AUCKLAND RAIL PROGRAMME BUSINESS CASE

ECONOMIC CASE – 30-YEAR RAIL PROGAMME

CAPEX COST REPORT

30 AUGUST 2023

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ECONOMIC CASE – 30 YEAR RAIL PROGRAMME

CAPEX COST REPORT

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REV	DATE	DETAILS
B	28/08/2023	Draft for client and peer review

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Approved by:			
File/Ref	1-C2233		

Executive summary

Table 1 below summarises the estimated costs for the PBC Preferred Programme, grouped by main asset categories:

Table 1 - PBC Preferred Programme – CAPEX cost estimation summary

Row Labels	Sum of Total Property Costs P50	Sum of Project Development Costs P50	Sum of Pre-Implementation Costs - P50	Sum of Implementation Costs (Consultancy Fees and Client Managed Costs) - P50	Sum of Physical Works Costs P50	Sum of Total P50	%
New Track	9(2)(i) - Commercial Activities						
Level crossing removal							
Station improvement							
EMU rolling stock							
EMU depots and stabling							
Platforms							
Maintenance plant and equipment							
Traction power system							
Maintenance depots							
Disruption management charges							
Stations (new)							
Signalling							
Telecomunication							
Access track for maintenance							
Studies and investigations at programme level							
Regional Services stabling							
Network Control							
Grand Total	**2,600,700,000**	**608,400,000**	**994,300,000**	**577,600,000**	**16,406,300,000**	**21,187,300,000**	
	12.3%	2.9%	4.7%	2.7%	77.4%		

It should be noted that the CAPEX costs report is complementary to and shall be read and understood in conjunction with:

1. The cost model, attached hereinafter as Appendix 1, which provides all detailed calculations, unit rates and quantities, and cash flow information and

2. The Power BI interface (https://app.powerbi.com/groups/b7141089-7bc0-4ca9-aee9-6a119f92ecf2/reports/0d6e4df6-6e6c-4b15-b604-f9f70ec3b5df/ReportSection6c30a25deb4b28aa8607?experience=power-bi) which provides consolidated calculations and summaries, graphic representations and cash-flow information.

1 Introduction

1.1 The Context

This report is part of a suite of asset reports (Table 1-1) supporting documents recording the analysis of factors enabling refinement of the options and the preferred programme. These reports inform the overarching Programme Business Case (PBC), especially the Economic Case. See Figure 1-1: Auckland Rail PBC Document Map.

Table 1-1: List of asset strategies supporting the 30-year rail programme report in the PBC's Economic Case.

#	Asset/Cost Reports	Contents
A1	Stations	• Assessment of current stations against the Transport Design Manual (TDM) and potential upgrades, based on future forecast demand. • Preferred station platform configuration on a two, four and a six-track railway. • Platform extension requirements to enable longer passenger trains.
A2	Track and Civils	Track infrastructure, including discussion on typical cross section.
A3	EMU Fleet	Overall fleet size over time, based on passenger demand per departure in peak. Rolling stock concept and considerations.
A4	Traction Power and OLE	Traction Power and Overhead Line Equipment (OLE).
A5	Signaling and Network Control	Signaling and Network Control, including the path to ETCS Level 2.
A6	Level Crossings	Grade separation, or closure, of level crossings.
A7	EMU Stabling and Depot	Considerations for a Passenger Fleet Depot and Stabling locations.
A8	Access, Maintenance and Renewals	• Asset Management. • Maintenance and Renewals. • Access: physical (on-tracking pads, satellite depots) and time-window (six hours nightly, rolling weekly block of lines). • Codes and Standards. • Competency and Training. • P&E. • Areas Exposed to Climate Change.
	CAPEX Cost Report (this report)	Cost Breakdown structure and assumptions for development of intervention costs.

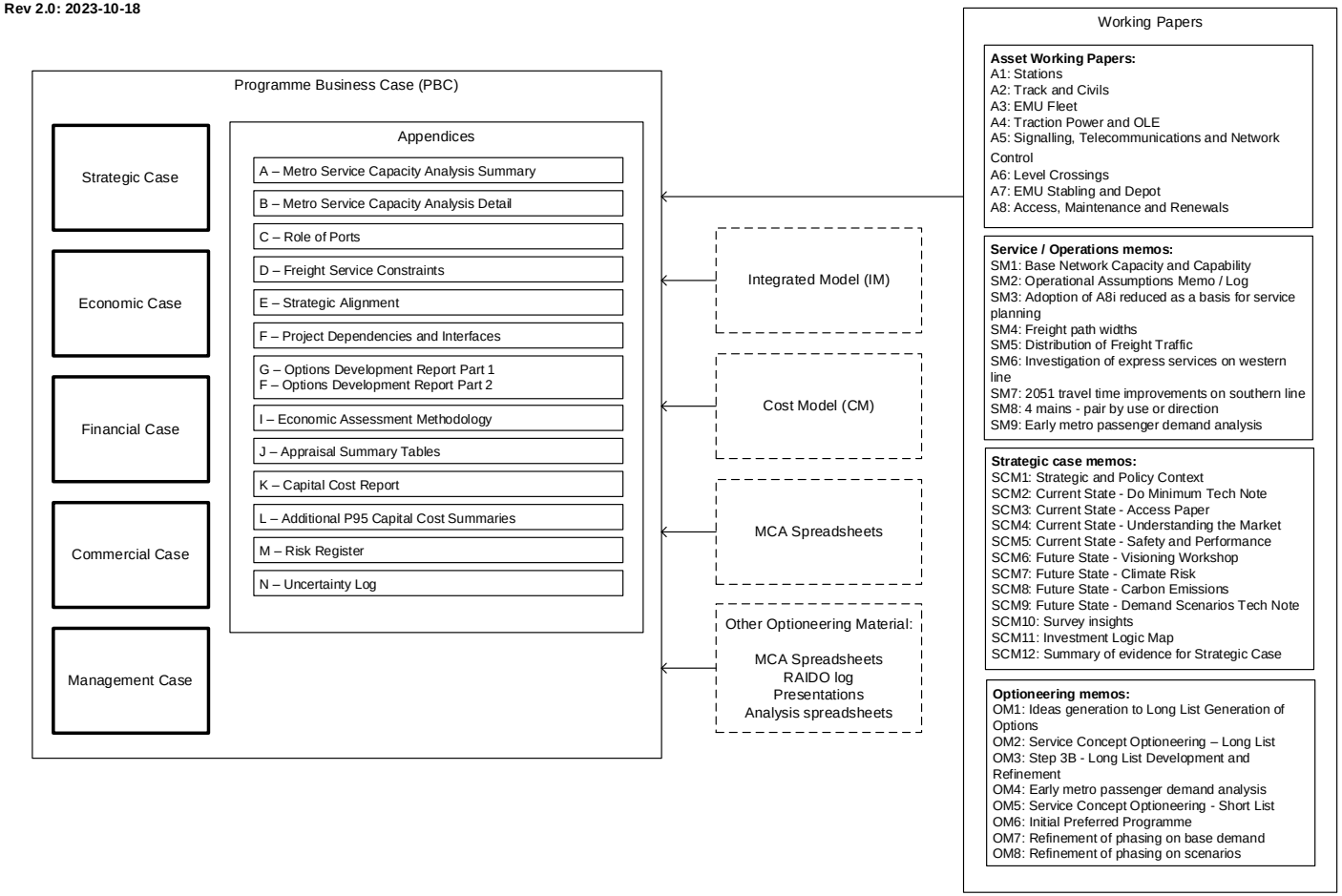


Figure 1-1: Auckland Rail PBC Document Map

This report ('Report') has been prepared by WSP exclusively for Auckland Transport and KiwiRail ('Client') in relation to the Auckland Rail Programme Business Case ('Purpose') and in accordance with contract number 781-21-393-PS Rail Programme Business Case dated 4 February 2022. The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

1.2 Purpose

This report sets out to identify, structure and quantify the cost of interventions to be funded and implemented for the successful delivery of all Investment Objectives and Conditional Outputs developed for the 30-year Auckland Rail Programme Business Case. Investment cost estimates summarises the cost elements and the assumptions for the upgrade of each asset class providing also the elements needed to fulfil the Waka Kotahi cost manual SM014 requirements, including the assessment of contingency and funding risks.

1.3 Cost estimate background

A series of cost estimates were produced as part of the earlier stages of the PBC's steps. They might be grouped into two main categories:

- Stage 1: High Level Initial Estimate – At thematic concept stage – sufficient detail to enable comparison between options for differentiating components.
- Stage 2: Indicative Estimates – Long list to short list stage – refinement of the costs for the differentiating items.

Current report represents a further cost estimate development, the CAPEX Programme Business Case Estimates, which quantifies the capital investment costs for the shortlisted options ("the initial preferred programme").

2 Preferred 30-Year Programme

2.1 Scope and functionalities

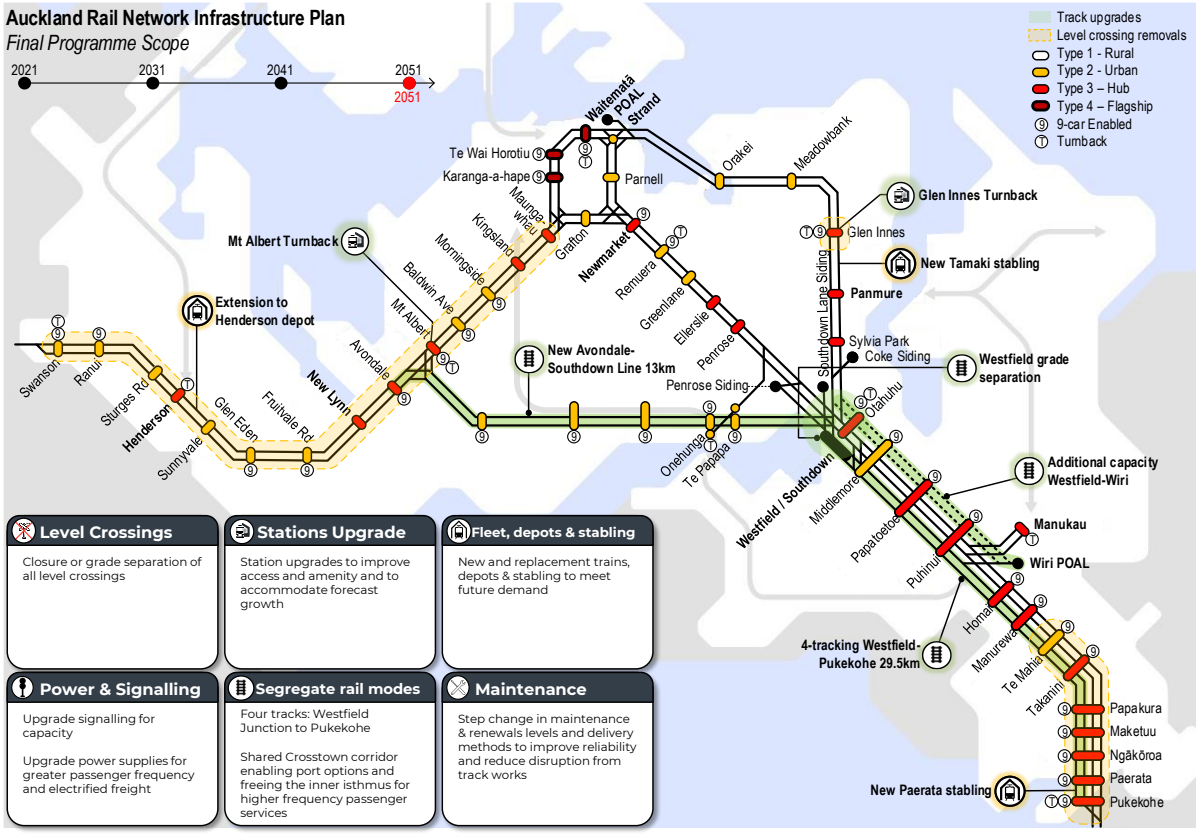


Figure 2-1: Auckland Rail PBC - Scope on a page

2.2 Cost Breakdown Structure

The CAPEX Programme Business Case Estimates contains several individual elements that will probably be delivered by the programmes shown in the table below.

***Table 2-1**: Cost Breakdown Structure*

Programme	Main Components
4-tracking Westfield - Pukekohe	4T Wiri to Westfield (one additional track) 4T Wiri-Pukekohe (two additional tracks) Platforms Pedestrian Bridges, elevators and buildings
Additional capacity Wiri-Westfield	Additional items of infrastructure Platforms Third track at Swanson

Westfield Junction Grade Separation	Westfield Junction Grade Separation
Avondale-Southdown	Avondale - Southdown - Advanced Works Avondale - Southdown - 2T 13 km Avondale - Southdown - Greenfield stations Avondale Junction - Grade Separation
East-west peak overlay (Mt Albert to Glen Innes)	Third track at Mt Albert Stations Third track at Glen Innes Stations
9-car extensions	Third track at Remuera for 9-car limited stops service. Platform Extensions Pedestrian Bridges, elevators, and buildings
Westfield to Penrose siding freight track	Westfield to Penrose siding freight track
Signalling and network control	Signalling - ETCS Level 2 Initial overlay Signalling - GOA2 Driver assist enhancement. Traffic Management System Upgrade Signalling optimisations
Traction power and OLE	Traction power at P2P South (upgrade to 2SFCs) Replacement of traction power facilities at Westfield Feed WSF Tx with 2SFC 1 SFC South Zone OLE switching improvements
Level crossing removal	Road/Pedestrian Level Crossings removal Pedestrian only Level Crossings removal
EMU fleet, depots and stabling	Rolling Stock (EMUs) EMUs Depot and stabling facilities
Station upgrades	Safety/ Security/ Comfort Requirements Operational Requirements Services Requirements Connectivity Requirements

Maintenance plant and equipment	Maintenance plant and equipment
Maintenance depots	Heavy Maintenance Facility Maintenance satellite depots Maintenance Sidings Inventory Store Staff Facilities
Disruption management	Disruption management charges

The Cost model provides also different sets of grouping, including cost assignment per leading funder, type of assets and geographical divisions.

