



Draft Report

# Auckland CBD Rail Link Study – Options Evaluation Report

Prepared for ONTRACK and ARTA

By APB&B

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## Executive Summary

The Auckland CBD Rail Link Study (the Study or the Project) aims to identify a preferred route for an underground rail link from Britomart to the western line (North Auckland Line - NAL) around the Mt Eden area. The study is jointly funded by ONTRACK (the New Zealand Railways Corporation) and the Auckland Regional Transport Authority (ARTA). AECOM, Parsons Brinckerhoff, Beca and Hassell (working together as APB&B) have been commissioned to undertake the Study on behalf of ONTRACK and ARTA.

The purpose of this report is to provide a summary of the evaluation process undertaken to identify a preferred route option including number and location of stations. The criteria used to evaluate the various options and station locations has been refined throughout the process and reflects the project's objectives, principles and engagement with key stakeholders.

The evaluation process included technical work by the APB&B team along with a series of internal and external workshops, the latter involving key stakeholders. A multi-criteria evaluation process evaluated the feasible alignments, general area and desirable number of stations along the route, optimal station locations within the general areas, and finally the alignments that best served the preferred station locations.

More than three stations on the rail link is not possible primarily due to the gradient constraints between Britomart Station and the NAL. Further, more than three stations is inconsistent with the catchment and patronage requirements along the proposed routes, and with international benchmarking. The evaluation process did consider both one and two station options for the rail link. However early analysis provided no compelling reason to 'drop' the number of stations from three.

Twelve station location options (5 in the Newton area, 3 in the Karangahape Road (K Road) ridge area, 1 under the Central Motorway Junction, and 3 in the Aotea area) have been developed for the Study. All of these have been assessed against the evaluation criteria. In total fourteen alignment options have been considered in the Study. Only eleven of these met the Study's mandatory criteria and were part of the evaluation process.

A weighting and sensitivity testing exercise was undertaken at key multi-criteria evaluation workshops to ensure that the evaluation process was robust. This included applying varying weight to both criteria and categories of criteria (i.e. station location criteria, operational impacts criteria, construction impacts criteria).

The result of the multi-criteria evaluation process was a ranking of station locations in each area and a shortlist of feasible alignment options for further development. The top ranking station locations are:

- Newton 1 - located under the intersections of Symonds St, Khyber Pass and Newton Road;
- K Road 1 - located under Karangahape Rd, Pitt Street and Mercury Lane; and
- Aotea 1 - located under Albert Street between Wellesley and Victoria Streets.

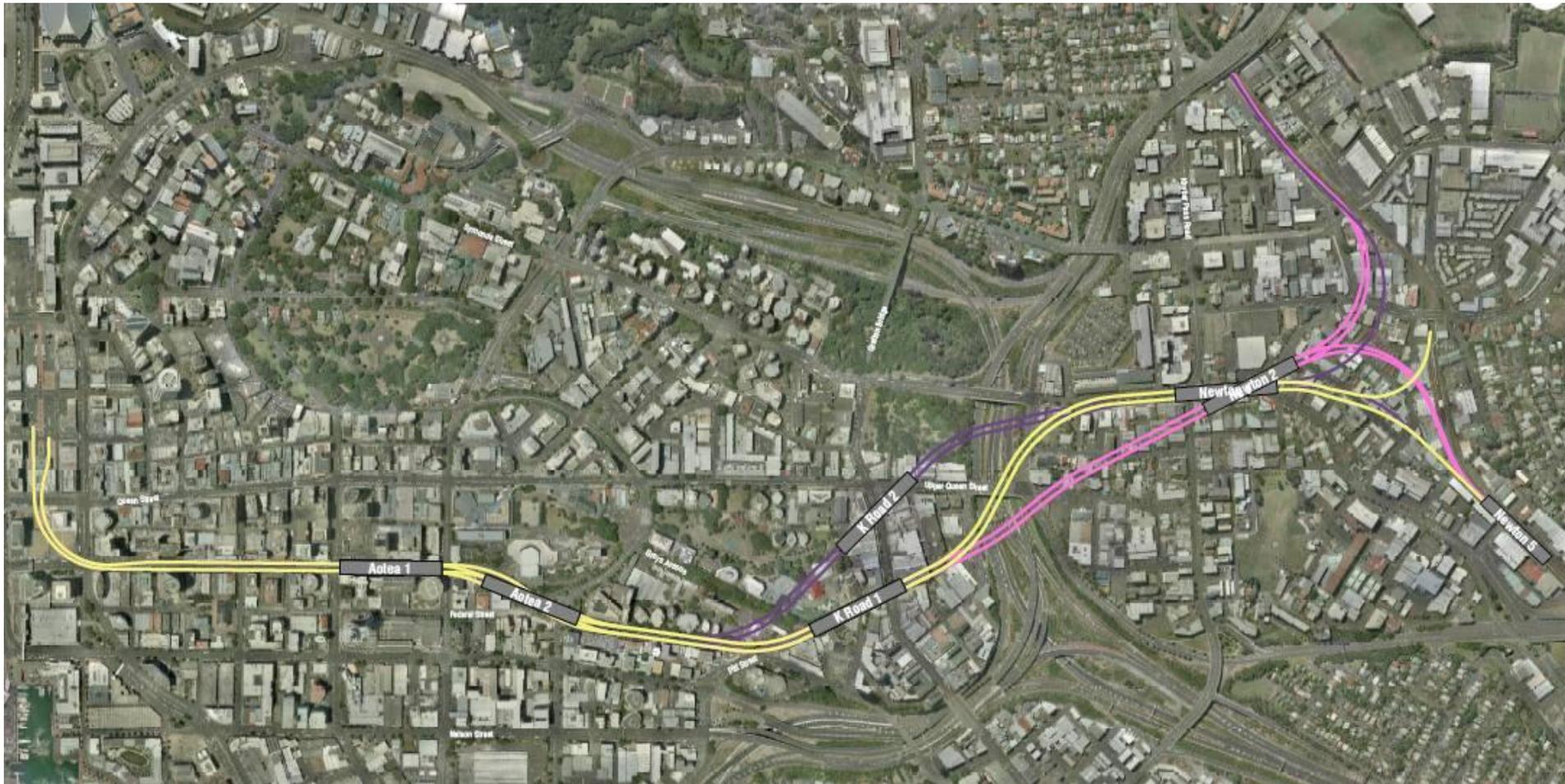
Of these three "preferred" station locations, only the location of Aotea 1 station was considered to present any substantial constructability and/or cost impacts. Due to the comparable scores, Newton 2, Newton 5, K Road 2, and Aotea 2 stations were recommended to be included for further development.

The proposed shortlist of feasible alignment options for further development was 6, 6a and 1c. These, along with the station locations mentioned above are shown on Figure 1 and also within Appendix 1.

Work has been undertaken by the APB&B team to further evaluate the shortlist of feasible options in order to determine a preferred alignment and confirm the preferred station location at Newton, K Road, and Aotea. In terms of confirming alignment option 6 as the preferred option at the conclusion of the multi-criteria evaluation process, it was identified that this option could have issues with piles on the Upper Queen St Bridge over the Central Motorway Junction (CMJ). Work to establish the extent and risk of these issues was undertaken along with consideration of refinements to alignment 6 to avoid this bridge. No further work on the other top ranked alignments was undertaken as there was not seen to be any comparable refinements to 6a and 1c without replicating another existing alignment.

The result of this further evaluation work is that the preferred alignment for the rail link is 6c (a minor refinement of alignment 6 which avoids passing directly beneath the Upper Queen Street motorway over bridge), and station locations Newton 1, K Road 1 and Aotea 1. This alignment and the station locations are shown on Figure 1A and within Appendix 1A.

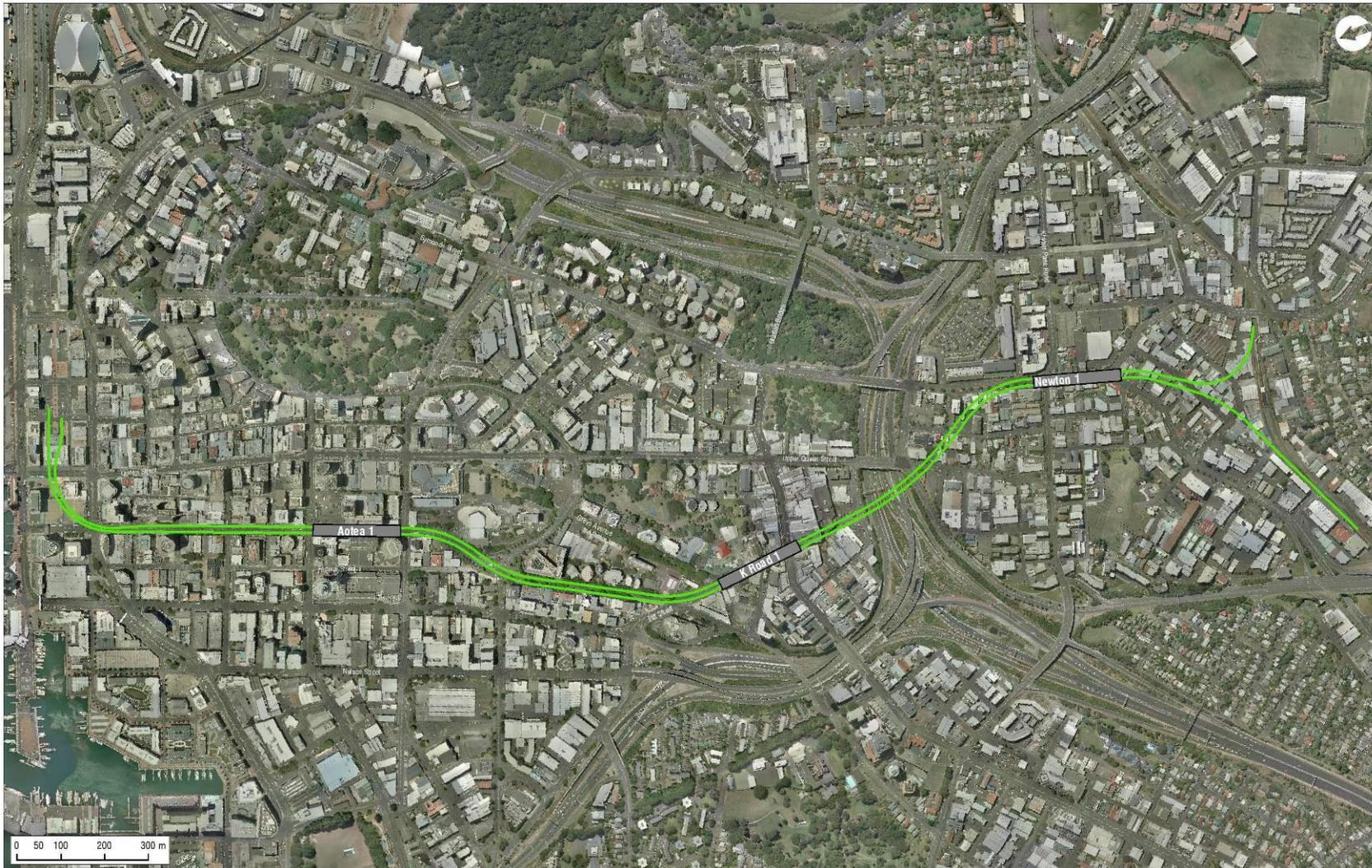
Figure 1 - Shortlist of Station and Alignment Options



**Alignment Information**

- ~ Option 1c
- ~ Option 6
- ~ Option 6a

Figure 1A – Preferred Alignment and Station Locations



It is recommended that the ONTRACK and ARTA Boards confirm the preferred CBD Rail Link Alignment and station locations to be taken forward into Phase 2 and 3 of the Study is alignment 6c, and station locations Newton 1, K Road 1 and Aotea 1.

Once the recommendation of the preferred alignment and station locations has been approved by the ONTRACK and ARTA boards, the following works will be undertaken:

**During Phase 2:**

- The preferred alignment option and station locations will be further investigated and technical reports completed with concept design progressing.
- Key aspects of this phase will include the further refinement of project risks and costs, potential construction timeframe, the development of the station surface structures and internal station layouts, overall stakeholder, property and environmental impacts.

**During Phase 3:**

- Phase 3 will result in the completion of NOR documentation.

## 1 Introduction

The Auckland Central Business District (CBD) Rail Link Study (the Study or the Project) aims to identify a preferred route for an underground passenger railway running beneath the central business district (CBD) and linking the Britomart Transport Centre to the western line (North Auckland Line - NAL) in the vicinity of Mount Eden. The CBD Rail Link will be approximately 3.5 km long and will include up to three underground stations, with Britomart being converted from a terminus into a through station. The Study, jointly funded by ONTRACK (a division of the New Zealand Railways Corporation) and the Auckland Regional Transport Authority (ARTA), will also consider the social, environmental and economic benefits and likely costs for the proposed rail link and possible new stations along the way, and begin the process of protecting the route for future construction.

AECOM, Parsons Brinckerhoff, Beca and Hassell (working together as APB&B) have been commissioned to undertake the Study on behalf of ONTRACK and ARTA.

### 1.1 Purpose of this Report

The study is being undertaken in three phases. This report has been prepared at the end of Phase 1 with the objective of determining a preferred scheme option to carry forward for further study in Phase 2.

The purpose of this Option Evaluation Report is to provide a summary of the evaluation process undertaken to identify a preferred route alignment and station locations. This report details the following:

- A description of previous studies undertaken for a CBD Rail Link;
- An outline of the evaluation framework/method, including the objectives and principles of the Study, stakeholder engagement, and assessment criteria, systems and methods;
- A summary of the option development process and outcomes;
- A summary of the option evaluation process;
- Discussion regarding weighting and sensitivity analysis;
- Conclusions from the evaluation and analysis process;
- Further evaluation of the top ranked feasible alignment; and
- A discussion on the proposed steps to be undertaken in Phases 2 and 3 of this Study.

## 2 Evaluation Framework/Method

### 2.1 Project summary

#### 2.1.1 Brief Outline of Project

The APB&B team have set out 3 phases of work required to complete these investigations:

- Phase 1: Undertake an options evaluation process to determine a preferred route alignment, station numbers, and station locations (the deliverable for this phase being this report).
- Phase 2: Develop a preferred alignment concept design and undertake the associated technical investigations; and develop the project business case.
- Phase 3: Prepare and issue Notice of Requirement (NOR) documentation to ONTRACK and ARTA.

The outcome of the Phase 1 evaluation process is a preferred route alignment and station locations which will then be further developed and evaluated during Phase 2 of the study, thus focusing the study team's efforts on those options which appear to best meet the objectives for the CBD Rail Link project. APB&B's aim has been to maintain flexibility to permit subsequent more detailed iteration and to not preclude opportunities for potential generation of benefits by the Project. Given this, opportunities for stations in the three distinct areas have been investigated in this phase of option evaluation. The general locations for stations are defined by topography, operational and catchment considerations and are midtown CBD, uptown (Karangahape Road ridge) area, and Newton.

The evaluation process has been structured in a manner which will provide a robust and transparent evaluation under the Resource Management Act (in respect of the adequate consideration of alternatives), as well as form the basis for subsequent assessments of the costs and benefits in the development of the Project business case in Phase 2.

Currently APB&B has only been able to establish a preliminary understanding of the costs and benefits of the options so meaningful quantitative assessments of these cannot be made as part of the Phase 1 evaluation process. Factors which indirectly enable a comparative assessment of potential cost drivers and benefit sources, have however, been included in the option evaluation criteria. For example there are criteria assessing directness of route (i.e. length of tunnels) and depth of stations, as well as criteria testing property development and PT modal connectivity potential. Such criteria, along with others testing operational and construction impacts, provide a means of comparing alignment options sufficiently for initial short listing, whilst retaining the ability for more detailed assessment during Phase 2 to determine the merits of particular aspects such as specific station locations.

#### 2.1.2 Purpose and drivers

Patronage on passenger services on the Auckland rail network has increased significantly in recent years following investment by central, regional and local government in improved services, trains, stations and infrastructure. Growth in patronage is projected to continue over the next decade as further investment in electrification and electric trains comes on line.

The current Auckland CBD rail terminus at the Britomart Transport Centre is expected to reach maximum capacity by around 2020 on current growth projections. In addition, the numbers of

people living and working in the CBD and fringe areas is projected to more than double in the next 30 to 40 years, which will put significant strain on existing roads and public transport services.

The proposed CBD Rail Link:

- Will allow more train movements through unlocking the capacity constraint of Britomart (by developing Britomart into a through station);
- Is regarded as a key element in future transport infrastructure for Auckland by increasing capacity across the entire rail network, bringing the rail network into the heart of the city and stimulating economic development in the busy CBD area by reducing traffic congestion; and
- Will unlock the potential of Auckland's rapid rail transit network, making the rail link as important to the rail network system, as the Central Motorway Junction (CMJ) is to the motorways; and
- Provide stimulus for inner city development by providing new major transport hubs around the new underground rail stations.

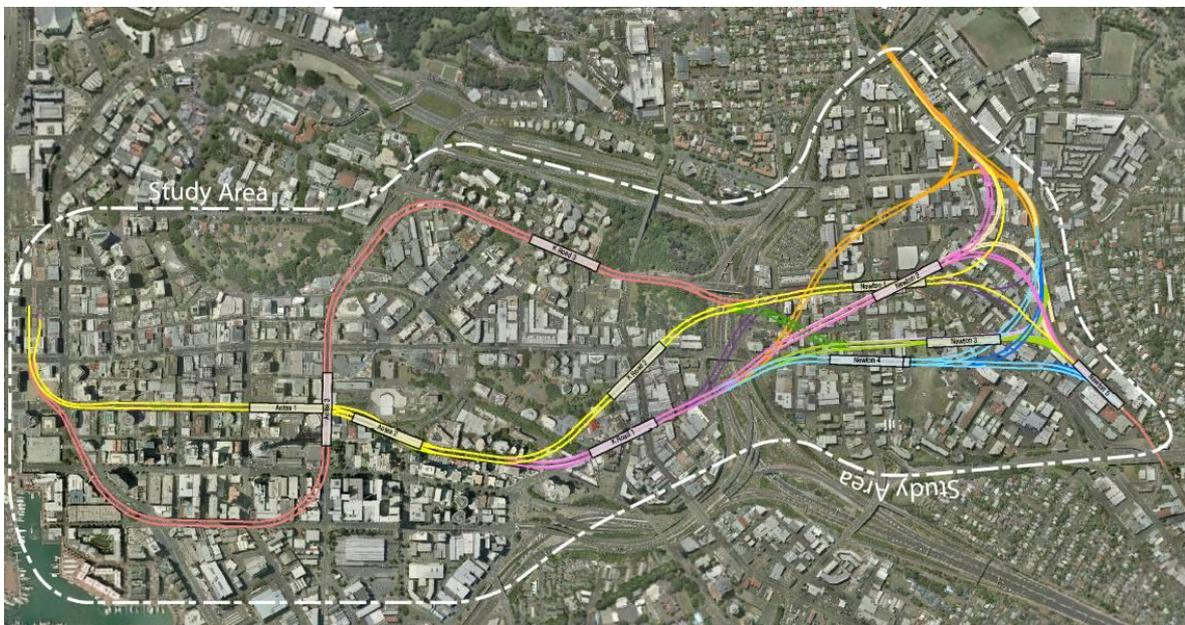
### 2.1.3 Brief Outline of Study Area

The study area comprises:

- The Auckland CBD area, encompassed by the CMJ, the motorway leading to the Harbour Bridge and the motorway connections through Grafton Gully; and
- Those areas of Newton/ Eden Terrace/ Mt Eden encompassed by the Southern and North-Western Motorways, Ian McKinnon Drive and the NAL.

The study area is illustrated in Figure 2.

**Figure 2 – Study Area of the Auckland CBD Rail Link Study**



The Auckland region is populated by 1.3 million people and is the fastest growing urban centre in New Zealand.

Auckland is a city built on a volcanic field, characterised by a landscape littered with the remnants of cones and craters, ridges and valleys. The terrain climbs steeply from the Waitemata Harbour edge to meet ridges bounding the city on the east, west and south. Symonds Street continues along the

north/south ridge, whilst Karangahape (K Road) and Ponsonby Roads continue along the east/west ridge. Queen Street is the city's primary pedestrian and vehicle aerial, springing from the wharf piers in the north and continuing south along a valley to intersect K Road. The North Western, Southern and Northern Motorways are nestled in gullies bordering the ridges, parting the city from adjacent inner city districts.

Newton, an inner city district, is located on the southern outskirts of the CBD. Symonds Street and Upper Queen Street connect the Newton area to the CBD over the Motorway corridor. Symonds Street splits into two branches, becoming New North and Mount Eden Roads that continue to outer suburban regions.

The terrain in this contained precinct is dramatic, characterised by steep dips and rises between suburban blocks. Mount Eden dominates the landscape on the southern boundary.

## 2.2 Objectives

The development of Project objectives is a key component of a NOR and its ability to meet the requirements for a designation under section 171 of the Resource Management Act 1991 (relating to project necessity and confirming whether the works and designation are reasonably necessary for achieving the objectives of the Requiring Authority, being ONTRACK).

A set of overarching objectives for the Study were developed by ONTRACK and ARTA prior to the start of the current study and have been agreed with both Auckland City Council (Auckland City) and the Auckland Regional Council (ARC) as key stakeholder organisations with a Memorandum of Understanding (MOU) with ONTRACK and ARTA for this Study. These have been supplemented by a set of more specific project objectives, developed with stakeholders and by the APB&B team to facilitate option development and evaluation, and agreed at workshops with ONTRACK and ARTA in September 2009.

The Project objectives largely drive the evaluation criteria content. All of the evaluation criteria have been linked back to the objectives (both overarching and specific). These linkages are noted within Appendix 2. Other drivers include the study and operational parameters, and engineering requirements (i.e. maximum gradients, curves, etc). The overarching objectives are listed in Table 1 and the specific objectives in Table 2.

**Table 1**

Overarching Objectives for the Project	
01	Support to desired future growth and development of the CBD and Region
02	Optimise public transport patronage potential and accessibility to / from and within the CBD
03	Optimise efficiency and potential of the Rapid Transport network including integration with passenger transport, active modes and freight requirements
04	Continue to develop Auckland rail as part of an integrated national rail network

**Table 2**

Specific Objectives for the Project	
S1	To contribute to an attractive, sustainable and integrated passenger transport system that offers choices for travellers to / from and within the CBD
S2	To provide quality rail stations and connections in optimal locations in the CBD and fringe to facilitate the regional growth objectives of land use intensification, sustainability and economic development around transport nodes
S3	To encourage use of passenger rail services to achieve passenger transport modal share targets for the Auckland CBD and region in accordance with the regional transport policy framework
S4	To improve journey time, increase reliability and enhance modal integration for passenger services to / from and within the CBD
S5	To enable the expansion of the passenger rail network to penetrate into the midtown and uptown areas of the CBD and to increase the capacity of Britomart Station by: <ul style="list-style-type: none"> <li>- - Protecting rail corridor and station locations between the NAL (western line) and Britomart Station; and</li> <li>- - Making Britomart Station into a through station</li> </ul>
S6	To enable the operation of enhanced rail services across the region, to and from the CBD, as an integrated part of the wider Rapid transport Network
S7	To not preclude a potential interchange between the CBD rail link and a future North Shore passenger rail line

## 2.3 Principles of the Study

### 2.3.1 General Principles

The principles of the Study were discussed at two stakeholder workshops held on 3<sup>rd</sup> September 2009 involving ONTRACK, ARTA, Auckland City, ARC, the New Zealand Transport Agency (NZTA), Ministry of Transport (MOT), and the Auckland Transition Agency (ATA). The principles will primarily inform the Phase 2 concept design, and it is therefore proposed that they be reviewed at the start of Phase 2. However, it is noted that at a high level they also link into the Project objectives, particularly those relating to land use development and inter modal transport opportunities. The general principles of the Study are:

- Promote Design excellence combined with value for money to achieve quality environments;
- Promote Sustainable Design and sustainability principles;
- Achieve integration of rail with other modes and land use:
  - Optimise integrated land use opportunity - potential to integrate with land use developments (shops, commercial, residential etc - possibly within stations but particularly above/ adjoining);
  - Proximity to centres of activity and destination/ origin – walking distances and PT, close to/easy access to Queen Street;
  - Ability to promote land use change and renewal promoting growth strategy objectives of intensification and land use / transport integration;
- Achieve integrated rail with other modes:
  - Design for easy PT/ modal interchange;
  - Include/allow for bus stations/services within corridor;
  - Provide for better interchange and potentially increasing patronage;
  - Consider the stations as interchanges – not just a rail station;

- ONTRACK can only designate for rail infrastructure. Provision for incorporating bus and interchange facilities also needs to be examined around station precincts;
- Achieve good connectivity – stations and pedestrian connections should:
  - Promote safe and easy, universal access/ egress and clear way finding;
  - Minimise interchange time;
  - Provide continuous weather protection for mode interchanges/ connections;
- Consider integration with other services – other network utility operators providers may be able to integrate/share the corridor – e.g. Vector. Likely to be safety and operational constraints;
- Avoid or minimise effects / impacts (e.g. noise and vibration) on sensitive land uses (e.g. heritage buildings, medical surgeries, theatres such as Aotea Centre);
- Avoid or minimise the permanent loss of public amenity / open space land (e.g. parks and reserves, trees, public spaces, heritage) - consider whether temporary loss may be acceptable in circumstances;
- Avoid or minimise the impact on private property. For instance, using public land (such as road reserve) can avoid or minimise private property impacts (acquisition of land or rights either temporary or permanent), which can have a significant influence on the costs, acquisition and consenting process; and
- Minimise impacts on traffic/ other PT/ access, in particular at peak hours, during construction.

