the figure on the following page.

To construct the lift pit, foundations and associated structure, the operation of the underpass will be impacted. Depending on the final design size and location, it may be possible to construct the lift in its current location. However, it is likely that the underpass width will be reduced around the construction site of the lift.

Furthermore, there is limited information on the structural condition and likely impacts to the structure during construction of the adjacent lifts and overpass foundations.



Snippet from Reference Design Drawing 1002 showing lift locations and clash with the underpass

Possible options to resolve the clash between the underpass and the lift include:

- Shift the lift locations so that they are not located above the underpass or any of the access voids. This option would likely require a longer overpass.
- Shift the lift locations so that they are positioned within the voids created by the existing stairs. This option may require the bridge to be shifted closer to the water treatment plant to make space for the lift. The stairs can be closed as the underpass is accessible from the ramps.
- Shift the lift locations so that they are located behind the underpass ramps and stairs. This option will require the section of underpass underneath Cambridge Terrace to be closed, so lift construction could only commence after the pedestrian crossing point is operational. With the lift placed behind the ramps and stairs, the underpass will still be accessible for pedestrians to cross the rail line.

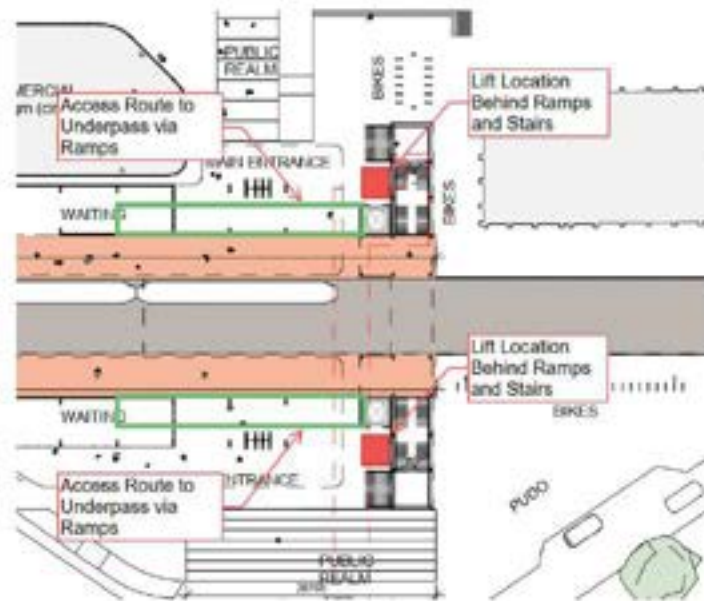


Figure: Alternate location for lifts to be positioned outside of the footprint of the existing stairs and ramps.

Proximity of Works to Rail Line

The Reference Design includes works immediately adjacent to and over the Wairarapa Rail Line. Controls such as a Block of Line, for major works such as lifting the overpass into position, and Rail Protection Officers will be required. While not uncommon for rail station developments, these controls are likely to constrain the programme, particularly the Block of Line. Subsequently, early engagement with KiwiRail and understanding opportunities and timing of Block of Line periods will be key to successful construction.

Waterloo Water Treatment Plant

The Waterloo Water Treatment Plant is located immediately adjacent to the Waterloo Station on the western side of the Wairarapa rail line. The water treatment plant must remain accessible and operational throughout the construction period. Bulk water mains run on the western side of the station site, near or under the existing canopy, buildings, and western car park. The bulk watermains must also remain operational during the construction works.



Figure – Snapshot from HCC GIS Portal showing bulk watermains in light blue. The Waterloo Water Treatment Station is bordered by the black rectangle.

The bulk watermains from the Waterloo Treatment Plant run along the western edge of the Reference Design area. The mains will require protection during construction to ensure they remain operational. It is recommended that the design accounts for the location of the bulk water mains to ensure that any foundation and building works remain clear of the bulk water mains and Wellington Water offsets.

The location of the Treatment Plant does restrict access to the site from Oxford Terrace, in particular with regard to the construction of the overpass. Notwithstanding, the proposed construction staging has been developed to incorporate this constraint.

Waiwhetū Aquifer

The Waiwhetū Aquifer Borefield is located near the station footprint and is a key source of drinking water for the Wellington Region.

One of the project objectives is that the project should not result in negative impacts on water quality or supply. Risk of impact to this supply may come from the construction of the foundations and utilities servicing the rail station and interchange that are in the vicinity of the Waiwhetū Aquifer. The foundation system for the buildings and overpass has yet to be designed, but piles are likely to be used as the foundations. It is recommended that the foundations and any piles are designed to avoid or minimise any penetration into the Waiwhetū Aquifer.

Demolition of Existing Canopy Structure

The demolition of the existing canopy structure is a critical construction consideration that must be carefully planned and sequenced. Spanning above the rail corridor and overhead electrical systems, the removal of the canopy poses significant operational and safety challenges. Its demolition will require a Block of Line and temporary station closure to safely dismantle the roof structure above the rail envelope. It would be preferable for this to be undertaken as a single event over a long 1-2 week Block of Line, making the extended Christmas–New Year period the most practical period for execution.

During project planning, several actions should be considered to mitigate risks and ensure smooth delivery:

- Detailed structural assessment of the canopy to inform safe demolition methods.
- Coordination with KiwiRail to confirm Block of Line timing and operational impacts.
- Contingency planning for unforeseen structural complexities.

4. Details to Confirm in Next Design Stages

The Waterloo Station Project is in an early stage, with the Reference Design containing high-level information only. This section lists items that should be addressed and confirmed to minimise impact on construction costs and programme.

Station Operational Requirements During Construction

Operational Requirements

The minimum operational requirements for the Waterloo Station have yet to be confirmed. For this initial constructability review, it is assumed that the station and the rail corridor crossing will remain open. Operational requirements that need to be confirmed include, but are not limited to:

- Minimum length of platform required to remain open
- Size of passenger waiting areas (shelters, number of seats, etc)
- Toilet facilities
- Security and fire systems, including emergency evacuation
- Sizing of ingress and egress walkways for passengers

It will be possible to maintain station operations during construction; however, this will come with increased construction cost and programme duration. If the construction requirements are too onerous, there will be significant impacts on productivity, resulting in total construction costs and duration that will likely be unaffordable or undesirable.

Station and Rail Corridor Crossing Closure

Closing Waterloo Station and the underground rail corridor during construction will remove multiple constraints, allowing for maximum productivity to be achieved. This will result in a reduced construction programme and likely lower construction costs.

Conversely, closing the station and the underpass will likely increase costs for operating the wider public transport network as routes and scheduling will need to be changed to minimise the impacts of the closure. It is possible that works to increase capacity at other train stations or bus stops may be required to maintain network capacity.

It is recommended that an assessment is undertaken in the subsequent design stages to confirm whether a full closure of Waterloo Station and the Rail Corridor Crossing during construction is a feasible option and represents value for money.

Early Engagement with KiwiRail

KiwiRail, as owner of the rail network and operator, is a key stakeholder for the project. KiwiRail owns the land under a significant portion of the Waterloo Station footprint, including the rail corridor, much of the land under the station canopy, and the carparks on the eastern side of the rail line.

Design Approval and Approval to Construct Assets in the Rail Corridor

The Reference Design includes modifications to KiwiRail-owned assets, such as the platforms and the shifting of a signalling hut. The overpass will be a new asset constructed within the rail corridor, while the existing underpass within the rail corridor is to be decommissioned.

KiwiRail has standard processes for new third-party assets within the rail corridor that will apply to the overpass. KiwiRail advertises that a Deed of Grant can take up to 10 weeks to process and requires supporting documentation, including:

- Location plan
- Construction drawings and methodology

- Photos of the site and environment
- Soil test results
- Confirmation that clearance requirements are met.

As the overpass is an integral part of the Reference Design, it is likely that the Deed of Grant process will take longer than the 10-week period advertised by KiwiRail. It is possible that KiwiRail may require design modifications, which could further extend the timeframe for a Deed of Grant.

Although it has not been sighted by RCP, a Deed of Grant or similar agreement should be in place for the existing underpass. KiwiRail will have an interest in how the Underpass is decommissioned after the overpass is opened.