3 General Principles

3.1 Inputs

CAPEX Programme Business Case Estimates (CPBCE) uses the following inputs:

- Instructions and guidelines in SM014 – Cost estimation manual (Waka Kotahi, 2021).
- Initial studies including schematic designs and sketches aiming to depict the main characteristics of the proposed interventions for large majority of the proposed interventions (e.g., 4-tracking Westfield – Pukekohe and Level Crossing removal).
- Parametric assessments using the results of the above studies for other interventions (e.g., 4T from Papakura to Pukekohe, Avondale Junction grade separation, Additional capacity Wiri-Westfield).
- Asset strategy reports and other inputs which form part of the PBC.
- Up-to date requirements in accordance with the applicable standards and regulations.
- Previous studies undertaken by third parties such as:
    - Traffic Impacts of Level Crossings report (Resolve, 2022).
    - Avondale to Southdown Rail Link report (T&T, June 2020).
    - Wellington business case for ETCS Level 2.
    - Kiwi Rail's power studies and costs from similar previous business cases.
- Inputs provided by Kiwi Rail and/or Auckland Transport:
    - Applicable investigation, pre-implementation and implementation percentages for client costs and consultancy fees.
    - Property costs for Avondale to Southdown and Papakura to Pukekohe corridors.
    - Access track and maintenance costs (plant and equipment, depot and stabling facilities).
    - Switches improvements.
    - Disruption management charges.

3.2 Assumptions

This section provides details and explanations regarding general assumptions and details which are used for the CPBCE.

In addition, particular assumptions are provided in each separate section for each asset.

3.2.1 Applicable standards, norms, and regulation

CPBCE is developed according to the Waka Kotahi Cost Estimation Manual (SM014) and it is based on the applicable standards, norms, and regulations at the date of this report. Preliminary considerations regarding sustainability and climate changes adaptation and carbon emissions reduction are considered in general and contingency provisions are added in this regard.

3.2.2 Base year for costing

The base year for costing has been assumed to be June 2023 rates. As an exception, the estimates for Avondale – Southdown 2T which are based on the cost report provided by Tonkin and Taylor in 2020, have been indexed with 21% to be consistent with June 2020 rates.

For indexation of other historical reference figures, the General CPI index has been used.

3.2.3 Future escalation

No future escalation has been applied, as per SM014 Cost Manual requirements for long term programming.

3.2.4 Historic rates

The following factors have been considered in the assessment of historical rate:

- the inclusion of on-site overheads (indirect costs):
- the inclusion of off-site overheads and profit.
- market conditions.
- age of data.
- geographical location.
- similarity of work items; ·
- changes in technology, methodology, materials, plant, and machinery.

3.2.5 Rounding

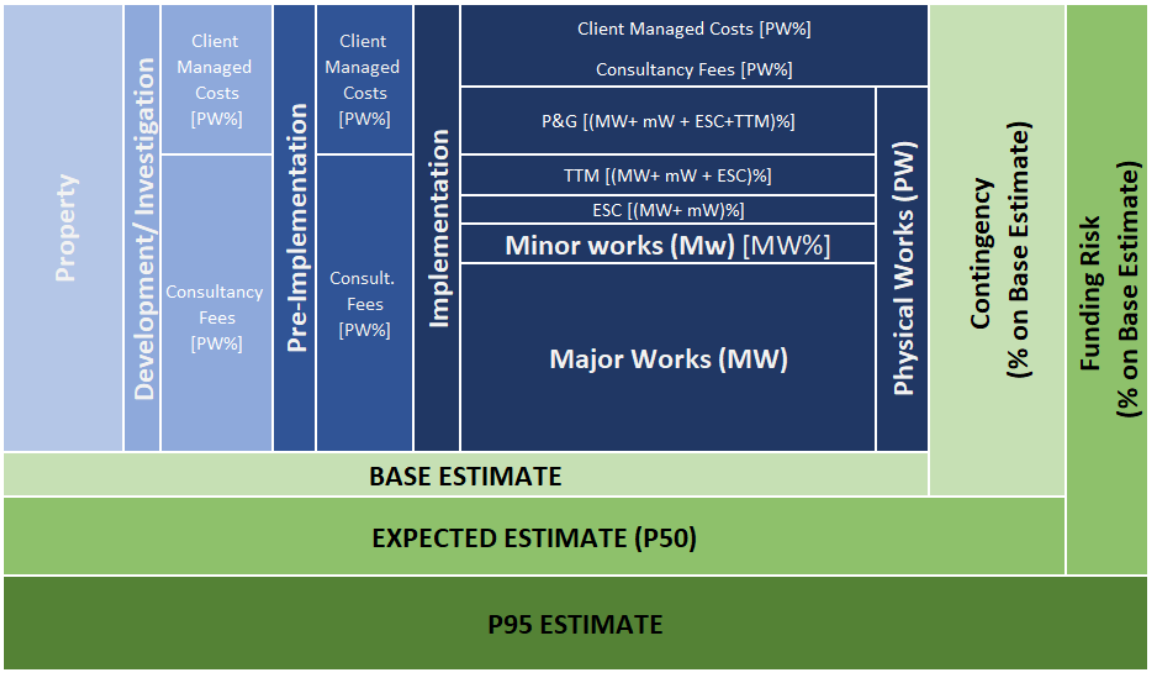
All Base Estimates, P50 and P95 figures have been rounded to the nearest 100,000$.

4 Cost estimation structure

4.1 Cost estimation components

Costs estimates components are following the recommendations of SM014 – Cost estimation manual (Waka Kotahi, 2021) and proposed the following high-level components:

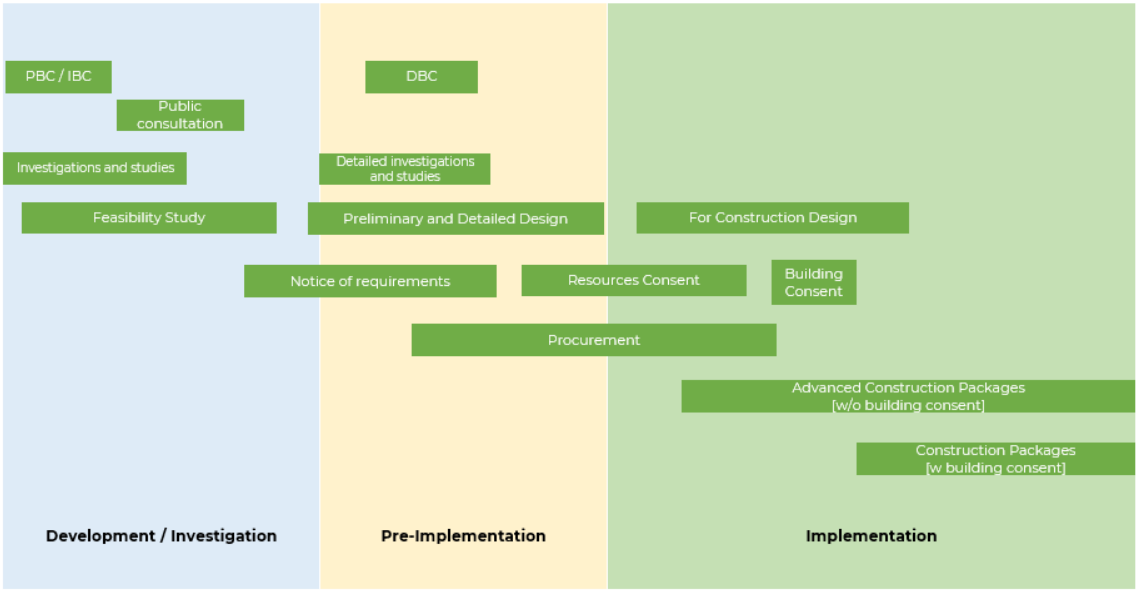
Table 4-1: Cost estimation components



4.2 Project Phases

A short description of each project phase is presented in the table below.

Table 4-2: Main phases description



5 Property

5.1 Generalities

Costs estimates for Property include gross acquisition costs and no allowance was made for future surplus land disposal revenue.

Only full section acquisitions have been considered due to:

- Inability to perform detailed analyses regarding the impacts of a partial acquisition on the usability of the remaining parts of the property (e.g., access, parking lots, relocation of utilities, needs for consolidation, or other structural interventions). Such analyses are to be included in the next programme development stage.
- Reduced design level and construction methodology details doesn't allow for a clear definition of the required property acquisition borders.
- Subdivision consents could generate delays at the program level which cannot be quantified at this stage.

Refinements could be done during the next development phases.

On "case-by-case" basis, technical assessments have been performed to determine the location where cost savings can be achieved by applying other construction solutions (e.g., retaining walls) instead of property acquisition.

In specific and limited locations (summing up to a total of less than 3% of the entire track alignment length), where property acquisition would result in an exceedingly high property cost, retaining walls and a reduced cross-sectional width was priced. An example of this approach is the property around the Takanini Mall where the proposed alignment interferes with the main mall infrastructure. Such situation would have required purchasing and reconstructing the mall, which is considered an unreasonable assumption.

5.2 Property acquisition cost assignment

Property acquisition costs are assigned to Kiwi Rail, except the additional land acquisition which is required for level crossing removals which are assigned to Auckland Transport, subject to the following clarifications:

- Rail station land. Currently there are and have been several processes that have been followed for total rail station land ownership incorporating land parcels within and external to the rail corridor e.g., station access / lifts within the road corridor. For the purposes of the PBC all land costs for station expansion have been associated to KiwiRail. As AT and KiwiRail progress business cases and designs for station upgrades, confirmation of financial responsibilities for project delivery including for land purchase will be confirmed.
- New EMU depot and stabling land. The development of new depot / stabling areas for an expanded EMU fleet outside current Kiwi Rail land ownership has not been undertaken in Auckland recently. Costs associated with the development and delivery of depot/ stabling buildings, facilities and land will be significant. For the purposes of the PBC all land costs associated with new depots and stabling for EMU's have been associated to KiwiRail. As AT and KiwiRail progress business cases and designs for new depot and stabling areas, confirmation of financial responsibilities for project delivery including for land purchase will be confirmed.

5.3 Calculations

All Property costs are explicitly provided in "Cost Model Database" sheet, part of the Cost Model.

Detailed property calculations for EMUs Depot and stabling facilities and Level Crossing removal are provided in Appendix 3. Property mark-ups and considerations for the 4-track alignment are provided in Appendix 2.

Property costs for track alignment are based on the detailed reviews of Wiri to Westfield section which provides applicable unit rates for various alignment typology (residential, industrial, commercial). Such rates are used for the entire 4-tracking project, except:

- Dedicated lump sum estimates for significant commercial or infrastructural facilities (e.g., hospitals).
- Property costs for Avondale – Southdown and Papakura to Pukekohe alignment which are provided by Kiwi Rail.

Property costs for heavy maintenance depot, maintenance satellite depots, sidings, inventory store and staff facility are currently included in the lump sum allowance.

For rails stations, a provision of 4,000 m2 per station with a rate of 1,500$/ m2 is considered.

9(2)(i) - Commercial Activities

No property costs considered for Westfield Junction and Avondale Junction grade separations.

A summary of the property acquisition estimates is provided in the table below.

Table 4.2.1 Property acquisition cost summary

Project	Estimated needs for Property Acquisition (Base estimate costs and rates)
4T Papakura to Pukekohe 2T, 18,5 km	9(2)(i) - Commercial Activities
4T Wiri to Westfield - 1T, 8km	
4T Wiri-Papakura 2T, 11km	
Additional infrastructure (Wiri to Westfield) 8km	
Avondale - Southdown - 2T 13 km	
Henderson Stabling and Depot - Property Acquisition	
Tamaki Stabling	
Paata Stabling	
Bruce McClaren (Road over Rail) Level Crossing	

Level Crossings - Group 2 Southern Crossings	9(2)(i) - Commercial Activities
Level Crossings - Group 3a (Eastern & Inner West)	
Level Crossings - Group 3b Inner West (Mt Albert)	
Level Crossings - Group 4 (Outer West – New Lynn to Swanson)	
Level Crossings - Group 5 Outer Southern Crossings (P2P)	
Stations, accesses, and connection to the stations	
Property allowance for Maintenance depots	
Regional Services stabling	
Replace WSF Tx with 2SFC (Mid1b) 2035	
1 SFCMid/South Zone (Mid2) 2037	

6 Consultancy Fees and Client managed costs

Consultancy Fees and Client managed costs are based on the analysis undertaken for each type and phase based on the physical works base estimate, as follows:

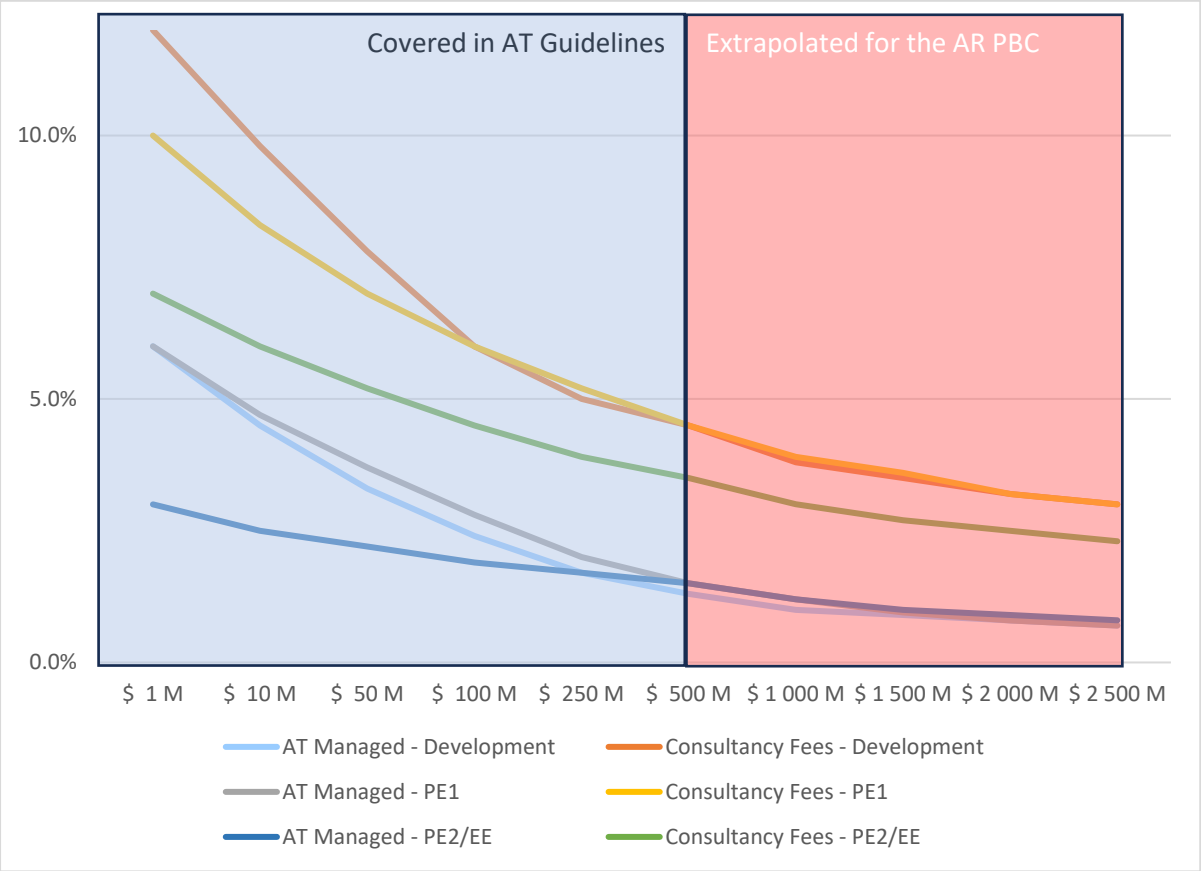


Figure 6-1: Consultancy fees and Client Managed costs rations by phase (PE1= pre-implementation, PE2(EE)=pre-implementation)

Table 6-1: Consultancy fees and Client Managed costs rations by phase

	Based on Client and Consultant Fee Table from AT							Extrapolated from "Fees" up to $500M			
Phase	Physical Works cost ($M)	1	10	50	100	250	500	1 000	1 500	2 000	2 500
Investigation (PBE, IBE, DBE)	9(2)(i) - Commercial Activities										
Pre-Implementation (PE1)											
Implementation (PE2(EE))											
Total all phases											
Total fees											

For increasing the accuracy level of these ratios, extrapolation has been used for project values above 500 mil$ and interpolation for the projects value between two consecutive range values (refer to “Input fees” sheet in the CAPEX Cost Model). Resulting figures are presented in “%fields” sheet in the CAPEX Cost model.