### 2.3.2 Station Architecture Principles

The CBD Rail Link is expected by ARTA to:

- Increase capacity across the entire Auckland rail network;
- Bring the rail network into the heart of the city; and
- Unlock the potential of Auckland’s rapid rail transit network.

It is thought that this would make the CBD Rail Link as important to the Auckland rail system as the CMJ is to the motorway system.

The APB&B team, using its previous experience from similar studies, has developed a set of principles relating to Station Architecture. Station Architecture for Phase 1 is at a high conceptual level. However, given that the CBD Rail Link is expected to complement a world-class transport system that meets the needs of a rapidly growing Auckland region, the development of station architecture principles in Phase 1 is important for guiding both this phase and the Phase 2 concept design.

Stations have the opportunity to provide access to commercial and community facilities in the Auckland CBD, K Road and Newton areas. The overarching station design objective is to achieve a successful and memorable transport experience. The station environment must be attractive, functional, safe and inviting, and accessible to all Aucklanders. Stations will be integrated into the existing environment, creating and enhancing quality built environments.

The design principles adopted in the conceptual development of stations are:

- High quality design and operational performance;
- A comfortable and convenient passenger experience;
- Optimal passenger and staff safety, amenity and accessibility;
- Station environments will be attractive and inviting;
- Station entries will be instantly recognisable and clearly signed urban landmarks; and
- Station precincts will be easy to navigate and customer focused.

The urban design objectives for the station domain are:

- Integrate with the local urban environment in which it operates;
- Facilitate future transit oriented urban development;
- Develop station precincts that enhance the public realm, including expanding pedestrian space;
- Provide efficient interchange with existing modes of public transportation, including walking and cycling;
- Provide opportunity for place making;
- Stations will define and activate existing centres of activity;
- Minimise visual, acoustic and amenity impacts of station plant on existing environments;
- Celebrate and protect significant buildings, spaces and connections;
- Reinforce predominant street edges and building alignments;
- Facilitate future opportunities for connections with adjacent landowners; and
- Encourage travel behaviour change toward public transportation.

## 2.4 Option Evaluation Inputs

In general, inputs into the Option Evaluation process are as follows:

- Review of previous studies and background information:
 

A number of previous studies into the feasibility of a CBD Rail Link have been undertaken. The APB&B team have undertaken a review of these in order to gain a general understanding of previous background, to understand which alignments have been evaluated historically, and whether any of these alignments were feasible and should be considered as options as part of this Study. These background studies are more fully described in section 4.1 to this report and Appendix 3 (Technical Paper: Option Generation) plus Appendix 4 (Technical Paper: Transport Planning, Rail Operations and Preliminary Benefits Assessment).
- Identification of high level cost, benefit and risk drivers.
- Constraints Mapping – rail operational, physical / topographical, and other existing environment features:
 

A constraints mapping exercise was undertaken in order to identify whether there are any impediments which will influence the ability to locate a station and / or an alignment option between the stations. This included (but was not limited to) looking at existing and known future building structures (particularly foundation depths and construction type), existing services (particularly the location of the Vector tunnel and Orakei sewer), known heritage and archaeological buildings and sites, known sensitive noise activities, and existing plus known future community facilities.

The constraints mapping exercise is further discussed in section 4.2 of this report.
- Generation of technically feasible options for station locations and alignments:
 

Development of station locations and alignment options were evaluated against mandatory criteria (see section 2.5.1 of this report). Those station locations and alignments which did not meet these criteria were not progressed. This option generation process is more fully described in Appendix 3 (Technical Paper: Option Generation).
- High level urban design analysis including population densities and pedestrian sheds (“ped-sheds”):
 

A high level urban design analysis was undertaken to highlight and identify where existing and future growth (and subsequently potential rail users) is anticipated and where opportunities exist to create and / or enhance urban form.

- Land use analysis:  
A high level land use analysis was undertaken in conjunction with the urban design analysis to identify areas for potential growth opportunities. This considered both the current District Plan provisions and the known aspirations of Auckland City via its Future Planning Framework. Influences which may stem achieving maximum potential growth, such as the volcanic view shaft protections, were also identified.
- Initial rail operational modeling and development of service pattern scenarios:  
This was undertaken to inform patronage and operational assumptions.
- Interaction with the parallel Auckland City Spatial and Transport Planning studies (see section 3.1.7 of this report).

## 2.5 Evaluation Criteria, System and Methods

### 2.5.1 Introduction

A multi-criteria evaluation system has been developed for use to assess both the station location options and the alignment options between stations. The evaluation criteria developed are attached in Appendix 2. At the conclusion of the multi-criteria evaluation process a further evaluation process was undertaken as described in section 8 of this report. This section only provides detail on the multi-criteria evaluation processes.

The first tier of the criteria evaluation system is the mandatory criteria or “coarse screening” process. These are essentially the “test” that all options must meet in order to progress. The ‘failed’ options have been recorded although not scored against the overarching or general evaluation criteria. A number of criteria were identified as being mandatory requirements that needed to be met or would trigger a ‘fatal technical flaw’ for any option.

The second tier of the criteria evaluation system is the overarching criteria, and these provide the strongest link between the project objectives and the evaluation criteria.

The third tier of the criteria evaluation system is the general evaluation criteria. The general evaluation criteria have been grouped into 5 different sections, which are:

- 1 Criteria for evaluating the number of stations to be provided;
- 2 Criteria for station location;
- 3 Criteria for operational impacts (i.e. permanent);
- 4 Criteria for construction impacts (i.e. temporary); and
- 5 Alignment specific criteria.

### 2.5.2 Development of criteria

This section of the report provides a summary of the criteria development. The evaluation criteria have been developed in consideration of the following:

- The Project objectives (both the overarching and the specific ones);
- The parameters of the study area, including any constraints;
- Operational and engineering requirements (i.e. maximum gradients, curves etc);
- A review of the previous studies undertaken and an identification from these of constraints and opportunities; and
- A review of evaluation criteria (and their development) used on other comparable linear infrastructure designation or options evaluation projects.

It should be noted that the criteria have changed throughout the process. From their development the criteria evolved and were altered during the workshop process (described in section 2.5.3 of this report) to refine the criteria. An additional criterion was added in Workshop 4 relating to access for visitor attractions as it was felt that the other criteria did not represent this potential user group. Appendix 2 contains the final criteria, additionally noting which criteria are relevant to the project objectives and the measures used to score the criteria.

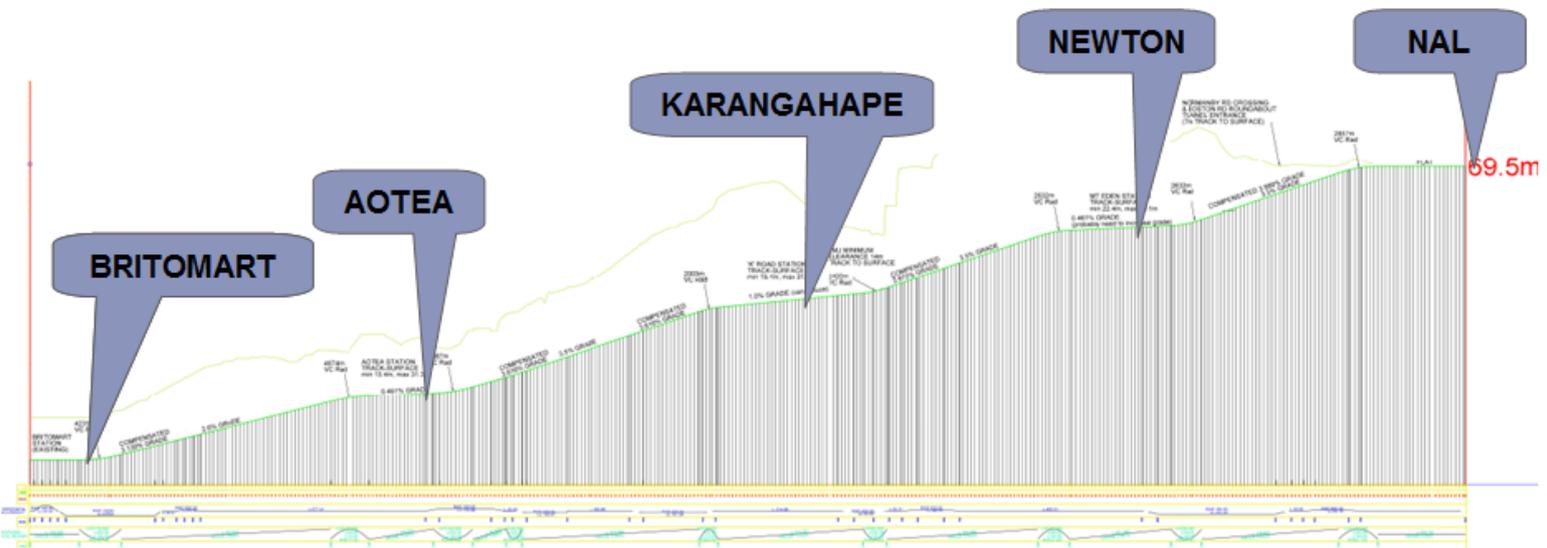
### 2.5.3 Outline methodology

This section outlines the methodology and scoring process for evaluating the alignment options within the parameters and constraints requirements.

#### a. Parameters, constraints

- The Study area is largely defined as the CBD area within the Auckland City Central Area District Plan, and the Isthmus area bordered by the CMJ/Southern Motorway, NAL and Ian McKinnon Drive (refer to Figure 2 page 6).
- A list of operational requirements of the alignment and stations are included in Appendix 5.
- The opportunity exists for three stations along the rail link. The maximum number of stations along the rail link is constrained by the elevation difference between Britomart and the NAL, necessitating steep rail gradients while accommodating flat station locations, which poses operational constraints of future rolling stock (see figure 3).

**Figure 3 – Step gradients from Britomart to NAL (with indicative locations of potential future stations)**



## **b. The process for evaluation:**

Broadly the option evaluation process undertaken in Phase 1 was:

- Step 1 Development of options and evaluation criteria
- Step 2 Coarse screening of options against mandatory technical criteria
- Step 3 Workshop 1 (10<sup>th</sup> November 2009): Internal APB&B workshop to evaluate and determine a recommended number of stations for the rail link:
  - options counter checked against mandatory technical criteria;
  - options enabling 1, 2 and 3 stations evaluated against criteria category 1.0 – overarching criteria;
  - options evaluated against criteria 2.0 – number of stations to be provided
- Step 4 Workshop 2 (16<sup>th</sup> November 2009): Internal APB&B workshop to evaluate station location options and feasible alignments between station locations:
  - evaluation of Newton station locations, K Road station locations, Aotea station locations against criteria categories:
    - 3.0 – station location;
    - 4.0 – operational impacts; and
    - 5.0 – construction impactsto determine recommended highest ranking station locations in each area
  - based on the results of the evaluation of the station locations, determination of feasible alignments
  - evaluation of feasible alignments against criteria:
    - 1.0 – overarching criteria; and
    - 6.0 – alignment requirements
  - sensitivity testing of different weightings of criteria categories as well as particular criteria
- Step 5 Workshop 3 (20<sup>th</sup> November 2009): Client workshop - presentation of evaluation process and results to ONTRACK and ARTA
- Step 6 Workshop 4 (2<sup>nd</sup> December 2009): Stakeholder workshop - presentation of evaluation process and results to Auckland City, ARC and MOT representatives
- Step 7 Submission of Draft Report: Auckland CBD Rail Link Study – Options Evaluation Report, prepared for ONTRACK and ARTA by APB&B, dated 15<sup>th</sup> December 2009 (evaluation process resulted in the identification of top ranked station locations in Newton, K Road and Aotea and top ranked alignments to join them)
- Step 8 Subsequent to the multi-criteria process, further evaluation work was undertaken on the top ranked alignment to confirm the preferred alignment and station locations in Newton, K Road and Aotea.

## c. Evaluation System

Apart from the mandatory criteria (which have either Yes/No answers), two comparable evaluation systems were used to evaluate the different study criteria groupings. The two systems were used to reflect the differences between benefit criteria and environmental effects criteria.

### Evaluation System A

Evaluation	Rating
Strongly supports criteria	5
Supports criteria	4
Limited support of criteria or neutral to this criteria	3
Not supportive of criteria	2
Strongly not supportive of criteria	1

Evaluation System A was used to evaluate the following criteria groupings:

- Grouping 1.0 - Overarching Criteria
- Grouping 2.0 - Criteria for evaluating the number of stations to be provided
- Grouping 3.0 - Criteria for station location
- Grouping 6.0 - Alignment specific criteria

### Evaluation System B

Evaluation	Rating
Significant Potential Positive Effect	5
Potential Positive Effect	4
No more than Minor Adverse Effect (with limited or no consideration of mitigation)	3
Adverse Environmental Effect (with opportunities to remedy or mitigate)	2
Significant Adverse Effect (with limited opportunities to mitigate)	1
Potentially Significant Adverse Effect with little or no scope to mitigate and difficult to consent (RED FLAG)	

Evaluation System B is to be used to evaluate the following criteria groupings:

- Grouping 4.0 Criteria for operational impacts
- Grouping 5.0 Criteria for construction impacts

## 3 Stakeholder Engagement

### 3.1 Stakeholder Engagement

At the beginning of Phase 1, a number of various stakeholder groups were identified that may have an interest in the Study. These were:

- Strategic and regulatory bodies;
- Statutory bodies (including Crown agencies);
- Operators within the rail corridor;
- Groups likely to have an interest in the project beyond the general public.

These stakeholders include:

- Auckland City Council (Auckland City);
- Auckland Regional Council (ARC);
- Emergency Services (NZ Fire Service, NZ Police and St John Ambulance);
- Ministry of Transport (MOT);
- Ngati Whatua o Orakei;
- The New Zealand Transport Agency (the NZTA);
- Auckland Transition Agency (ATA);
- Veolia Transport Auckland and ARTNL Britomart Ltd; and
- Utilities providers (Watercare Services Ltd, Vector Communications Ltd, Chorus/Telecom New Zealand and Metrowater).

These stakeholders have been consulted throughout this phase of the Study and investigations process so far. In particular Auckland City and the ARC have been identified as key local government stakeholders to be consulted with at regular intervals. Accordingly a Memorandum of Understanding covering the study has been agreed by ONTRACK, ARTA, Auckland City and the ARC.

The following provides a summary of the stakeholder engagement to date.

#### 3.1.1 Stakeholder Consultation Series

##### First series

The first series of stakeholder engagements occurred in a workshop on 3<sup>rd</sup> – 4<sup>th</sup> September 2009 through a series of sessions dedicated to a discussion of particular topics. These were as follows:

##### Thursday 3<sup>rd</sup> September 2009

- Session 1 – Study Objectives
- Session 2 – Project Aspirations
- Session 3 – Initial Briefing for Emergency Services
- Session 4 - Key Principles and Outcomes
- Session 5 – Key Project Risks/Opportunities

## Friday 4<sup>th</sup> September 2009

- Session 6 – Technical and Operational Requirements
- Session 7 – Tunnels and Stations

The outcomes of these workshop sessions were outlined in a report entitled 'CBD Rail Link Study – Client Workshop Report Final Draft' (APB&B) prepared for ONTRACK and ARTA, dated 28 September 2009.

## Second series

The second series of stakeholder engagement is ongoing fortnightly stakeholder meetings with Auckland City and ARC. Minutes from meetings can be found in Appendix 6.

## Third series

The third series of engagements was the involvement in the Options Evaluation Assessment in Workshop 4. This is discussed further in section 5.2.5 with comments of the workshop within Appendix 7. This included a subsequent stakeholder meeting on 11 December 2009.

## Fourth series

For the fourth series political briefings were undertaken with Auckland City Transport Committee and ARC Transport and Urban Development Committee.

### **3.1.2 Auckland City Council**

Auckland City has been heavily involved as a stakeholder in Phase 1 due to its strategic and regulatory interest in the Project as a planning and governing body. The entire CBD Rail Link is within the jurisdiction of Auckland City and therefore the station locations (in particular) will have a major impact on Auckland City, its existing (and future) urban form and movement around the City.

Auckland City representatives attended Sessions 1 - 7 of the stakeholder workshops outlined above, and were involved in the discussion about the overarching objectives and principles of the Study.

Auckland City representatives are involved in regular stakeholder meetings held every 2 weeks with ONTRACK, ARTA, ARC, MOT and the APB&B team to discuss the project. Minutes from the stakeholder engagement are included in Appendix 6 of this report.

Auckland City representatives also attended the interactive Stakeholder Evaluation Workshop 4, and the following stakeholder meeting on 11 December 2009, both of which are further discussed in section 5.2.5.

Further to this, the Auckland City Transport Committee was briefed on the progress of the Study on the 3<sup>rd</sup> December 2009.

### **3.1.3 Auckland Regional Council**

The ARC has had significant involvement as a stakeholder in Phase 1 because of both its statutory and regulatory roles in regional planning and environmental management and its role, through its subsidiary ARTA, in funding public transport services.

Representatives of the ARC participated in sessions 1 and 2 of the stakeholder workshops on the 3<sup>rd</sup> September outlined above. The ARC was involved in the discussion about the overarching objectives and principles of the Study.

The ARC are involved in regular stakeholder meetings held every 2 weeks with ONTRACK, ARTA, Auckland City, MOT and the APB&B team to discuss the project. Minutes from the stakeholder engagement are included in Appendix 6 of this report. ARC representatives also attended the interactive Workshop 4, which is further discussed in section 5.2.5 below, and in Appendix 7.

Further to this, the ARC Transport and Urban Development Committee was briefed on the progress of the Study on 3<sup>rd</sup> December 2009.

### 3.1.4 Emergency Services

The emergency services (Police, Fire, Ambulance Service) were initially briefed on 3<sup>rd</sup> September 2009 (Session 3), with an additional targeted interactive workshop held on 28<sup>th</sup> September 2009 to develop the thinking on the functional requirements in the concept planning. Potential issues during operation include control of incidents, safety of personnel, access provisions and communication systems and protocols. It was also noted that specific consideration during construction is required to ensure that the operation of existing emergency service facilities are not interrupted (which is included as an evaluation criteria).

### 3.1.5 Iwi

Initial contact has been made with the Ngati Whatua o Orakei representatives, but they did not attend the Stakeholder Workshop 4.

### 3.1.6 Other Consultees

- MOT – A MOT representative attended in Sessions 1 – 2 and 4 – 7. Additionally, MOT has participated in stakeholder meetings (including Workshop 4 and the follow up stakeholder meeting on 11 December 2009, which is discussed in section 5.2.5). An initial focus of consultation with the MOT has been to understand the possible configuration and characteristics of the electric trains to be purchased for Auckland, as the MOT has been coordinating this work with KiwiRail, ARTA, ONTRACK and the ARC.
- The NZTA was involved in Sessions 1 – 2 to discuss and feed into project objective discussion. NZTA has a number of roles of relevance to the CBD Rail Link:
  - Asset Manager for the State Highway network, under which (CMJ) the CBD Rail Link will pass; and
  - A funder of public transport services.
- Rail Safety Regulator
- The Auckland Transition Agency (ATA) attended Session 2 to discuss the project aspirations and key station design principles.
- Veolia Transport Auckland (train operators) and ARTNL Britomart Ltd (station managers) were involved in Session 6 to identify rail operational constraints/standards or requirements and determine parameters and assumptions.
- Utilities providers – Utilities providers have been provided with information displaying the locality and scale of the Study in order to confirm whether any services may be affected by the Study (and in particular any major obstacles that may require rerouting of the alignment or service). A Utility briefing session was held by APB&B on 23<sup>rd</sup> September 2009, which was attended by ACC, Metrowater, Vector, and Chorus. Further information is contained within the existing environment summary of 'Services' within Appendix 8.

### **3.1.7 Auckland City CBD Stations Urban Planning/ Land Use Capacity Study**

Following the initial Stakeholder Workshop on 3<sup>rd</sup>/4<sup>th</sup> September 2009, Auckland City has undertaken work to assess possible CBD Rail station locations from urban planning and land use perspectives. Although not part of the formal CBD Rail Link Study stakeholder engagement, the APB&B team has participated in workshops held for the Auckland City study and has received outputs from its work.

## 4 Options Development Summary

### 4.1 Literary Review

Previous work and studies undertaken were reviewed as part of the options development process. These are summarised in the following Appendices:

- Appendix 3: Technical Paper: Option Generation; and
- Appendix 4: Technical Paper: Transport Planning, Rail Operations and Preliminary Benefits Assessment.

There are numerous existing documents regarding a potential CBD rail link, which have been sourced and reviewed as part of the Phase 1 work. The documents listed below contain the more relevant information pertinent to this study:

- Tonkin and Taylor (Dec 2002). Britomart West Rail Link;
  - This report reviewed work completed to 2002 and updated a previous report to address consenting issues, feasibility of construction in the locality of Britomart and to assess construction costs.
- Beca (Jan 2003). Britomart Station Pedestrian Capacity Modelling;
  - This report assessed the passenger throughput capacity of the Britomart station, operating as a through station for heavy rail only.
- Tonkin and Taylor (July 2003). Britomart West Rail Link – Geotechnical Appraisal;
  - This report presented a geotechnical long section from Britomart through to the North Western Rail Line with 4 cross sections along the route.
- URS, GHD (Jan 2004). Britomart West Rail Extension Feasibility Study;
  - This document addressed the technical feasibility and the potential economic viability of the Britomart West Rail Extension, assessing the viability of 7 alignment options.
- Halcrow Pacific Pty Ltd (Aug 2005). EMU Performance in Proposed CBD Tunnel;
  - This technical note looked at the likely Electrical Multiple Units (EMU) vehicles to service the CBD Rail Tunnel.
- Beca, PB (Dec 2005). Auckland CBD Rail Loop Peer Review;
  - This report reviewed five previous papers related to the geotechnical, planning and costs estimates for a twin track underground rail connection from Britomart to near the existing Mt Eden station.
- Maunsell | AECOM (June 2008). ARTA Rail Stations Upgrade Policy and Specification;
  - This report was an addendum to the existing ARTA Rail Stations Design Guide and Stations Upgrade Policy and Specification.
- Crayford, J. (Oct 2008). Towards a Britomart Rail Tunnel Notice of Requirement;
  - This report looked at the history of work completed prior to 2008 for the CBD Rail Link and identified some of the key strategic planning issues that are likely in progressing this project.
- Connell Wagner Ltd (Nov 2008). CBD Rail Tunnel Aotea Extension – Revision 2.
  - This document developed a number of alignment options based on previous reports and design analysis completed as part of their brief.
- Ascari (2008), Preliminary Economic Assessment 2008;
  - This preliminary report analysed the potential transport and wider economic benefits of the CBD Rail Link.

- Ascari (2008), CBD Rail Tunnel – Aotea Extension Planning and Economic Analysis Report.