It is recommended that the need for a Deed of Grant for the overpass and the decommissioning of the underpass be discussed with KiwiRail as soon as possible. This will ensure that KiwiRail's requirements for the overpass design and the underpass decommissioning are understood and included from the start of the design development process. The design programme must include a timeframe at the end of detailed design to obtain the Deed of Grant and other approvals from KiwiRail.

Block of Lines and Rail Corridor Access

A Block of Line (BOL) is a scheduled closure of the rail corridor to allow for construction and maintenance works to take place without conflicting with passing train services. For the Wellington Region, these are typically programmed for the Christmas/New Year period. Notwithstanding, a BOL are often scheduled for other periods such as the Easter break and long weekends.

We anticipate that both the canopy deconstruction and the overpass installation will require a BOL. It is recommended that the BOL be scheduled and approved with KiwiRail at least 12 months prior to the works commencing.

The other works included in the Reference Design appear to be outside of the rail line but within the rail corridor. The construction activities will, at a minimum, require a Rail Protection Officer while work is being carried out within the rail corridor. Some works, such as platform upgrades, may also require a speed restriction on the rail line and other controls to be installed to maintain safety between the working areas and the rail services.

It is recommended that KiwiRail are engaged early during the planning process to discuss the level of controls required.

Early Engagement with Hutt City Council

Changes to Local Roads

The design includes changes to both Cambridge Terrace and Oxford Terrace, where Hutt City Council is the Road Controlling Authority. The Reference Design includes a pedestrian crossing facility on Cambridge Terrace and changes to bus stop layouts and markings on Oxford Terrace. The type of pedestrian crossing facility has yet to be confirmed, but is likely to be either a set of traffic signals or a formal pedestrian crossing.

The changes made to the local roads will need to be agreed with Hutt City Council. It is recommended that Hutt City Council be engaged in the next design stage to get their agreement to the proposed changes.

Southbound Platform Extension

The reference design involves relocating the southbound platform to be situated opposite the northbound platform. The platform shift is completed by extending the platform south and removing the northern section of the platform.

The rail line to the south of Waterloo station has a slight curve to the east, and this curve partly overlaps the southern extension of the southbound platform. From discussions during the design stage, it is understood that there are three possible options to resolve the clash between the curved rail and the platform. These are:

- Option 1 – Shorten the platform extension so that it does not clash with the curve.
- Option 2 – Construct a curved platform along the section of curved rail

- Option 3 – Realign the rail along the platform so that it is straight



Figure: Aerial image taken from GWRC GIS, showing a markup with the location of the southbound platform extension and curve in the rail line to the south of Waterloo Station.

From a buildability perspective, Option 1 is preferred as it does not change the construction activities, sequencing, or constraints on site. An additional length of the northern end of the southbound platform will need to be upgraded to ensure that the required platform length for the station is constructed.

Option 1 will result in the northbound and southbound platforms being offset from one another. Although less than the current platform offset, it is not as efficient in footprint as the Reference Design. The impacts on future potential development will need to be considered.

Option 2 is also achievable a curved platform will be more difficult to install than a straight platform to achieve the required alignments. However, it does not fundamentally change the construction works required. The main concern is that curved platforms are not standard practice and will require KiwiRail approval.

Option 3, realignment of the track, should not be considered, as it would bring additional scope of work and increased cost. Any realignment may require shifting both tracks to maintain clearances and extending them some distance south to meet geometric requirements. Any realignment works either must be completed under a Block of Line or under a closure of one of the two rail lines to and would result in significant programming constraints. Any realignment works will require KiwiRail agreement and design approvals

It is recommended that only Options 1 and 2 are considered to address any clash with the southbound platform extension and the rail alignment.

Rail Signal Infrastructure

We understand that the southbound platform extension clashes with an existing KiwiRail signalling hut, and the signals for the platform will need to be relocated and adjusted. The design for relocating the signal hut and adjusting the signals has not been finalised. It is not anticipated that relocating the signal hut would be complicated, as there is sufficient space available to construct a new hut.

Signal design requires KiwiRail's confirmation and approval. Limited nationwide resources for signalling design may constrain the design programme.

Property Ownership and Agreements

The land area and assets at Waterloo Station, which are impacted by the Reference Design, are owned by KiwiRail, Hutt City Council, and GWRC. KiwiRail owns the rail corridor, the rail platforms, a significant portion of the existing canopy, and the carparks on the eastern side of the rail line. Hutt City Council owns the Cambridge Terrace and Oxford Terrace Road Reserves, as well as Trafalgar Square. Refer to the figure below showing land ownership at the Waterloo Station Site

Property Agreements will need to be confirmed and agreed with both KiwiRail and Hutt City Council before works can commence. The agreements will at a minimum need to include access to the property to complete the works, allowance for temporary works, and agreement to modify, demolish, and decommission existing infrastructure, as well as to construct new infrastructure.



Figure: Land ownership of the Waterloo Station Site and surrounding area.

Early Contractor Involvement

The site presents several physical, programming, and operational constraints that will make construction challenging, particularly if the station and rail crossing must remain operational. Construction works will need to be staged in a manner that allows an acceptable level of service to be maintained. The staging will not just be dependent on site constraints but also on the contractors' capacity and capabilities.

It is recommended that an Early Contractor Involvement (ECI) process be considered as the design progresses. This will ensure that a construction methodology and staging are in place to meet operational requirements before construction commences. It will also allow any temporary works considerations to be incorporated in the permanent design.

Groundwater

The area around Waterloo Station can experience high groundwater tables, especially during winter. The existing underpass has ongoing issues with groundwater ingress. Large excavations will need to be either completed during the summer when groundwater levels are lower or allow for dewatering to control groundwater ingress. Areas of excavation that could be impacted include any basement or foundation excavations for the Commercial Building, rain gardens, and trenching for underground services. The method to decommission the underpass has not yet been confirmed, but it is understood that it will not be removed. Subsequently, it will have to be backfilled to minimise the risk of future subsidence. Potential long-term drainage may have to be considered.

Rain Gardens

The design includes large areas of rain gardens for landscaping, stormwater control and pretreatment. Raingardens require an area of soil to be excavated out to provide space for drainage and filter layers, as well as storage capacity. The gardens are typically surrounded by a cast-in-situ or precast concrete wall to provide separation from the surrounding soils.

Construction of rain gardens can be adversely impacted by underground services, which either must be diverted or penetrations made through the surrounding walls for the services. Service penetrations pose a risk of the surrounding soil migrating into the rain garden, potentially impacting its long-term maintenance, as well as the maintenance requirements of the service asset if it is located within the rain garden.

It is recommended that rain garden locations are optimised to minimise clashes with underground services and designed to a depth that allows construction to be completed without or with minimal dewatering.

Existing Services

There are several underground services located within and near the Waterloo Station site, in addition to the bulk watermain discussed in Section 0. These services will need to be located, and either be relocated, protected, or avoided as the design progresses.

The 900mm diameter gravity wastewater main running on the western side of Cambridge Terrace has been identified as being shallow and requiring protection during construction.