As an exception to the above, lower figures have been used for Signalling - ETCS Level 2 Initial overlay, Signalling - GOA2 Driver assist enhancement, Traffic Management System Upgrade and Rolling Stock (EMUs) because these projects will be tendered-out under a design and build environment (which requires less client managed and consultancy fees) or some of the required fees are funded out of the PBC.

All Consultancy Fess and Client managed costs are provided in “Percentual cost and fees” sheet, part of the Cost Model.

7 Physical Work

7.1 Cost Components

Table 7-1: Physical Works components

Cost component	Physical Works Base Percentage
Major Costs	As detailed in the cost model
Minor Costs	0%, 20% or 25% x [Major Costs]
Environmental Statutory Compliance (ESC)	2% x [Major +Minor Costs]
Temporary Traffic Management (TTM)	6% x [Major +Minor + ESC Costs] or calculated based on a detailed build-up [Level crossing removal]
Preliminary and General (P%G)	24% x [Major +Minor + ESC + TTM]

7.2 Major Costs

Major costs represent the high-cost items which were identified and priced in the CPBCE.

Method of quantifying the Major Cost for each asset is individually explained in the next sections.

7.3 Minor Costs

Minor costs represent a factor for 'minor works' which was applied to the Major Costs to cover the costs associated with smaller elements ("known unknows") that have not specifically formed part of the estimate, but will likely be required, such as:

- Stormwater wetlands, culverts, and watercourses.
- Network upgrades, connections/ modifications to existing infrastructure.
- Construction temporary works, such as temporary rail, sheet pile or retaining walls temporary bridges, temporary rail barriers.
- Local road upgrades to facilitate construction, footpath upgrades, intersection, or signals upgrade/ modifications.
- Urban design features, decarbonisation and sustainability initiatives, material durability, noise and vibration mitigation measures.

The percentage used for each Minor Costs is dependent on the Major Costs value, and the extent of minor works required.

Minor Costs have a range between 0% to 25%, according to the proposed estimation method and the extend of the design and project knowledge in general, as follows:

- 0% for projects which are based on either market confirmed unit rates (rolling stock, maintenance plant and equipment) or on parametric estimates benchmarked by "as

built" ratios or unit rates (signalling related items, traction power supply and OLE switching improvements, Avondale Junction grade separation).

- 20% as standard value applicable for track extension, Westfield Junction grade separation, Avondale to Southdown greenfield stations, and station upgrades which are quantified based on some additional studies. Similar projects have been used as reference to quantify the gap between Major Cost assessed based on similar studies and the final "as built" costs. The gap between is represented by the "Minor Costs".
- 25% for projects on which the level of investigation and study level of development is low and further analysis and decisions (out of the PBC stage) should be taken. Such rate of Minor Costs is applicable only for level crossings removal programme.

7.4 Environmental Sediment Control (ESC)

ESC was calculated at 2.5% of the physical works cost. Where "all-inclusive" rates have been used (greenfield stations, signalling, rolling stock) or items which refers to "on the shelf" assets or equipment, no ESC costs are assigned.

7.5 Temporary Works and Traffic Management costs (TTM)

Temporary Works and Traffic Management costs include:

- implementation of traffic management plans
- public notification
- lane changeovers
- road diversions
- plant and equipment hire costs (e.g., cones, barriers, vehicle attenuator, etc)
- temporary construction to allow for a safety circulation (roads, bailey bridges, footpaths, etc) to enable the TTM
- site labour.

Mitigation costs for rail disruptions or interruptions for both passengers, and freight services, including operation of busses as a replacement, public notifications, temporary arrangements allowing for bus replacement and other similar activities are included under Disruption management.

It should be also clarified that the temporary works costs required to be incorporated into the permanent works are included into the unit rates for such permanent works.

In general, a percentage of 6% has been used, except for the level crossing removal chapter for which TTM cost was priced based on the duration of construction, 9(2)(i) - Commercial Activities [redacted]

7.6 Preliminaries and general (P&G)

List of P&G items is composed of:

- Site establishment, operation (e.g., time related costs like site sheds, phones, or photocopying), disestablishment and clean-up
- Site management (non-manual labour)
- Bonds and insurances
- Consents if not already obtained (e.g., Building Consents)
- The cost of preparing and maintaining quality, health & safety, security, temporary erosion and sediment control, temporary traffic management plans, programming, and reporting
- Public relations costs

- Any other costs associated with running the construction side of a project.

A percentage of 24% is added for all projects, except for Avondale Station Grade separation (which already has embedded P&G in the reference costs), signalling related projects and OLE switching improvements, EMU fleet, fleet renewal and Maintenance plan and equipment.

7.7 Disruptions management charges

Disruptions to the operation and maintenance activities due to the development and implementation of the AR PBC infrastructure projects have been globally estimated based on the actual figures for similar interventions, and include provisions for:

- replacement transportation means (mainly buses for passengers and tracks for freight)
- signs, communication, and public relation cost
- management and other resources for transition stages.

All components of the Physical costs are provided in “Cost model database” and “Percentage cost and fees” sheets, parts of the Cost Model.

8 Contingency and Funding Risk

8.1 General Approach

As outlined in the Waka Kotahi Cost SM014 Manual, Risk & Contingency represent financial provisions added to the Base Estimate to provide for uncertainty in relation to the estimate inputs and specific project related threats and opportunities.

- Contingency represents an addition to the Base Estimate (components of which are visually presented in Figure 3 above), to provide for uncertainties in relation to specific project risks and opportunities, resulting the "most- liked" value ("Expected Estimate").
- Furthermore, supplementary provisions to cover unidentified risks ("unknown unknowns"), Funding Risk, are added to cover the difference between the statistical mean and statistical 95th percentile value ("Worst Case Scenario") as presented in the below figure.

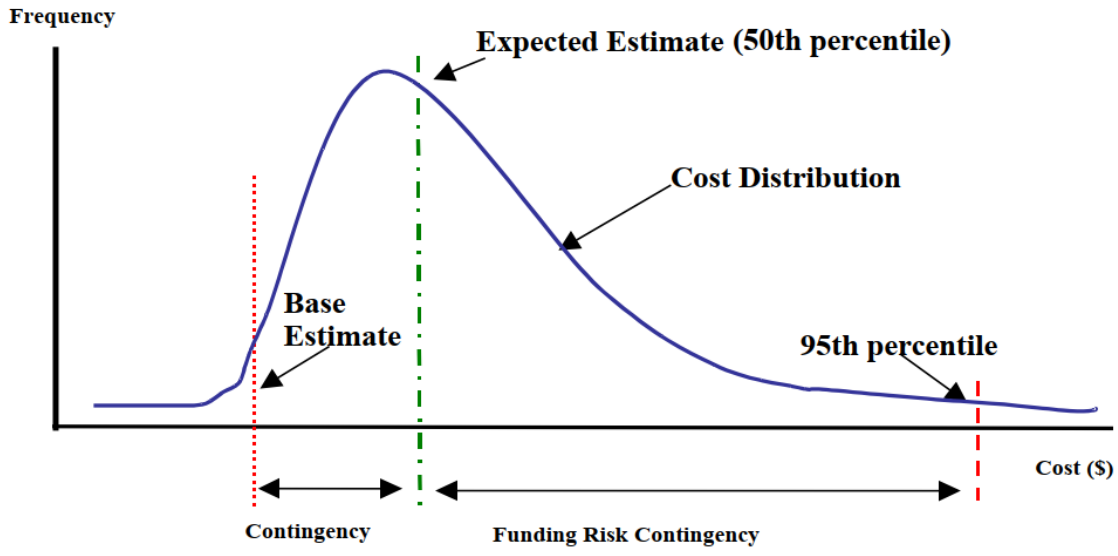


Figure 8-1: Terminology used for risk adjusted cost estimates

The expected costs evolution during the life cycle of a project is illustrated below in Figure 8-2 below. Accordingly, the expectations are that the development of the design and other project related investigations should allow for a better understanding of the project and its surrounding environment, reducing in this way the level and number of uncertainties and providing risk mitigation measures which are to be included into the Base Estimate.

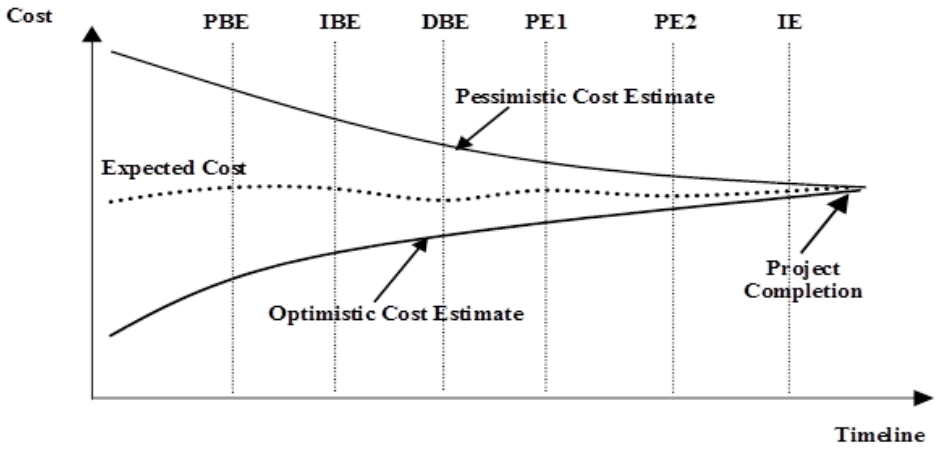


Figure 8-2: Estimate of risk at each stage in the Waka Kotahi Business Case Project Cycle

8.2 Property costs

The following % have been applied to the property in accordance with WSP's property team experience, backed-up by the confirmation of Kiwi Rail's property team.

Table 8-1: Contingency and Funding risks levels for Property costs

Item	Percentage
Contingency (50th)	15%
Funding Risk (95th)	25%

8.3 Consultant Fees, Client managed costs and Consent management

Based on historical data from previous similar programmes, the following percentages have been used:

Table 8-2: Contingency and Funding risks levels for Consultant Fees, Client managed costs and Consent management

Item	Percentage
Project Development/ Investigation Phase	
Contingency (50th)	10%
Funding Risk (95th)	10%
Pre-Implementation Phase	
Contingency (50th)	20%
Funding Risk (95th)	10%
Implementation Phase	
Contingency (50th)	20%
Funding Risk (95th)	15%

8.4 Physical works

8.4.1 Auckland Transport guidelines

Auckland Transport guidelines provide the following contingencies and funding risks ranges for Physical Works:

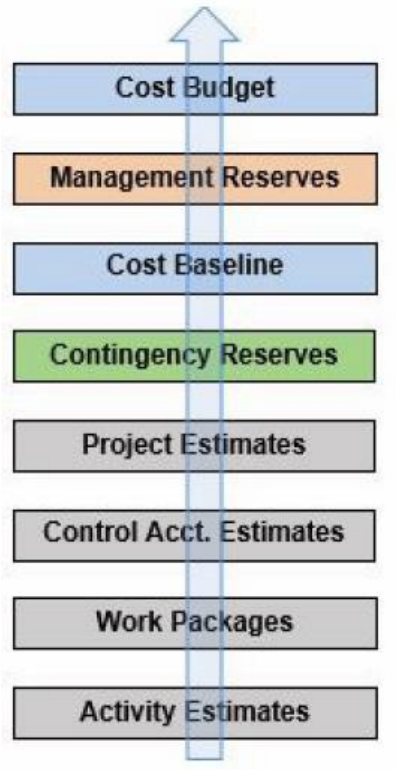
COST ESTIMATE AT PHASE ACTIVITY. NOTE: 1. P50 contingency is added to the base estimate. 2. P95 contingency can be added to the base estimate, or the difference between P95 and P50 added to the P50 expected estimate (as done on the AT estimate summary excel sheet). In either case the funding risk contingency is the difference between the P50 and P95 figures and reported as such on the Estimate Summary Sheet.	CONTINGENCY RANGE (EXPECTED ESTIMATE P50)	CONTINGENCY RANGE (95TH PERCENTILE P95)
Programme Business Case (provides budgets)	+40 to 60%	+70 to 150%
Indicative Business Case (based on multiple options)	+30 to 50%	+50 to 70%
Detailed Business Case (based on preliminary design for preferred option)	+30 to 50%	+50 to 70%
Pre-Implementation 1 (include preliminary design updated with NOR / RC conditions)	+20 to 40%	+40 to 60%
Pre-Implementation 2 (also called the Engineer's Estimate. Based on detailed design for the implementation phase)	+15 to 20%	+20 to 30%
Implementation Phase Estimate (based on preferred tender price). AT does not do these estimates.	+15%	+15-20%

Figure 8-3: Auckland Transport guidelines

According to the above classification and the level of investigations and studies already performed, AR PBC could be categorised as an Indicative Business Case. Therefore, the applicable cumulative percentage of contingencies ranges between 30% and 150% or 30% to 60% for Contingencies and 10% to 50% for Funding Risks Contingency.