## 4.2 Existing Environment Analyses

The options (including station locations and alignments) were developed by the APB&B team in collaboration with the existing environment analyses (included within Appendix 8). These existing environment analyses were undertaken in order to highlight any potential 'red flags' or 'show stoppers' which would need the alignment to be diverted around and avoided (e.g. certain piled foundation structures, heritage buildings etc). The following environments were examined:

- Geotechnical:
  - Geotechnical information was gathered from previous work undertaken by the APB&B companies, past studies, Auckland City property files and geotechnical reports, and ARC geotechnical groundwater information.
  - This information was used to determine whether any bore holes had been undertaken and if they were deep or shallow. Aerial photo maps were produced to show the location of the geotechnical reports, which are included in Appendix 8.
- Structures:
  - A range of building information has been collected for priority sites that will be of benefit in both the current phase of the project and subsequent phases, such as the levels of basements and foundation types.
  - Priority has been given to properties along the proposed alignments. The information has generally been compiled visual survey, Auckland City property files and heritage records.
  - Land Information Memorandums, archaeological sources and proposed/future developments have not been looked into during Phase 1.
  - Several potential structural obstructions have been identified including building, bridge and retaining walls, below ground basements, soil anchors; and historic buildings.
  - These are shown in the plans attached in Appendix 8.
- Services:
  - A number of service providers have been contacted and given information on the scale and locality of the Study, in order to determine whether any of their assets may clash with the rail link and whether these may be difficult to move and / or provide an obstacle.
  - All but two of the Service Providers have assets in the area, including two major utilities being the Watercare 'Orakei' Sewer in Victoria Street and the Vector Tunnel as it enters the CBD from the CMJ corridor.
  - Further information can be found in Appendix 8.
- Land use;
  - A review of the existing Auckland District Plan: Central Area and Auckland District Plan: Isthmus was undertaken in regard to planning controls and land use activities within the study area and in particular around the three station areas.
  - A review of the Auckland City Council 'Future Framework (July 2009)' was undertaken in regard to the Council's future plans for future development around the Isthmus area (in this case Newton).
  - These documents were used to ascertain areas identified with special characteristics and functions; height controls, site intensity controls, and any other specific issues that relate to certain parts of the study area with respect to development control.

- Following the gathering of the above information, opportunities and constraints could be identified with respect to land use and development controls around the vicinity of each station.
- Urban Design;
  - In regard to the existing urban environment an outline of key urban design objectives, goals and evaluation criteria for the project was prepared.
  - Following this an overview of the wider study area, with particular regard to potential connectivity and growth areas was undertaken.
  - An urban design analysis of the proposed station locations was completed and used to assist in multi-criteria analysis decision making, having particular regard to:
    - Topography;
    - Existing social and cultural attractors;
    - Constraints;
    - Opportunity sites;
    - Existing residential and employment populations;
    - Potential future residential and employment populations; and
    - Future potentials and opportunities within the Aotea area.
  - Further information on the analysis undertaken can be found in Appendix A within Appendix 8.
- Noise/Vibration:
  - For Phase 1 the potentially sensitive noise activities located within the study area were identified.
- Natural resources (air, earth, water)
  - For Phase 1 features such as volcanic cones, listed landscapes, water bodies and contaminated sites were identified.
- Heritage:
  - A review of the Auckland City District Plans, ARC Heritage Inventory, New Zealand Historic Places Trust (NZHPT) and New Zealand Archaeological Association along with a visual survey was undertaken to highlight buildings and sites within the study area with archaeological and/or heritage properties.
  - From a high level (desktop) analysis no archaeological and/or heritage properties were identified that would require altering the station location and alignment options. However a number of properties were identified that would potentially be affected (generally within their subterranean strata) by the stations and/or alignment options:
    - In Phase 2 further investigation will only be required where a scheduled building is potentially affected by one of the shortlisted options. This is in terms of the location of station portals and service buildings, and in terms of the tunnel and stations themselves, i.e. if the heritage building is known to be an unreinforced building, there may be adverse effects on the structural integrity of the building during construction and operation.
  - It was noted that any alignment option would require an archaeological order from NZHPT due to the large number of archaeological and/or heritage sites within the study area.
- Traffic/transport:
  - The existing transport environment (i.e. roading locations, layout, hierarchy, existing available traffic movements and counts, and existing public transportation routes) has been looked at. This information has fed into the option evaluation process in terms of looking at both the impacts during the construction phase and permanent impacts as a result of the placement of station locations and / or alignments. Impacts looked at included:

- re-routing of public transport routes;
  - whether high volume roads would require temporary or permanent diversions and whether these could likely be accommodated; and
  - likely availability of new locations for the relocation of traffic / transport services.
- The plan attached in Appendix 8 provides a high level overview of the traffic volume counts within the Study area.

## 4.3 Rail Operational Issues and Possible Service Patterns

Prior to the commencement of the Study, little work had been undertaken to investigate both the practical capacity (in terms of throughput or trains per hour) of a CBD Rail Link and how rail passenger service patterns might be operated if a CBD Rail Link was constructed.

During Phase 1 work has been undertaken on both of these issues to inform the option development and to provide a basis for subsequent work in Phase 2. This work is documented in Appendix 4 and is summarised below.

### 4.3.1 Rail Operational Modelling

The likely steep gradients on the CBD Rail Link alignment options (refer to section 2.5.3) and uncertainty over the type and configuration of future Electric Multiple Unit (EMU) trains to be purchased for Auckland under the current Electrification project, meant that it was prudent to undertake some preliminary rail operational modelling during Phase 1.

ONTRACK, on behalf of APB&B, simulated the performance of a number of 3 car EMU configurations over a representative CBD Rail Link alignment option, using a specialised rail simulation software tool, OPENTRACK, to calculate the journey times (including station stops) for each train configuration. In addition, simulations of two following trains were undertaken to estimate the achievable headway (i.e. the minimum spacing between trains) for two assumed signalling systems. The outcomes of this preliminary operational modelling were as follows:

- Uphill journey times between Britomart and Kingsland, including stops at stations at Aotea, K Rd and Newton, were between 9 minutes & 13 seconds and 13 minutes & 13 seconds. The comparable times between Britomart and Boston Rd were 7 minutes and 35 seconds and 11 minutes & 30 seconds, with journey time increasing when the EMUS have fewer powered axles within each trainset.
- The 3 car EMUs to be used for CBD Rail Link services should have a minimum of 50% powered axles in order to provide optimum journey times and to have sufficient power to be able to rescue a failed train by pushing it to the next station uphill.
- If a simple rail signalling system is installed, with only departure signals at each station, the capacity of the CBD Rail Link would be around 12 to 15 trains per hour in each direction.
- If a more sophisticated signalling system was installed, with both arrival and departure signals at each station, the capacity of the CBD Rail Link would potentially rise to around 20 to 24 trains per hour in each direction.

### 4.3.2 Possible Post CBD Rail Link Service Patterns

Preparation of a post CBD Rail Link rail network operational plan is outside the scope of the current CBD Rail Link study. However, it has been necessary to generate some scenarios of possible passenger service operating patterns using the CBD Rail Link in order to develop patronage forecasts for both the passenger transport network as a whole and for the CBD Rail Link stations.

In addition scenarios have been generated to test the patronage impacts of:

- (a) western and eastern connections at the NAL; and
- (b) to compare the merits of an underground station in the Newton area with a 'surface' station on the NAL (in the vicinity of the current Mt Eden station).

Eight scenarios have been developed to date, which are summarised in Table 3, together with the assumed post-electrification but pre CBD Rail Link service pattern as a Do-Minimum comparison.

**Table 3 –Scenarios of Service Patterns**

Peak Period Services Scenario	Trains Per Hour in Tunnel	
	Towards Britomart	Towards Mt Eden
Do Minimum (existing electrified network with 10min freqs)	n/a	n/a
Scenario 1: 10 min (6tph) Western - Eastern services via Tunnel	6	6
Scenario 2: Scenario 1 plus 50% Southern services via Tunnel	9	9
Scenario 2a: Scenario 2 with 50% of Western Services via Nmkt	6	6
Scenario 3: Scenario 2 with 5 minute frequencies	18	18
Scenario 4: Scenario 3 with 50% Western Services via Nmkt	12	12
Scenario 5: Scenario 1 with Southern services to/from Aotea via Bmt	6/12 <sup>3)</sup>	6/12
Scenario 6: Scenario 1 plus 6tph City Loop Service	12	12
Scenario 7: Scenario 1 plus Southern & Onehunga Services via CBD Rail Link	12	12

Further details of these scenarios are provided in Appendix 4: Technical Paper: Transport Planning, Rail Operations and Preliminary Benefits Assessment. It should be noted that these scenarios have not as yet been assessed from the perspective of network capacity (beyond the CBD Rail Link itself), operational robustness or train fleet requirements.

As a result of problems which have been experienced with patronage modelling outputs during Phase 1, patronage forecasts to date for these service scenarios have been of limited value in distinguishing between options, other than to verify that all of the route alignment options under consideration would enable any of the service scenarios to be operated.

Issues which will be investigated further in Stage 2, once credible patronage forecasts are available, include:

- Whether or not some western rail services should still serve Newmarket directly after the CBD Rail Link is opened (i.e. not use the CBD Rail Link);
- The need for an eastern connection between the CBD Rail Link and the NAL in the Mt Eden area;
- The case for an underground station in the Newton area, or for provision of an interchange station on the existing NAL in the vicinity of the current Mt Eden station;
- The optimal service frequencies that should be operated through the CBD Rail Link;
- The extent to which other infrastructure works on the Auckland rail network may be required to address capacity constraints, which may prevent the full potential of the CBD Rail Link from being realised; and
- The extent that further investment in electric rolling stock will be needed to enable optimal CBD Rail Link services to operate and patronage forecasts realised.

## 4.4 Option development and descriptions

A number of alignment and station options were considered. In general the station location options were determined to be centred within the three pedestrian catchments (those being within a 500m radius including consideration of gradients and operating distances) of Aotea Centre, K Road ridge and Newton (as shown on the plan included in Appendix 9).

### 4.4.1 Option Generation

A full description of the option development process is included within section 3 of Appendix 3. The option generation was undertaken in a series of steps, summarised as follows:

1. Review tunnel geometry and selection of single or twin bore configuration;
2. Review of existing alignments and determination of those which should be carried forward into this option generation exercise (using previous studies material);
3. Development of technically feasible vertical and horizontal alignments within the projects designated area of interest;
4. Developed generic station forms from international examples in a context of the general station location, space requirements, ground conditions and access;
5. Investigate technically feasible general station locations for 3, 2 and 1 station options based upon patronage catchments, rail operational considerations;
6. Investigated station and tunnel ventilation and building services needs to determine space requirements underground or in adjacent buildings;
7. Tailoring the generic station forms for proposed station locations, e.g. location of vent buildings, entrances and platform and plant layout;
8. Refine alignment options to workable vertical and horizontal alignments within the constraints of function requirements, existing buildings and structures (EBS) and ground conditions (using existing environment material);
9. Introduced additional alignment refinements for grade separated junctions and alternative radii to improve the option performance against the functional requirements; and
10. Check for fatal flaws in all alignment options and station options.

### 4.4.2 Development of Generic Station Forms

A number of key criteria were developed to guide the development of generic station forms. These are included within Appendix 3. Station option and rail alignment development has proceeded in parallel. The feasible alignments have identified likely station locations and potential station locations have influenced possible alignments. Three generic station forms (cavern, station box and double cavern (also referred to as a “binocular” cavern)) have been developed to accommodate the range of depths and construction environments encountered along the potential rail link. These generic forms will be customised to each confirmed station location in Phase 2, with associated services and means of access.

The technically feasible station form is determined by a number of factors, including but not limited to the following:

- Ground Cover;
- Space required for construction at ground surface;
- Clearances to adjoining buildings;
- Rolling stock;
- Concourse Access configuration interaction with station form;
- Relocation of utilities;
- Clearance to existing utilities;
- Pedestrian and Passenger Studies;
- Vertical Transportation;
- Civil and Structural Engineering;
- Building Services including Station and Tunnel Ventilation; and
- Fire and Life Safety Strategies.

The selection of station form is also done in the context of known construction costs and operational costs from experience of other similar developments e.g. Sydney, Perth, Hong Kong and Europe. The generic station forms were then applied to specific station locations and adapted to respond to alternative scenarios and context.

The architectural scope of these preliminary conceptual forms included:

- Assessment of the existing built environment;
- Assessment of critical platform dimensions and coordination with engineering design to develop generic station forms;
- Exploration of station locations with respect to possible entry points and service plant structures; and
- Exploration of station planning schemes.

The Phase 1 work has been sufficient to demonstrate a technically feasible arrangement is available, sufficient to rank alternative options and sufficient to identify the key constraints and issues to be carried through to Phase 2.

The final number of station portals, service structures, station location and operational requirements, along with the development of public place opportunities will be determined in the next phase of work. The architectural sketches included in Appendix 3 provide a number of scheme options and layout concepts to be carried forward for further development as required in Phase 2.

#### **4.4.3 Station Options**

A total of 12 Station location options have been generated (5 for Newton, 3 for K Road, 1 for CMJ station and 3 for Aotea) and these are described in full in Appendix 3 and summarised below. Within some station options there are possible variations that could be developed. The station locations can be seen on the plan attached in Appendix 10, and the station schemes are included within Appendix 3.

## Newton Station Options

- Newton 1 – This station option is parallel with Symonds St / New North Road and is centred under the Khyber Pass Rd/Newton Rd intersection.
- Newton 2 – The station underlies New North Road and Mt Eden Road, approximately centred on the intersection of these streets.
- Newton 3 – The station long axis for this option aligns with Exmouth Street, crossing under the intersection of Exmouth Street and New North Road, with the Southern margin of the station on the South side of Ruru Street.
- Newton 4 – This station option is perpendicular to Newton Rd and between St Benedicts St and Upper Queen St.
- Newton 5 – This station option is located within the existing NAL, centre to the Porters Avenue on-grade crossing.

## K Road Station Options

- K Road 1 - This option aligns with Pitt St and passes under the intersection of Pitt Street and Karangahape Road.
- K Road 2 - This option lies across Karangahape Rd, with the Southern end crossing Upper Queen St at an oblique angle.
- K Road 3 - This station is located on Symonds Street between Wakefield Street and K Road.

## Central Motorway Junction Option

- “Option 9” was based on the same alignment as alignment option 3 (refer to section 4.4.5 for a description of alignment option 3) except that the K Road and Newton station location options were replaced with one station location underneath the CMJ.
  - This option was discounted due to the lack of benefits of creating a station in this location.

## Aotea Station Options

- Aotea 1 - The station lies underneath Albert Street between Wellesley Street and Victoria Street.
- Aotea 2 - The station location for this option lies under Mayoral Drive from the intersection with Vincent Street. A part of the station construction envelope extends into the Western portion of the Aotea Centre site.
- Aotea 3 – This station would be located underneath Wellesley Street roughly centred on Albert Street in an ‘east – west’ axis.

### **4.4.4 Number of Stations**

A workshop was held on the 10th November 2009 to ascertain any apparent benefits in reducing the number of stations. A maximum of 3 stations were possible given the gradient constraints and while 2 and even 1 station alignments were considered there was no compelling reason to ‘drop’ the number of stations from 3. All alignments could accommodate 3 stations (or less if necessary). At this stage it was therefore determined that options should ‘not preclude’ accommodating 3 stations. Further discussion is included in section 5.2.1 below.

### **4.4.5 Alignment Options**

The overall rail link horizontal alignment options (a total of 14 alignment options) have been generated and these are described in full in Appendix 3 and summarised below.

The alignments were generated in three general phases and in consideration of previous alignment options. A 'base case' option (known as Option 2F from the Connell Wagner report undertaken in November 2008 (refer to section 4.1 above) was used and referred to as option 1. Generally the alignments were generated in accordance with the mandatory criteria (i.e. if the alignment did not meet the mandatory criteria they were altered where possible to rectify this).

These are as follows:

## **1st Phase Alignments (Options 1a, 1b, 1c, 2, 2a, 3 & 3a)**

First phase alignments were generated to set the maximum gradient required to provide a workable solution and were based around three stations within the tunnel alignment:

- Option 1a to 1c follow under Albert Street with a station at Aotea 1 or 2. The alignment then follows along Mayoral Drive and Vincent Street with a proposed station at K Road 1. The alignment goes underneath the CMJ to the west of Upper Queen Street and has a station at Newton 2 before turning out onto the NAL. The only difference between Options 1a, 1b and 1c is the curve radii onto the NAL.
- Option 2 - Option 2 follows under Albert Street with a station at Aotea 1 or 2. The alignment then follows along Mayoral Drive and Vincent Street with a proposed station at K Road 1. From K Road 1 the alignment follows to the west of Newton with a station at Newton 4, before turning out onto the NAL.
- Option 2A – Option 2a is similar to Option 2 except that the eastern turnout to the NAL is further to the west with a reduction of the NAL curve radii.
- Option 3 – Option 3 follows under Albert Street with a station at Aotea 1 or 2. The alignment then follows along Mayoral Drive and Vincent Street with a proposed station at K Road 1. From here the alignment veers further to the west of Newton with a station at Newton 3, before turning out in a tight curve onto the NAL.
- Option 3a – Option 3a is similar to Option 3 except for the K Road station location. Option 3a has a station at K Road 2 before curving back to Newton 3 station.

## **2nd Phase Alignments (Options 4, 4a & 5)**

Second phase alignments were generated to assess the effects of proposing two stations along the route instead of three, whilst providing for a transfer station on the existing NAL, effectively providing the third station:

- Option 4 – Option 4 was a refinement of Option 1c but with Newton 5 replacing Newton 1 as the station in Newton with a reduced curve radii.
- Option 4a - Option 4a was also a refinement of Option 1c, which replaced Newton 5 with the existing Mt Eden Station (albeit extended and rotated), with the approach to Mt Eden station from the east on the NAL.
- Option 5 – Option 5 follows under Albert Street with a station at Aotea 1 or 2 and station at K Road 1, before a station at either Newton 5 or at Dominion Road.

## **3rd Phase Alignments (Options 6 & 6a)**

Third phase alignments were completed based on refining the three station (within tunnel) alignments to suit the preferred station locations decided upon during a series of internal and external workshops:

- Option 6 – Option 6 follows under Albert St with a station at Aotea 1 or 2. The alignment then follows up Mayoral Drive and Vincent St with a station at K Road 1. The alignment passes under the CMJ in a diagonal direction (under Upper Queen St bridge) to reach the Newton 1 station, before turning out onto the NAL.
- Option 6a – This option is similar to Option 6 except the alignment has a station at K Road 2 and does not cross under Upper Queen St Bridge.

## Previous URS alignments

- Option 7 - Option 7 is based on “URS 3A and 3B” in URS Britomart West Rail Extension study of 2004 and follows the Dominion Road corridor with a NAL turnout around the Dominion Road flyover, the western most turnout of the options. Potentially this could provide a transport interchange with a large number of Dominion Road buses.
- Option 8 – Option 8 is an alignment based on the alignment identified as “URS 5” in URS Britomart West Rail Extension study of 2004. It follows a westerly direction onto Fanshawe St before turning onto Nelson St with a tight turn east onto Wellesley St where station Aotea 3 is located. From Wellesley St the alignment has another tight curve onto Symonds St where station K Road 3 is located. The alignment then heads down Symonds Street to Newton 1 station and turns out onto the NAL.

## 4.5 Constructability Features and Differentiators

The proposed rail link passes through some of the most densely populated and highly developed areas in New Zealand and will need to be built within major streets adjacent to existing businesses. Whilst this presents many challenges for the project it is a common feature where underground metro projects are built through established urban environments. In our region most Asian and Australian cities have faced this challenge, such as Perth, Sydney, Hong Kong, Singapore, etc. The technology and systems to design, build and operate such an underground link are well established, and APB&B have been able in developing and evaluating these options, to bring this specialist international knowledge and experience of similar projects to this study. An important difference to note between Auckland and other cities in the region is the ground topography and level changes between the suggested station locations.

The very nature of construction can be highly disruptive and impact significantly on the environment which necessitates particular attention being made to utilise techniques and configure the design to minimise these effects. The primary factors that were considered in developing the options and construction methodologies include:

- Protecting existing buildings and structures, including utilities and groundwater;
- Minimizing disturbance to the built environment and the impacts to the current urban activities;
- Access for construction and surrounding properties;
- Delivery of equipment and materials and removal of spoil; and
- Use of cost effective and rapid methods.

The purpose of this section is to highlight those constructability differentiators between the options that were considered as a part of the assessment process. Firstly it is important to gain an overall understanding of the construction methods which are common to all options.

### 4.5.1 Tunnels

Given the depths of the tunnel and the highly developed nature of the land the tunnel alignment could follow, the less disruptive Tunnel Boring Machine (TBM) construction methodology was

agreed to be the most appropriate construction option for as much of the running tunnels as possible. However, there are still significant sections of the route which cannot be constructed this way, which include the section from Britomart to Albert St, the 3 stations (Aotea, K Road, and Newton) and the connection from Newton Station to the North Auckland Line (NAL), where the east and west alignments curve tightly to reach the existing rail corridor. These elements require construction of cut and cover boxes (top down for some elements such as Aotea) or “RoadHeader” mining type equipment.

The main feature of a TBM is that it excavates, supports the virgin ground, and then lines the excavated hole in one continuous operation, and hence provides a very robust solution to ground support and minimising the risk of ground movements. However TBM's are complex, sophisticated and expensive factories under the ground. They have limitations on the curve radii they can transit, and of course can only dig round holes. Also the logistical support for spoil, lining, personnel and materials is considerable in its extent and room required.

Roadheaders mine the ground using rotary wheels in particular sequences depending on the rock geology, and then ground support systems follow behind. Providing the ground has sufficient strength, this technique has more flexibility in shape but is considerably slower than a TBM.

At this stage it is envisaged that the main TBM launch and service site will be located at the south end of the alignment close to the NAL, where suitable land is more readily available and environmental impacts will be less than locating it at the bottom of Albert Street, which would also be disadvantaged more by the length of time that would be required for the TBM operation to occupy the Westfield site. However, tunnelling downhill has particularly difficult issues to overcome with water control. These factors will be investigated and resolved further in Phase 2 as they are the same for all options considered, with the exception of option 8, which potentially has even greater lengths of cut and cover construction at its northern end.

The main rail running tunnels will be bored tunnels constructed using modern earth pressure balance tunnel boring machines (EPB TBM's), to control ground movements and impact on groundwater. These sophisticated machines require major back up facilities above ground to deliver components and remove muck. As such the location of construction sites is critical. They also operate 24 x 7, requiring management of noise and spoil disposal movements.

The running tunnels will be connected by cross passages for emergency egress at intervals of approximately 250m. It is currently envisaged that additional escape stairs and / or ventilation shafts will not be required given the spacing of stations. However, this conclusion will need to be revisited should a lesser number of stations than 3 be provided for.

## 4.5.2 Stations

Construction methodologies for the stations included:

- Generic Cavern;
- Generic Cut and Cover Box;
- Generic Cut and Cover Box with centre columns; and
- Generic Double-Cavern.

These are further explained within Appendix 3 with the construction of each station option differing depending on the depth of the station.

The generic cavern requires the main station platforms to be built in a single underground excavation, with connections to associated shafts and structures for access, concourses and plant.

In order for this type of construction to be feasible, a sufficient thickness of competent rock is necessary above the station cavern arch. The alignment options reviewed in this Study present opportunity for this form at K Road and Newton areas. This form allows a deep station to be built economically as it optimises excavated volume to station functions, reduces the impact during construction (particularly relating to the more limited hole sizes at the ground surfaces), whilst still delivering a high quality internal environment. Examples of this station form are found on the recently completed Epping to Chatswood rail link in Sydney.

The generic cut and cover box form of station (here envisaged for Aotea 1 and 2) is the most common solution for stations at shallower depths in confined urban areas (e.g. Perth Metro and Sydney's Airport Link). Typically it requires a box to be formed from street level using vertical walls to support the ground and keep out groundwater, with the inside then constructed by first building the ground level deck and then constructing top down. It is a tried and tested approach suitable to rail depths of up to about 25m. However, it does require the closure and/or significant disruption of existing streets within the station footprint. The preference for these stations is for them not to require internal central columns to support the roof and road above. Adding those columns is a variant sometimes necessary for structural integrity. This will be further examined in Phase 2.