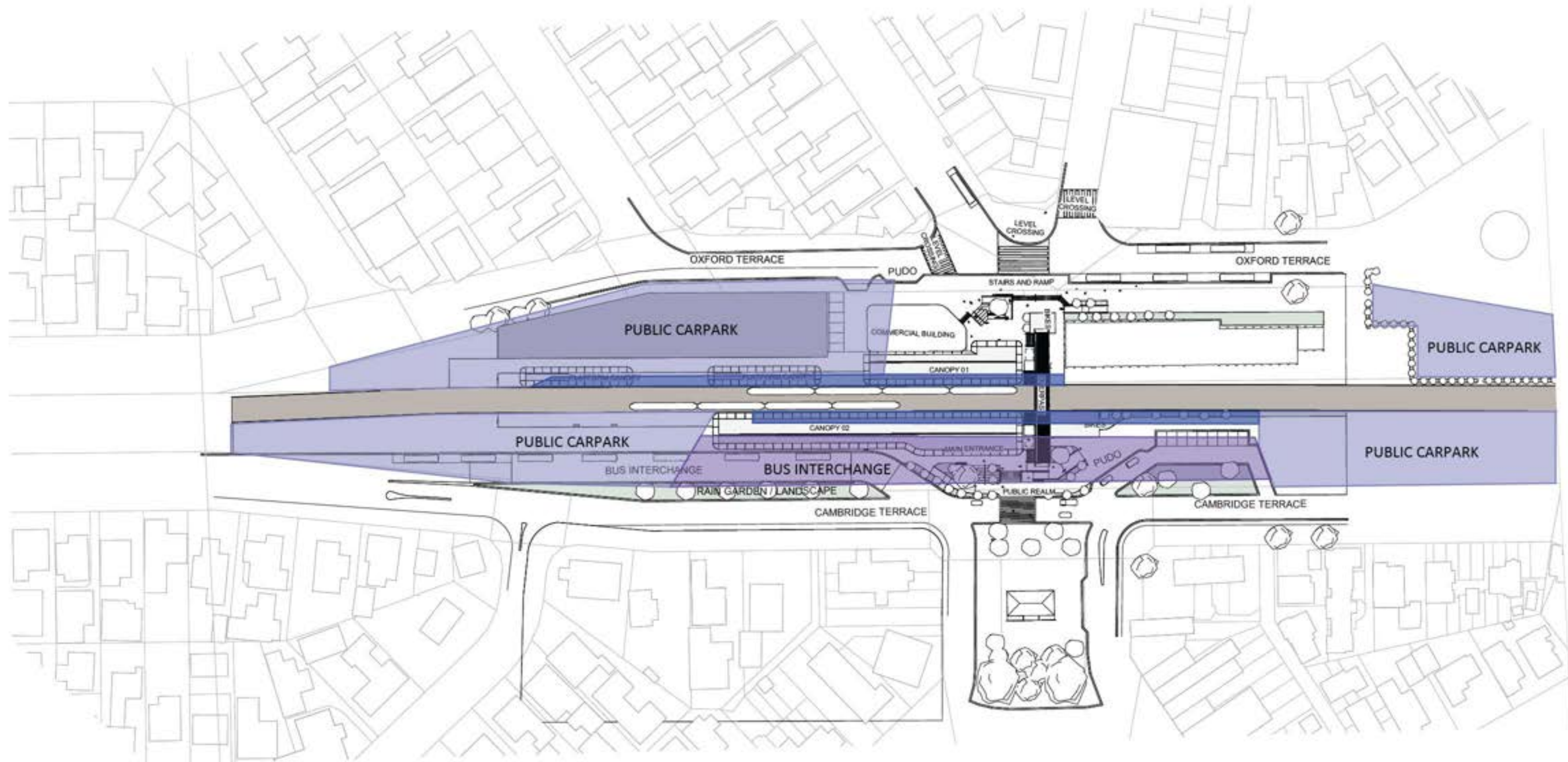


Figure – Snapshot from HCC GIS Portal showing the 900mm diameter gravity wastewater line (red line) running along the eastern edge of the Waterloo Station site.

It is recommended in the next design stages that the location, depth, and condition of underground infrastructure within and near the site be determined. It is essential that the actual location of underground services, as well as any necessary relocation, removal, or protection, is incorporated into the design before construction commences.

Appendix A

Construction Staging Drawings



STAGE 0 - CURRENT STATE

BASE DRAWING CARE OF GRIMSHAW



SCALE
NTS



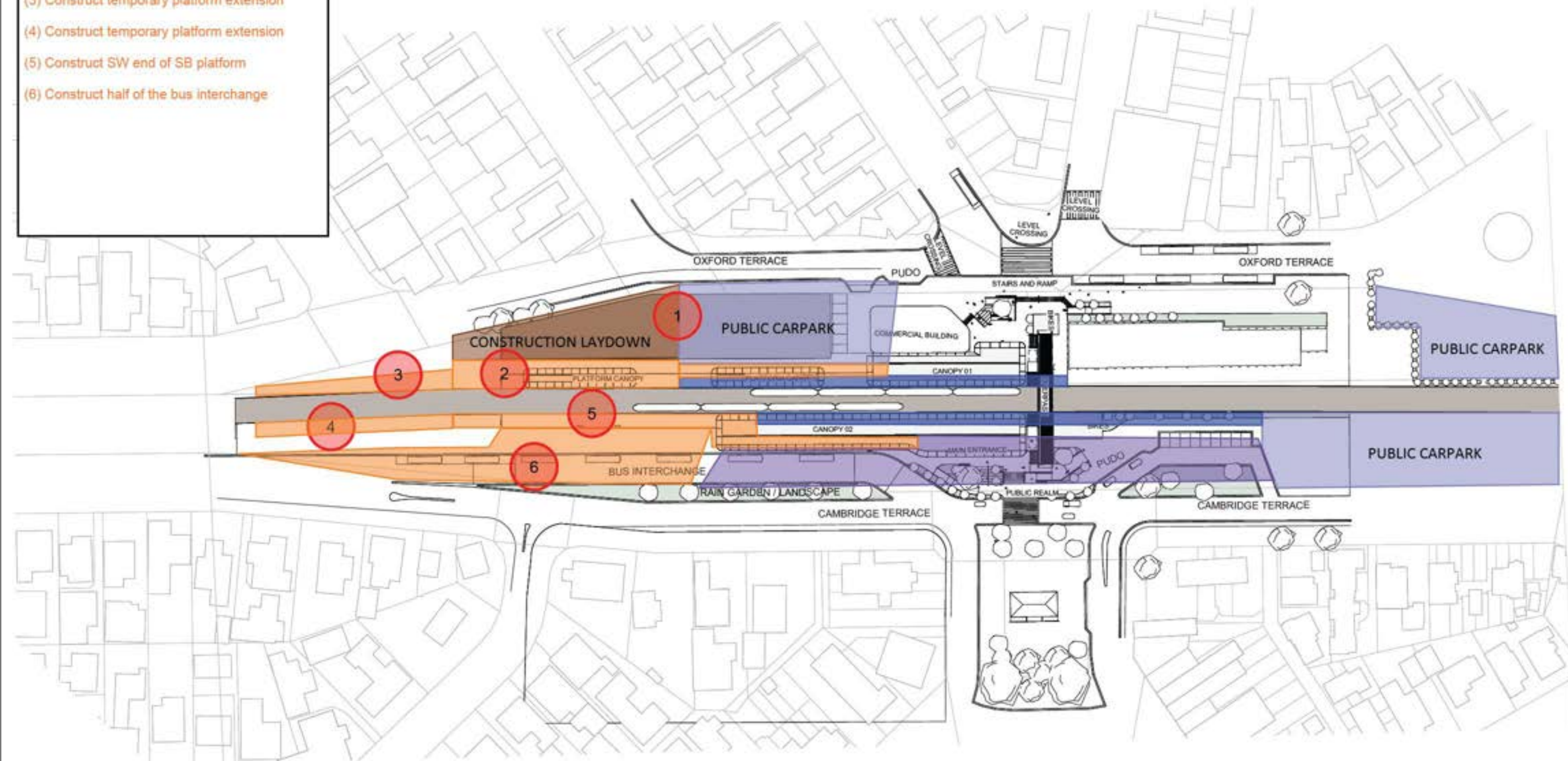
Drawing Title

WATERLOO STATION CONSTRUCTION STAGING

Issue Status:	REFERENCE	
Issue Date:	15/08/2025	
Sheet No:	[SHEET NO]	Revision A

CONSTRUCTION ACITIVITIES

- (1) Reduce size of public carpark and create construction laydown
- (2) Construct SW end of NB platform
- (3) Construct temporary platform extension
- (4) Construct temporary platform extension
- (5) Construct SW end of SB platform
- (6) Construct half of the bus interchange