Due to significant cost impact to the total CAPEX cost, WSP's methodology proposed to evaluate the Contingencies and Funding Risk Contingency not only at programme level, but also to enter into the next level of granularity and provide assessments for each asset.

8.4.2 PMI interpretation



Contingency reserve

- PMI documents provide the following explanation: "*Time or money allocated in the schedule or cost baseline for known risks with active response strategies.*"
- Addresses known risks, but with an unknown amount of rework.

Management Reserve

- Unlike contingency reserve, which is for known-unknown risks (or simply known risks), the management reserve is for unknown-unknown risks (or simply unknown risks). PMI documents management reserve as follows: "An amount of the project budget or project schedule held outside of the performance measurement baseline (PMB) for management control purposes, that is reserved for unforeseen work that is within scope of the project."

For AR PBC, the management reserve as defined by the PMI could be assimilated with "Funding Risk Contingency".

8.4.3 Contingency

To increase the level of accuracy, the methodology differentiates between two contingency sub-categories:

- Design contingencies, with a range between 10% and 30%, which quantifies the level of design development and reliability of the cost data.
- Risks contingencies for "known risks with an unknown impact", between 5% and 30%, which estimates the potential influence of unpredictable events.

8.4.3.1 Design Contingencies

For the assessment of Design Contingencies, 3 classes (relevant for the PBC) have been defined as per the recommendations of Association for the Advancement of Cost Engineering (AACE) Guidance, as follows:

Table 8-3: Design Contingency classification

Estimation class	Contingency	Design Contingency %
Class 5	It is performed at the "Conceptual Design" stage of the project. The project development is approximately 30 % complete.	30%

	The information generally required to develop construction estimate is the description of the process, capacity, and location. Capacity factored, parametric models, judgement or analogy methodologies are employed to estimate.	
Class 4	It is called as Feasibility Study Estimate. It studies the feasibility of the project and determine the viability of the project. It is employed for organization heads and construction managers for strategic business planning. It requires around 1 to 15 % of the project information. The process flow diagrams (PFDs), major construction activities and equipment lists also influence the project costs. Parametric models, factoring and proportioning are used on more specific item, to estimate.	20%
Class 3	It is called as the budgetary estimate used for budget authorization or control. It is the first control estimate that is performed at the beginning of the project planning stage. Class 3 estimate is developed from the preliminary or basic engineering design (BED). The maturity level of the project will be 10 to 40 % of the complete project. It is estimated using semi-detailed unit costs with assembly-level line items.	10%

Based on the above, each main AR PBC assets have been categorized, as follows:

Table 8-4: Design Contingency per asset class

Programme	AACE Class	Contingency %	Explanations
4-tracking Westfield – Pukekohe	Class 3	10%	Following the optioneering exercise, WSP further developed the conceptual inputs into an initial preliminary design, built

			the estimates on a detailed take-off. Includes 25% minor costs.
Additional capacity Wiri-Westfield	Class 5	30%	WSP's feasibility study level of design, no take-offs, but an increase level of confidence due to previous preliminary studies on the same alignment. Includes 25% minor costs, but the final solution is unknown.
Westfield Jcn Grade Separation	Class 4	20%	No design, but feasibility stage. Estimates built-up on take-off. Includes 25% minor costs.
Avondale-Southdown	Class 5	30%	Initial preliminary design and detailed take-off performed by Tonkin and Taylor with high chances of not being implemented. Includes 25% minor costs. Different design solution in progress, apparently more economic.
Signalling and network control	Class 5	30%	Little conceptual designs and cost estimates used parametric models, expert judgement, and analogy with similar projects in New Zealand.
Traction power	Class 5	30%	Little conceptual design exists. Cost estimates used parametric models, expert judgement, and analogy with similar projects in New Zealand.
OLE switching improvements	Class 5	30%	Little conceptual design exists. Cost estimates used parametric models, expert judgement, and analogy with similar projects in New Zealand.
EMU fleet	Class 4	12,5% Average (5% and 20%)	Fleet estimate is an average of the two main components: design and costs of the rolling stock (which, with minor changes, is a replication of the existing one) – Class 2 (5% accuracy) and the required number of vehicles according to the requirements deriving from different operational scenario and simulations (which can be assimilated at a feasibility level) – Class 4.

EMU depots and stabling	Class 5	30%	Little conceptual design exists. Cost estimates used parametric models, expert judgement, and analogy with similar projects in New Zealand.
Level crossing removal	Class 4	20%	Initial preliminary design built the estimates on a detailed take-off. Includes 25% minor costs.
Station upgrades	Class 5	30%	Conceptual and generic approach only, and parametric estimates for the main group of required interventions. Includes 25% minor costs.
Platforms	Class 4	20%	Initial preliminary design built the estimates on a detailed take-off. Includes 35% minor costs.
Pedestrian Bridges, elevators, and buildings	Class 4	20%	Conceptual and generic approach only, and parametric estimates for the main group of required innervations. Includes 25% minor costs.
Maintenance plant and equipment	Class 4	10%	Based on existing maintenance regime, assignment of "on the shelf" equipment and machines.
Maintenance facilities	Class 5	30%	Little conceptual design exists. Cost estimates used parametric models, expert judgement, and analogy with similar projects in New Zealand.

8.4.3.2 Contingencies for "known risks with an unknown impact"

During dedicated sessions, WSP team together with the SMEs identified and classified the relevant known risks for each asset. The result of such assessment is provided below:

Table 8-5: Risk Contingency per asset class

Programme	Contingency %	Short explanations
4-tracking Westfield – Pukekohe	30%	The infrastructure has been assessed at a high level, primarily focused on mainline and platform configurations. Risk that track alignments and land impact footprints change.

Additional capacity Wiri-Westfield	30%	Same as above. Additionally, there is no alignment to base costing on.
Westfield Jcn Grade Separation	30%	Same as above.
Avondale-Southdown	30%	Same as above. Additionally, the T&T report which constitutes the basis of the estimation is currently subject of redesign with huge impact on the adopted solutions and related costs.
Signalling and network control	20%	Costing based on Wellington ETCS Level 2 upgrade market prices provides a reasonable level of confidence.
Traction power	20%	Costing based on Glen Eden, Western Power Feed budget and number of feeds from early simulation based on updated fleet.
OLE switching improvements	30%	Lump sum based on high-level assessment, without having developed a specific sectioning diagram aligned with maintenance sectioning demands.
EMU fleet	10%	Fleet costs based on market prices and the existing contract prices which transfers most risks to the supplier.
EMU depots and stabling	20%	Final site locations may need to be changed, necessitating special design due to ground conditions and existing infrastructure.
Level crossing removal	30%	Later road network modelling may necessitate a greater design complexity of road-over bridges.
Station upgrades	10%	TDM standard relatively well specified. Property risks for some station upgrades if not covered by adjacent LX or platform works.
Platforms	20%	Costing based on general approach; station specific analysis may lead to need for special arrangements/solutions. However, these are standard works, with a low level of unknown.
Pedestrian Bridges, elevators, and buildings	20%	Costing based on general approach; station specific analysis may lead to need for special arrangements/solutions. However, these

		are standard works, with a low level of unknown.
Maintenance plant and equipment	30%	Shorter future possible maintenance window may necessitate more machine heavy maintenance. Such situation is only partially covered by the planned amount of equipment.
Maintenance facilities	30%	No site-specific analysis done, may necessitate special design due to ground conditions and existing infrastructure.

8.4.3.3 Cumulated contingency

Final Contingency percentages represents the sum of design contingencies and "known risk" contingency:

Table 8-6: Cumulated Contingency per asset class

Programme	Design Contingency %	Risk Contingency %	Total contingency %
4-tracking Westfield – Pukekohe	10%	30%	40%
Additional capacity Wiri-Westfield	30%	30%	60%
Westfield Jcn Grade Separation	20%	30%	50%
Avondale-Southdown	30%	30%	60%
Signalling and network control	30%	20%	50%
Traction power	30%	20%	50%
OLE switching improvements	30%	30%	60%
EMU fleet	12,5%	10%	22,5%
EMU depots and stabling	30%	20%	50%
Level crossing removal	20%	30%	50%
Station upgrades	30%	10%	40%
Platforms	20%	20%	40%
Pedestrian Bridges, elevators, and buildings	20%	20%	40%
Maintenance plant and equipment	40%	10%	30%
Maintenance facilities	30%	30%	60%

8.4.4 Funding Risk Contingency

As explained in NZTA Cost Estimation Manual (SM014): "*For the PBE and IBE stage estimates, and often at the DBE stage, project definition is low, and consequently, the level of understanding of project threats and opportunities is also low. There is a risk when knowledge of the project is low, that both the General method and the Advanced method of risk management from Z/44 could significantly under-estimate the contingencies. This may necessitate a high-level assessment based on experience and the application of judgement rather than relying on the output from analysis of an incomplete risk register.*"

Due to significant cost impact in the total CAPEX cost, WSP's methodology proposed to evaluate the funding risk contingency not only at programme level, but to progress into the next level of granularity and provide assessments for each asset part of the programme.

Accordingly, qualitative assessment workshops were organized on this matter with the participation of relevant management representatives and SMEs, using the following criteria:

- Resources and market risks
- Planning, legal and regulatory risks
- Natural Hazards
- Management and political risks
- Others

Each criterion has been quantified by using expert judgment techniques. The assessment of possible consequences and the probability for them to happen is depicted by using a green-yellow-red colour scale and a quantitative scale from a 20% to 50%, as follows:

Table 8-7: Funding risk Contingency per asset class

Programme	Resources and market risks	Planning, legal, and regulatory risks	Natural Hazards	Management and political risks	Others	Total funding risks contingency %
4-tracking Westfield – Pukekohe						30%
Additional capacity Wiri-Westfield					No information on the adopted solution	40%
Westfield Jcn Grade Separation		sensitive mana whenua	flood			30%
Avondale-Southdown					No information on the adopted solution	50%
Signalling and network control					Historical evidence shows that globally many rail projects had issues	40%

					with signalling systems	
Traction power and OLE switching improvements						30%
EMU fleet					Foreigner exchange rate	30%
EMU depots and stabling					Property acquisition risks	30%
Level crossing removal						50%
Station upgrades						30%
Maintenance plant and equipment		Future track alignment may require more machine			Foreigner exchange rate	30%
Heavy Maintenance Depot and stabling		Future track alignment may require more heavy maintenance				30%

9 Applied Rates and Allocations

Unit rates, functional unit rates and all-inclusive rates have been used, and they all contain all permanent works, temporary and enabling works, direct and indirect overheads, and profit, excepting only Environmental Statutory Compliance (ESC), Temporary Traffic Management (TTM) and Preliminary and General (P%G), as explained above.

Source of these is the WSP's internal cost database built-up on and supported by the knowledge from previous similar projects.

A comprehensive list of Allin Rates, Functional rates and Allowances are provided in "Rates and allocation" sheet in the cost model. Additional comments and detailed are provided for a better understand of each unit.

10 Rail Corridor Widening

10.1 Scope summary

The following sections are subject of rail corridor widening under the PBC:

- Wiri to Westfield, 4th track.
- Wiri-Papakura, 3rd, and 4th tracks.
- Papakura to Pukekohe, 3rd, and 4th tracks
- Provisions for additional infrastructure to sustain the future grows between Wiri to Westfield

10.2 Methodology

10.2.1 Basis for measurement

Each part of the preferred corridor was assessed individually by considering its particularities and surrounding environment.

Two generic cross sections were considered:

- Allowance for four tracks with 7m between centre mains (25m)
- Allowance for four tracks with 7m between centre mains and two access tracks (37.5m)

For pricing purpose, an average of the two cross section was used, as it was considered unlikely to obtain two access tracks along the entire rail corridor.

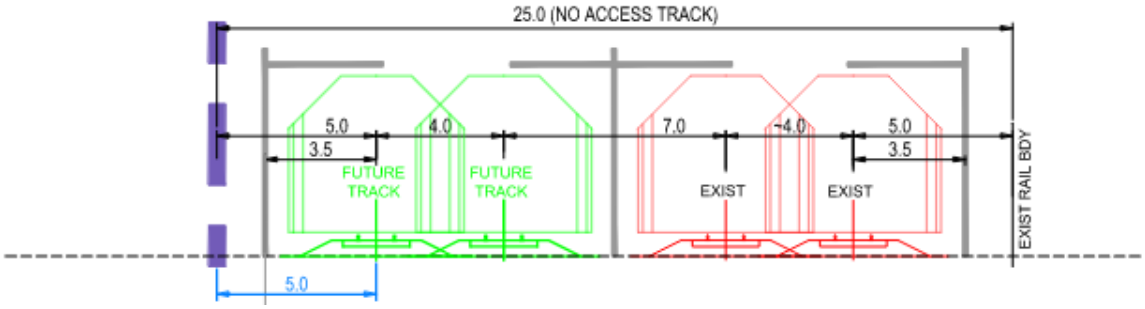


Figure 10-1: 'Purple' Cross-Section: Allowance for four tracks with 7m between centre mains

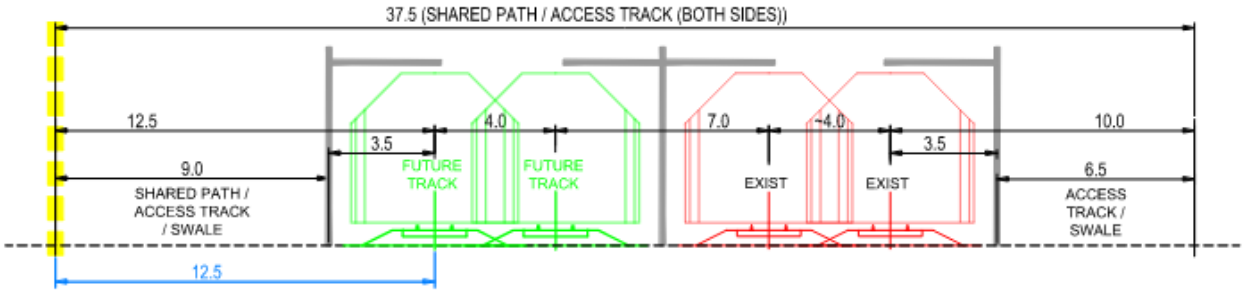


Figure 10-2: 'Yellow' Cross-Section: Allowance for four tracks with 7m between centre mains and two access tracks

An additional 5m was allowed to determine the actual bounds of the second option due to potential batter slopes (red dotted line in **Figure 10-3**). Google Earth was used to determine an average of 5m additional.