A double cavern is a variant of the single cavern, in which two bores are used for the platform tunnels connected by large cross-passages. Its main advantage is that it reduces excavated volume and can be built in weaker ground than the full single span. However, the quality of the resulting public space is somewhat compromised as a result. This form may be an option for the deeper K Road and Newton stations should a single cavern prove inappropriate.

#### **4.5.3 Constructability Differentiators**

##### **Stations**

##### **i. Aotea 1, 2 and 3**

Both Aotea stations 1 and 2 would be built as cut and cover boxes via the top down construction technique and have similar challenges. However, Aotea 1, being located between Victoria and Wellesley Streets, is tightly constrained by adjacent buildings, and in particular has a major effect on access to the Crown Plaza for both public and services. It has opportunities with a number of adjacent sites, which could potentially be integrated into the design or used to ease construction. In order to keep this section of Albert Street open, the construction will be slow and fragmented, requiring a half street closure at a time. An alternative is to close the entire street between Victoria and Wellesley until the top deck has been constructed, although this would have acknowledged greater impacts on the road operations. The station construction could then be undertaken from beneath this deck with access achieved from more restricted sites.

Although Aotea 2 has more space around the station and may even be able to be mined at the south end, it may require further cut and cover works to be extended in a northern direction (which would also impact the Crown Plaza and ASB buildings in a similar manner to Aotea 1), as the depth of cover to the top of the running tunnels leading to the station are insufficient for TBM construction. The impacts on the operating street are therefore not likely to be less than Aotea 1 and indeed may be greater. The Public Trust heritage building currently straddles the end of the box and this is likely to be impacted. This will lead to significant engineering challenges to mitigate these impacts. Early work suggests that moving the alignment away from this building by introducing of a 400m horizontal curve at this location causes considerably greater impacts and hence this has not been progressed.

Aotea 3 would be set deeper than either station at locations 1 or 2 to allow the running tracks to pass under Queen Street with reasonable cover. The approx 200m length of the station crosses the ridge line along Albert Street obliquely so that cover on the rail level decreases at each end. These considerations make it inappropriate to construct the station using top down methods and it will need to be a cavern form. This will reduce impacts on the surrounding buildings, but places more constraints on the location and form of the concourse level, entrances and service connections. The proximity of the ASB building and prestigious older buildings to such a large cavern make excavation and support challenging.

## **ii. K Road 1, 2 and 3**

Both K Road 1 and 2 would be constructed utilising a similar cavern construction method. Access would be restricted and constrained by the adjacent Heritage buildings. However, K Road 2 is likely to have a greater impact on existing buildings and require extensive mitigation works. Furthermore, at Myers Park the station cavern gets quite shallow and may impact on surface features.

K Road 3 station is a cavern form but at considerable depth, due to being of the vertical alignment climb towards the NAL. The street width here is sufficient for the station to be constructed in public land although there are several larger buildings to the east. It is anticipated that the cavern would be in sound ECBF rock but the depth presents some challenges in the form of connections to the surface.

## **iii. Newton Stations**

Newton 1 and 2 (as cavern stations) would be constructed under Symonds Street and have very similar constructability issues. They differentiate with Newton 3 and 4 in having less invasive construction impacts. Newton 3 is a cut and cover box, thereby having similar challenges to the Aotea stations and significant impacts on the built environment. Newton 4, as a binocular cavern, still has significant surface disruption, and being shallower there is a significant risk that this construction form on detailed investigation will fail to meet the mandatory technical and overarching project criteria.

## **Alignments**

### **i. General Alignment**

Most of the alignments considered were very close (within 10%) in comparison of overall length.

### **ii. Option 8 Alignment Length**

The exception to the difference in overall length is Option 8, which is some 800m longer than the other options. This factor, plus the extensive cut and cover works at the northern end along with the amount of time that the construction establishments would prevent ongoing use and development, will be significantly greater than the other options. Option 8 was previously promoted in the URS report (URS alignment 5).

### **iii. Option 8, Northern End**

This alignment requires a considerable length of cut and cover construction along Fanshawe Street. This is needed in order to build the running tunnels before the alignment turns south and gets sufficient rock depth to commence tunnelling. Traffic diversions and staging will be necessary to keep this heavily trafficked arterial route running. This is also likely to require adjacent properties for

worksites and hence the impacts for this option are considerable greater than the other options with respect to running tunnel construction.

#### iv. Building impacts

As part of APB&B investigations an analysis of the impacts on buildings along each alignment was undertaken and this was fed into the evaluation process. The analysis looked at the impacts under five categories:

- the number of properties potentially impacted along each alignment;
- how many of these were piled structures;
- the number of storeys buildings impacted;
- the number of buildings impacted; and
- the number of heritage listed buildings which were alongside or over each alignment.

Table 4 below shows the information gathered during these investigations. It is noted that this table includes buildings which are on or touch each alignment. It does not take into account any buildings which have settlement away from the alignment, as with the current level of information regarding water levels this cannot be confirmed. Further investigations early in 2010 will clarify whether buildings away from the alignment will be affected by settlement.

**Table 4**

<b>Alignment (Within 4m of Tracks)</b>	<b>Number of Properties</b>	<b>Number of Piled Structures</b>	<b>Number of Storeys</b>	<b>Number of Buildings</b>	<b>Heritage (Alongside or over)</b>
Option 1c	118	7	174	62	20
Option 2	78	8	143	49	15
Option 2a	69	6	130	43	15
Option 3	65	9	124	39	15
Option 3a	104	11	192	58	9
Option 4	111	6	168	61	21
Option 4a	82	5	148	40	19
Option 5	82	10	153	50	15
Option 6	71	4	121	37	16
Option 6a	100	8	197	39	8
Option 8	81	8	198	51	19

It is clear from these results that option 6 has the least impact on buildings along any of the alignments, although it does not have the least impact on Heritage buildings. Option 6 has only approximately 60% of the impact on buildings along its route when compared to that of option 1c and option 6 is therefore likely to require significantly less building take. When compared to option 6a the percent is slightly less but still very significant but 6a did have the least impact on heritage buildings.

## 5 Options Evaluation Summary

The overarching and project specific objectives (see section 2.2.1 of this report) focus on passenger transport patronage, modal integration, and land use and economic development potential of the CBD Rail Link. As these benefits are primarily related to stations, APB&B considered that the option evaluation process should concentrate on determining the optimum number and location of stations, whilst also ensuring that there were feasible alignment options to link the station locations.

Accordingly the steps of the evaluation process were as follows:

- 1 Ensure all options meet mandatory technical criteria
- 2 Coarse screening to confirm maximum number and broad areas for stations (1, 2 or 3 stations)
- 3 Evaluate specific station locations to determine the highest ranking station sites
- 4 Identify and rank feasible alignments which link optimal station locations to shortlist options
- 5 Weighting and sensitivity testing to confirm shortlisted options

### 5.1 Coarse screening of Options – Mandatory Criteria

Initially, the options were screened against the mandatory criteria. These criteria were also used to discard alternatives considered during the option generation stage. Any options which did not meet all of the criteria were eliminated at this early stage. Table 5 shows a summary of this coarse screening.

**Table 5 – Coarse Screening of Options against the Mandatory Criteria**

Criteria	Option Number – Meet Criteria? (Y/N)													
	1A	1B	1C	2	2A	3	3A	4	4A	5	6	6A	7	8
The alignment shall link Britomart to the North Auckland line (in the vicinity of Mt Eden)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
The alignment converts Britomart to a through station by extending the existing tracks on platforms 1 and 5	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
The alignment provides Eastern and Western connections to the NAL at Mt Eden	<b>N</b>	<b>N</b>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	<b>N</b>	Y
The alignment allows for provision of double track alignment	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
The alignment facilitates a future passenger Interchange with the North Shore Line	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
The alignment does not require dedicated CBD Rail link services and rolling stock (i.e passenger services using the CBD Rail Link are part of integrated Auckland rail network)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
The desirable maximum gradient of the alignment should be 2.5% uncompensated (or 3% when compensated for effect of curvature). The absolute maximum gradient shall be 3.5% uncompensated (4% compensated)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
The desirable minimum horizontal curvature of the alignment should be 300 metres radius. The absolute minimum horizontal curve radius shall be 130m	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Stations shall be able to accommodate 170m long platforms	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
The desirable maximum gradient of station platforms should be 0.25% The absolute maximum gradient shall be 0.5% (value to be confirmed)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

As a result of the coarse screening process Options 1a, 1b, and 7 did not get taken forward for evaluation under the workshop option evaluation criteria. This was because of their inability to provide for feasible western and eastern connections to the NAL. In terms of option 7 it is noted that moving this alignment to the east to provide for this connection would generally replicate another existing alignment option.

The alignment options and station locations carried through to the next stage of the evaluation process are shown in Appendix 10.

## 5.2 Final evaluation

Following the coarse screening the remaining options were evaluated in Workshops 1 – 4 using the methodology outlined in section 2.5.3. The scores and comments from each workshop are included within Appendix 7 and are summarised by Workshop below.

### 5.2.1 Workshop 1 - Number of Stations (1, 2 or 3)

#### Aim

The aim of this Workshop was to recommend the *number* of stations (1, 2 or 3) for any of the alignments between Britomart and the NAL. The number of stations was evaluated against criteria sets 1.0 and 2.0 (included in Appendix 2). The test used was: “Is there was any reason to eliminate a station in Newton/Mt Eden, K Road or Aotea at this stage in the Study?” (i.e. maintaining maximum flexibility of station options).

#### Results

- From this Workshop, the number of stations were recommended to be taken forward was 3 stations (in comparison to 1 or 2 stations), for the following reasons:
  - Promotes more opportunities for economic development and intensification/urban renewal;
  - Achieves better transport and land use integration;
  - Allows for improved penetration throughout the Study area which also promotes active modes of transport to/from the stations (i.e. walking, cycling);
  - There are three distinct areas to be serviced by the line (around Aotea Centre, K Road and Newton);
  - Allows for ‘within CBD’ trips as well as ‘to/from CBD’ trips;
  - Improves journey flexibility for rail users;
  - Further comments and scores are included in Appendix 7.
- Having 4 stations along the route was considered; however due to the gradients required for the alignment (in order to reach the NAL at grade) and station operational requirements (requiring a maximum gradient of 0.5% for the platforms) meant that this was not feasible for all of the routes except possibly Option 8. In addition a fourth station’s 500m catchment would likely significantly overlap the catchments of adjacent stations.

### 5.2.2 Workshop 2 – Station Locations (Preliminary)

#### Aim

The aim of this workshop was to evaluate the station location options and feasible alignments between the highest ranked station locations. A plan of the alignment options and stations is included as Appendix 10.

The stations were evaluated against criteria categories 3.0, 4.0 and 5.0. The feasible alignments were then evaluated against criteria categories 1.0 and 6.0.

#### Results - Stations

The results of this workshop was that the highest ranked stations for each area were Newton 1, K Road 1 and Aotea 1:

- Newton 1 was identified as the highest ranked station of the Newton options because:

- Its location in the centre of the Newton area, a future node/hub (noted by Auckland City's future framework), with good potential for mixed use development within the 500m catchment of the station ;
  - Integration with other public transport modes to the CBD, Newmarket (and routes from there), Dominion and New North Roads to the west and Mt Eden to the south;
  - Opportunity to enhance existing active frontages and amenity and improve the area as a focal point;
  - The ability to construct a concourse under the intersection of Symonds Street, Khyber Pass and Newton Road, enhancing connectivity within this area;
  - Flexibility in design, with a number of options available to provide access buildings and portals; and
  - Fewer dependencies on the requirement to gain private landowner agreement and land acquisition (as Newton 1 is generally located within the road reserve).
- K Road 1 was identified as the highest ranked station of the K Road options because:
    - Its central location on the Karangahape Rd ridge , promoting both access to the immediate area servicing both residential, retail & commercial and leisure/visitor land use activities, but also connectivity to good level and largely covered walking routes in both directions towards the Hospital and towards Ponsonby Rd;
    - Opportunities for development on K Road and Mercury Lane;
    - Fewer dependencies on the requirement to gain private landowner agreement and land acquisition (as K Road 1 is generally located within the road reserve); and
    - To provide increased penetration of public transport services into this area (currently it is only served by the Link Bus and bus services from Western areas).
  - Aotea 1 was identified as the highest ranked station of the Aotea options because:
    - Ability to provide a station entrance on the corner of Mayoral Drive and Wellesley Street as a focal point;
    - Potential interchange with bus services on Albert St;
    - Good pedestrian connections to Queen Street, Albert Street, Sky City, Aotea Square, the Universities and the Victoria Quarter;
    - Opportunities for access from adjacent buildings (e.g. the proposed Dai Ju Development on the current Bungy Jump site ); and
    - No heritage buildings affected.
  - The scores (including weighted scores) and further comments are included in Appendix 7.

In summary, the stations were given the following weighted scores and subsequently ranked (with the weighting being criteria 3.0 (Station Location) - 50%, criteria 4.0 (Operational Impacts) - 40%, and criteria 5.0 (Construction Impacts) - 10%).

### Newton Stations

Station	Score	Ranking
Newton 1	39.72	1
Newton 2	38.37	2
Newton 3	30.51	4
Newton 4	29.38	5
Newton 5	33.37	3

## K Road Stations

Station	Score	Ranking
K Road 1	35.79	<b>1</b>
K Road 2	34.15	2
K Road 3	33.62	3

## Aotea Stations

Station	Score	Ranking
Aotea 1	37.88	<b>1</b>
Aotea 2	35.33	3
Aotea 3	36.08	2

### Results - Alignments

The stations were then combined as Newton – K Road – Aotea groupings to determine which (if any) alignments matched the station combinations. The top ranked station combinations were as follows (with the feasible alignments in **bold**):

Ranking	Station Combinations	Feasible Alignment?	Alignment
<b>1</b>	<b>N1-K1-A1</b>	<b>Yes</b>	<b>6</b>
<b>2</b>	<b>N2-K1-A1</b>	<b>Yes</b>	<b>1c</b>
<b>3</b>	<b>N1-K2-A1</b>	<b>Yes</b>	<b>6a</b>
	N1-K1-A3	No	N/A
<b>4</b>	<b>N1-K1-A2</b>	<b>Yes</b>	<b>6 with A2</b>
	N1-K2-A3	No	N/A
<b>5</b>	<b>N2-K1-A2</b>	<b>Yes</b>	<b>1c with A2</b>
<b>6</b>	<b>N1-K3-A3</b>	<b>Yes</b>	<b>8</b>
<b>7</b>	<b>N1-K2-A2</b>	<b>Yes</b>	<b>6a with A2</b>
	N2-K2-A3	No	N/A
	N2-K2-A2	No	N/A

The top 3 feasible alignment options which accommodate the above mentioned stations were 6, 6a and 1c. Due to the closeness in scoring between some of the stations, option 8 was also included. Further comments and discussion was made regarding the alignments. These comments included:

- Option 6 (ranked the highest) could have issues with piles on the Upper Queen St Bridge over CMJ; however it was noted that the alignment could possibly be amended to avoid this bridge.
- Option 6 and 6a both had fewer effects on heritage buildings than 1c and 8.
- Options 6, 6a and 1c are similar in length; whilst option 8 is approximately 700m longer.
- Option 8 would require a large section of cut and cover construction along Fanshawe St due to shallow depths on the approach to Britomart. This is considered to be technically challenging and a major construction impact on traffic (whilst the other options are largely bored tunnel and would have less impact on traffic / more manageable).

- Further comments are included in Appendix 7.

## Weighting and Sensitivity Testing – Workshop 2 Results

Following the Workshop the scores were subjected to sensitivity testing to ascertain any changes if the weighting was adjusted for any category of evaluation criteria (making up the overall score for each station option). The results of these sensitivity tests are documented in section 6.1.

### **5.2.3 Workshop 3 – Client Organisation Evaluation**

#### Aim

- The aim of this Workshop was to present the evaluation process and results to OTNRACK and ARTA.

#### Results

- From this Workshop the scoring of the stations and alignments did not change, with the highest ranked three options (Options 6, 6a and 1c) remaining the same.
- It was noted that the broad routes defined at present may contribute to the minor variations between the top three options, and that additional work could be undertaken in order to come up with one preferred alignment option (e.g. groundwater investigations).
  - Further comments and scores are included in Appendix 7.

### **5.2.4 Changes following Workshop 3**

A number of changes were made following Workshop 3 to both the criteria and scores as a result of discussions on the day. These are included in Appendix 7 along with explanatory comments. It is noted that no changes were made to the operational and construction impacts criteria and therefore these are not included in Appendix 7 for this section. The changes involved the following:

- Overarching Criteria 1.0 (Number of Stations):
  - Changes to scoring for criteria 1.1
  - Changes to criteria 1.3 and 1.7
- Criteria for Number of Stations 2.0:
  - Changes to criteria 2.3
  - Changes to scoring and criteria for criteria 2.5
- Overarching Criteria 1.0 (Alignments):
  - Changes to criteria 1.3 and 1.7
  - Changes to scoring for criteria 1.8
- Alignment Specific Criteria 6.0:
  - Changes to criteria 6.5-6.7
  - Changes to scoring 6.6-6.7.

### **5.2.5 Workshop 4 – Stakeholder Evaluation**

#### Aim

- The aim of this Workshop was to present the preliminary evaluation process and results to Auckland City, ARC and MOT officers.
- Following Workshop 3 a number of changes were made to the criteria (which is reflected in the final criteria noted in Appendix 2).

- The APB&B team led the stakeholders through a description of the options evaluation (including option generation) process and the scoring and comments undertaken to date.
  - The stakeholders were then given the opportunity to discuss the station options, alignments and scoring given.

## Results

- As a result a number of changes were made to scores and an additional criteria was added:
- Criteria 3.0 – Station Location Criteria:
  - 3.1: The K Road station scores were changed to reflect the high number of existing employees and residents around K Road 3 compared to K Road 1 and 2, increasing K Road 3 to score 5 and decreasing the other two stations from 5 to 4. This information about existing numbers in each area were discovered following Workshops 1 – 3.
  - 3.2: The K Road station scores were changed to reflect that all stations support this criteria similarly providing a number of public/community facilities, services and centres, therefore all stations scored 4.
  - 3.5: Due to the radius distances noted within this criteria it was considered that all Newton station options had a fairly even development potential, hence the scores were changed to all 4's. K Rd 3 did not receive a 5 as it was considered that due to the number of modern buildings new opportunities for development was likely to be within K Rd 1 and 2 areas.
  - 3.11: Aotea 1 station was increased from 2 to 3 to reflect the flexibility in design that the station provided due to the multiple areas available to provide for access including safety design.
  - 3.12: Aotea 2 was reduced from 3 to 2 as to reflect the importance of affected heritage building and the issues that this may raise.
  - New Criteria 3.13: Accessibility for visitor attraction. This was thought to represent the 'visitor' numbers to each area of Auckland City for (amongst others) entertainment, shopping and restaurant/bar activities. Newton 1 and 2, K Road 1 and 2 and all Aotea options were scored highly; however K Road 1 and 2 and Aotea were considered to be closer in proximity to attractions with subsequent larger visitor/leisure numbers than Newton 1 and 2 hence were given scores of 5.
- Criteria 4.0 – Operational Impacts Criteria:
  - 4.10: It was considered that this criteria was 'doubling up' with other criteria (such as 3.4) and as such all options were given a neutral score.
  - 4.11: It was also considered for this criteria that there was a 'doubling up' with other criteria (such as 3.2) and as such all options were given a neutral score.
- Criteria 6.0 – Alignment Specific Criteria:
  - 6.2: Option 8 was reduced from 2 to 1 to reflect the land requirements needed for the northern portion of the route requiring cut and cover to Fanshawe St (and possibly a section of Auckland University of Technology).
  - 6.4 The Criteria was slightly altered by taking out 'reduced' and 'costs' so that the criteria read 'the alignment provides optimal line speed and ~~reduced~~ operations and maintenance ~~costs~~'. This was done because 'reduced' combined with 'costs' indicated that the alignments were compared to each other which was not done for any other criteria (which were scored independently).
- Further comments and discussions are included in Appendix 7.
- The changes in scores however did not change the overall rankings.

## 5.2.6 Stakeholder Meeting – 11 December 2009

### Aim

The aim of this meeting was to continue the stakeholder meetings as described in section 3.1.

The key stakeholders who attended workshop 4 provided at the time, and via communications following, their inputs into what criteria categories and individual criteria should undergo further sensitivity testing. Therefore, in addition to the usual discussion topics at this meeting, an evaluation update on the further sensitivity testing undertaken post workshop 4 was provided. The opportunity was also taken by the APB&B team to provide an update on patronage forecasts.

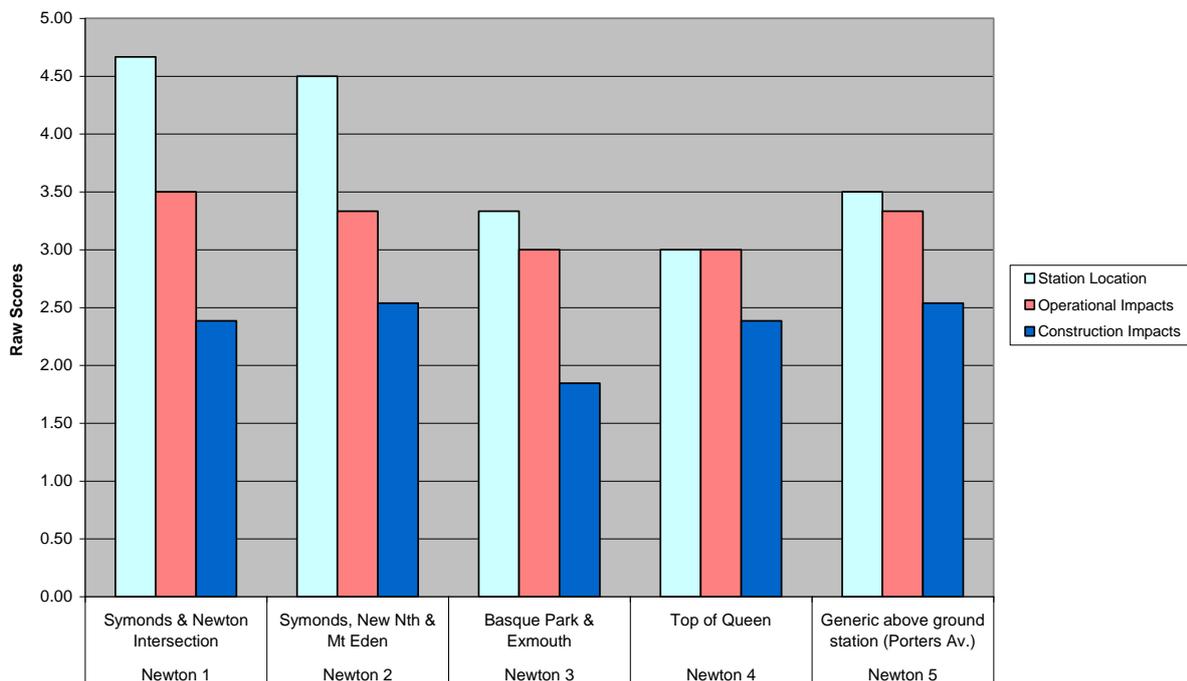
### Results

The results of the further sensitivity testing undertaken is provided in section 6. The information on the patronage forecasts is included in Appendix 4.