SCALE
NTS



Drawing Title

WATERLOO STATION CONSTRUCTION STAGING

STAGE 1

BASE DRAWING CARE OF GRIMSHAW

Issue Status: REFERENCE

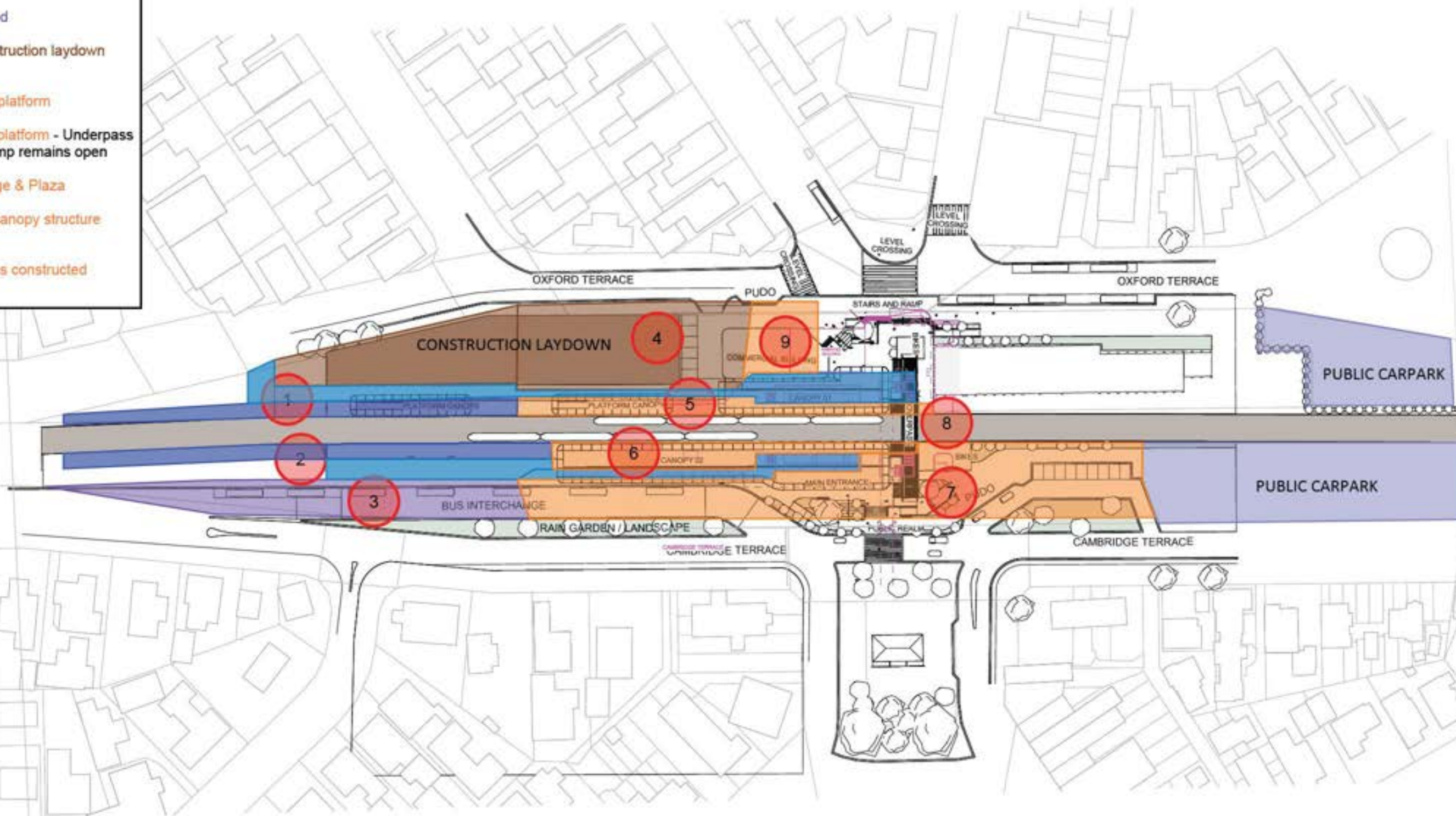
Issue Date: 15/08/2025

Sheet No: [SHEET NO]

Revision: A

CONSTRUCTION ACITIVITIES

- (1) NB Platform relocated with temporary connection to underpass
- (2) SB Platform relocated with temporary connection to underpass
- (3) Bus Interchange relocated
- (4) Carpark closed and construction laydown expanded
- (5) Construct NE end of NB platform
- (6) Construct NE end of SB platform - Underpass stairs temporarily closed, ramp remains open
- (7) Construct Bus Interchange & Plaza
- (8) Demolish existing large canopy structure under Block of Line
- (9) Temporary Station access constructed



SCALE
NTS



Drawing Title

WATERLOO STATION CONSTRUCTION STAGING

STAGE 2

BASE DRAWING CARE OF GRIMSHAW

Issue Status: REFERENCE

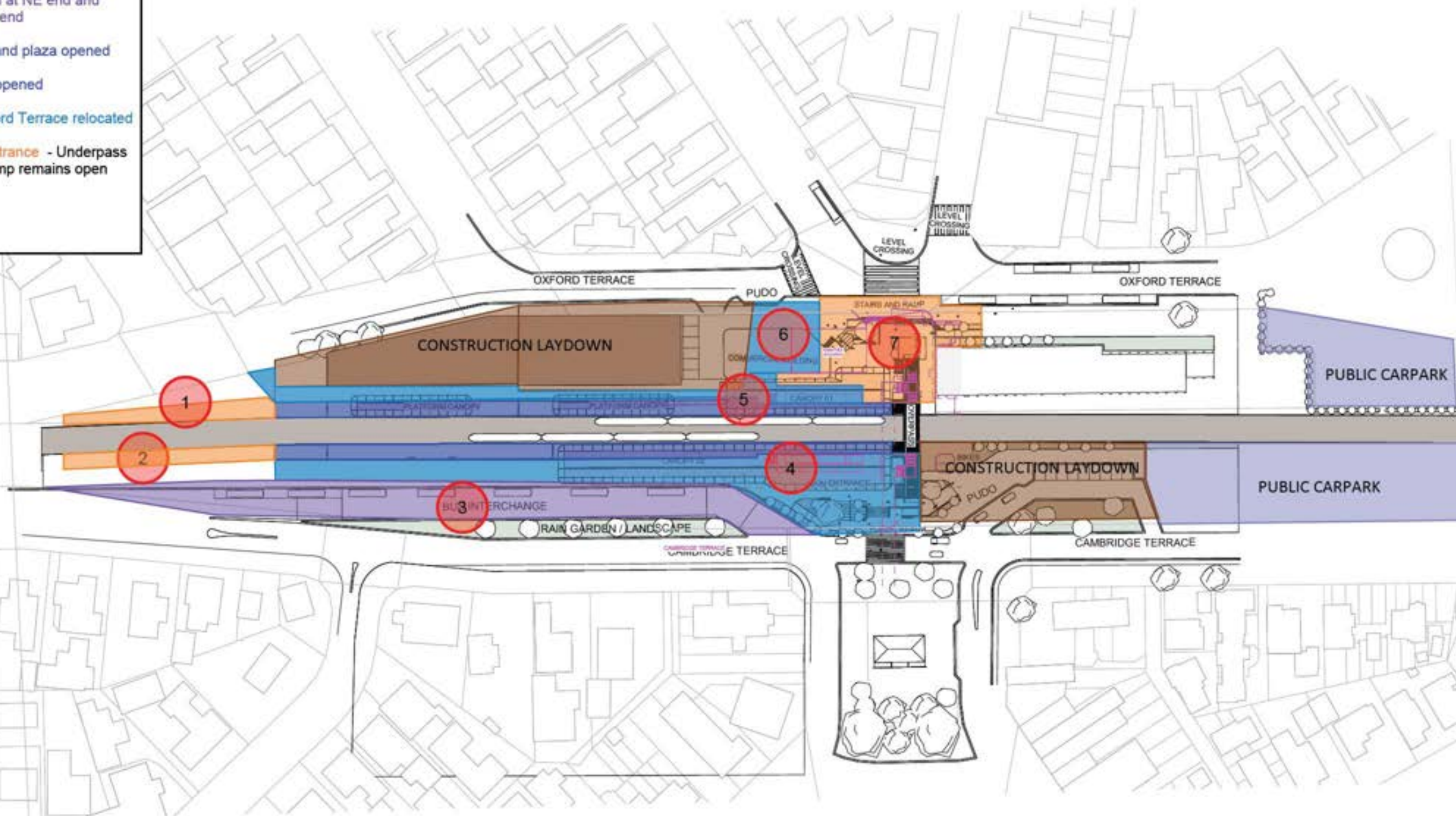
Issue Date: 15/08/2025

Sheet No: [SHEET NO]