Figure 10-3: Track Boundary Extents on Plan View

Note: Marks-up and comments on the initial track alignment from Wiri to Papakura are provided as part of Appendix 2 – Cost assumptions and mark-ups for Track Alignment (including for property costs)

Using these inputs, the high-cost items were identified and priced ("Major Cost"), then a factor for Minor Costs was applied to this total to cater for costs associated with smaller elements which are not priced in detail.

The track memo also provides additional information on this subject.

Exception to the above approach:

The calculation for Papakura to Pukekohe section was based on the resulting unit price for Wiri-Papakura, 3rd, and 4th tracks section, with the following amendments which consider the rural nature of this segment:

- 80% less need for retaining and mass block walls.
- 70% reduction of ground improvement works.
- 90% reduction in the price estimation/ km for service relocation.

10.3 Costing Assumptions

10.3.1 Earthworks

Earthworks was priced based on the additional width required to accommodate the respective option. The factor for batter slopes for the cut/fill areas is a 2:1 slope.

In areas where retaining is proposed, the earthworks were reduced.

Clearing was priced on a m^2 basis on land required.

If existing infrastructure was impacted, removal and reinstatement was priced (e.g., bridges).

10.3.2 Ground Improvements

Ground improvements was priced on a m^2 basis.

Additional tracks were assumed to require some form of Ground Improvements and a nominal sum was allocated.

Replacement bridges were assumed to require ground improvements at their abutments.

Nominal allocation of contaminated land removal was priced due to asbestos brake pads used on trains in the past.

10.3.3 Drainage

Reinstatement of the drainage infrastructure will be required. This was priced based on a per m length.

10.3.4 Pavement and Surfacing

Pavement was priced only when we needed to realign a road and reconstruct a removed bridge with its tie-ins.

Access tracks in Option 2 included as part of this elemental breakdown.

10.3.5 Structures

Where existing bridges did not have enough span to cater for 4 tracks, completely new bridges were priced i.e., we did not widen an existing bridge.

A nominal sum was allocated for basic new train stations.

Pedestrian overbridges were also allocated on a case-by-case basis for where we require new stations.

10.3.6 Retaining Walls

Retaining walls were priced throughout the alignments. The locations of the retaining walls were determined on a case-by-case basis (e.g., in many instances, cost savings are achieved by constructing the retaining wall instead of property acquisition).

Retaining walls were priced as follows:

- If located in a “cut area”, bored pile or secant walls depending on height of cut.
- If located in a ”fill area”, mass block walls or UC walls, depending on height of fill.

10.3.7 Traffic Services

Assumed reinstatement of lighting across replacement bridges would be required.

10.3.8 Service Relocations

Service relocation was priced on a LS basis. The amount allocated was determined by the extent (length) of work required.

10.3.9 Landscaping & Entrances

Assumed that a new corridor protection fence would be required for the full length, where adding tracks.

Planting has been assumed for batter slopes.

10.4 Calculations

As part of the optioneering stage, different alignments were studied by applying the detailed methodology described above, including for Wiri to Westfield, 3rd track and Wiri-Papakura, 3rd, and 4th tracks.

To allow for possible future variations of the proposed alignment, unit rates per kilometre were calculated for each type of work. Such unit rates are used to quantify the preferred alignment.

As a variation of the below, for Papakura to Pukekohe, 3rd, and 4th tracks, the unit rates for Wiri-Papakura 2T are used. However, some adjustments have been done due to the particularities, rural and greenfield nature of the alignment, including reduced need for retaining and ground improvement solutions. Such adjustments are incorporated in the cost model at the end of the relevant chapter.

Only for calculation purpose, the estimations for the Additional infrastructure (Wiri to Westfield) are built of the assumption that a 6 Tracking solution will be adopted. For the removal of doubts, the final solution is subject of additional investigations and future decisions. Such estimation is considering the difference between two set of detailed calculations performed at optioneering stage: Wiri to Westfield, 3rd track and Wiri to Westfield 3rd, 4th and 5th track. Difference between adding three additional tracks and adding a single track is considered the relevant for covering the increase for 4 Tracking to 6 tracking.

Dedicated calculations for each part of the alignment could be found in the costs model (see Wiri to Westfield – 3T, Tracks Wiri-Papakura 4T and Wiri to Westfield – 6T sheets).

10.5 Westfield to Penrose

Siding freight track between a Westfield to Penrose has been calculated using average unit rates for Railway tracks, turnouts, electrification, and signalisation.

10.6 Additional third tracking

Due to operational requirements, additional third tracking is required at Mt Albert Station, Glen Innes Station, and Remuera Station. The estimates for these items of infrastructure are also based average unit rates for Railway tracks, turnouts, electrification, and signalisation.

10.7 Evidence and Benchmarking

Wiri to Quay Park physical completion costs were compared and reconciled to the unit rates used for the current estimate. This exercise made sure that the latest cost inputs from a similar project are considered.

11 New Rail corridor

11.1 Avondale to Southdown

A new rail corridor has been identified for the initial preferred programme between Avondale and Southdown.

The PBC has not completed any additional work on the alignment or costs for the new Avondale Southdown corridor. Costs have been taken from the Southdown to Avondale Rail Link report (T&T, June 2020) with minor adjustments to accommodate the Waka Kotahi cost manual SM014 requirements regarding:

- Separate organization of the consultancy and client managed costs.
- Individualisation of the P&FG costs, contingency and fundings risks allowing for consistency with all other PBC costs.
- 21% indexation since the T&T report is dated June 2020.

Advanced works provisions have been considered to allow for the performance of preliminary works in parallel with the light rails developments which are planned in the immediate vicinity of the rail corridor.

Detailed calculations are available in Avondale – Southdown sheet of the cost model.

11.2 Advanced Works package for Avondale to Southdown

As per PBC's phasing, the Avondale to Southdown corridor shall be developed after 2034, however, part of the corridor will be shared with a light railway project which has a much earlier starting date.

In order not to preclude the heavy rail project, to increase the efficiency, minimise the reworks and reduce interfaces between the two projects, the following activities are planned to take place in parallel with the light railway project:

- Necessary investigation, studies, design, and consenting costs ensuring a proper integration and optimisation of interfaces with the light railway project and with the remaining part of the Avondale to Southdown heavy rail corridor, communication with all the involved stakeholders and communities and minimising the disturbances to the public and neighbourhood.
- Construction of all the below track works (including excavation, bridges and all other items of infrastructure, drainage and service relocations) in a way that allows the completion of the heavy rail investment in a tight corridor, at a later date without impacting in any way the light railway project.

Cost assessments of the above-mentioned elements are based on a bottom-up estimation using an initial conceptual design with a reduced level of details and engineering solutions and a very high degree of uncertainty.

11.3 Avondale to Southdown stations

The costs of the 5 greenfield stations provisioned for Avondale to Southdown corridor are based on the inputs received for Drury stations (see Drury Stations input sheet in the cost model) which are currently under construction. It has been assumed that at two stations will

be common with light railway stations, therefore the costs for them will be split between the two projects.

12 Signalling, telecommunication, and network control upgrades

12.1 Scope summary

As presented in detail in the Signalling and Network Control strategy, the following signalling improvements are required at network level:

- Signalling - ETCS Level 2 Initial overlay
    - Radio Core (Dual Redundant System)
    - Spectrum potential cost (Crown may grant spectrum or require it to be purchased)
    - Radio Coverage (Auckland Electrified Area)
    - Train Radio Fit (95 Auckland CAF EMUs)
    - Train Radio Fit (125 DL Locomotives)
    - Radio Block Centre (RBC) (Dual Redundant System) and data changes
    - Temporary Speed Restriction (TSR) Manager/Server
    - Training
    - Simulator Updates
- Signalling - GOA2 Driver assist enhancement
    - Additional stopping accuracy balises
    - Temporary TSR management balises (for trial and safety case)
    - Training
    - Simulator updates
    - Modification of cab dash (e.g., additional buttons etc) (95 Auckland CAF EMUs)
    - Dynamic journey profile interfacing with TMS
- Traffic Management System Upgrade
- Signal optimisation territory
- Temporary signalling arrangements in coordination with the contraction works to take place prior to the implementation of ETCS Level 2

The following main assumptions have been used:

- Digital Radio Systems overlapping coverage system.
- Addition of digital radio hardware to all ETCS fitted trains.
- RBCs (x2 for redundancy) and interface work to existing signalling interlocking.
- Implementation of Temporary Speed Restriction management system. (Note that the Crown may grant spectrum or require it to be purchased).
- Replacement of voice communications platform with digital radio solution for metro trains and voice interface for backward compatibility with freight locomotives.
- Operational deployment of GOA2 Driver assist enhancement. Only operational deployment costs included. No direct door control or other upgrades included (e.g., CCTV) are included.
- Upgrade of the existing KiwiRail Train Control System (Rail9000) to a new or upgraded KiwiRail Traffic Management System (TMS).

In addition to the above-mentioned components of the signalling system at network level, each track corridor requires local signalling upgrades. Such upgrades of the signalling are incorporated into the cost model as follows:

- Progressive removal of signals would only be carried out section-by-section, as signalling infrastructure needs to be modified for other reasons. For example, when an additional track section is added, the signalling costs are included in the cost estimation for that track section.
- For the network parts with no change in the track configuration or other significant interventions, costs for optimising the local signalling are separately provided, independently, as a physical works lump sum value for each segment, as follows:

    - Signal optimisation territory for inner southern
    - Signal optimisation territory for Inner western and eastern
    - Signal optimisation territory for outer southern
    - Signal optimisation territory for outer western and Avondale to Southdown.

Further explanations and details are provided in the Signalling, Telecommunication and Network control strategy.

12.2 Methodology

Cost estimates used parametric models, expert judgement, and analogy with similar projects in New Zealand and Australia.

12.3 Evidence and Benchmarking

Resulting figures are confirmed by and aligned with the results of the Wellington Programme Business Case, very similar in term in scope and constraints.

13 Traction power and overhead line equipment

13.1 Scope summary

Traction power and overhead line equipment require upgrades in the light of an increasing number of electric (passenger or freight) train and rail infrastructures to be operated, allowing simultaneously for an improved flexibility during operation and maintenance.

The following cost items are included:

- P2P South upgrade to 2SFCs ("Sth1 – 2032")
- Replace WSF Tx with 2SFC ("Mid1b -2035")
- 1 SFC Mid/South Zone ("Mid2- 2037")
- OLE switching improvements, including allowances for additional switches, motorizing the existing switches, earthing and visual information.

Further details are provided in Traction Power and OLE strategy report.

13.2 Methodology

Cost estimates consider initial and preliminary studies, modelling and simulations performed by KiwiRail at network level.

Future requirements are estimated by using parametric models, expert judgement, and analogy.

13.3 Evidence and Benchmarking

Resulting estimates are benchmarked with similar projects in New Zealand.

14 Level crossings removal

14.1 Scope summary

Increasing train frequencies, to satisfy forecast demand and road traffic growth, place further pressure on the existing level crossings, increasing the safety risk to both, road, and rail users.

To eliminate this risk, all at-grade crossings on the Auckland network shall be removed, either via grade separation or closure.

The following tables (Table 14-1 and Table 14-2) identifies the assumed level crossing removal technical solutions. It should be noted that these treatments are indicative only – the final treatment of crossings, as well as their prioritisation and timing, will be determined at subsequent phases of investigation and design. Also note that for cost purpose, where two or more options were feasible, the most expensive one was considered.

Table 14-1: Level crossing removal treatment

Main level crossings groups	Level crossing	Technical solution for removal
Level Crossings - Group 2 Southern Crossings	Manuroa Road Level Crossing	Road over Rail
	Spartan Level Crossing	To be closed
	Taka Level Crossing	To be closed
	Takanini Station - Pedestrian Level Crossings	To be closed
	Walters Level Crossing	Road over Rail
Level Crossings - Group 3a (Eastern & Inner West)	Asquith Level Crossing	To be closed
	Avondale Station (Crayford St) Pedestrian Level Crossings	To be closed
	Baldwin Avenue, Mt Albert Pedestrian Level Crossings	Bridge over rail
	George Level Crossing	To be closed
	Morningside Level Crossing	Road under Rail
	Rossgrove Level Crossing	To be closed
Level Crossings - Group 3b Inner West (Mt Albert)	Chalmers Level Crossing	To be closed
	Fruitvale Level Crossing	To be closed
	Glen Innes Station North and South - Pedestrian Level Crossings	To be closed
	Portage Level Crossing	Road over Rail
	St Georges Level Crossing	To be closed
	St Judes Level Crossing	Road over Rail
	Woodward Level Crossing	Road over Rail
Level Crossings - Group 4 (Outer West –	Christian Level Crossing	To be closed
	Glenview Level Crossing	Road over Rail
	Metcalfe Level Crossing	Road over Rail
	Bruce McClaren Level Crossing	To be closed

New Lynn to Swanson)	Mt Lebanon Level Crossing	To be closed
	Sherrybrooke Level Crossing	To be closed
	Sturges Rd Station, Ranui, Pedestrian Level Crossings	To be closed
Level Crossings - Group 5 Outer Southern Crossings (P2P)	Boundary Level Crossing	To be closed
	Crown Level Crossing	Road over Rail
	Opaheke Level Crossing	Road over Rail
	Ranui Station - Pedestrian Level Crossing	Bridge over rail
	Sutton Level Crossing	Road over Rail
	Te Mahia Station Pedestrian Level Crossing	Bridge over rail
	Tuhimata Road, Paerata Pedestrian Level Crossing	Bridge over rail

The Level Crossing strategy contains the methodology on whether individual level crossings should be grade separated or closed. Accordingly, the following summary is provided:

Table 14-2: Level crossing removal treatment summary

Main level crossings groups	Road Level Crossing			Pedestrian Level Crossings		
	Total	To be grade separated	To be closed	Total	To be grade separated	To be closed
Level Crossings - Group 2 Southern Crossings	4	2	2	1	0	1
Level Crossings - Group 3a (Eastern & Inner West)	4	1	3	2	1	1
Level Crossings - Group 3b Inner West (Mt Albert)	7	3	4	1	0	1
Level Crossings - Group 4 (Outer West – New Lynn to Swanson)	6	2	4	1	0	1
Level Crossings - Group 5 Outer Southern Crossings (P2P)	4	3	1	3	3	0
TOTAL	24	11	13	8	4	4

14.2 Methodology

Cost estimations are performed considering detailed analyses by a variety of experts for each individual level crossing, identification of the most appropriate construction methodologies and building-up the list of Major Cost items. No formal design was done.