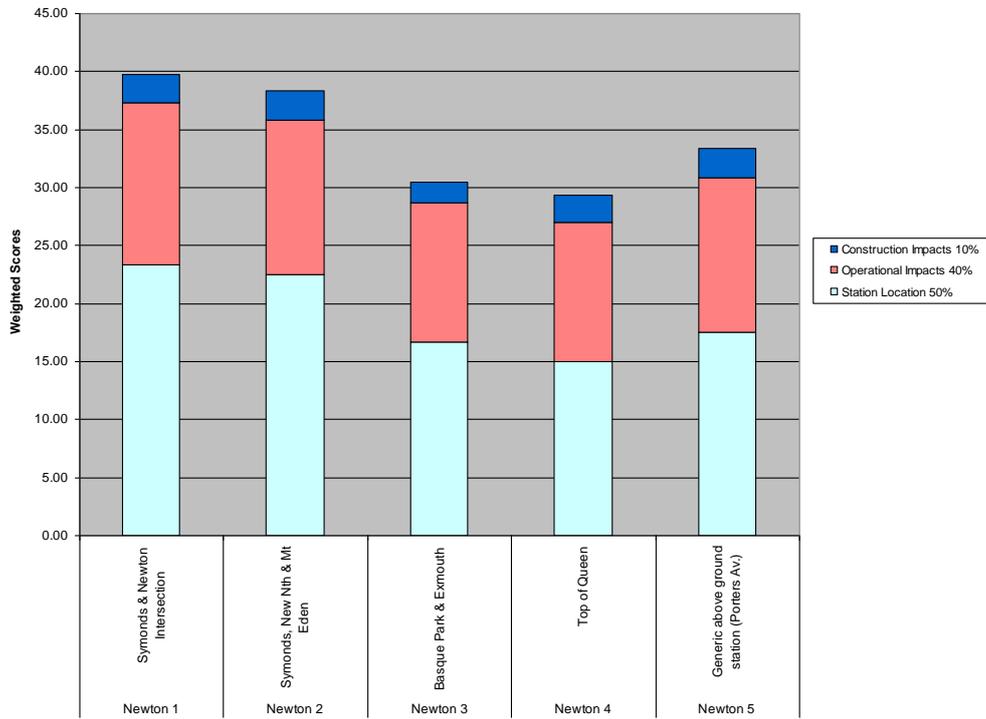
## 5.2.7 Multi-Criteria Evaluation Results

A summary of the results at the conclusion of the multi-criteria evaluation process described in sections 5.2.1 to 5.2.6 are shown on the following graphs (figures 4 to 10).

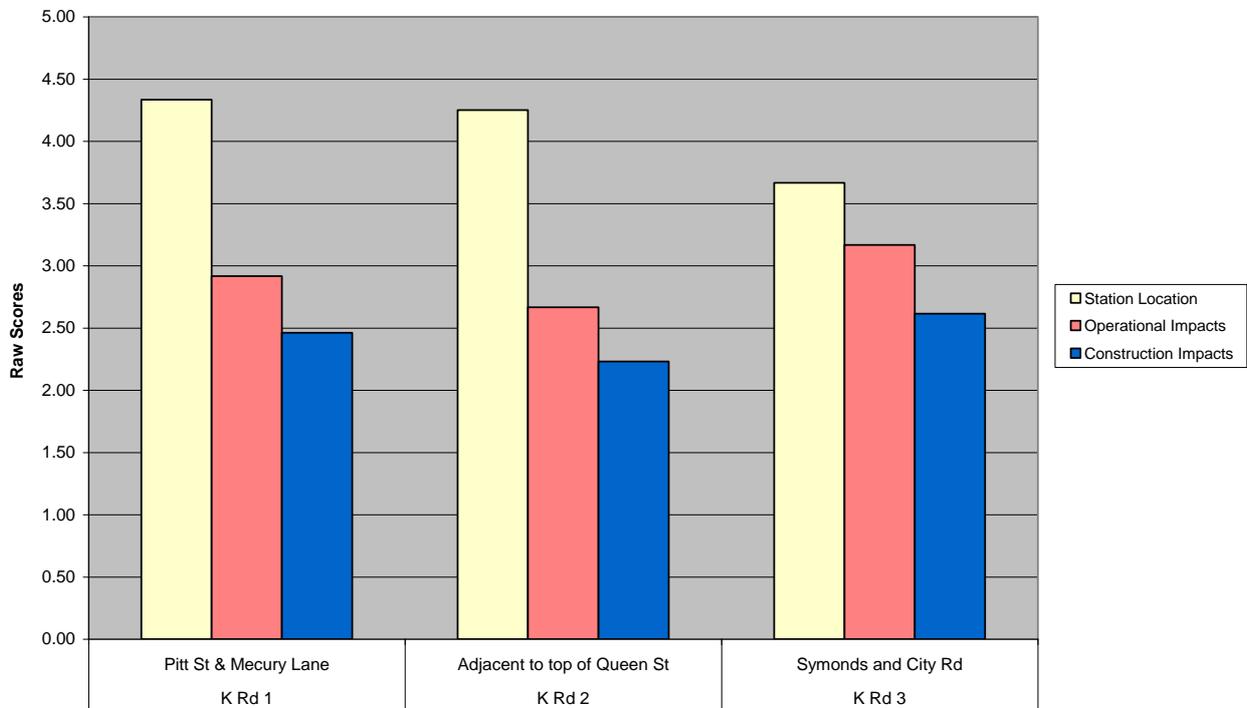
**Figure 4 – Newton Station Locations (Neutral Weighting)**



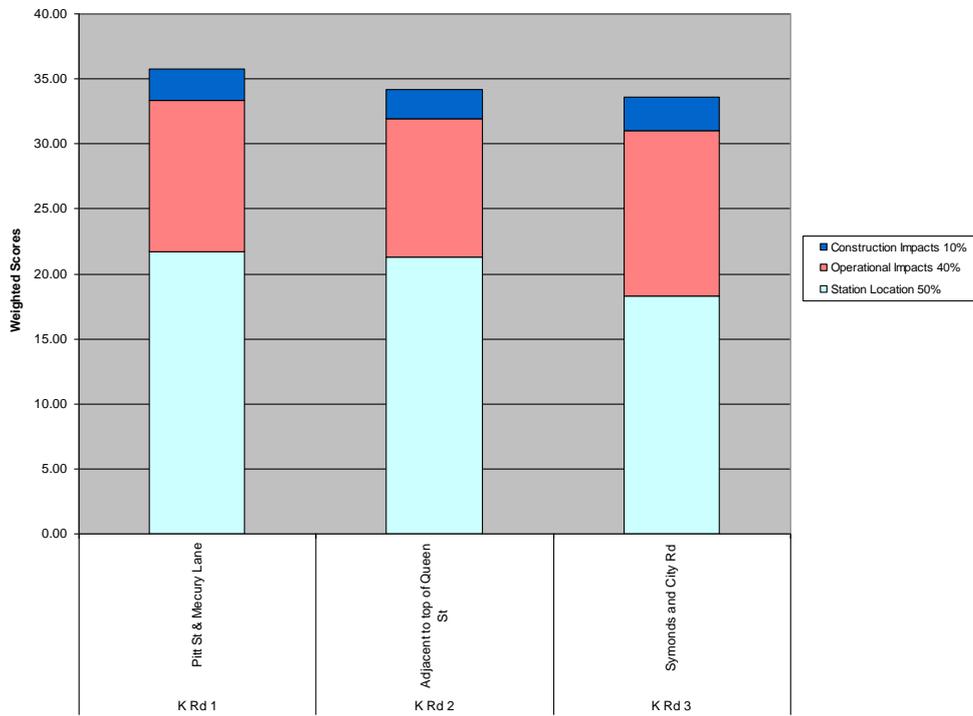
**Figure 5 – Newton Station Locations (Weighted)**



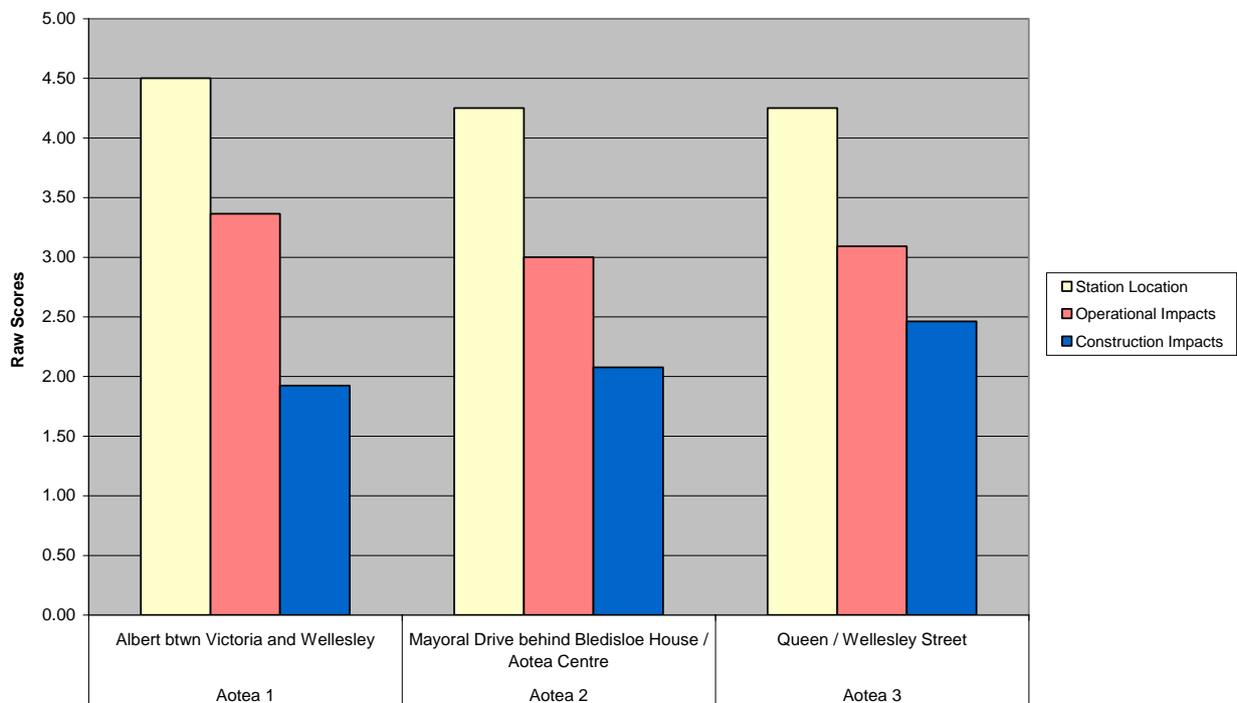
**Figure 6 - K Road Station Locations (Neutral Weighting)**



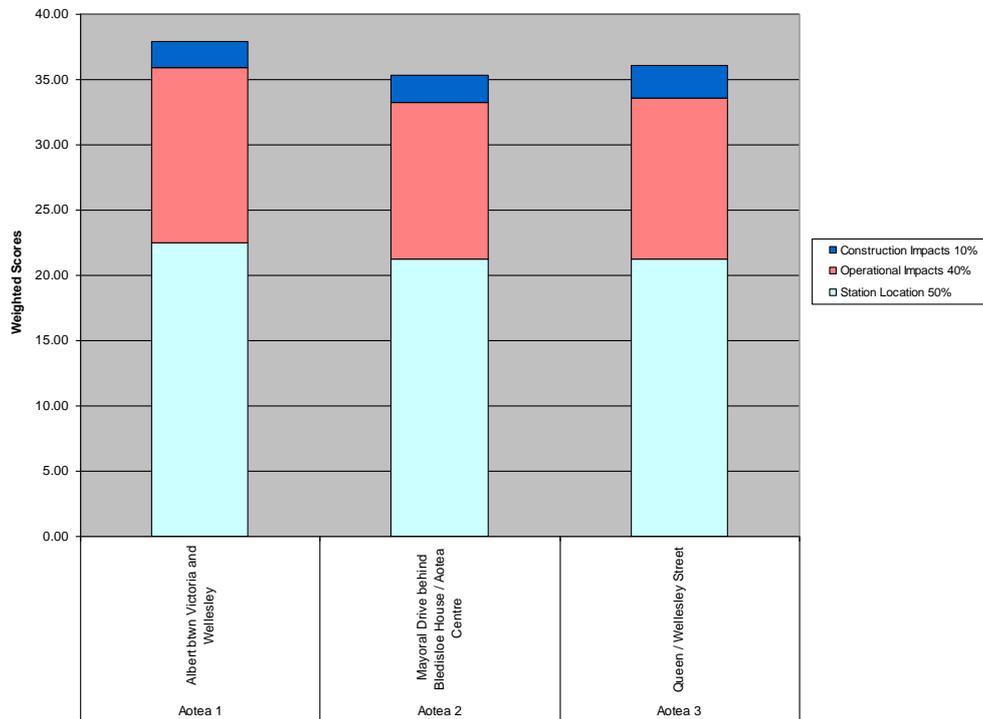
**Figure 7 - K Road Station Locations (Weighted)**



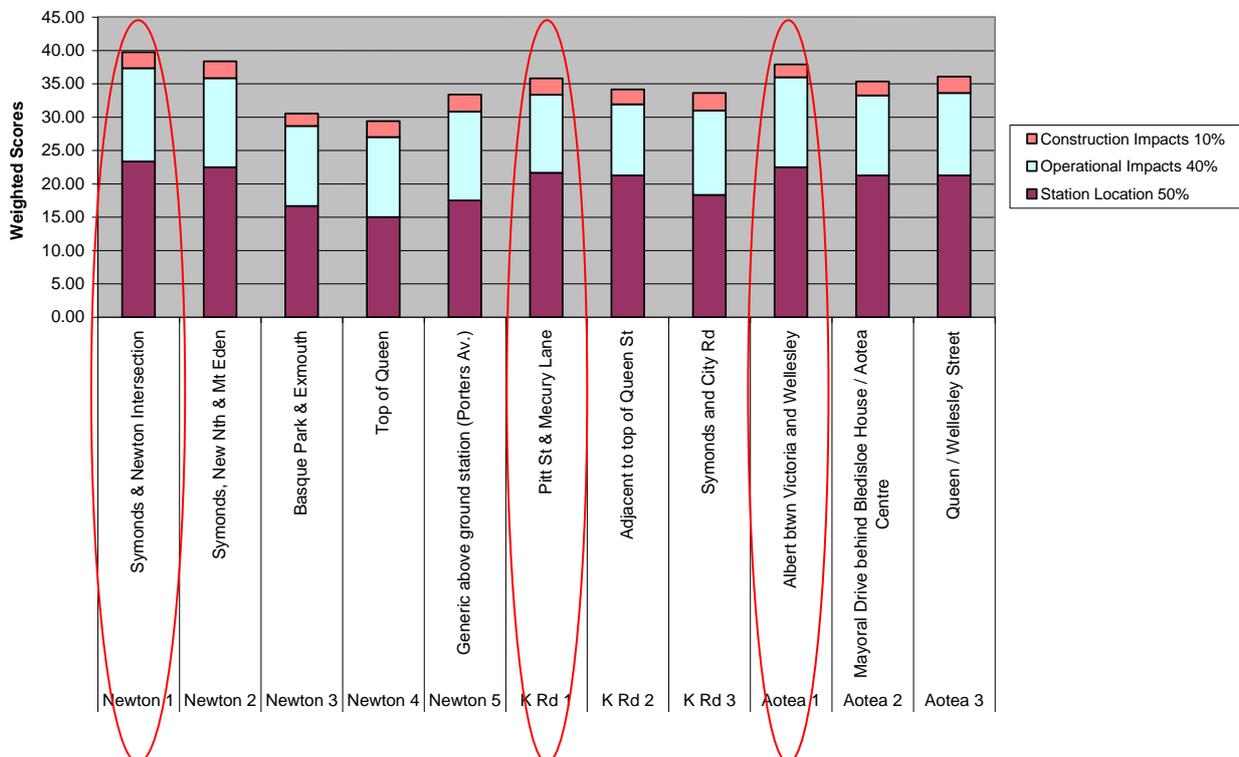
**Figure 8 - Aotea Station Locations (Neutral Weighting)**



**Figure 9 - Aotea Station Locations (Weighted)**



**Figure 10 - All Station Locations (Weighted)**



Note: The highest ranked stations are circled in red.

## 6 Weighting and Sensitivity Testing

Weighting and sensitivity testing has been undertaken to ensure robustness of the multi-criteria evaluation process and to determine the impact on these evaluation results of:

- Changing the weightings applied to each category of evaluation criteria making up the total score for each station location option; and
- Applying weighting to specific criteria within each category of evaluation criteria.

### 6.1 Changes to Category Weightings

During the initial evaluation stages criteria were neutral (non-weighted), so that the short listed options result from a 'base evaluation'. However, combined scores for each of the station locations were derived using the following evaluation category weightings:

- 3.0 - Station Location- 50%
- 4.0 - Operational Impacts- 40%
- 5.0 - Construction Impacts- 10%

These weightings recognise that typically the construction period for large infrastructure projects such as the CBD Rail Link lasts for only a very short portion of the overall project lifespan, and that the operational effects are a permanent fixture. Upon reflection of the project objectives the importance of the station location criteria (and subsequent weighting) was identified.

Sensitivity testing was undertaken using both neutral weightings for these categories (33.33% each) and a higher construction impact weighting of 20% (reducing operation impacts to 30%). Although this resulted in slightly different results (generally lower scores for both sensitivity weightings), the rankings only changed for some stations in regard to the neutral weighting. These changes in ranking were as follows:

- Newton 4 scored slightly higher than Newton 3;
- K Road 3 scored higher than K Road 2; and
- Aotea 3 scored marginally higher (0.05) than Aotea 1.

For both Newton and K Road these sensitivity weightings did not change the highest ranked station in each area. Aotea 3 was included as option 8 was initially carried through as an alignment option (the only alignment to have this station). Graphs displaying these weightings are included in section 5.2.7.

### 6.2 Weighted Criteria

The impact of applying weighting to some criteria within each category was tested to check for any change of ranking or relativity between options. The process followed was:

- A weighting (percentage of overall category score) was applied evenly to selected criteria in each category – i.e. weight / number of weighted criteria;
- The balance of score was applied evenly to remaining criteria i.e. ( 100%- weight %) / number of unweighted criteria;
- A weighted score was calculated for each option and criteria and the sum of the weighted scores was compared to the average raw score for each option; and

- The weighting applied was varied between 10% and 90% and changes to the ranking of and gaps between options were examined.

The results of the criteria weighting sensitivity tests are described following.

## 6.2.1 Overarching Criteria

Weighting was applied to the overarching criteria scores for the 4 highest ranking alignments:

- 1.1 - assists economic development
- 1.6 - optimises PT patronage
- 1.7 - provides operational flexibility

Increasing the weighting percentage up to 90% was found to widen the gap between the top 3 ranking alignments (6,6a and 1c) and Option 8. This indicated that option 8 was less effective at supporting these criteria and strengthened the conclusion that it was a less preferred alignment than the other top ranking alignments

## 6.2.2 Number of Stations

Weighting was applied to the following criteria:

- 2.1 - potential growth area
- 2.2 - realisable development potential

Increasing the weighting percentage did not change the ranking of the options. However, at weightings of less than 30%, the gap between the 2 and 3 station alignments reduced, whereas at percentages over 30%, the merging between the 3 station options and the 1 and 2 station options increased.

## 6.2.3 Station Locations

Weighting was applied to the following criteria:

- 3.1 - existing or future growth area
- 3.5 - realisable development potential to generate patronage
- 3.8 - assist revitalising public realm and connectivity
- 3.11 - flexibility for design/construction

The results of changing the weighting percentage between 10% and 90% on each group of station options were as follows:

- Newton- No changes to ranking of station options
- K Rd- No changes to ranking of station options. As the weighting increases the gap between K Rd 1 and K Road2 / K Road 3 grows
- Aotea- No changes to ranking of station options. As weighting increases the gap between Aotea1 and Aotea 3/ Aotea 2 grows

## 6.2.4 Operational Impacts

Weighting was applied to the following criteria:

- 4.3 - permanent impacts on open space
- 4.4 - permanent impacts on sensitive landscapes

- 4.5 -permanent impacts on heritage buildings
- 4.7 -permanent impacts of road network

The results of changing the weighting percentage between 10% and 90% on each group of station options were as follows:

- Newton: at weightings greater than 35%, Newton 5 becomes the preference due to replacement of Porters Ave level crossing by an over bridge under this option. If 4.7 is not weighted, then Newton 1 and Newton 5 score equally under any weighting level
- K Rd: Increases in weighting reduces the gap between K Road 3 and K Road 1/ K Road 2 but no change in ranking
- Aotea: only criteria 4.5 has a difference in scoring between the options. Increasing the weighting significantly increases the difference between Aotea 1 against Aotea 2/ Aotea 3. No change to ranking

### 6.2.5 Construction Impacts

Weighting was applied to the following criteria:

- 5.12 - public transport
- 5.13 - pedestrian routes
- 5.14 - emergency services
- 5.15 - adjacent businesses/shops

The Criteria selected represent reputational or Public Relations risks, on the basis that these criteria are less easily mitigated by money. Sensitivity tests were applied to the construction impacts of both the station options and the top scoring alignment options. The results of the tests were as follows:

- Newton stations: Newton 5 becomes more attractive while Newton 1 becomes less with increased weighting
- K Road stations: No change in ranking but gaps minimise between options as weighting increases
- Aotea stations: No change in ranking but the gap between Aotea 3 and 1 increases as weighting increases
- For the alignment options: No change in ranking but gap reduces significantly between options 6a, 6 and 1c as weighting increases

### 6.2.6 Alignment Criteria

Weighting was applied to the following criteria:

- 6.1 - land required for construction
- 6.4 - optimal operational costs
- 6.6 - most direct route

At weightings above 45%, option 1c becomes the preference.

### 6.2.7 Sensitivity testing summary

The conclusion of the above sensitivity tests is that applying weighting to specific criteria within each category of criteria, does not change the top ranked options within those criteria.

## 7 Summary of Findings: Multi-Criteria Evaluation Process

### 7.1 Summary

At the conclusion of the multi-criteria evaluation process a short list of the top ranked station locations and the feasible alignments to join them was identified.

From the options evaluation the highest ranked stations were:

- Newton 1;
- K Road 1; and
- Aotea 1.

However due to the comparable scores the following additional station locations were added to the short list:

- K Road 2;
- Newton 2; and
- Newton 5.

The short listed alignment options which are technically feasible with the above stations are:

- Option 6
- Option 6a; and
- Option 1c.

These are shown on Figure 1, page 1 and in Appendix 1.

### 7.2 Robustness of Findings

The various sensitivity tests carried out throughout the multi-criteria evaluation process have demonstrated that the short-listed options respond well to varying the various weightings of the key criteria. This provides a high level of confidence that the short-listed options are the appropriate set of options. The scoring was such, however, that no clear front-runner or single preferred option emerged.

## 8 Further Option Evaluation of Top Ranked Alignment 6

The results of the multi-criteria evaluation process resulted in a shortlist of alignment options and station locations (as described in sections 5.2.1 to 5.2.7). The top ranked alignment (that joined the top ranked station locations) was alignment option 6. Alignment option 6 passes beneath the Upper Queen Street motorway bridge within the CMJ area. It was identified that there was a substantial area of risk to this option which could have an impact on the alignment. This related to impacts on motorway structures and in particular with piles on the Upper Queen St Bridge over CMJ. Work to establish the extent and risk of these issues was undertaken along with consideration of refinements to alignment 6 to avoid this bridge.

The work undertaken following the multi-criteria evaluation process focussed on engineering constraints, technical issues, operational optimisation and risk (and associated relative costs). No further work on the other top ranked alignments was undertaken as **there was not seen to be any comparable refinements to 6a and 1c without replicating another existing alignment.**

### 8.1 Alignment 6 Refinements

Further engineering investigation and broad relative cost work was undertaken to further define the impacts of option 6 on the Upper Queen Street over bridge and to determine whether or not this alignment and the corresponding stations could be confirmed as the recommended preferred option.

Two minor refinements to alignment 6 were developed – alignment 6b and 6c. Both of these options provide an alternative alignment within the CMJ area of the route which avoids the need for the rail link to pass directly under the Upper Queen Street motorway over bridge. Briefly:

- Option 6b – This option curves eastwards immediately as it leaves the southern end of K Road 1 station. The alignment keeps to the north of the motorway until the eastern side of the Upper Queen Street motorway over bridge. Here it curves southwards under the motorway to join option 6 at Symonds Street.
- Option 6c – This option retains a more or less straight alignment as it heads south from K Road 1 station, crossing under the motorway to the west of the Upper Queen Street motorway over bridge (essentially following alignment 1c to this point). Once on the south of the motorway, this option curves eastwards underneath Upper Queen Street and St Benedicts Street, curving south onto Symonds Street to the immediate north of Newton 1 station.