Revision: A

CONSTRUCTION ACITIVITIES

- (1) Temporary NB platform removed
- (2) Temporary SB platform removed
- (3) Temporary arrangement - Bus Interchange adjusted, Bus PUDO located at NE end and public PUDO located at SW end
- (4) Permanent SB platform and plaza opened
- (5) Permanent NB platform opened
- (6) Station access from Oxford Terrace relocated
- (7) Construct new station entrance - Underpass stairs temporarily closed, ramp remains open



SCALE
NTS



Drawing Title

WATERLOO STATION CONSTRUCTION STAGING

STAGE 3

BASE DRAWING CARE OF GRIMSHAW

Issue Status: REFERENCE

Issue Date: 15/08/2025

Sheet No: [SHEET NO]

Revision: A

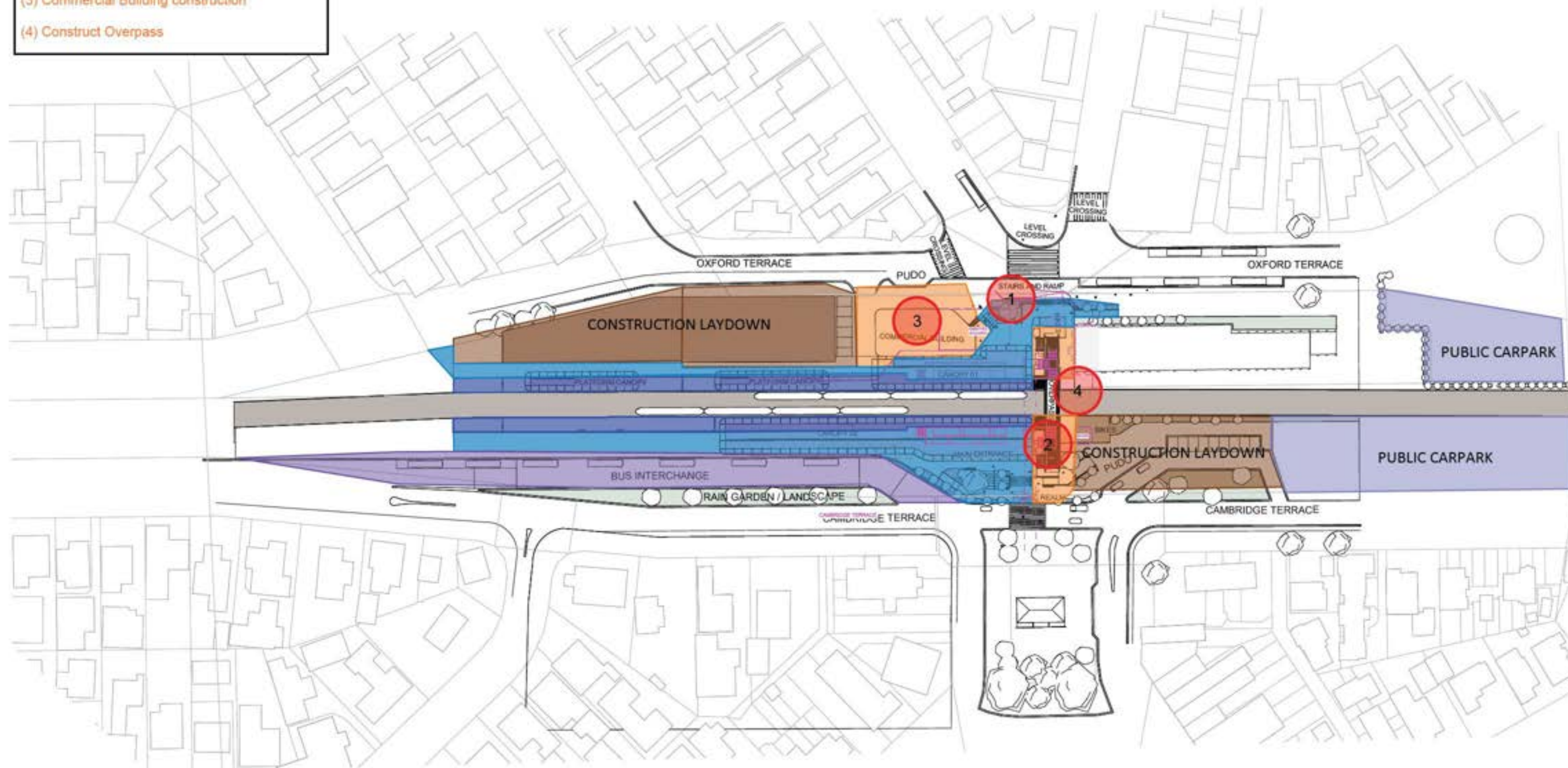
CONSTRUCTION ACITIVITIES

(1) Permanent Station entrance from Oxford Street opened

(2) Underpass stairs closed

(3) Commercial Building construction

(4) Construct Overpass



BASE DRAWING CARE OF GRIMSHAW



SCALE
NTS



Drawing Title