The Level Crossing strategy contains the methodology on whether individual level crossings should be grade separated or closed.

The cost for the OBL crossings has not been included, as the level of service is not planned to increase on these crossings (and hence the risk profile).

14.3 Costing Assumptions

14.3.1 Grade separations

Depending on the existing configuration and the nature of surrounding environment, a maximum of 2 options for grade separating each road level crossing were considered, as follows:

1 Road Over Rail; This was considered on along existing road alignment, with railway retained at its current level.
2 Rail under Road; This was considered on along existing rail alignment, with road retained at its current level.

All grade separations were assumed to be online with the single exception of Sherbrooke Place. There is an opportunity to explore offline solutions for potential cost efficiencies and to minimise the impact on customers during construction.

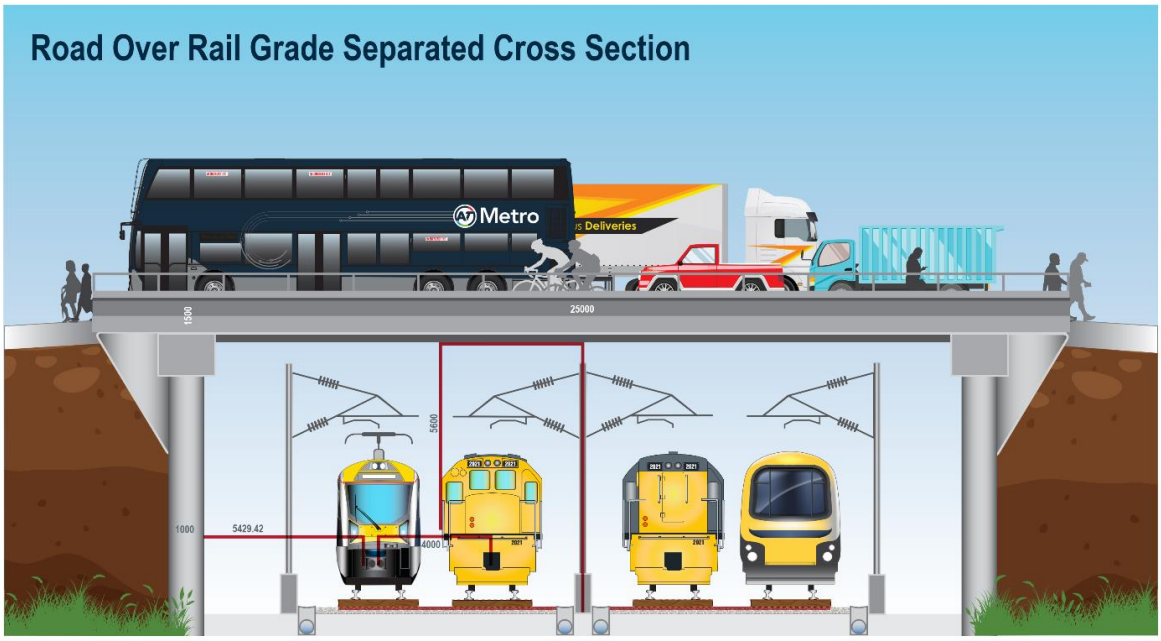


Figure 14-1: Road over Rail typical cross section

High-level assumptions that led into the costing estimates included rail corridor clearance parameters (horizonal and vertical), assumed structural superstructure depth, ramp grades and associated approach retention and earthworks and affected property costs.

The constraints applied to all assumptions are:

- Maximum 1:13 slope ratio for the road ramps (Road Over) due to pedestrian requirements results in a minimum Ramp length of 104m to achieve 8m clearance for Road Over options.
- Maximum 2% grade for the railway line changes (Rail under), resulting a minimum of 400m of track is required on either side of the road for 8m clearance.
- A span allowing to cross a 4-track railway has been considered for all level crossings (provision for future proofing).

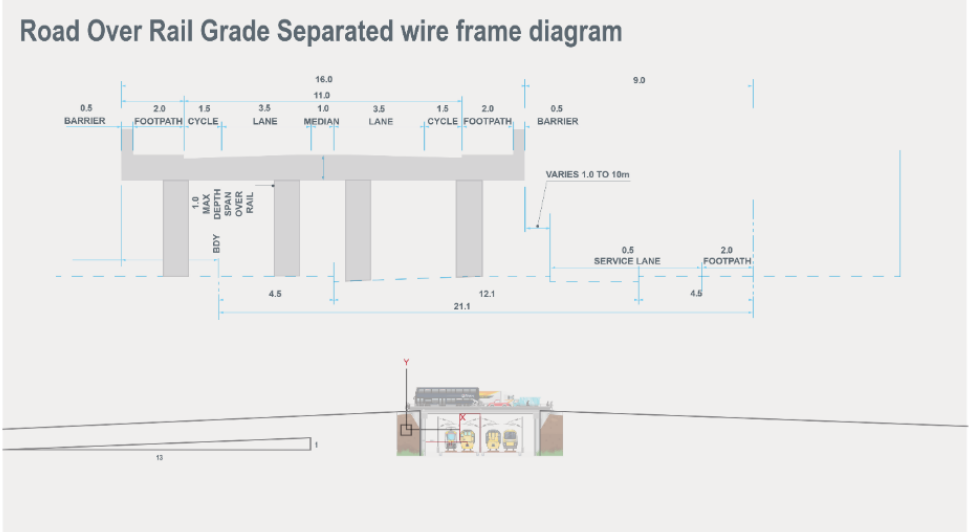


Figure 14-2: Typical bridge cross section

Pedestrian level crossings to be grade separations are substituted with a pedestrian bridge, 2,5 m width.

14.3.1 Closures

For the existing road level crossing proposed for closure, the following cost elements have been included:

- An average of 200m2 enlargement of an existing bridge located in the immediate vicinity of the level crossing to be closed. Such allowance provides some ability to undertake some additional traffic volumes which could be generated by the level crossing closure.
- Provisions for decontamination of the affected areas and landscaping arrangements.

For pedestrian level crossings proposed for closure only decontamination and light landscaping works are provisioned.

14.4 Assumptions

14.4.1 Earthworks

The earthworks for Road Over Rail was mainly comprised of the fill required for the bridge ramps. To minimise property impacts, we proposed a tied wall construction for the bridge ramps, with concrete facing.

The earthworks for Rail under Road were assumed mainly comprised of the cut required to drop the rail line.

14.4.2 Ground Improvements

Ground improvements were assumed to be required at the bridge abutments and based off the bridge deck area.

14.4.3 Drainage

All road drainage was assumed to be kerb and channel. A flat unit rate per metre of kerb was used, where the rate factored in costs associated with catchpits, catchpit leads, manholes and lateral piping.

It is assumed we can connect into the existing lateral piping and connection network, and no betterment or upgrading of existing is required.

Assumed side lateral drainage along new rail section for Rail Under.

14.4.4 Pavement

For Road Over Rail, pavement was based on a typical high AADT pavement that did not require SAC as a base layer.

14.4.5 Structures

Assumed Single Span Super Tee bridges will be sufficient to span the required lengths of the rail corridor.

For the road bridge over the rail line assumed Single Span Super Tee bridges will be sufficient to span the required lengths of the rail corridor.

All road bridges have footpaths.

14.4.6 Retaining Walls

For Road over Rail, retained ramps were priced to reduce property impact / cost. All bridges have an MSE wall at the bridge abutment.

For Rail Under Rail, diaphragm walls are assumed.

14.4.7 Traffic Services

Nominal sum (based on affected length)) allocated per crossing.

Any existing signalised intersection remined signalised. If that intersection was modified e.g., vertical height changed, all new signalised infrastructure was priced as a lump sum.

14.4.8 Service Relocations

Service relocation was priced on a LS basis. The amount allocated was determined by the extent (length) of work required.

14.4.9 Landscaping & Entrances

Landscaping costs were based on degree of affected existing area and included allocation of costs for remedial works as required.

14.4.10 Rail Components

For Road over Rail, it was assumed all bridge abutments sat outside the existing rail designation. Extended bridge construction durations were used due to block of line construction requirements.

All rail components were priced under this elemental breakdown. This included general industry rates for tracks, OLE, signalisation allocation etc.

14.5 Evidence and Benchmarking

The number of similar interventions in New Zealand is very limited and cannot provide sufficient basis of evidence and/or benchmarking.

Therefore, our attention moved to Melbourne LXRA programme that includes the removal of 110 level crossing and has a cumulated budget of 27,7 billion AUD, including here some interventions in stations. Results about 252 mil AUD/ level crossing removal, including

stations. Considering an average of one station per each level crossing and rate of 100 mil AUD / station, the average cost for a level crossing removal is: 152 mil AUD or 165 mil$.

The AR PBC includes grade separation of 11 Level crossings with a total P50 costs of 2 billion $ or an average cost per level crossing removal of 182 mil $, about 10% higher than the average cost for Melbourne LXRA programme. Such difference could be explained by a better productivity level in Melbourne directly proportional with the number of removals.

15 Westfield and Avondale Junctions grade separations

15.1 Westfield Junction grade separation

The methodology and costing assumptions explained above in chapter 14 are adopted for estimating the investment costs for Westfield Junction grade separation.

Two options were explored, as follows:

Option 1: Construction of an **embankment** to bring the NAL mainline tracks over connecting tracks to Westfield/Southdown yards and future Avondale-Southdown mainlines.

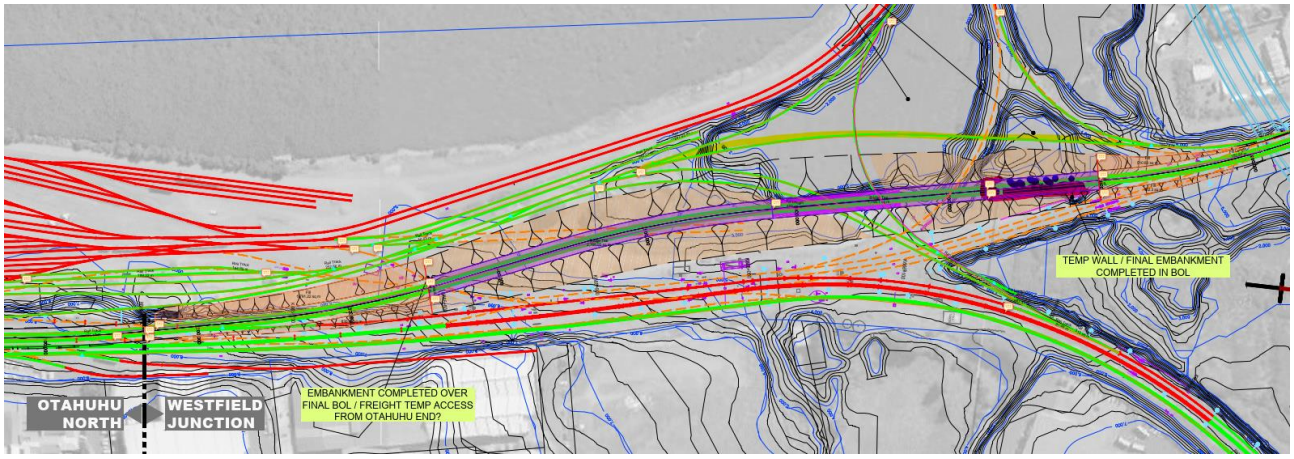


Figure 15-1: Westfield Junction – embankment option

Note that the exact track layout concept has evolved slightly from this initial design, but these changes are expected to have negligible implication to overall costs.

Option 2: An alternative solution to allow for the same track but replaces the embankment with a **bridge structure** as schematically illustrated below.

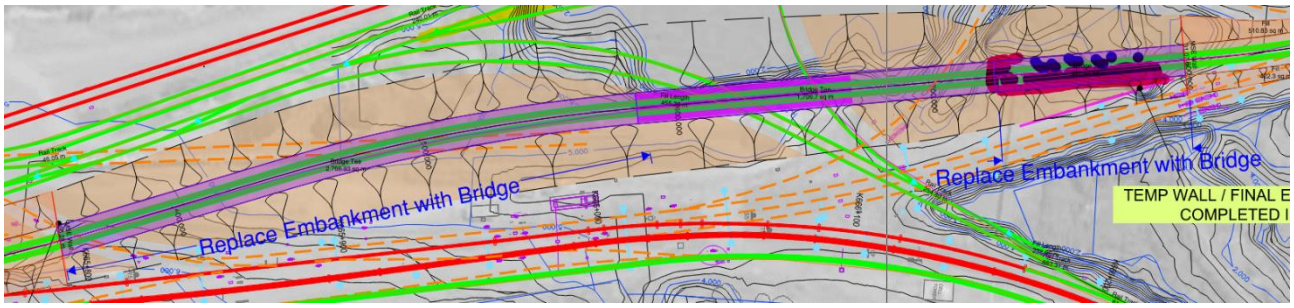


Figure 15-2: Westfield Junction – bridge option

First option above provides for much higher costs deriving primarily from a greater degree of "ground improvement" required by the embankment option, particularly given this area exposed to flood risks. The difference in ground improvement alone is 492 mil vs 72 mil in physical costs (embankment vs. bridge).

Following consultation with all stakeholders, it has been decided to adopt the second option – bridge solution which allows for significant cost reductions and provide at least the same functionality and flexibility to future changes (probably better ability to adapt to possible changes where modular elements are used).

15.2 Avondale Junction grade separation

The costs for Westfield junction grade separation have been used as a proxy to estimate the cost of a grade separated junction at Avondale for the Avondale – Southdown project.

The main assumption is that the interventions for Avondale Junction grade separation will not exceed 50% of the interventions provisioned for Westfield Junction grade separation.