### 8.2 Evaluation System

A qualitative evaluation system has been used to evaluate alignments 6, 6b and 6c against each other. A high level quantitative evaluation and back check of the qualitative evaluation process against the next top ranked alignments (options 1c and 6a) was also used. These systems are shown in the evaluation attached in Appendix 11.

### 8.3 Qualitative Evaluation Results

The qualitative evaluation of alignment 6, 6b and 6c between Newton 1 station and K Road 1 station was undertaken. This evaluation is attached in Appendix 11. Alignment option 6c is the preferred alignment option as a result. In summary:

- There is negligible difference between the alignment options in terms of distance and gradient;

- Option 6c is favoured over options 6 and 6b as it contains fewer curves (of less than 200m radius), and therefore has lesser impacts in terms of a tunnel boring machine (tighter curves mean progress of the tunnel boring machine is slower, so increased risk and cost);
- Option 6c contains only one curve of tight radius less than 200m (located immediately to the north of Newton 1 station). This allows trains to achieve better operational speed (than either 6 or 6b) due to fact that at this curve trains would be still powering up leaving Newton 1 city bound, or slowing down heading into Newton 1 west bound;
- Any alignment under CMJ will require ground improvement/strengthening works. However, options 6b and 6c require less tunnel length within the motorway corridor, avoid major structures, and consequently require less work and incur a (relative) lower cost;
- Options 6 and 6c have less impacts than 6b on known piled buildings (other than motorway structures);
- Option 6c passes in close vicinity to a listed Heritage building, requiring mitigation through under pinning, but the relative cost of this work is considered negligible in context of the overall project costs; and
- Option 6c capital cost when compared (relatively) to other options is cheaper.

Appendix 11 also contains the back check of this evaluation against the next top ranked alignments (options 1c and 6a). This back check was undertaken to ensure that the evaluation process is robust; i.e. that the new information available to assist this process did not result in altering the multi-criteria evaluation process to an extent that alignment options 1c or 6a (being the next top ranked), and therefore Newton 2 and K Road 2 station locations, would have been ranked higher. In summary no change is considered necessary to the scoring appointed to alignments 1c and 6a during the multi-criteria evaluation process. Alignment 6c, when compared to alignment 6, would score higher in some of the multi-criteria evaluation, such as criteria 6.6 and 6.7 relating to providing the shortest route length and minimising impacts on surface activities during construction (see Appendix 7 “changes as a result of Workshop 3”, where option 6 is scored 4 for both these criteria, but 6c would score 5 due to being a shorter length and removing the potential for surface impacts around the Upper Queen Street motorway overbridge).

A high level quantitative evaluation based on the qualitative evaluation comments was also undertaken to check the robustness of the evaluation process. The quantitative evaluation is also attached in Appendix 11. This quantitative exercise appointed a number ranking system (1 being highest ranked through to 3 being lowest ranked) to the qualitative comments for each alignment option. Broad costs for works anticipated with each option (above the neutral base costs across the project), were identified. This evaluation confirms alignment 6c as the preferred alignment as it scored the lowest in the ranking exercise, and the likely costs for this option (above the neutral base costs across the project) were substantially lower. This quantitative evaluation shows a clear difference between the refined options in comparison to the qualitative evaluation, where the distinction between the refined options is closer.

## 8.4 Summary of Findings: Qualitative Evaluation

At the conclusion of the qualitative evaluation process the preferred:

- Alignment option is 6c; and
- Station locations are Newton 1, K Road 1 and Aotea 1.

The high level quantitative evaluation and the back check of the qualitative evaluation process provides a high level of confidence that the chosen preferred options are the appropriate ones to progress into Phase 2 of the Study.

## 9 Way Forward (Phases 2 and 3)

It is recommended that the ONTRACK and ARTA Boards confirm the preferred CBD Rail Link Alignment and station locations to be taken forward into Phase 2 and 3 of the Study is alignment 6c, and station locations Newton 1, K Road 1 and Aotea 1.

Once the recommendation of the preferred alignment and station locations has been approved by the ONTRACK and ARTA boards, the following works will be undertaken:

### During Phase 2:

- The preferred alignment option and station locations will be further investigated and technical reports completed with concept design progressing.
- Key aspects of this phase will include the further refinement of project risks and costs, potential construction timeframe, the development of the station surface structures and internal station layouts, overall stakeholder, property and environmental impacts.
- Further consideration of the issues associated with constructing Aotea station in the “Aotea 1” location. These issues are mainly associated with the impact on the surrounding major properties during construction, and in particular access and servicing.
- Further analysis of the turnouts onto the NAL.
- In conjunction with the NAL turnouts confirm any changes to the existing Mt Eden Rail Station (including consideration of a possible Newton 5 Station).
- A closer examination of the issues associated with the Britomart station interface.
- Undertake more patronage and project benefit analysis based on an agreed set of assumptions for the operation of the new CBD rail link.
- Consider the overall cost of the project including at a high level the potential ramifications of the construction of an Aotea 1 station.

### During Phase 3:

- Phase 3 will result in the completion of NOR documentation.

Report

# City Rail Link: 2012 Option Evaluation Summary Report

Date: July 2012



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## Glossary

AC	Auckland Council
ARTA	(Former) Auckland Regional Transport Authority
AT	Auckland Transport
CBD	Central Business District
CCMP	City Centre Masterplan
CCO	Council Controlled Organisation
CMJ	Central Motorway Junction
CRL	City Rail Link
INWI	Inner West Interchange
LGACA	Local Government (Auckland Council) Act 2009
NAL	North Auckland Line (also known as the Western Line)
NoR	Notice(s) of Requirement
NZTS	New Zealand Transport Strategy 2008
PA	Auckland Transport's Principal Advisor: Aurecon (in association with Mott MacDonald, Jasmex, Grimshaw)
PTMA	Public Transport Management Act 2008
RA	Requiring Authority
RMA	Resource Management Act 1991
RLTS	Auckland Regional Land Transport Strategy 2010-2040
RLTP	2012/15 Regional Land Transport Programme
RPTP	Auckland Regional Public Transport Plan 2009
SOI	Auckland Transport Statement of Intent
TBM	Tunnel Boring Machine

## Executive Summary

Auckland Transport (AT) is the council-controlled organisation (CCO) of Auckland Council (AC) responsible for managing and controlling Auckland's transport system under the Local Government (Auckland Council) Act 2009 (LGACA). Auckland Transport's purpose as set out in section 39 of the LGACA is "*to contribute to an effective and efficient land transport system to support Auckland's social, economic, environmental, and cultural well-being*". Sections 45 and 46 of the LGACA outline AT's functions and powers in respect of the land transport system and AT's role as the Road Controlling Authority. AT is also deemed a Requiring Authority (RA) as a network utility operator under Section 167 of the Resource Management Act (RMA) for transport purposes (LGACA Section 47). In addition, AT is responsible for preparing the Regional Land Transport Programme for Auckland in accordance with the Land Transport Management Act 2003 (LGACA Section 45(a)).

Proposals for a City Rail Link (CRL) have been discussed since the 1920s. In the 1970s, Auckland's Mayor Sir Dove-Myer Robinson included the link in his vision for Auckland, which proposed the development of a rapid rail network. In 2008, the government requested that KiwiRail investigate protecting a route for the CRL. KiwiRail and the Auckland Regional Transport Authority (ARTA) completed this study in 2010.

The CRL is one of the main components in the Auckland Regional Land Transport Strategy 2010-2040, and is identified as the top priority transport project in the Auckland Plan.

The purpose of this report is to provide a summary of the refinement and evaluation processes undertaken since AT assumed responsibility for the delivery of the CRL Project. As a result of these processes, certain changes have been made to the alignment, station locations and associated CRL infrastructure. These changes are summarised in this report.

### **2010 Option Evaluation Report and concept design**

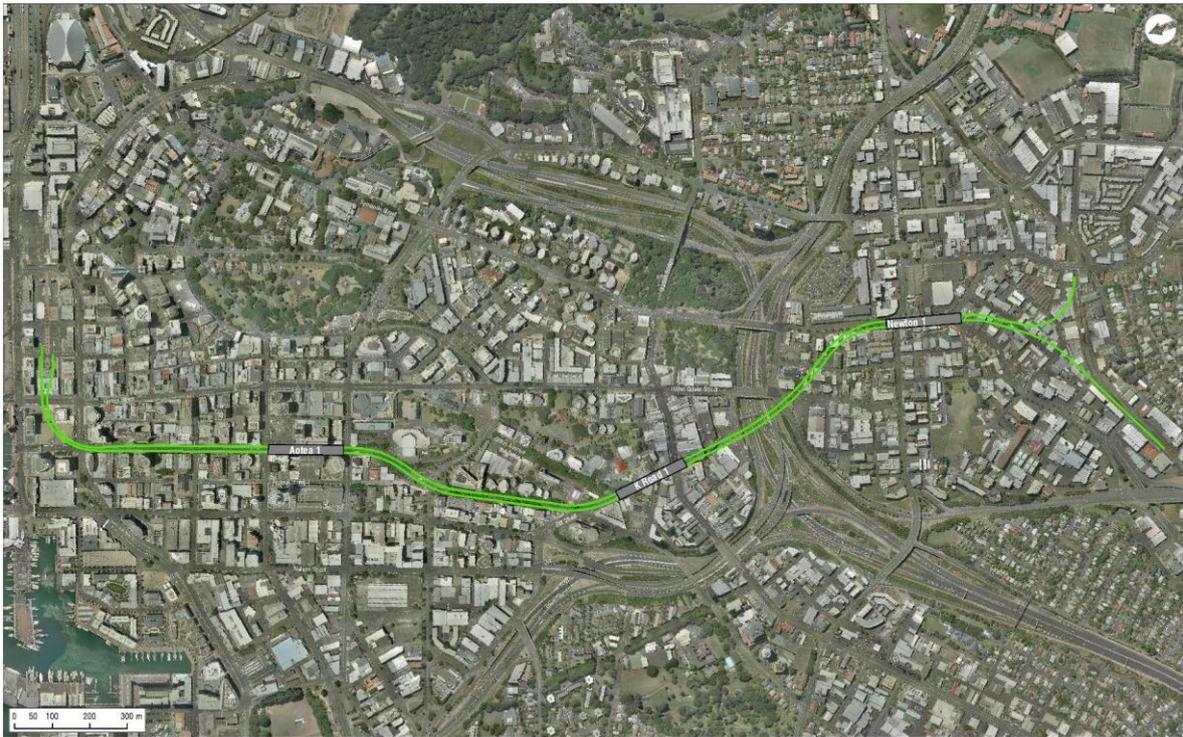
In 2008, KiwiRail and the ARTA commissioned a study to identify a preferred route for the CRL. The outcome of this work is the 2010 Option Evaluation Report which included technical work and the development of a multi-criteria evaluation process. A weighting and sensitivity testing exercise was undertaken to support the key multi-criteria evaluation to ensure that the evaluation process was robust. This included applying varying weight to both criteria and categories of criteria (i.e. station location criteria, operational impacts criteria, construction impacts criteria). This process evaluated the feasible alignments, general area and desirable number of stations along the route, optimal station locations within the general areas, and concluded with the alignments that best served the preferred station locations.

The 2010 Option Evaluation Report resulted in an alignment being identified including two CRL tunnels between Britomart Rail Station (Britomart) and the North Auckland Line (NAL) in the vicinity of Mt Eden Station, along with the provision and indicative location of up to three underground stations (refer to figure 1).<sup>1</sup> A concept design was developed for this preferred alignment for KiwiRail and ARTA to demonstrate construction and operational feasibility.

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<sup>1</sup> For ease of reference the stations referred to in this report have been temporarily named Aotea Station, Karangahape Station, Newton Station, and Inner West Interchange. The stations will be formally named in the future.

**Figure 1 – 2010 Option Evaluation Report Preferred Alignment and Station Locations**



Auckland Transport was established in November 2010 and combines the transport functions and operations of ARTA and the eight former local and regional councils of Auckland.

In 2011, AC requested that AT designate land for the CRL to allow for the future construction, operation and maintenance of one of its priority transport projects. The AT Board accepted the request by AC and resolved to protect the route through designations under Section 168 of the RMA to ensure land - both surface and sub-surface (sub strata) - is protected for the future construction and operation of the CRL.

As the first step in this process, AT initiated a review of the 2010 Option Evaluation Report and the concept design prepared previously for KiwiRail and ARTA. This review was to determine whether any additional work would be required to support route protection to enable the construction, operation and maintenance of the CRL. Section 171(1)(b) of the RMA requires consideration of alternative sites, routes or methods of undertaking the work.

### **2012 Option Evaluation Summary Report**

Further investigations, option evaluations and technical assessments have been completed and/or commissioned by AT in 2012 to progress the concept design. This work has determined an alignment, revised station footprints and prudent effects assessments, which in turn have determined the land required to give effect to the Project Objectives.<sup>2</sup> It has also confirmed the CRL and designation are reasonably necessary to meet the objectives of AT.

This report summarises the evaluation processes and changes made since AT accepted responsibility for the delivery of the CRL. As a result of the refinement and evaluation processes outlined in this report, the following have been incorporated into the concept design:

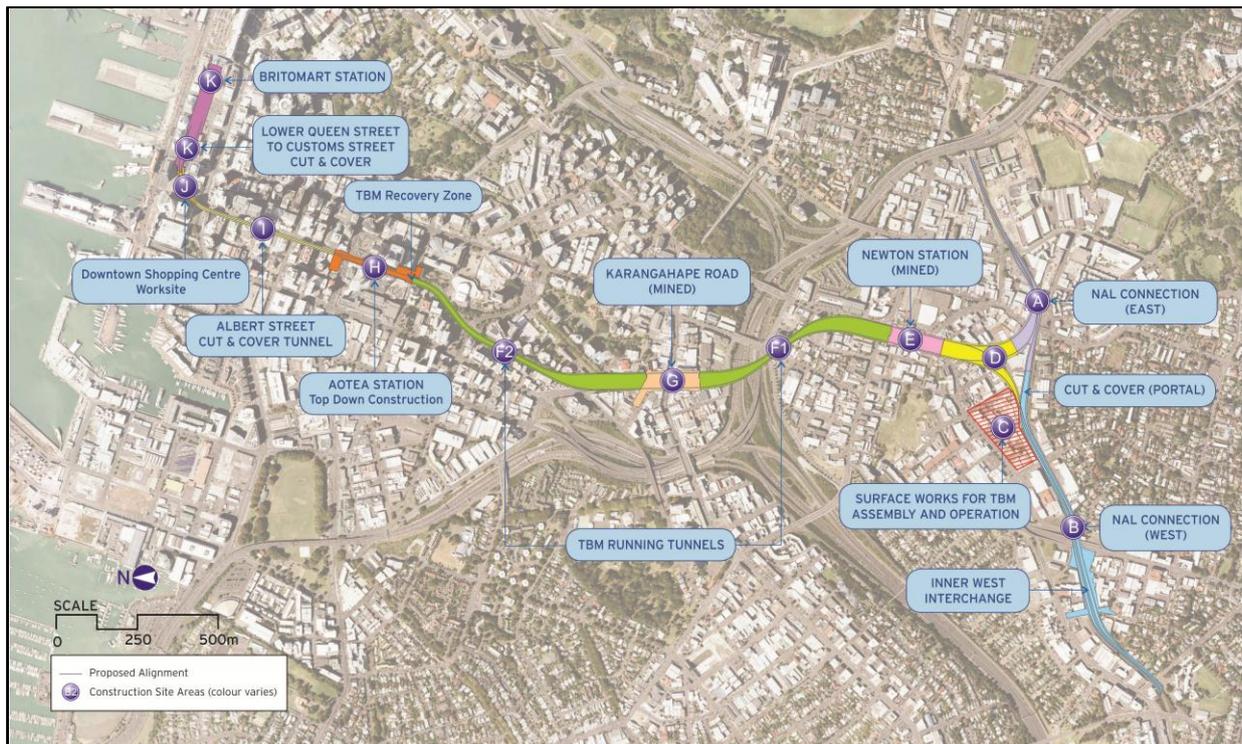
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<sup>2</sup> The CRL Project Objectives are listed in figure 3 (refer section 1.3)

- (a) The indicative station construction methodology for Karangahape and Newton Stations has changed from caverns to mined side platforms. This change was adopted following a review of the earlier concept design which determined that the risks associated with the cavern construction methodology were unacceptably high.
- (b) An alteration to the station footprint for both Karangahape and Newton Stations from those identified in 2010. This is driven by the change in the indicative station construction methodology outlined above. The change is from a single large cavern with an island platform, to a station where the platforms are located in smaller separately mined tunnels on the side of each rail track. These platforms are then linked via a central underground concourse. As a result, each of the mined tunnels is much smaller, but the overall underground footprint is larger. The principal entrance for Karangahape Station is unchanged. The principal entrance for Newton Station has changed to a single location on the western side of Symonds Street.
- (c) An altered alignment for the two tunnels between the southern end of Vincent Street (south of Aotea Station) and Newton Station as a result of changes to the location of Karangahape and Newton Stations. This alteration is driven by the changed underground station forms outlined above and the resultant need for the two tunnels to separate to a greater extent than required by a cavern station as envisaged in 2010.
- (d) A change to the indicative construction methodology for the northern end of Albert Street from a mixture of tunnel boring machine (TBM) and cut and cover tunnelling to cut and cover tunnelling only. This is necessary to mitigate a significant constructability risk associated with a relatively large stormwater utility running along this section of Albert Street, which directly but unavoidably clashes with the proposed running tunnel alignment. This utility (along with many other smaller services) will need to be diverted as a result of the CRL. Although cut and cover methods of construction have been proposed and the envelope of effects assessed accordingly, with further investigation of the construction issues and risks, alternative tunnelling methods may still be feasible and maybe further considered as the project progresses.
- (e) Provision for a new rail interchange within the NAL between George Street and Dominion Road.

The 2012 alignment and station/interchange locations, incorporating the refinements outlined above, is shown here as figure 2.

**Figure 2 – 2012 Option Evaluation Summary Report Alignment and Station Locations**



The combination of the 2010 Option Evaluation Report, earlier concept design work completed for KiwiRail and ARTA and the refinements summarised in this report has enabled AT to finalise the concept design and complete the Notices of Requirement for the CRL.

The overall outcome of the evaluation exercises undertaken to date is that the CRL alignment, station locations and associated infrastructure have now been identified which:

- Is reasonably necessary for achieving the CRL and wider Project Objectives.
- Follows the approach of locating the works:
  1. Primarily within the road corridor (within AT management and control) or existing NAL, or
  2. On AC land, or
  3. Where within privately owned land, at a subterranean level wherever possible to reduce the landtake requirements and impact on private landowners at a surface level.
- Preserves flexibility to enable future innovations and efficiencies to optimise the project nearer to construction.

The evaluation exercises completed to date have also ensured that where private land is required to undertake the works, alternative sites, routes or construction methodologies have been appropriately considered.

## 1. Introduction and Purpose of this Report

In 2011, Auckland Transport (AT) accepted responsibility for delivery of the CRL following a request from Auckland Council (AC). The AT Board resolved to secure the route through designations under Section 168 of the RMA to ensure land - both surface and sub-surface (sub strata) - is protected for future construction, operation and maintenance of the CRL.

The first step in this process was to initiate a review of the 2010 Option Evaluation Report and concept design work completed previously for KiwiRail and ARTA to determine whether any additional work would be required to support route protection to enable the construction, operation and maintenance of the CRL.

The 2010 Option Evaluation Report resulted in a preferred alignment being identified including two CRL tunnels between Britomart Rail Station (Britomart) and the North Auckland Line (NAL) in the vicinity of Mt Eden Station, along with the provision of up to three underground stations and the identification of the preferred location for these (refer to figure 1).<sup>3</sup>

Having reviewed the robust analysis set out in the 2010 Option Evaluation Report, AT has accepted the preferred alignment and indicative station locations as the base position from which the 2012 option evaluation and refinements should be considered.

This 2012 Option Evaluation Report has been prepared to complement the 2010 Option Evaluation Report and both documents support the CRL Notices of Requirement (NoR) providing a summary of the alternative sites, routes and methods considered. This report confirms the preferred alignment, station/interchange footprints and prudent effects assessment that has determined the necessity for the land required to give effect to the Project Objectives.<sup>4</sup> It also confirms the CRL and designation are reasonably necessary to achieve the objectives of AT.

This report summarises the work undertaken in 2012, and is structured as follows:

- The options and refinements that have been considered in 2012 (section two);
- An outline of the evaluation framework/method for assessing each option (section three);
- The evaluation analysis and outcomes (section four);
- The preferred options and refinements made in 2012 (section five).

### 1.1 Purpose and Drivers for the CRL Project

Patronage on the Auckland rail network has increased significantly in recent years following investment by central and local government in improved services, trains, stations and infrastructure. Growth in patronage is expected to continue over the next decade and beyond as further investment in electrification and electric trains comes to fruition. By 2030, Auckland regional rail journeys are expected to increase from their present 10 million to 30 million per year (with 30,000 train travellers

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<sup>3</sup> For ease of reference the stations referred to in this report have been temporarily named Aotea Station, Karangahape Station, Newton Station, and Inner West Interchange. The stations will be formally named in the future.

<sup>4</sup> The CRL Project Objectives are listed in figure 3 (refer section 1.3)

each morning and afternoon peak). There is also an anticipated increase in the percentage of total public transport journeys completed by rail, from 10% in 2006 to 20% by 2030.<sup>5</sup>

The first stages of creating an efficient and effective rail network in Auckland have already begun. Central Government and Auckland have spent or committed over \$2 billion since 2001 developing the Auckland rail network in various network upgrades. Work to electrify the Auckland suburban rail network is underway and AT is acquiring new electric trains to run on this network. The CRL will enhance the benefits of the resources already committed to electrification.

A key purpose and driver of the CRL is to make the city centre more accessible, resulting in increased economic performance (including attracting a greater concentration of employment opportunities), creating changes in land use and value, stimulating development opportunities and facilitating intensification (particularly around stations). The CRL enables passengers to better access the city centre beyond the downtown area (served by Britomart) by opening new stations at midtown (Aotea), uptown (Karangahape) and the city fringe (Newton).

The ability of the current Auckland rail network to meet expected future demand is restricted due to its limited capacity. Based on current growth projections, the present Britomart terminus station at the northern edge (downtown end) of the Auckland city centre is expected to reach capacity between now and 2024.<sup>6</sup> As a result of connecting train services directly to the NAL at Mt Eden and in removing the Britomart constraint the CRL scheme has the potential to almost double the capacity of the existing Auckland rail network.

## 1.2 Auckland Transport's Functions and Obligations

Auckland Transport is the council-controlled organisation (CCO) of Auckland Council responsible for managing and controlling Auckland's transport system under the Local Government (Auckland Council) Act 2009 (LGACA). Auckland Transport's purpose as set out in section 39 of the LGACA is *"to contribute to an effective and efficient land transport system to support Auckland's social, economic, environmental, and cultural well-being"*. Sections 45 and 46 of the LGACA outline AT's functions and powers in respect of the land transport system and AT's role as the Road Controlling Authority. AT is also deemed a Requiring Authority (RA) as a network utility operator under Section 167 of the Resource Management Act (RMA) for transport purposes (LGACA Section 47). In addition, AT is responsible for preparing the Regional Land Transport Programme for Auckland in accordance with the Land Transport Management Act 2003 (LGACA Section 45(a)).

### 1.2.1 Statement of Intent, Auckland Plan and City Centre Masterplan

AT's strategic approach and priorities are outlined in its Statement of Intent (SOI) 2012-2015. This document recognises the important partnership between AT and AC in the delivery of shared outcomes, and presents an AT 'Outcomes Framework' aligned with the Auckland Plan. AT's overarching outcome identified in the SOI is *"Auckland's transport system is effective and efficient, and provides for the region's social, economic, environmental and cultural wellbeing."*<sup>7</sup>

To deliver such a transport system, AT has identified the following impacts that it aims to achieve over the 2012-2015 period:

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<sup>5</sup> ARTA, *Rail Development Plan 2006* @ <http://www.aucklandtransport.govt.nz/improving-transport/plans-proposals/Rail/Pages/RailDevelopmentPlan20062016.aspx>

<sup>6</sup> Auckland Transport, *Draft Integrated Transport Plan 2012 – Appendix E*

<sup>7</sup> Auckland Transport Statement of Intent: 1 July 2012 – 30 June 2015 (page 5)

- Better use of transport resources to maximise return on existing assets;
- Increased customer satisfaction with transport infrastructure and services;
- Auckland's transport network moves people and goods efficiently;
- Increased access to a wider range of transport choices;
- Improved safety of Auckland's transport system; and
- Reduced adverse environmental effects from Auckland's transport system.