WATERLOO STATION CONSTRUCTION STAGING

STAGE 4

Issue Status: REFERENCE

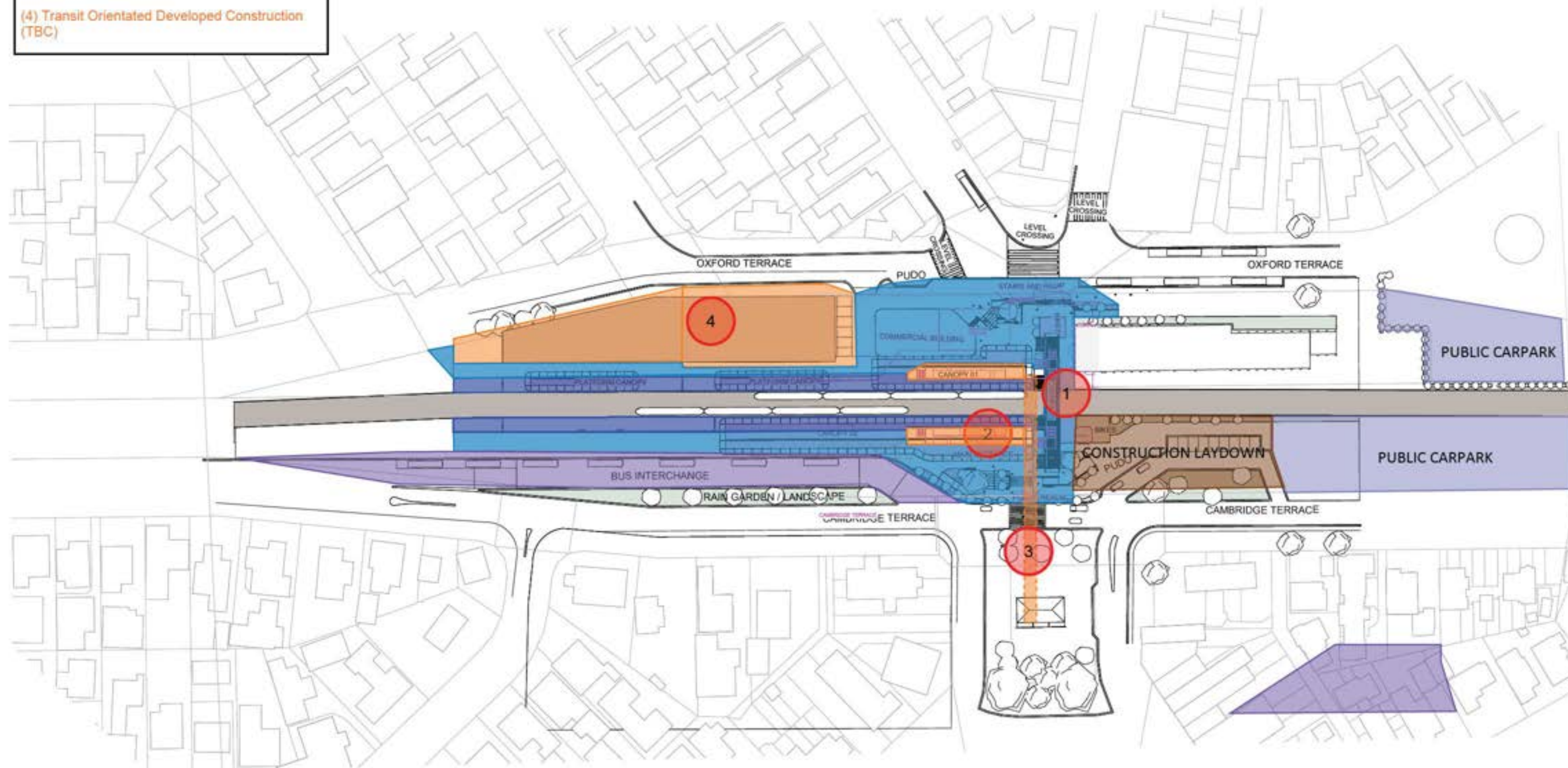
Issue Date: 15/08/2025

Sheet No: [SHEET NO]

Revision: A

CONSTRUCTION ACITIVITIES

- (1) Overpass opened
- (2) Underpass ramps backfilled
- (3) Underpass backfilled
- (4) Transit Orientated Developed Construction (TBC)



SCALE
NTS



Drawing Title

WATERLOO STATION CONSTRUCTION STAGING

STAGE 5

BASE DRAWING CARE OF GRIMSHAW

Issue Status: REFERENCE

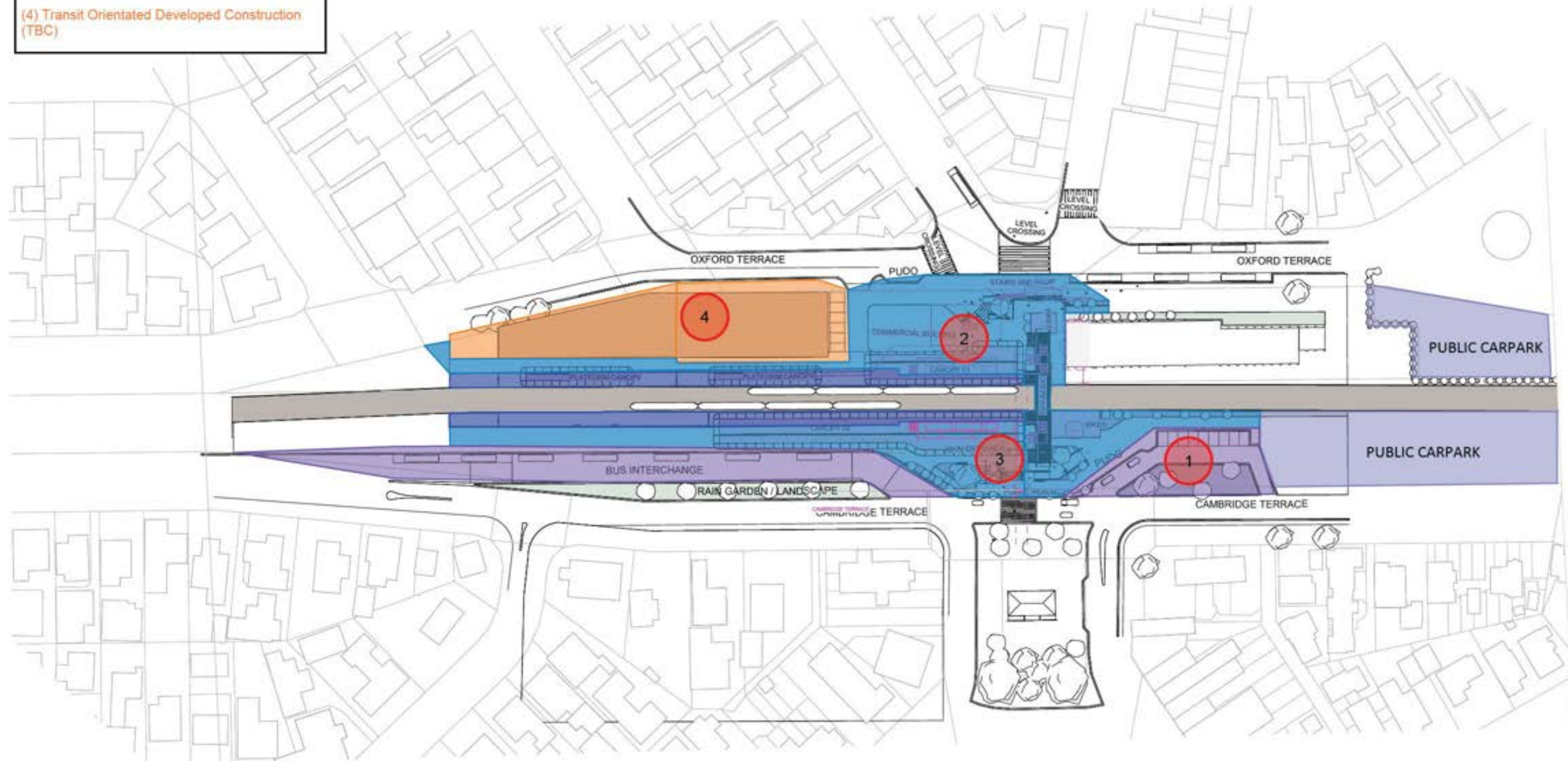
Issue Date: 15/08/2025

Sheet No: [SHEET NO]

Revision: A

CONSTRUCTION ACITIVITIES

- (1) Public PUDO Opened
- (2) Oxford Terrace side of Station complete
- (3) Cambridge Terrace side of Station complete
- (4) Transit Orientated Developed Construction (TBC)



SCALE
NTS



Drawing Title

WATERLOO STATION CONSTRUCTION STAGING

STAGE 6

BASE DRAWING CARE OF GRIMSHAW

Issue Status: REFERENCE

Issue Date: 15/08/2025

Sheet No: [SHEET NO]