16 EMU Fleet estimated costs

16.1 Number of EMU-cars needed

The numbers of rolling stock needed are summarised in Table 16-1 below:

Table 16-1: *No. of 3-car units needed to meet service demand for different Configuration States*

	Fleet plan (3-car trains)											
Year	Configuration State	Description	Total Revenue trains	Spares	Spare %	Added fleet	Total new fleet	Existing Fleet	Total # trains in tranche	Delivery period	Delivery N°	Tranche N°
2024	Pre-CRL		90	5	6%			72				
2025	CS0	CS0 (CRL Day 1 Reduced)	90	5	6%	0[1]	23	95				
2028	CS0-1	CS0-1 (CRL Day 1 Full)	90	5	6%	0		95				
2031	4T	4T Pukekohe-Wiri (loss of stabling)	90	5	6%	0		95				
2032	CS0-2	CS0-2 (Full 6-car Operation and Signal Enhancements)	110	12	11%	27	27	95	63	2032	1	1
2037	CS0-3	CS0-3 (9-car Southern express and re-routing)	114	11	10%	3	30	95		2037	2	
2040	CS0-4	CS0-4 (Glen Innes to Mt Albert peak overlay)	124	13	10%	12	42	95		2037	3	
2042	CS1	CS1 (14tph to Pukekohe)	144	14	10%	21	63	95		2042	4	
2051	CS3	Avondale-Southdown services	151	16	11%	9	72	95	109	2051	5	2
2052	Outside of the PBC's scope	Replace CAF batch 1, modify Wiri depot	151	16	11%	57	129	38		2052		
2057		Replace CAF batch 2	151	16	11%	15	144	23		2057		
2060		Replace CAF batch 3	151	16	11%	28	172			2060		

According to above table, two different procurements are suggested (tranche 1 and 2) with five deliveries in 2032, 2037, 2042 and 2051 for a total of 72 additional EMUs.

It should be also noted that replacing current CAF fleet is outside the ARPBC period.

[1] It is recommended to extend the current delivery batch 3 from CAF with the last option for 5 EMUs. In this table, these 5 EMUs are shown as part of the first batch.

16.2 EMU Fleet physical works assumptions

The base estimate of 12,43 mil $ (compose of 11,20 mil $ physical costs plus additional costs with investigation, pre-implementation and implementation costs with consultancy fees and client managed costs) for a 72m 3-car unit has been derived based on market research[2] of EMU procurements, mainly in Europe (and benchmarked with estimates in the ARDP and with the recent price for batch three of the CAF-units).

This has provided the following relationship with the size of the order (price level 2020):

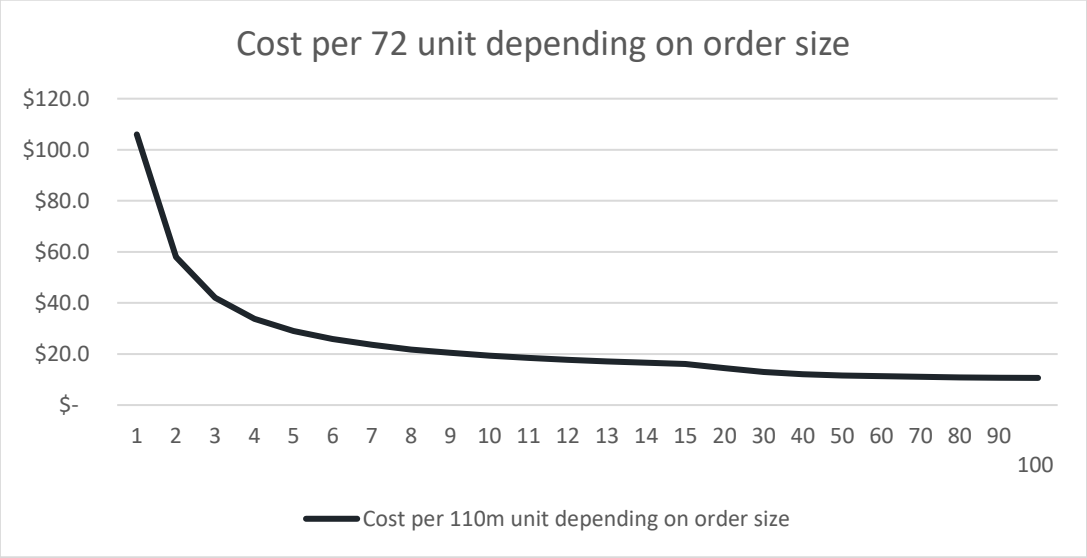


Figure 16-1 - Typical cost of a 72m long EMU as a function of the order size[3]

The first tranche of the ARPBC is 63 units, the second is for 109 units, which according to this market price-based function would provide a unit price of 11 mil$ in 2020 price levels or around 12,40 mil $ in 2023 price level.

The ARDP assumed a cost per unit (equivalent to an existing 72m CAF 3-car EMU) of 10 mil $ in 2015 (based on the order that CAF received in 2011), which escalated to 2023 corresponds to 12,46 mil $ per 3-car.

[2] Provided at the end of Appendix 4

[3] Based on market research of EMU procurements mainly in Europe

17 EMU Depot and Stabling estimated costs

17.1 Scope summary

Table 16-2 summarises the need for new workshop facilities (maintenance roads) and stabling roads. Assuming that the existing Wiri depot will be at maximum capacity with the 95x3car EMUs at CRL Day One, for the PBC it is assumed that another workshop of similar size, functionality (i.e. a full-function facility) and capacity, will be needed to serve the new EMU fleet.

***Table 16-2** : Fleet and Depot Plan (based on 3-car units)*

Fleet & Depot plan 3-car trains			Stabling Capacity (3-car trains)								Southern Line Revenue Trains	Southern stabling				East-West Line Revenue Trains	East-West Stabling				OBL Service (Henderson)	Spare Trains		A-S Revenue Trains	Fleet plan (3-car trains)													
Year	Configuration State	Description	Papa & Puke	Paerata triangle	Wiri	Total Southern	Henderson	Strand	Tamaki	Total East-West & OBL	Total		Papa & Puke	Paerata triangle	Wiri	Spare trains (Wiri)		Henderson	Strand	Tamaki	Wiri		Wiri (until Tamaki)	Tamaki		Total Revenue trains (3-car)	Spares	Spare %	Fleet required = stabling need	Stabling buffer	E-W buffer	South buffer	Added fleet	Total new fleet	Existing Fleet	Total # trains in tranche	Delivery period	Tranche
2024	*Pre-CRL*		*21*		*50*	**71**	*18*	*8*	*0*	**26**	**97**	*44*	*21*	*0*	*23*	*3*	*42*	*14*	*8*	*0*	*20*	4	*2*	*0*	*0*	*90*	*5*	*6%*	*72*	*2*	*-22*	*24*			72			
2025	CS0	CS0 (CRL Day 1 Reduced)	21		50	**71**	18	8		**26**	**97**	44	21		23	3	42	14	8		20	4	2			90	5	6%	95	2	-22	24		*23*	95			
2028	CS0-1	CS0-1 (CRL Day 1 Full)	21		50	**71**	18	8		**26**	**97**	44	21		23	3	39	11	8		20	7	2			90	5	6%	95	2	-22	24	0		95			
2031	4T	4T Pukekohe-Wiri (loss of stabling)	8	18	48	**74**	18	8		**26**	**100**	44	8	18	18	3	39	11	8		20	7	2			90	5	6%	95	5	-22	27	0		95			
2032	CS0-2	CS0-2 (Full 6-car Operation and Signal	8	18	48	**74**	45	0	21	**66**	**140**	52		18	34	5	48	34	0	14		10		7		110	12	11%	122	18	1	17	27	27	95		2032	
2037	CS0-3	CS0-3 (9-car Southern express and re-routing)	8	18	48	**74**	45	0	21	**66**	**140**	56	8	18	30	4	48	35	0	13		10		7		114	11	10%	125	15	1	14	3	30	95	63	2037	1
2040	CS0-4	CS0-4 (Glen Innes to Mt Albert peak overlay)	8	18	48	**74**	57	0	21	**78**	**152**	56		18	38	4	58	47	0	11		10		9		124	13	10%	137	15	1	14	12	42	95			
2042	CS1	CS1 (14tph to Pukekohe)	8	27	48	**83**	57	0	21	**78**	**161**	76	8	27	41	5	58	47	0	11		10		9		144	14	10%	158	3	1	2	21	63	95		2042	
2045	CS2	6-track	8	27	48	**83**	57	0	21	**78**	**161**	76	8	27	41	5	56	47	0	9		10		9		144	14	10%	158	3	3	2	0	63	95			
2051	CS3	Avondale-Southdown services	8	27	48	**83**	57	0	30	**87**	**170**	76	8	27	41	5	56	50	0	20		7		9	14	153	14	9%	167	3	1	2	9	72	95		2051	
2052	Replace Batch 1	Replace CAF batch 1, modify Wiri depot	8	27	48	**83**	57	0	30	**87**	**170**	76	8	27	41	5	56	50	0	20		7		9	14	153	14	9%	167	3	1	2	57	129	38	104	2052	2
2057	Replace Batch 2	Replace CAF batch 2	8	27	48	**83**	57	0	30	**87**	**170**	76	8	27	41	5	56	50	0	20		7		9	14	153	14	9%	167	3	1	2	15	144	23		2057	
2060	Replace E	Replace CAF batch 3	8	27	48	**83**	57	0	30	**87**	**170**															153	14	9%	167	3	87	83	23	167			2060	

17.2 EMU Depot and Stabling physical works assumptions

The costing has been based on the outline designs in *Figure 16-2*, *Figure 16-3* and *Figure 16-4* (N.B! These locations are only used for the purpose of costing, later business cases will determine final locations), using parametric costing based on track lengths, building size etc.

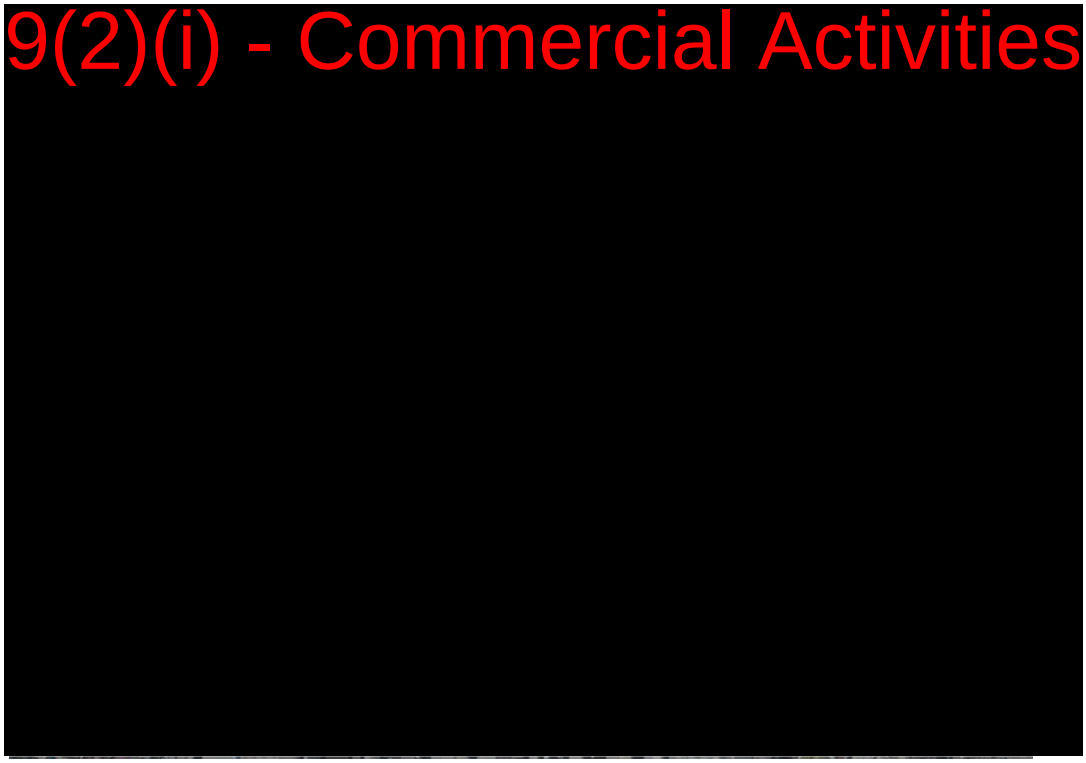


Figure 16-2 Outline design for the Main EMU Depot and Stabling at Henderson

Figure 16-3 Outline design for the EMU Stabling at Tamaki

Figure 16-4 Outline design for the EMU Stabling at Paerata

Main components build-up of the cost is summarised in "Depot and stabling" sheet, part of the cost model.

In addition, provisions have been added to allow for an independent feed for all EMU depot and stabling and the existing Wiri depot and stabling.

17.3 Benchmark costs

The ARDP assumed a cost of about 9(2)(i) - Commercial Activities for a Henderson light maintenance depot, including cleaning facilities, to serve a total fleet of about 22 full-length trains vs a total of about 30 in the ARPBC.

Taking into account that an additional wheel lathe and washing plant, and facilities for heavy maintenance will also likely be needed, **a range of 300-350 mil$ is assumed for the ARPBC maintenance depot,** property cost not included**.** 9(2)(i) - Commercial Activities This has been compared to international benchmarks and found reasonable.

Three new stabling yards, each capable of 10-15 full-length trains, are assumed (taking into consideration that some existing stabling roads will be lost after CRL Day One, e.g., construction of the 4th main track on the NIMT requires closure of the 14x3-car stabling, 10x3-car stabling is lost by not using stations and maintenance tracks for stabling, and some is lost when existing 6-car stabling cannot be used efficiently by full-length trains).

Using ARDP cost estimates escalated from 2015 to 2022, would indicate a price **range of 80-100 mil$ per such stabling yard**.

The costing has also been compared to international benchmarks and found reasonable.

18 Station Upgrades

Table 16-3 summarises what upgrades will be done to each station (except for the upgrade to current typology as per section 18.1 below). This is used for the costing of each upgrade as outlined in sections 18.2-18.4.