The SOI also provides an AT Programme of Action for the 2012-2015 period. The CRL is included in the programme as part of integrating transport planning and investment with land development.

The Auckland Plan identifies that *"The CRL is the top priority transport project for Auckland, with a targeted date to become operational in 2021"*.<sup>8</sup> The CRL is also identified in AC's City Centre Masterplan, where it is listed as one of the eight moves designed to transform the city centre.

In order to meet its legislative requirements, AT also has a number of other statutory and non-statutory strategic plans, documents and policies which it must consider when planning infrastructure. The CRL is consistent with these plans and policies, a number of which are discussed in the section below.

### 1.2.2 Transport Policy Documents Supporting the CRL

This section outlines a number of overarching policies within which, and in support of which, the CRL project is being delivered.

The National Rail Strategy 2005-2015 sets the government's rail objectives and priorities. The National Rail Strategy seeks to maximise the Government's more recent investment in rail, and to support objectives for transport as a whole. Priorities include improving rail's contribution to regional development and encouraging more use of urban rail passenger services as part of the public transport network.

The New Zealand Transport Strategy 2008 (NZTS) sets five key objectives that the land transport system in New Zealand must contribute to. These are:

- Ensuring environmental sustainability
- Assisting economic development
- Assisting safety and personal security
- Improving access and mobility
- Protecting and promoting public health.

These objectives also guide the content of the Auckland Regional Land Transport Strategy 2010-2040 (RLTS).

The RLTS is developed under the Land Transport Act 2002 and identifies the CRL as a main component of improving public transport and delivering on the key objectives of the strategy. The 2012/15 Regional Land Transport Programme (RLTP) for Auckland gives effect to the RLTS and identifies progressing the CRL as one of its key priorities.

The Auckland Regional Public Transport Plan 2009 (RPTP), developed under the Public Transport Management Act 2008 (PTMA), highlights the benefits that the CRL can bring to Auckland following

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<sup>8</sup> The Auckland Plan: Chapter 13 Auckland Transport. Refer box 13.2 The City Rail Link

electrification of the Auckland rail network. This is due to the provision of new stations and an increased frequency of services, which in turn increases the accessibility of the city centre.

Additional relevant documents include the Auckland Transport Plan 2010, the Auckland Passenger Transport Network Plan, the Auckland Sustainable Transport Plan and the Auckland Rail Development Plan 2006-2016. The CRL project is consistent with the direction provided in these policy documents, and is identified as a key project in most of these plans.

### 1.3 Project Objectives

The project objectives are a key component of an NoR and enable an assessment as to whether a project meets the requirements for a designation under section 171 of the RMA (relating to project necessity and confirming the works and designation are reasonably necessary for achieving the objectives of the RA).

Overarching and specific project objectives were developed and agreed at workshops with KiwiRail and ARTA in September 2009 (2009 Project Objectives, see **Appendix 1**).

Auckland Transport was established in November 2010 and combines the transport functions and operations of ARTA and the eight former local and regional councils of Auckland. In 2011 when it accepted the request from AC to designate for the CRL, AT undertook a review of these objectives, and as a result refined and clarified them through minor wording changes to ensure they were consistent with and reflective of AT's functions and obligations. The refined Project Objectives were endorsed by the AT Board in March 2012. It is important to note that while the Project Objectives have been refined and clarified, they remain consistent with the 2009 Project Objectives in their purpose and intent as outlined in the 2010 Option Evaluation Report. The revised Project Objectives are set out in the table below and have been a key consideration in the evaluation of options considered in 2012.

**Figure 3: CRL Project Objectives**

CRL Project Objectives	
<b>1</b>	Improve transport access into and around the city centre for a rapidly growing Auckland (a) Future proof for expected growth
<b>2</b>	Improve the efficiency and resilience of the transport network of urban Auckland (a) Improve journey time, frequency and reliability of all transport modes (b) Maximise the benefits of existing and proposed investment in transport (c) Release the rail capacity constraint at Britomart
<b>3</b>	Significantly contribute to lifting and shaping Auckland's economic growth (a) Support economic development opportunities (b) Provide the greatest amount of benefit for cost (c) Enable a more productive and efficient city
<b>4</b>	Provide a sustainable transport solution that minimises environmental impacts (a) Limit visual, air quality and noise effects (b) Contribute to the country's carbon emission targets
<b>5</b>	Contribute positively to a liveable, vibrant and safe city (a) Enhance the attractiveness of the city as a place to live, work and visit (b) Protect our cultural and historic heritage for future generations (c) Help safeguard the city and community against rising transport costs

## 2 Summary of Options Considered and Refinements Made in 2012

### 2.1 Overview

Several refinements have been made to the concept design developed for KiwiRail and ARTA in 2010 as a result of the options assessments and technical reports commissioned by AT in 2012. The following have been undertaken to arrive at the concept design:

- (a) A review of the indicative construction methodology for Karangahape and Newton Stations taking into account additional information on the risks associated with the large diameter caverns envisaged in the earlier concept design. This is discussed in section 2.2.
- (b) Refinement of the location and footprints for Karangahape and Newton Stations. This involved considering several options for each station and is discussed further in sections 2.3, 4.1 and 4.2.
- (c) Consideration of any additional infrastructure required to deliver a flexible, sustainable and future proofed rail network. This identified the need for an Inner West Interchange which is discussed further in sections 2.4 and 4.3.
- (d) Identification of an altered alignment to link Aotea Station to Karangahape and Newton Stations as a result of the 2012 station locations. This is discussed in section 2.5.
- (e) Review of the indicative construction methodology for the CRL tunnel under Albert Street between Britomart and Aotea Station to address the utility constraints identified post 2010. This is discussed in section 2.5.

### 2.2 Indicative Construction Methodology – Karangahape and Newton Stations

For the purposes of identifying the designation footprint and assessing effects, two alternative construction methodologies were investigated in 2012 for Karangahape and Newton Stations. The earlier concept design completed for KiwiRail and ARTA was based on the assessment of an indicative 'cavern' construction methodology, while the two alternatives assessed in 2012 were the 'mined side platform tunnels' and 'top down cut and cover' approaches. This change was required following an assessment of the risks involved with the proposed cavern construction methodology as outlined below.

#### 2.2.1 Cavern Construction

The concept design developed for KiwiRail and ARTA proposed a cavern construction methodology for Karangahape and Newton Stations. Cavern stations are constructed via a shaft(s) from which a large underground cavern is excavated. Post construction, the shaft (or shafts) form the permanent access and egress path between the underground station and street level.

In 2012, AT's Principal Advisor (PA) undertook an engineering, architectural and value engineering review of the earlier concept design which concluded that the proposed cavern method of construction was inappropriate as the basis for the NoR. Key findings from this review were that:

- The proposed cavern methods of construction for Newton and Karangahape Stations presented significant technical challenges to design and construction requiring large and highly specialised construction crews;

- The caverns would be on an unprecedented size in Auckland conditions;
- While cavern construction may minimise environmental and third party effects, caverns are inherently much more complex from a design and construction perspective and entail much higher risks;
- Given both caverns were on the project critical path, the overall risk to the project programme would be unacceptably high.

When assessing the cavern construction methodology, consideration has also been given to the detailed investigation undertaken between 2008 and 2011 for the Waterview SH20 Tunnels.

It has also been noted that the cavern methodology constrains flexibility as:

- It provides less ability to continue to operate the CRL (with minimal disruption) during the construction of the stations should these be staged in the future;
- Once built, the ability to improve capacity at the cavern stations would be extremely limited.

Therefore cavern forms for the two stations were removed from the evaluation process. The 'mined side platform tunnels' and 'top down cut and cover construction' methodologies (discussed further below) were considered for the stations in the 2012 assessment as they offered more certainty and reduced risks.

### 2.2.2 Top Down Cut and Cover Construction

Top down cut and cover construction consists of the installation of vertical retaining walls at the dimensions required (i.e. perimeter of the station box) followed by construction of a top slab. The ground in between the retaining walls is then sequentially excavated. The size of the station box is determined by the separation of the adjoining running tunnels, the width and length of the platforms and the depth to the base of the platforms.

This has been assessed as an alternative to the cavern approach as it provides a methodology with many Auckland precedents. This is considered the most flexible, least complex and least risky construction methodology. However the key issue from this type of station is the adverse effects on the locality and transportation network during construction. This type of station would require substantial works to be undertaken in the road reserve, affecting vehicle and pedestrian access.

Cut and cover methods of construction were considered for Karangahape Station Option 1 (see 2.3.1 below) and Newton Station Option 1 (see 2.3.2 below). Functionally, these stations are similar to those identified in the earlier concept design (i.e. stations with centre island platforms constructed primarily within the road reserve), but with changed construction methodologies to recognise the risks associated with large diameter caverns.

### 2.2.3 Mined Side Platform Tunnels

In this type of station, platform tunnels are constructed via shaft access from the surface. The tunnels are then mined out using mechanical means such as a roadheader. These side platform tunnels are significantly smaller than the caverns proposed in the earlier concept design, and platforms are linked via a central underground concourse and walkways. This means that while the individual tunnels are smaller, the overall underground footprint of this type of station is larger. The larger underground footprint increases the sub-strata land take requirements.

This type of station also influences the alignment of the CRL tunnels, as the rail lines need to be separated further apart when entering and exiting the underground stations. This is necessary to

provide room between the side platforms for the underground passageways and concourse. This results in additional sub-strata land take requirements as the tunnels shift from being located under roads to a mixture of under roads and private land (this is discussed further in section 2.5 below).

The key benefits from this type of station are that:

- They present a greatly reduced technical challenge to design and construct than the large diameter caverns proposed in the earlier concept design;
- They provide flexibility to stage construction of the station in the future with lesser impacts on the running lines;
- They have substantially lesser effects on the road during construction than the top down cut and cover options.

In terms of the station options, mined side platform tunnels would be used under Options 2A and 2B for Karangahape Station (see 2.3.1 below) and Options 2(A-D) and 3 for Newton Station (see 2.3.2 below).

#### 2.2.4 Station Construction Conclusion

As noted above, cavern forms for the two stations have been removed from the evaluation process. As an alternative to cavern construction, the cut and cover methodology has been considered in assessing Option 1 for Karangahape and Newton Stations below. However for a number of reasons, these options have not been recommended for the concept design. See sections 4.1, 4.2, Appendix 4 and Appendix 5 for further details.

Therefore the PA recommended that the Karangahape and Newton Stations adopt the mined side platform station form for the concept design.

It is important to note that these remain indicative methodologies at this point and may alter in the final construction. However for the purpose of this report and to determine a prudent envelope of effects these have been developed as the most practicable construction methods.

### 2.3 Station Location – Karangahape and Newton Stations

The possibility of constructing mined side platform stations has required reassessment of the locations/footprints for Karangahape and Newton Stations from those identified in the 2010 Option Evaluation Report.

#### 2.3.1 Karangahape Station Location Changes

Three station location options were evaluated in 2012, all of which retained the main station entrance in Beresford Street (known as Beresford Square). Each option is briefly described below. Plans showing each location are set out in **Appendix 2**.

##### Option 1

The preferred station location identified in the 2010 Option Evaluation Report. This would be constructed using top down cut and cover methodology with the majority of works taking place within the Pitt Street road reserve. The station would serve both CRL tunnels using an island platform configuration and would utilise escalators to a main access point in Beresford Square.

### Option 2A

The station is located with one mined side tunnel below Pitt Street (starting at the intersection with Karangahape Road and heading north), and the other tunnel to the west below private property running from Karangahape Road, under Beresford Square and ending approximately at the St Johns Ambulance site. Due to the orientation of the principal entrance in Beresford Square relative to the required tunnel alignment, the two tunnels are splayed some distance apart. The central shaft and entry point for the station is located within Beresford Square, with a secondary emergency access shaft located on the St Johns Ambulance site.

### Option 2B

The station has a central and main entrance located in Beresford Square. From this location the two mined side tunnels sit below private property to the south from Beresford Square, under Karangahape Road and under each side of Mercury Lane. A potential second entrance to the station at its southern end is provided on private property located on the west side of Mercury Lane.

As with Option 2A, this option utilises a larger underground footprint than Option 1 and the CRL rail tunnels are located further apart to leave room in between for the side platforms, passenger access ways and underground concourse area.

## 2.3.2 Newton Station Location Changes

The six options evaluated are briefly discussed below. Plans showing the location of the options are set out in **Appendix 3**. Similar to Karangahape Station, Option 1 involves a change in construction methodology (from cavern to cut and cover) but is otherwise similar to the preferred option identified in the 2010 Option Evaluation Report.

### Option 1

The preferred station location identified in the 2010 Option Evaluation Report. The station would serve both CRL tunnels using an island platform configuration. The main entrance would be located on the AT car park on the northeast corner of the Symonds Street and Mt Eden Road intersection. A second entrance is provided at the corner of Symonds Street and Newton Road.

### Options 2A to 2D

Under these options the station form would be mined side platform with a central access shaft. As with Option 1, the main entrance would be located on the AT car park on the northeast corner of the Symonds Street and Mt Eden Road intersection.

As a result of the side platform configuration, the underground station footprint is larger than Option 1 and the two rail tunnels are located further apart to provide space for the passenger access ways and underground concourse. Options 2A through 2D consider varying the station location on either side of Symonds Street.

### Option 3

The station location for this option is on the west side of Symonds Street predominantly beneath the existing buildings located in the block bound by Symonds Street, Basque Road, Dundonald Street and Newton Road. As with Option 2(A-D), this station would have a mined side platform configuration with a central access shaft (meaning a larger station footprint and rail tunnels located further apart than Option 1).

In this option, the access shaft (and resultant pedestrian entrance/exit) is located on the western side of Symonds Street at the intersection with Mt Eden Road and New North Road. A second shaft and building will be constructed at the northern end of the station for ventilation and emergency egress purposes.

## 2.4 Additional Infrastructure (the Inner West Interchange)

In 2012, AT undertook further investigations to identify any additional infrastructure requirements needed as part of the CRL to ensure Auckland has an efficient, flexible, sustainable and future proofed rail network. The investigations tested a number of operating patterns for the Auckland rail network to determine if any additional infrastructure requirements would be needed.

This analysis identified the need for additional rail infrastructure in the form of a four track interchange on the NAL to the west of the CRL portals to enable some trains exiting the CRL to terminate and return either back into service or to stabling. To enable reliable network operations, provision of the interchange requires the NAL to be widened by an additional two tracks. Clearly, the closer the interchange is to the CRL portals, the smaller the land requirements associated with widening to accommodate four tracks will be.

To accommodate the required infrastructure, four locations were evaluated to determine the most suitable location for the interchange, these are briefly described below. Plans showing the location of the options are set out in **Appendix 6**.

### Option A

Locate the interchange facility at the existing Morningside Rail Station.

### Option B

Locate the interchange facility at the existing Kingsland Rail Station.

### Option C and D

Locate the interchange at a new facility on the NAL to the East and West of Dominion Road. Following the initial evaluation, Option C was further refined into two alternatives which considered using private land either on the north or the south side of the NAL for the additional tracks and interchange requirements. Both of these options enable trains to be turned around as soon as possible after exiting the CRL tunnels.

## 2.5 Other Refinements Made

### 2.5.1 CRL Tunnel Alignment

The station construction methodologies discussed above also has an impact on the alignment and extent of sub strata private land take required for the CRL tunnels. In particular, a mined side platform station requires separating the two running tunnels further apart to provide space for the station's side platforms, underground passenger tunnels and concourse area. This means additional private property land take is required for the stations and CRL tunnels.

In particular, additional sub strata private landtake will be required in the following locations to construct the CRL tunnels associated with mined side platform stations at Karangahape and Newton:

- (a) The southern end of Vincent Street where one tunnel is located under private property on the eastern side of the street;

- (b) The length of Pitt Street where the two tunnels are located under private property on both sides of the street;
- (c) Mercury Lane where the two tunnels are located under private property on both sides of the street;
- (d) Symonds Street where one tunnel is located under private property on the western side of the street.

The refined rail alignment is set out at **Appendix 8**. While this does run beneath more private property than the 2010 alignment (which ran predominantly beneath the road reserve), the tunnels are located entirely sub-strata and any effects on the properties can be managed.

#### 2.5.2 Indicative Construction Methodology - Albert Street between Britomart and Aotea Station

The indicative construction methodology outlined in the earlier concept design provided for a tunnel boring machine (TBM) to tunnel right through from the NAL to the northern end of Albert Street, approximately midway between Mills Lane and Swanson Street. The remaining portion of the tunnels (from the southern portal of the TBM to Britomart) would be constructed using cut and cover methodology, as would Aotea Station.

In 2012, AT's PA undertook an engineering review of the indicative construction methodology proposed in the earlier concept design for the construction of the two tunnels under Albert Street between Britomart and Aotea Station. This has required a change to the indicative construction methodology from a mixture of TBM and cut and cover tunnelling to cut and cover tunnelling only. This is necessary to mitigate a significant constructability risk associated with a relatively large stormwater utility running along this section of Albert Street, which directly but unavoidably clashes with the proposed running tunnel alignment. This utility (along with many other smaller services) will need to be diverted as a result of the CRL.

Although cut and cover methods of construction have been proposed and the envelope of effects assessed accordingly, with further investigation of the construction issues and risks, alternative tunnelling methods may still be feasible and may be further considered as the project progresses.

### 3 Evaluation Methodology

#### 3.1 Location Assessment Methodology – Karangahape Station, Newton Station and Inner West Interchange

An evaluation methodology for assessing station locations was developed and documented in the 2010 Option Evaluation Report. This multi-criteria evaluation methodology has also been applied to the assessment of station locations in 2012. In applying this methodology in 2012, AT determined that the criteria developed as part of the 2010 Option Evaluation Report was appropriate with some refinements for evaluating station locations for Karangahape Station, Newton Station and the Inner West Interchange.

The 2012 refinements involved creating a subset of criteria selected from the 2009 ‘master list’ as in some circumstances the original criteria were unlikely to differentiate the options under consideration in 2012. The subset of criteria is set out in section 3.2.

Each criteria score can be used for either (1) the degree to which the option being considered supports that criteria or (2) the scale of effect resulting from the option being considered. The scale included a sixth ‘red flag’ scoring option i.e. “Potentially Significant Adverse Effect with little or no scope to mitigate and difficult to consent”.

The evaluation system is as follows:

Evaluation	Rating
1. Strongly supports criteria <u>or</u> 2. Significant Potential Positive Effect	5
1. Supports criteria <u>or</u> 2. Potential Positive Effect	4
1. Limited support of criteria or neutral to this criteria <u>or</u> 2. No more than Minor Potential Adverse Effect (with limited or no consideration of mitigation)	3
1. Not supportive of criteria <u>or</u> 2. Potential Adverse Environmental Effect (with opportunities to remedy or mitigate)	2
1. Strongly not supportive of criteria <u>or</u> 2. Significant Potential Adverse Effect (with limited opportunities to mitigate)	1
Potentially Significant Adverse Effect with little or no scope to mitigate and difficult to consent (RED FLAG)	⚠

AT considered the benefits of using weighting in this evaluation process and on balance decided to give all criteria equal weighting in the mathematical scoring process further described below. The reason for this is that AT pre-selected the evaluation criteria that would allow for effective differentiation of the options being considered. Once the options had been scored (i.e. following evaluation) AT then considered the relative merits of each criteria in relation to the overarching CRL objectives.

For assessment and presentation, the scores have been divided into the following four main groups:

- Group 1 - Outcome focused criteria (e.g. the ability of the station to deliver superior passenger amenity);

- Group 2 - Operational effects criteria (e.g. the vibration effects of the running trains post-construction);
- Group 3 - Construction effects criteria (e.g. the noise and traffic impacts during construction);
- Group 4 - Providing flexibility for potential staging of station construction.

Within each group the criteria was sorted into subgroups which aligned with the Project Objectives (i.e. Transport, Economic, Environmental and Social). As each subgroup has a different number of criteria, the scores within each subgroup were averaged. The average scores were then totalled to produce a score for each option in each group. It is these figures that are presented in section four (i.e. the subgroup average and total group score for each option).

For group one (outcome focused criteria), the higher the score the greater the extent to which the option supports the Project Objectives. For groups two and three, a higher score indicates that an option has a lower overall effects profile (i.e. its effects impact will be smaller either in extent or due to the mitigation available). For group four, the higher the score the greater the extent to which the option can be staged.

### 3.2 Location Assessment Criteria – Karangahape Station, Newton Station and Inner West Interchange

The following evaluation criteria has been used in 2012 to assess the potential location options for Karangahape Station, Newton Station and the Inner West Interchange.<sup>9</sup>

Outcome focussed criteria	
Transport	<ol style="list-style-type: none"> <li>1. The extent to which the option design provides maximum operational flexibility and service reliability between the city centre and the wider regional network</li> <li>2. The extent to which the option provides for flexibility in design and construction form (e.g. number and size of station entrance and exit points)</li> <li>3. The travel time taken from ground level to platform including consideration of: <ul style="list-style-type: none"> <li>• Waiting time (if lifts)</li> <li>• Number of different escalators (if escalators) – length of time on escalator / speed</li> </ul> </li> <li>4. Station dwell times (island vs. side platform)</li> </ol>
Economic	<ol style="list-style-type: none"> <li>1. The extent to which the option assists economic development through supporting an integrated and coordinated approach to land use and transport. Key considerations include: <ul style="list-style-type: none"> <li>• The employment density within 500m and 1000m now and in 2031</li> <li>• The composition of employment within 500m and 1000m (by Australian and New Zealand Standard Industrial Classification [ANZSIC] code)</li> <li>• The location enhances potential for population and employment growth</li> <li>• Current realisable potential for development near to the station to generate patronage (e.g. 250m, 500m and 1000m radius for commercial. 500m and 1000m radius for residential)</li> <li>• Potential exists (in the form of underdeveloped sites in close vicinity) for public/private partnerships which may aid in the provision of enhanced public realm and mixed use development around the station precinct</li> </ul> </li> </ol>

<sup>9</sup> Please note that the wording of some criteria has been slightly amended between stations to ensure they are relevant to each unique situation.

Environmental and Social	<ol style="list-style-type: none"> <li>1. The extent to which the option aligns with the Auckland Council City Centre Masterplan outcomes</li> <li>2. The extent to which the option provides for general passenger amenity including safety and security (actual and perceived)</li> </ol>
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<b>Operational effects criteria</b>	
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Economic	<ol style="list-style-type: none"> <li>1. The on-going maintenance and operational cost of the option</li> </ol>
Environmental and Social	<ol style="list-style-type: none"> <li>1. The extent of potential visual impact of surface structures (e.g. vent shafts) on underlying residential zones and on other activities sensitive to visual impact</li> <li>2. The extent of potential operational noise impacts and the effect on any sensitive receivers</li> <li>3. The extent of potential operational vibration impacts and the effect on any sensitive receivers</li> </ol>

<b>Construction effects criteria</b>	
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Transport	<ol style="list-style-type: none"> <li>1. The extent of potential impacts on the surrounding transport network (e.g. roads, public transport routes, pedestrian connections and access)</li> </ol>
Environmental and Social	<ol style="list-style-type: none"> <li>1. The extent of potential impacts on air discharge (i.e. dust) above ground on underlying residential zones and on other activities sensitive to air discharge</li> <li>2. The extent of potential construction noise impacts and the effect on any sensitive receivers</li> <li>3. The extent of potential construction vibration impacts and the effect on any sensitive receivers</li> <li>4. The extent of potential impacts from contaminants to the receiving environment</li> <li>5. The extent of potential impacts on groundwater/settlement on buildings</li> <li>6. The extent of potential impacts on significant/major stormwater, network services and utilities</li> <li>7. The extent to which the option requires private land take</li> <li>8. The extent to which the option requires temporary land take (i.e. construction lay-down areas, material removal sites)</li> <li>9. The extent of potential impacts on the operation of emergency services</li> <li>10. The extent of potential impacts on adjacent businesses/shops (i.e. ability to operate)</li> <li>11. The extent of potential impacts on pedestrian connections and access</li> <li>12. The extent of potential impacts on scheduled heritage buildings</li> <li>13. The extent of potential impacts on known archaeological sites</li> <li>14. The extent of potential impacts on known cultural sites</li> <li>15. The extent of potential impacts on areas of open space, biodiversity and/or significant vegetation/trees and/or habitat of significant fauna.</li> </ol>

<b>Staging Criteria</b>	
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Staging <sup>10</sup>	<p>Considerations include:</p> <ol style="list-style-type: none"> <li>a) The extent to which the option enables staging</li> <li>b) The extent of the risks of operating the CRL tunnels during construction of this station at a later date</li> <li>c) The extent of the disruption to services during construction of this station while the CRL is operating.</li> </ol>
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<sup>10</sup> The staging criteria was not assessed for the Inner West Interchange as this related specifically to the city centre underground stations being built along the CRL tunnels

## 4 Evaluation and Results

A number of workshops were held during 2012 to assess the location options for Karangahape Station, Newton Station and the Inner West Interchange. Workshops utilised the evaluation criteria outlined in section 3.2 above which gives consideration to a large number of factors including construction, transportation, urban design and engineering matters.