Revision: A

8.11 SAFETY IN DESIGN

Hazard source and identification				Hazard Evaluation and Management Through Design				Initial Assessment				Controls and Treatment Management					
Hazard ID	Location	Status	Discipline	Final Occurrence	Lifecycle	Hazard Category	Hazardous Event	Who is exposed?	Potential Causes	Consequences of Harm	Initial Likelihood	Initial Consequence	Initial Risk	Controls — What have we incorporated in the design?	Further Controls — What more could we do? (To be developed in preliminary design)	Barriers — Why can't we do more? (To be developed in preliminary design)	Actions — What arises as a result of assessment? (To be developed in preliminary design)
	Overpass	Open	Architecture	Maintenance	Construction	Operational life	Electric shock	Electrocution hazard during regular maintenance of station canopies, facades or other soffit in proximity OHLE	Construction, Maintenance	Staff installing/maintaining/cleaning areas close to OHLE equipment. Insufficient protection of steelwork to overpasses requiring more regular maintenance. Cleaning of gutters on canopy during operational hours adjacent to OHLE.				Overpass and canopy roofs to be accessible by trained maintenance workers during BoL. Length of restraint system to be designed so that maintenance staff will be restricted to this zone. Anchor points for abseiling will be incorporated into the roof design of the overpass. Locations based on input from abseiling specialist (and subject to structural design.) Also aim to double up lifting points and abseil points.			
	Station area	Open	Architecture	Design	Operational life	Electric shock	Trespasser / Public Electrocuted	Public	Unauthorised access to building. Unauthorised access to services by passengers resulting in electrocution.	Loss of Life, Serious injury				Adequate lighting and CCTV provided, as well as perimeter fencing/ gates to KiwiRail Requirements and a station shutdown gate/shutter. Services suitably enclosed or located out of reach of general public. Balustrades and barriers provided, except platform edges. Areas close to OHLE will be designed in accordance with KiwiRail and Minimum Requirement Standards.			
	Overpass	Open	Architecture	Operation	Operational life	Electric shock	Electrocution due to flashover event	Public	Water drips off pedestrian bridges onto OHLE resulting in flashover to a structure with inadequate E&B	Loss of Life, Serious injury				Water dripping on OHLE is a normal environmental occurrence. E&B Strategy developed and design to incorporate E&B of structures and components. Overpass raised to exceed KiwiRail preferred minimum clearances to further mitigate. Developed detailing with façade engineer.			
	Station area	Open	Architecture	Construction	Working at height / height		Fall from height during installation or maintenance	Construction, Maintenance	Access to canopies and overpass during construction and maintenance.	Loss of Life, Serious injury				Anchor points for abseiling to be incorporated into the roof design of the overpass. Fall restraint system to be provided on all roofs. Sufficient fall protection to be provided at roof edges as well as safe access routes. Design and locations to be based on input from working at height specialist. At grade cleaning/Maintenance: Bypass gate made wide enough to allow EWP equipment capable of reaching canopy underside. Ceiling panels to facilitate removal and replacement and be located no more than 7.5m above floor level to allow access by EWP or mobile scaffold as appropriate			
	Station area	Open	Architecture	Construction	Construction	Clearance	Collision between people and vehicle/equipment	Construction, Maintenance	Congested construction site leads	Loss of Life, Serious injury				Building footprints minimised			
	Station area	Open	Architecture	Operation	Operational life	Security	Trespassing persons or animals on track	Public	People or animals trespass onto the track and are struck by a train resulting in a fatality.	Loss of Life, Serious injury				Warning signs. Public education programs. Enforcement.			
	Station area	Open	Architecture	Construction	Operational life	Vandalism / trespass / self-harm	Trespassers on canopies/overpass roof		Trespassers gain access to canopies or overpass roof through poor design.	Loss of Life, Serious injury				Passive surveillance. Appropriate barriers provided. Warning signs. Public education programs. Enforcement.			
	Station area	Open	Architecture	Operation	Operational life	Vandalism / trespass / self-harm	Inadequate resistance to vandalism, & requiring maintenance activity	Public	Damaged surfaces or equipment might cause injury to passengers, staff & contractors	Falls, minor to moderate injury, concussion				Specification of materials and finishes to follow the Minimum Requirements, Kiwi Rail – Civil Engineering Standard - Passenger Platforms (where applicable) and the New Zealand Standards. Architect to specify materials and finishes with a high level of durability. Contractor to provide testing certificates etc			
	Platform canopies	Open	Architecture	Construction	Operational life	Maintenance	Cleaning of platform canopies	Construction, Maintenance	Canopies are accessed outside BoL, maintenance accident (falling off) canopies during maintenance/cleaning).	Loss of Life, Serious injury				Canopies only be accessible by trained maintenance workers during BoL. Maintenance walkway to be designed into centreline of canopies. Length of restraint system to be designed so that maintenance staff will be restricted to this zone.			
	Station area	Open	Architecture	Construction	Operational life	Maintenance	Working at Height maintaining glazed façade elements including areas above stairs	Maintenance	Maintenance work required at height.	Loss of Life, Serious injury				Façade engineers to advise on maintenance requirements in conjunction with the maintenance team.			
	Station area	Open	Architecture	Operation	Operational life	Natural hazard	Wet station floors - slips, trips and falls.	Public	Wet floors within the station are a potential hazard (slips, trips and falls) to passengers / station operators due to rain entering through the air vents, flooding into the station, wet shoes and umbrellas and slippery flooring finishes.	Injury to persons				*Specification of materials and finishes to follow the Minimum Requirements, Kiwi Rail – Civil Engineering Standard - Passenger Platforms (where applicable)			
	Station area	Open	Architecture	Operation	Operational life	Security	Station security & terrorist attack	Public, Station staff	Difficulty in clearing the station at the end of the day due to station design poses difficulties and puts staff and/or facilities at risk of attack / vandalism that results in serious injury.	Loss of Life, Serious injury				Design includes gates lines for secure patronage, external bollards and steps, clear sightlines provided, CCTV provided, CPTED principles.			
	Station area	Open	Architecture	Operation	Operational life	Vandalism / trespass / self-harm	Vandalism to/misuse of the station equipment	Public, Station staff	Criminal activity, vandalism, local station controls have over-rides enabling trespassers to misuse the station equipment, possible injury to passengers during announced emergency.	Loss of Life, Serious injury				Equipment to be chosen based on durable/robustness. Design includes gates lines for secure patronage, clear sightlines provided, CCTV provided, CPTED principles. The stations are not designed to have cut-through routes within the stations.			

Station area	Architecture	Open	Operation	Operational life	Platform/maintained	Platform Widths - overcrowding Passenger Path - overcrowding Overcrowding - One or more missed headways	Public	Risk of passengers being crushed and / or a passenger being pushed onto the tracks due to incorrect assumptions in pedestrian modelling. Platform becomes overcrowded following one or more missed headways during a peak period resulting in persons falling onto the track and being struck by a train or unable to evacuate the station in the event of a fire (multiple fatalities).	Loss of Life, Serious injury				Station operational procedures to be developed and implemented to restrict access and prevent overcrowding in the event of more than one missed headway. Platform sized to 9 car and missed headways		
Station area	Architecture	Open	Operation	Operational life	Collision	Vehicle collision between bus or car and pedestrian(s)	Public	Buses and other vehicles moving within interchange area Insufficient separation of pedestrians from traffic Vehicle loses control and mounts footpath	Loss of Life, Serious injury				Physical separation of pedestrians from traffic where possible. Design for degraded operations (rail replacement bus)		
Station area	Open	Open	Operation	Operational life	Collision	Car accidentally/intentionally driven into station area	Public	Insufficient deterrents in place to stop car mounting footpath	Loss of Life, Serious injury				Correct kerb installation. Installation of Planters in front of station to stop vehicles Bollards at appropriate spacing in front of station entrance		
Station area	Open	Open	Operation	Operational life	Natural hazard	Sunstrike	Public	Train driver experiences sunstrike due to glare reflecting from the glass façade onto operational corridor resulting in an accident	Loss of Life, Serious injury				Specify appropriate glass performance (reflectivity etc) to limit reflections. Undertake a Solar Study for reflective materials used		
Station area	Open	Open	Operation	Operational life	Natural hazard	Extreme event (weather, earthquake, fire, explosion) causes structure to collapse	Public	Extreme event causes structure to collapse	Loss of Life, Serious injury				Design to NZ Building Code, Fire Engineering Report and applicable KiwiRail standards.		
Station area	Open	Open	Operation	Operational life	Natural hazard	Station and/or precinct flooding due to heavy rainfall	Public	Poor drainage, blocked drainage or significant weather event					Station and precinct to be built to future flood level requirements.		
Station area	Open	Open	Operation	Operational life	Infrastructure failure	Lift failure, including lift failure in the event of a fire	Public	Lift failure causing people to become trapped on platform or overpass					Implement an adequately funded asset management plan to regularly inspect, test, maintain and renew the lifts, including spare parts inventory. Emergency function of lifts to return to ground level upon fire detection - design standard. Emergency call buttons within lifts Standard operational practices in place to minimise the risk of a person being trapped in the lift during a fire	Design team to investigate potential UPS backup for the lift to allow short backup to get those who cannot take the stairs to return to the platform level	
Station area	Architecture	Open	Operation	Operational life	Post design	Signage fails to direct passengers to optimise flow at peak periods, inadequate wayfinding	Public	Signage poorly designed could exacerbate another station incident, crowding in station, on platforms or at top/bottom of stairs. Station operations response should control this					station circulation areas and signage Designed in accordance with requirements - refer to architecture report for details of signage and way finding signage and wayfinding package being developed with at and reviewed in CPAG workshops		
Station area	Open	Construction	Construction	Construction	Hazardous substance	Failure during demolition of existing (current) structures	Contractors	Unexpected structure/materials	Loss of Life, Serious injury				Experienced demo contractor (potentially whomever has taken portions of roof down already) Have backup days in case of adverse weather. Source as much information as possible re existing building and structure.		
Station area	Open	Construction	Construction	Construction	Hazardous substance	Workers exposed to hazardous substances during excavation (i.e. contaminated ground)	Contractors (Public if airborne)	Workers exposed to hazard substances during excavation demolition	Loss of Life, Serious injury				Contaminated land assessment prior to work Appropriate controls identified by assessment depending on level of contaminants		
Existing Subway	Open	Construction	Construction	Construction		Failure of existing tunnel	Contractors (Public if under road portion)	Work adjacent/ in alignment with existing tunnel 'box' results in damage/ requirement to demolish part of tunnel.	Injury to persons				Temporary support/ propping to tunnel. Potential infl of tunnel considered (method dependent to ensure no confined spaces)		
Whole site, particularly excavation for lift pits	Open	Construction	Construction	Construction		Water in excavations creating hazardous construction conditions.	Contractors	Excavation below existing water table	Injury to persons				Temporary works e.g. sheet pile water cutoff cofferdam or grout injection locally. We have required this risk by scheme not requiring as deep lift pits as some other options.		
Overpass	Open	Construction	Construction	Construction	Demolition	Failure during installation/demo (lifting) of overbridge	Contractors	Equipment failure, miscalculation, adverse weather, rush to take advantage of short construction window	Injury to persons, serious injury				Installation of new bridge span – incorporate lifting points in design, work with ECI re lifting points & sequence. Have backup installation window Re demolition - consider additional weight e.g. screed which may not be present original lift) Complete lift during Block of Line period		
Water treatment plant	Open	Construction	Construction	Construction		Disruption to water treatment plant operations	Public	Water treatment plant, blocking of access	Disruption to Wellington's water supply				Traffic management plan to be put in place during construction		
Overpass	Open	Construction	Construction	Construction		Proximity of new underpass to existing underpass leads to damage caused by construction.	Public, passengers	Miscalculation during design/Controls not in place to minimise risk of damage to existing underpass.					Survey of existing underpass locations prior to construction. Continual monitoring of existing underpass during construction to identify potential impacts		
Station area	Open	Construction	Construction	Construction		Existing services in unexpected locations and unknown services	Contractors	Unknown services not identified on plans	Injury to persons, serious injury Redesign during construction				Services investigations early on. Contractor to treat all services all live until proven redundant.		
Station area	Open	Operational	Operational	Operational		Maintenance impede station use.	Public, passengers	Maintenance occurs during operational hours impeding public use of station.					Maintenance plan to include all maintenance to be done outside of station hours.		
Station area	Open	Operational	Operational	Operational		Inadequate lighting	Public, passengers	Miscalculation during design	Poor CPTED, increased risk of accidents				Design to undertake appropriate QA to ensure adequate lighting is provided.		
Station area	Open	Operational	Operational	Operational		Environmental discomfort- exposure to high wind etc	Public, passengers	Poor design of overpass leads to passenger/pedestrian exposure to extreme weather.	Injury to persons				Design of overpass and canopies to take into account weather conditions.		