Table 16-3 Station upgrade summary and grouping

East-west peak overlay group (CS0-4)				Avondale-southdown (CS3)			
East-west Group							
Mt Albert to Glen Innes Peak Turnbacks and Group 3A Level Crossings	Type	9-Car	Platform	Avondale - Southdown and Group 3B and 4 Level Crossings	Type	9-Car	Platform
Mt Albert Station, 2040	2-3	Y	+1	Ranui Station, 2043	1-2	Y	
Baldwin Ave Station, 2032	1-2	Y		Fruitvale Rd Station, 2038	1-2	Y	
Morningside Station, 2029	1-2	Y		Te Papapa Station, 2051	1-2		
Glen Innes Station, 2040	1-3			Onehunga Station, 2051	1-2		
				Glen Eden Station, 2043	1-2	Y	
				Avondale Station, 2033	2-3	Y	

9-car express works (CS0-3)				4-tracking group (CS1)			
Southern Group							
Southern Line 9-car Express	Type	9-Car	Platform	Southern Corridor 4-Tracking	Type	9-Car	Platform
Strand Station, 2037				**Otahuhu Station, 2042**		**Y**	**+2**
Newmarket Station, 2037		Y		Middlemore Station, 2042		Y	+2
Remuera Station, 2037	**1-2**	**Y**	**+1**	**Papatoetoe Station, 2042**	**2-3**	**Y**	**+2**
Puhinui Station, 2037		**Y**		**Manurewa Station, 2042**	**2-3**		**+2**
Papakura Station, 2037		**Y**		**Te Mahia Station, 2042**	**1-2**		**+2**
Maketuu (Drury Central) Station, 2037	**2-3**	**Y**		**Puhinui Station, 2042**			**+2**
Ngaakooroa (Drury West) Station, 2037	**2-3**	**Y**		**Homai Station, 2042**	**2-3**		**+2**
Paeraataa Station, 2037	**2-3**	**Y**		**Takanini Station, 2042**	**2-3**		**+2**
Pukekohe Station, 2037	**2-3**	**Y**		**Papakura Station, 2042**			**+2**
Waitematā Station, 2037		**Y**		**Maketuu (Drury Central) Station, 2042**			**+2**
Te Wai Horotiu Station, 2037		**Y**		**Ngaakooroa (Drury West) Station, 2042**			**+2**
Karanga a hape Station, 2037		**Y**		**Paeraataa Station, 2042**			**+2**
				Pukekohe Station, 2042			**+2**

6-tracking group (CS2)
Capacity Extension Group

Capacity Extension Group	Type	9-Car	Platform
Swanson Station, 2045		Y	+1
Otahuhu Station, 2042			+2
Middlemore Station, 2042			+2
Papatoetoe Station, 2042			+2
Puhinui Station, 2045			+2

Further details and calculations are provided in Station Description sheet part of the Cost model.

18.1 Cost estimate to bring stations up to current TDM standard

The interventions required to bring the stations up to the current TDM standard are consolidated and grouped in the following 4 main categories:

- Safety/ Security/ Comfort Requirements
    - Well Lit
    - Station Closure and gating
    - Platform Seating
    - Platform Canopy
    - Emergency vehicle parking bay
    - Emergency Access
    - CPTED (Crime Prevention Through Environmental Design)
    - CCTV
- Operational Requirements
    - Storage
    - Staff Facilities
    - Platform length
    - Maintenance vehicle parking bay
    - Maintenance Access
- Services Requirements
    - ATM
    - Variable Signage
    - Station Sign, Map, Clock
    - Rubbish Bins
    - Public Toilets
    - Public facilities (infrastructure only)
    - Help Points (at the seats)
    - Help Points (at the lifts)
    - Drinking fountains
    - Digital public information
    - Customer Service Centre
- Connectivity Requirements
    - Station Access
    - Drop off/pick up/taxis
    - Cycle & Scooter Parking
    - Bus Parking Bays

The estimates to bring station up to their current TDM type requirements have been based on the gap analysis in *Table 16-4*.

For each cost element, where a station fully meets the requirement, no cost has been allocated:

- where the criterion is not met at all: 100% of the identified cost for that element has been allocated.
- where the requirement is partially met: 70% of the identified cost has been allocated.

Table 16-4 *TDM Type Gap Analysis*

			Well Lit	CCTV (within stn)	Station Access	Station A/H Closure	Platform Canopy	Platform Seating	Help Points (at the seats)	Help Points (at the lifts)	Variable Signage	Customer Service Centre	Staff Facilities	Storage	Maintenance Access	Emergency Access	Public Toilets	Public facilities (infrastructure only)	Rubbish Bins	Drinking fountains	Digital public information	Bus Parking Bays	Emergency vehicle P- bay	Maintenance vehicle P- bay	Drop off/pick up/taxis	Cycle & Scooter Parking	Station Sign, Map, Clock	ATM	Platform length	CPTED
Southern Line																														
1	Britomart	4																												
2	Parnell	2	Met	Met	Met	Met	(Met)	Met	Met	Met	Met	(Met)	(Met)	(Met)	Met	No	No	Met	No	No	No	No	No	No	(Met)	No	Met	No	Met	No
3	New Market	3	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met
4	Remuera	1	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	No	No	No	Met	Met	Met	(Met)	No	No	No	No	(Met)	Met	Met	Met	No
5	Greenlane	1	(Met)	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	No	No	No	Met	Met	Met	No	No	No	No	No	(Met)	Met	Met	Met	No
6	Ellerslie	2	Met	Met	Met	Met	Met	Met	Met	Met	Met	No	No	No	No	No	No	Met	Met	Met	Met	(Met)	(Met)	(Met)	Met	No	(Met)	Met	Met	Met
7	Penrose	1	Met	Met	Met	Met	Met	(Met)	(Met)	Met	Met	Met	Met	Met	Met	Met	No	Met	Met	Met	No	Met	No	No	No	(Met)	No	Met	Met	(Met)
8	Otahuhu	3	Met	Met	(Met)	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	(Met)	Met	Met	No
9	Middlemore	2	Met	Met	No	Met	Met	Met	No	Met	Met	Met	Met	Met	Met	Met	No	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met
10	Papatoetoe	2	Met	Met	Met	No	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	No	Met	Met	Met	Met	Met	Met	Met	Met	Met	No	Met	Met	Met
11	Puhinui	3	Met	(Met)	Met	Met	(Met)	Met	Met	Met	Met	No	No	No	No	No	No	No	Met	No	No	No	No	No	(Met)	No	No	Met	Met	Met
12	Manukau	3	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met
13	Homai	1	Met	Met	No	No	No	Met	No	Met	Met	Met	Met	Met	No	(Met)	No	No	(Met)	Met	No	No	No	No	No	No	Met	Met	Met	(Met)
14	Manuerwa	2	Met	Met	Met	(Met)	Met	Met	Met	Met	Met	Met	No	No	No	No	No	(Met)	Met	(Met)	Met	Met	No	No	No	Met	Met	(Met)	Met	Met
15	Te Mahia	1	No	No	No	No	No	No	Met	Met	No	Met	Met	Met	No	No	No	Met	No	No	No	No	No	No	No	Met	No	Met	No	No
16	Takaanini	1	Met	No	No	No	No	(Met)	Met	Met	(Met)	Met	Met	Met	(Met)	(Met)	No	Met	Met	Met	No	Met	(Met)	(Met)	(Met)	No	Met	Met	Met	No	Met
17	Papakura	3	(Met)	Met	Met	No	No	Met	No	No	Met	No	No	No	(Met)	(Met)	No	No	Met	No	No	Met	(Met)	(Met)	(Met)	No	Met	No	Met	(Met)	Met
Western Line																														

1	Swanson	2	Met	Met	Met	No	(Met)	Met	Met	Met	Met	Met	(Met)	Met	Met	Met	Met	Met	Met	No	No	(Met)	Met	Met	Met	No	Met	No	Met	(Met)
2	Ranui	1	Met	Met	(Met)	(Met)	(Met)	Met	Met	No	(Met)	Met	Met	Met	(Met)	(Met)	Met	Met	(Met)	Met	Met	No	(Met)	(Met)	Met	No	Met	Met	Met	(Met)
3	Sturges	1	Met	Met	(Met)	Met	(Met)	Met	Met	Met	(Met)	Met	Met	Met	No	No	Met	Met	(Met)	Met	No	No	No	No	No	No	Met	Met	Met	(Met)
4	Henderson	2	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	(Met)	Met	Met	Met	No	Met	Met	Met	Met
5	Sunnyvale	1	Met	Met	No	(Met)	Met	Met	Met	Met	(Met)	Met	Met	Met	(Met)	(Met)	No	Met	(Met)	Met	No	No	(Met)	(Met)	No	No	Met	Met	Met	(Met)
6	Glen Eden	1	Met	Met	(Met)	Met	Met	Met	Met	Met	(Met)	Met	Met	Met	Met	Met	(Met)	Met	(Met)	Met	No	No	(Met)	(Met)	(Met)	No	Met	Met	Met	Met
7	Fruitvale	1	Met	Met	No	No	(Met)	Met	Met	Met	(Met)	Met	Met	Met	(Met)	No	(Met)	Met	(Met)	Met	No	No	(Met)	(Met)	(Met)	No	Met	Met	Met	(Met)
8	New Lynn	3	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met
9	Avondale	1	Met	Met	No	No	Met	Met	Met	Met	(Met)	Met	Met	Met	(Met)	(Met)	No	Met	(Met)	Met	Met	No	(Met)	(Met)	No	No	Met	Met	Met	Met
10	Mt Albert	2	Met	Met	Met	Met	Met	Met	Met	Met	Met	(Met)	No	No	Met	Met	No	No	Met	Met	(Met)	(Met)	Met	Met	(Met)	No	Met	No	Met	(Met)
11	Baldwin	1	Met	(Met)	No	(Met)	(Met)	(Met)	Met	Met	Met	Met	Met	Met	(Met)	No	No	Met	Met	Met	(Met)	No	No	No	No	No	Met	Met	Met	(Met)
12	Morningside	1	Met	(Met)	(Met)	Met	(Met)	Met	Met	Met	Met	Met	Met	Met	Met	Met	No	Met	Met	Met	(Met)	(Met)	(Met)	(Met)	(Met)	No	(Met)	Met	Met	Met
13	Kingsland	2	(Met)	(Met)	Met	Met	(Met)	(Met)	Met	Met	Met	No	No	No	Met	Met	No	Met	Met	Met	No	Met	(Met)	Met	(Met)	No	Met	No	Met	Met
14	Maungawhau (Mt Eden)	1																												
15	Grafton	2	Met	Met	Met	Met	Met	Met	Met	Met	Met	No	No	No	Met	Met	No	Met	Met	Met	Met	Met	(Met)	(Met)	Met	(Met)	Met	No	Met	Met
Eastern Line																														
1	Strand	N/A																												
2	Orakei	1	Met	Met	Met	Met	(Met)	(Met)	Met	Met	Met	Met	Met	Met	Met	Met	No	Met	No	Met	No	No	Met	Met	Met	No	Met	No	Met	(Met)
3	Meadowbank	1	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	No	No	No	Met	Met	Met	No	(Met)	(Met)	(Met)	Met	No	Met	No	Met	(Met)
4	Glen Innes	1	Met	Met	No	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	No	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	(Met)
5	Panmure	3	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met
6	Sylvia Park	2	Met	Met	Met	Met	(Met)	Met	Met	Met	Met	(Met)	No	No	No	No	(Met)	Met	Met	No	No	(Met)	(Met)	(Met)	(Met)	No	Met	(Met)	Met	(Met)
OBL Line																														
1	Onehunga	1	Met	Met	Met	No	(Met)	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met	No	Met	Met	Met	Met	Met	Met	No	Met	Met
2	Te Papapa	1	(Met)	Met	No	No	(Met)	Met	Met	Met	Met	Met	Met	Met	Met	Met	No	Met	Met	Met	No	No	Met	Met	Met	No	Met	No	Met	No

18.2 Cost estimate to upgrade stations to future TDM standard based on forecasted patronage

Based on the typology change to meet future patronage some of the stations require updates as detailed in Stations Description sheet of the cost model. Standard interventions and costs

associate to an upgrade to a specific typology is summarised in Station Changing Typology sheet in the cost model.

18.3 Platform Extensions

Included elements:

- Two overbridges at each nine-car station as part of cost (required for fire)
- Elevators and ramps
- Platform fitout
- Waitematā Station
- Fitout of other CRL platform extension

Stations Description sheet of the cost model provides the information of which each station has been costed for platform extensions and considered quantities.

18.4 New Platforms

Included elements:

- Two overbridges at each nine-car station as part of cost (required for fire escape)
- Elevators and ramps
- Platform fitout
- New entrance/building

Stations Description sheet in the cost model provides the information of which each station has been costed for platform extensions and considered quantities.

18.5 Pedestrian bridges, elevators, and buildings

Pedestrian bridges, elevators, and buildings represents cost items resulting either from platform extensions (which generate the need of a second evacuation mean as required by fire brigade) or by adding new platforms (which require extension of an existing bridge, additional elevators, and provisions for rebuilding the station entrance).

Stations Description sheet in the cost model provides the information of which each station has been costed for platform extensions and considered quantities.

18.6 Excluded costs

Excluded elements:

1 Park & ride cost excluded. Only allowances for drop off/pickup/taxi, bus stops and bike parking in the immediate station vicinity has been included.
2 No provisions for platform screen doors.

19 Access and Maintenance estimated costs

CAPEX values for the plan, equipment, maintenance yards, satellite depot, sidings, inventory store and staff facilities constitute inputs provided by KiwiRail in May 2023.

19.1 Minor and Major Plant and Equipment

The complete list of minor and major plan and equipment is provided in Input Maintenance sheet of the cost model.

19.2 Maintenance Yard, Satellite Depots, Sidings, Inventory Store and Staff Facilities

The following maintenance facilities are included:

- Heavy Maintenance Facility depot
- Three Stabling Yards (one per decade, to enable stabling of the additional plant and equipment)
- Two maintenance sidings
- Inventory Store
- Staff Facilities
- Access tracks to optimise maintenance activities (in addition to the provisions considered IN Station chapter above)
- Additional manual switches and motorisation of an important part of the existing ones to improve isolation efficiency, facilitate maintenance access and increase the maintenance window duration.

20 Regional Services stabling

Stabling facilities provisions for regional services either at Strand station by rebuilding and reconfiguration the existing areas or as a new greenfield facility.

21 Studies and investigations at programme level

In addition to the studies, designs and investigations already included above, separate cost provisions are allocated for:

- Other network master planning activities and studies (likely to include Newmarket, Penrose & Quay Park junctions (including improvements for degraded mode operation, and wider master planning activities) and responding to externally led initiatives such those driven as ports policy), Onehunga connectivity, other sensitive level crossings and stations, interfaces with hospitals, commercial areas and other urban infrastructural items)
- Traction power studies, simulations, and analyses
- Climate changes and resilience studies

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