	Urban Realm	Open	Operation	Operational life	Hazardous substance	Allergies to landscape elements/poisonous plants	Public, passengers	Choices of landscape elements.	Injury to persons					Landscape plant section to take into consideration allergies.			
	Station area	Transport	Operation	Life	Operational	Collision	Traffic conflicts with buses and other traffic and vehicle collides with another vehicle at the intersections of the station entrance (From Cambridge Toe)	Public, passengers	Poor layout of intersections, poor sightlines, queuing traffic causes unpredictable movements	Loss of Life, Serious injury				Separate bus interchange from general traffic. Incorporate clear 'gateways' utilising road markings and signage			
	Station area	Transport	Operation	Life	Operational	Collision	Cyclist hits pedestrian, pedestrian walks into cyclist	Public, passengers	Poor separation between cycling and pedestrian infrastructure.	Loss of Life, Serious injury				Cyclists and pedestrians segregated on routes from station entrance to the station. Shared environment in front of the station			
	Station area	Transport	Operation	Life	Operational	Collision	Moving buses and other vehicles hit cyclists	Public, passengers	Poor separation between cycling and road infrastructure.	Loss of Life, Serious injury				Dedicated cycle facilities and traffic calming to reduce risk			
	Station area	Transport	Operation	Life	Operational	Collision	Any vehicle collides (Bus/Car) with pedestrians (Cambridge Toe crossing)	Public, passengers	Poor layout of intersections, poor sightlines, queuing traffic causes unpredictable movements	Loss of Life, Serious injury				Dedicated pedestrian crossing and traffic calming to reduce vehicle speeds. Maintain sightlines between modes			
	Station area	Transport	Operation	Life	Operational	Collision	Any vehicle collides (Bus/Car) with pedestrians (Oxford Toe crossings)	Public, passengers	Poor layout of intersections, poor sightlines, queuing traffic causes unpredictable movements	Loss of Life, Serious injury				Dedicated pedestrian crossings and traffic calming to reduce vehicle speeds. Maintain sightlines between modes			
	Station area	Transport	Operation	Life	Operational	Collision	Cyclists / scooter users losing control of when ascending or descending stairs.	Public, passengers	Poor layout of intersections, poor sightlines, queuing traffic causes unpredictable movements	Loss of Life, Serious injury				Provide lifts which are large enough to provide cycle access with signage telling cyclists to use lift. Install appropriate stair cycle ramps for ease of use by cyclists			
	Station area	Transport	Operation	Life	Operational	Collision	Bicycle / scooter users riding on overpass and clashing with other users	Public, passengers	Poor layout of intersections, poor sightlines, queuing traffic causes unpredictable movements	Loss of Life, Serious injury				Provide lifts which are large enough to provide cycle access with signage telling cyclists to use lift. Install appropriate stair cycle ramps for ease of use by cyclists			
	Station area	Transport	Operation	Life	Operational	Collision	Vehicle collides with pedestrian or cyclist in bus interchange or PUDO area	Public, passengers	Poor layout of intersections, poor sightlines, queuing traffic causes unpredictable movements	Loss of Life, Serious injury				Separate modes and reduce design speed in interchange area to 10km/h			
	Station area	Operational	Operation	Life	Operational	or Maintenance	Accidents occur during maintenance of services for the overpass	Maintenance providers	A person slips trips or falls or has an accident maintaining the mechanical equipment for the overpass	Serious injury				The design team have designed out the risk through the use of natural ventilation			
	Station area	Open	Operational	Construction	Operational life	Maintenance	Fall from height during installation or maintenance of lighting	Maintenance providers	A person slips trips or falls or has an accident maintaining the station lighting	Serious injury				All lighting and services to be located at a maintainable height. Maintenance plan to be put in place.	Once the design progress electrical engineer to work with architect on maintenance access strategy to minimize the amount of drivers required to access at high level.		
	Station area	Electrical	Construction	Operational life	Maintenance		Fire within the electrical MSB room	Maintenance Worker, Others, Pedestrian, Station customer, Station operations staff	Electrical equipment fault	Serious injury or fatality to passengers, station staff				Equipment rooms provided with a minimum fire integrity rating (compartmentation) The integrity rating of the compartments will contain the fire and preserve the structural integrity of the bridge	Fire suppression could be considered for asset protection of the rail systems equipment		
	Station area	AV	Open	Operation	Operational life	Infrastructure failure	Voice Alarm PA fails under emergency evacuation scenario	Train passenger, Station customer, Station operations staff	Poorly maintained and checked components in the PA system					Design of PAVA system at the station complies with the technical requirements provided by the Client. PAVA design is provided by the incumbent provider by the Client.			
	Station area	Building Services	Open	Operation	Operational life	Maintenance	Accident due to access of service pathways across the rail corridor	Maintenance providers	Design provided maintenance of service pathways under the tracks	Injury to persons, serious injury				Design to include service pathways within the overpass to mitigate having to trench under the rail corridor.			