The evaluation scoring determined at the workshops are set out in this section of the report. Further details, including the scores applied for each specific criteria, are set out in full in **Appendix 4**, **Appendix 5** and **Appendix 7**.

### 4.1 Karangahape Station Evaluation

#### 4.1.1 Group 1 - Outcome focused criteria

	1	2A	2B
Transport	4	3	3.2
Economic	3	3	5
Environmental and Social	4.33	3	4.33
<b>Total</b>	<b>11.33</b>	<b>9</b>	<b>12.53</b>
<b>Rank</b>	<b>2</b>	<b>3</b>	<b>1</b>

Option 2B has the highest score, followed by Option 1 and then Option 2A. This result was due to several key factors:

- Option 1 scores highest in the transport criteria due to the inherent flexibility that can be achieved in a cut and cover station with a central island platform.
- Option 2A had the lowest overall score in relation to both transport and environmental/social criteria.
- With regard to transport criteria, Option 2A offered lower flexibility for station design and construction due to its mined side platform configuration and constrained site.
- With regard to the environmental/social criteria, Option 2A scored lowest primarily due to its sole use of lifts (as opposed to the other options which would use a combination of lifts and escalators).
- Options 1 and 2B resulted in similar total scores in relation to environmental/social criteria, although for different reasons. Option 1 scored well in this area due to the superior passenger amenity able to be achieved in a cut and cover station with a central island platform (e.g. improved sightlines within the station and a larger platform area). Option 2B scored well due to its alignment with the City Centre Masterplan and the potential positive impacts on the local environs (in particular from the possible second entrance in the Mercury Lane area).
- The key differentiator between Options 1 and 2B was that Option 2B scored more highly in terms of its potential to assist economic development in the Karangahape Road area. This higher score was due to the incorporation of a potential second entry/exit portal at the station's southern end on Mercury Lane.

- Without a secondary entrance on Mercury Lane, Option 2B would be less favourable than Option 1. However Option 2B reflected opportunities outlined in the City Centre Masterplan should the second entrance be made available.

#### 4.1.2 Group 2 - Operational effects criteria

	1	2A	2B
<b>Economic</b>	3	4	4
<b>Environmental and Social</b>	3.4	2.6	3.2
<b>Total</b>	6.4	6.6	7.2
<b>Rank</b>	3	2	1

While Option 2B has the highest score, followed by Option 2A and then Option 1, the scores for all three were close with little differentiation. This was due to several key factors:

- From an operational sense, all three options will likely have similar minor effects (i.e. vibration and noise from trains running along the CRL).
- The key differentiator between Options 2A/2B and Option 1 was that Options 2A/2B scored higher for on-going maintenance and operational costs. In general terms, Option 1 is a larger station requiring more spend overall in terms of on-going maintenance and operational cost due mainly to the larger volume of underground space. Furthermore, while lifts (Option 2A) have lower power consumption than escalators, over a whole life assessment escalators (Option 2B) are considered to be more cost-effective.

#### 4.1.3 Group 3 - Construction effects criteria

	1	2A	2B
<b>Transport</b>	1	2.5	2
<b>Environmental and Social</b>	2.22	2.83	2.56
<b>Total</b>	3.22	5.33	4.56
<b>Rank</b>	3	1	2

Option 2A has the highest score, followed by Option 2B and then Option 1. This distribution was due to several factors:

- Option 1 scored lowest on traffic criteria as it would clearly have the most impact with cut and cover construction of the station within Pitt Street, together with the associated reduction in road capacity during the construction period.
- In terms of traffic, Option 2A scored slightly higher than 2B as it would involve less cut and cover impact at the surface.
- Option 1 had the lowest score in terms of environmental and social effects. Specific criteria in which Option 1 scored lowest included:
  - The extent of potential impacts on emergency services – All options will create potential impacts on emergency service access due to works required in the road reserve. However Option 1 would impact directly on the access and operation of both the St Johns Ambulance National Offices and Pitt Street Central Fire Station due to their location in proximity to the cut and cover station construction.
  - The extent of potential impacts on adjacent businesses/shops – Option 1 would effectively prevent access to large parts of Pitt Street (including the footpath areas) for

an extended period. It was unlikely that access to properties and businesses could be retained during the construction period. A particular concern was the lack of viable alternatives for accessing the rear of properties on the eastern side of Pitt Street and the northern side of Karangahape Road (on the east of Pitt Street). It was noted that under Option 1, businesses along the affected road frontage would need to be either compensated or relocated for the construction period.

- The extent of potential impacts on pedestrian connections and access – this criteria assesses the ability to keep footpaths operating during the construction period. The closing of Pitt Street's footpaths in Option 1 would have the most significant impact on pedestrian movement and access. Option 2A scores better than 2B as 2B would involve more pedestrian impacts given the effects in Mercury Lane and Pitt Street of cut and cover shafts.
- Options 2A and 2B had similar scores in terms of environmental and social effects (including land take requirements). The key differentiator that gave Option 2A a higher score overall was that Option 2B would require more sub strata private land take.

#### 4.1.4 Group 4 – Staging Potential

	1	2A	2B
Staging	3	5	5
Rank	3	1=	1=

Engineering advice was provided indicating that all three options could be staged if one of the two running rail lines was closed for approximately 12 months to permit construction. The closing of one of the two running lines for 12 months was considered to carry significant operational and economic risk. Relevant considerations included:

- The potential effect on rail passenger loyalty (i.e. will people switch to other transport modes and not return to rail post-construction of the station?).
- The value of time lost by rail passengers due to delays.
- The effect on the road network of rail passengers switching to private cars/public buses during station construction.

The difference between the three options is that while the staging of Option 1 requires the closing of a running train line<sup>11</sup>, there is opportunity to stage the construction of Options 2A or 2B in the future without closing a line. To facilitate this, construction of the two CRL tunnels would also include construction of the mined side platform tunnels and the breakout openings for cross passages. On that basis, Options 2A and 2B score higher than Option 1.

#### 4.1.5 Karangahape Station Conclusion

In terms of the CRL Project Objectives, anticipated effects and the potential for staging, Option 2B was evaluated as the preferred option. It is noted that this preference is supported by the ability to incorporate a second entry/exit portal at the southern end of the station on Mercury Lane.

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<sup>11</sup> Engineering advice from AT's PA is that there very likely no way to avoid this in order to manage operational risks to the operating railway

## 4.2 Newton Station Evaluation

### 4.2.1 Group 1 - Outcome focused criteria

	1	2A	2B	2C	2D	3
<b>Transport</b>	5	3	3	2.5	2.5	3.5
<b>Economic<sup>12</sup></b>	-	-	-	-	-	-
<b>Environmental and Social</b>	4	3	3	3	3	4
<b>Total</b>	9	6	6	5.5	5.5	7.5
<b>Rank</b>	1	3=	3=	5=	5=	2

Option 1 scores the highest in this section, followed by Option 3 and then Option 2(A-D). Key factors include:

- As with Karangahape Station, Option 1 scores higher due to the inherent flexibility and superior passenger amenity that can be achieved in a cut and cover station with a central island platform (e.g. improved sightlines within the station and a larger platform area).
- Option 1 provides passenger entrances/exits at either end of the station, while all other options only provide access from the southern (i.e. Mt Eden Road) end of the station.
- Of the remaining options, 2A, 2B and 3 score higher as the street level pedestrian entrances/exits are located directly above the stations. This means high speed lifts would be able to carry passengers directly from street level to the platforms. In contrast, Options 2C and 2D would require passengers to enter the station and cross under Symonds Street before being able to access the platform levels.
- Option 3 also rates higher as it provides for a potentially more spacious station facility with greater customer amenity at the intersection of Symonds Street, Mt Eden and New North Roads. This large footprint provides additional flexibility to design an appropriate sized concourse/ticketing area. The busy corner location adjacent to existing retail will also enhance the sense of passenger safety when entering and exiting the station (particularly at night).

### 4.2.2 Group 2 - Operational effects criteria

	1	2A	2B	2C	2D	3
<b>Economic</b>	3	4	4	4	4	4
<b>Environmental and Social</b>	3.33	3.33	3.33	3.33	3.33	3.33
<b>Total</b>	6.33	7.33	7.33	7.33	7.33	7.33
<b>Rank</b>	6	1=	1=	1=	1=	1=

The key differentiator in this group relates to on-going station costs. As with Karangahape Station, Option 1 is a larger station requiring more spend overall in terms of maintenance and operational cost due mainly to the larger volume of underground space. Due to the extra depth of the underground station, high speed lifts are considered more appropriate here than at Karangahape Station (where escalators were identified as the preferred method of getting passengers to and from platform levels). High speed lifts are assumed across Options 2(A-D) and 3, whereas Option 1 (with its large cut and cover box) may have the opportunity to utilise lifts and escalators.

<sup>12</sup> This criteria was reviewed and not considered to provide any differentiation between the Newton Station options.

All options score the same in terms of environmental and social criteria. This reflects the fact that the proposed station is very deep and located within solid rock. It is anticipated that station operations would have limited impacts on the locality, and that any effects could be managed/mitigated.

**4.2.3 Group 3 - Construction effects criteria**

	1	2A	2B	2C	2D	3
<b>Transport</b>	1	2	2	2	2	4
<b>Environmental and Social</b>	2.43	2.93	2.93	2.93	2.93	3
<b>Total</b>	3.43	4.93	4.93	4.93	4.93	7
<b>Rank</b>	6	2=	2=	2=	2=	1=

Option 3 scores significantly higher in this criteria than any other alternative. Key factors for this include:

- Under Option 3, the access shaft and construction site are located off road, which would have substantially less impacts on other road users during construction.
- Option 3 also provides the alternative that locates the underground station and access shaft the furthest away from the existing Watercare reservoir.
- Option 1 scores particularly poorly in this section due to the adverse effects from the proposed cut and cover construction methodology. This would involve significant at grade works in the Symonds Street road reserve, and would have adverse effects on road users and existing businesses in the area.
- The cut and cover construction methodology proposed under Option 1 would also create higher construction related effects (such as noise and dust) than the mined side platform alternatives.
- Option 2 is expected to have substantially less impact on the road reserve than Option 1, but more impact than Option 3 where the shaft and at grade works have been located off road.

**4.2.4 Group 4 – Staging Potential**

	1	2A	2B	2C	2D	3
<b>Staging</b>	3	5	5	5	5	5
<b>Rank</b>	6	1=	1=	1=	1=	1=

Like Karangahape Station, the difference between the options is that while the staging of Option 1 requires the closing of a running train line, there is opportunity to stage the construction of Options 2(A-D) or 3 in the future without closing a line. To facilitate this, construction of the two tunnels would also include construction of the mined side platform tunnels and the breakout openings for cross passages. On that basis, Options 2(A-D) and 3 score higher than Option 1.

**4.2.5 Newton Station Conclusion**

In terms of the CRL Project Objectives, anticipated effects and the ability to provide for the potential staged construction of the station, Option 3 was evaluated as the preferred option. In particular, it is noted that this option shifts the underground station furthest away from the Watercare reservoir, minimising the construction and vibration risks associated with this significant utility. The option also minimises the level of construction works undertaken in the road area, reducing adverse impacts from construction.

### 4.3 Additional Infrastructure (the Inner West Interchange)

An analysis of the potential operating configurations post construction of the CRL has identified that an Inner West Interchange (INWI) would improve the flexibility and efficiency of the Auckland passenger rail network. This interchange will allow some trains running through the CRL to terminate at INWI before returning through the CRL either to stabling or as part of their return journeys.

This section considers the location options for the interchange. The assessment methodology outlined in sections 3.2 has also been used to assess location options for the INWI.<sup>13</sup>

#### 4.3.1 Group 1 - Outcome focused criteria

	A	B	C(i)	C(ii)	D
Transport	3.5	2	3.5	4	4
Economic	4	2	4	4	n/a
Environmental and Social	3	2	3	3	n/a
Total	10.5	6	10.5	11	
Rank	2=	4	2=	1	

#### 4.3.2 Group 2 - Operational effects criteria

	A	B	C(i)	C(ii)	D
Economic	2	2	3	3	n/a
Environmental and Social	3	2.33	2.67	2.67	n/a
Total	5	4.33	5.67	5.67	
Rank	3	4	1=	1=	

#### 4.3.3 Group 3 - Construction effects criteria

	A	B	C(i)	C(ii)	D
Transport	1	1	2	2	n/a
Environmental and Social	2.58	2.42	2.5	2.75	n/a
Total	3.58	3.42	4.5	4.75	
Rank	3	4	2	1	

Based on the scores above, the evaluation of the four location options is set out below.

#### Option A - Locate the INWI at the existing Morningside Rail Station on the NAL

Morningside Rail Station currently has some land available for the interchange, but additional land would be required for the additional platforms and tracks. In terms of economic development and growth, Morningside and Kingsland would be expected to benefit from placing the INWI in this location due to the increased frequency of services and improved connectivity with the CBD.

Construction of the interchange facility at Morningside Station would have significant land impacts as it would require additional tracks to run from the CRL portals along the NAL to this location. This is anticipated to have substantial adverse effects on the areas impacted, in particular around Kingsland where the rail corridor is already geographically constrained.

<sup>13</sup> Note: the staging criteria (group 4 from section 3.3) was not assessed for the Inner West Interchange as this related specifically to the city centre underground stations being built along the CRL tunnels.

There are four key adverse effects from this option which make it less preferable than the preferred option:

- Locating the interchange at Morningside will require trains to travel further out West from the CRL before being able to terminate and return in the opposite direction (either to stabling or on their return journeys). This will result in increased operating costs and mean that additional train sets are required to maintain service frequencies.
- Additional tracks will need to be built in order to provide an appropriate level of reliability at a very high cost.
- Trains from the CRL and trains from Newmarket cannot be separated unless additional tracks (requiring additional property take and additional cost) are built along the NAL from the junction between the NAL and the CRL, without which there are additional conflicting train movements reducing the operational benefit of this option.
- Significant additional land take between Morningside and the CRL portals would be required for the four tracks.

#### **Option B - Locate the INWI at the existing Kingsland Rail Station on the NAL**

As with Morningside above, trains from the CRL and trains from Newmarket cannot be separated unless additional tracks (requiring additional property take and additional cost) are built along the NAL from the junction between the NAL and the CRL, without which there are additional conflicting train movements reducing the operational benefit of this option.

This option was considered to have substantial negative effects on Kingsland as the NAL is already constrained in this locality between the Kingsland village and Sandringham Road. Substantial land take would be required for the interchange, which would be a facility on a scale and form considered inconsistent with the heritage character of the surrounding area. There are also topographical constraints which make this option suboptimal, with Sandringham Road located below the existing NAL and the Kingsland village above.

The additional distance would also create a greater level of operational cost compared to an interchange located closer to the CRL portals.

#### **Option C - Locate the INWI on the NAL to the west of Dominion Road**

Locating the interchange to the immediate west of Dominion Road presented the best option in terms of overall requirements. The location would require some private land acquisition but some redevelopment post-construction would be possible. The location to the west of Dominion Road is approximately equidistant between the existing Kingsland and Mt Eden Rail Stations.

An interchange in this location requires less of the NAL to be widened (as opposed to the Kingsland or Morningside options discussed above) and trains to travel less distance before being able to terminate and begin their return journeys. This is anticipated to have a positive effect on the rail network's reliability, operational costs and fleet requirements.

Two sub options were considered for this location:

- C(i) Placement of the interchange and the accommodation of four tracks in this area through acquiring land on the north of the NAL; or
- C(ii) Placement of the interchange and the accommodation of four tracks in this area through acquiring land on the south of the NAL.

The following table assesses the two sub options:

<i>Indicative land impacts</i>	<p>Option C(i) will require widening on the northern side of the NAL and the indicative number of commercial properties that would be required to cater for the alignment totals seven.</p> <p>Option C(ii) will require widening to occur on the southern side of the NAL and this would require properties adjacent to the rail line at Onslow Road and Tawari Street for both permanent works and temporary construction access.</p> <p>The impact of the southern alignment is less than the north alignment when considering the number of properties that would be directly impacted.</p>
<i>Access and integration with other transport modes</i>	<p>Under Option C(i), the station is accessed via George Street at its western end.</p> <p>Option C(ii) incorporates two station entrances, one at George Street and another at the eastern end of the station near Dominion Road. This increases the station’s accessibility and passenger catchment, and provides an opportunity to link the station with bus services along Dominion Road.</p>
<i>Ability to avoid remedy or mitigate the associated effects</i>	<p>The northern alignment includes a number of commercial properties within a Mixed Use Zone (a mixture of light industrial, commercial and residential) under the Auckland District Plan Isthmus Section. This is likely to pose a higher risk regarding potential contamination than the residential zone on the southern alignment.</p> <p>Other effects such as noise and vibration, transport, heritage, social impacts etc. have also been considered. At a high level, it is considered unlikely these would be <i>significantly</i> different between the north and south alignments.</p>
<i>Redevelopment opportunities</i>	<p>AT considers that both alignments provide redevelopment opportunities once the station is operational.</p>

Overall it was considered that Option C(ii) was the preferred alternative as:

- I. It provided a better opportunity to integrate the interchange with both George Street and Dominion Road (for example, accessing the passenger catchment on the east side of Dominion Road and possible interaction with future bus services using Dominion Road<sup>14</sup>);
- II. Less land take on balance is required to accommodate the four tracks on the south side whereas on the north side most of the commercial properties located between George Street and Sandringham Road to the west would be required as the sites are almost entirely covered by buildings.

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<sup>14</sup> This bus service provision is anticipated to be included in the proposed Public Transport Network Plan post 2021.

### **Option D - Locate the INWI on the NAL to the east of Dominion Road**

This option was technically compromised due its proximity to the CRL portals. An interchange in this location would suffer from the following issues:

- The CRL tracks are still ascending out of the portal at this location and have not yet met the height of the existing NAL. This would likely mean that the CRL platforms would not be level at this station.
- As the tracks are still ascending from the CRL portal, the platforms for each line would not be on the same level (i.e. the NAL and CRL lines are at different grades at this point).
- There are operational issues regarding trains entering and exiting the interchange and the curved nature of the track to the east as trains enter/exit the CRL tunnels. This would not allow for the necessary switches/crossings to enable the interchange to function adequately.

Upon review, this location did not meet the design requirements and technical parameters for the CRL. The combination of track geometry, track levels, track switches and crossings and the absence of the remaining straight track length to accommodate station platforms results in this option not being viable.

#### 4.3.4 Inner West Interchange Conclusion

Based on the analysis above, Option C(ii) was evaluated as the preferred location for the INWI.

## 5 Conclusions

As a result of the evaluation set out in this report, the following options and refinements were adopted for the concept design.

### 5.1 Karangahape Station

**Option 2B** is the preferred option. Option 2B would consist of two, separately mined side platform tunnels with the northern end in the Beresford Street/Pitt Street area extending southwards toward lower Mercury Lane. The station would utilise escalators and may include a second station exit at the southern end of Mercury Lane.

### 5.2 Newton Station

**Option 3** is the preferred option. Under Option 3, the bulk of the station would be located to the west of Symonds Street, beneath existing buildings. The station would be constructed with two separately mined side platform tunnels accessed through a single pedestrian entrance/exit on the western side of Symonds Street at the intersection with Mt Eden and New North Roads. Lifts would be used to access the station platforms from street level.

### 5.3 Inner West Interchange

**Option C(ii)** is the preferred location for the INWI (to the west of Dominion Road and on the southern side of the existing NAL).

### 5.4 Alignment changes between Britomart Station and the NAL

The alignment set out at **Appendix 8** is the preferred alignment.

### 5.5 Station Construction Methodology

The concept design for the stations at Karangahape and Newton is to be based on mined side platform stations.

### 5.6 Lower Albert Street Cut and Cover

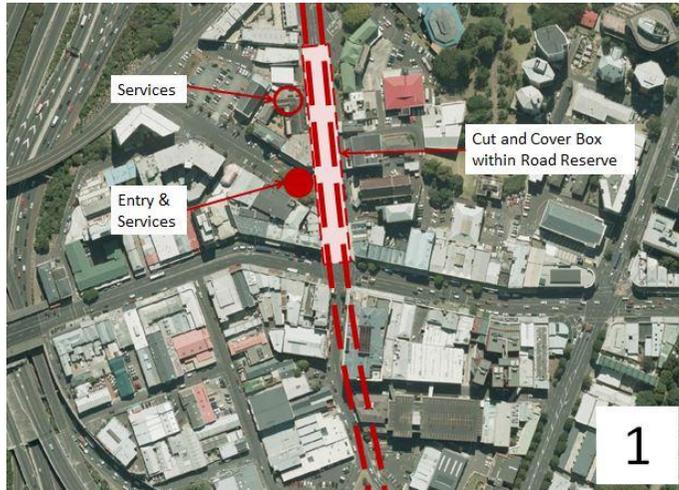
The Lower Albert Street portion of the CRL is to retain flexibility to be constructed using either the cut and cover or TBM construction methodology.

## Appendix 1 – 2009 Project Objectives

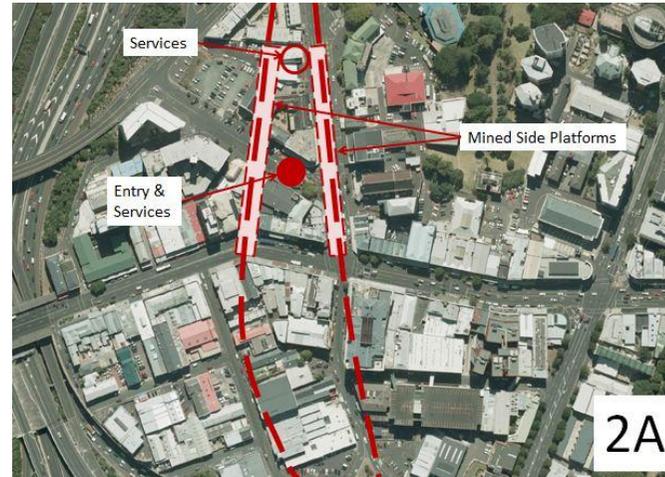
Overarching Objectives
<b>01</b> Support the desired future growth and development of the CBD and Region
<b>02</b> Optimise public transport patronage potential and accessibility to / from and within the CBD
<b>03</b> Optimise efficiency and potential of the Rapid Transport network including integration with passenger transport, active modes and freight requirements
<b>04</b> Continue to develop Auckland rail as part of an integrated national rail network
Specific Objectives
<b>S1</b> To contribute to an attractive, sustainable and integrated passenger transport system that offers choices for travellers to / from and within the CBD
<b>S2</b> To provide quality rail stations and connections in optimal locations in the CBD and fringe to facilitate the regional growth objectives of land use intensification, sustainability and economic development around transport nodes
<b>S3</b> To encourage use of passenger rail services to achieve passenger transport modal share targets for the Auckland CBD and region in accordance with the regional transport policy framework
<b>S4</b> To improve journey time, increase reliability and enhance modal integration for passenger services to / from and within the CBD
<b>S5</b> To enable the expansion of the passenger rail network to penetrate into the midtown and uptown areas of the CBD and to increase the capacity of Britomart Station by: - Protecting rail corridor and station locations between the NAL (western line) and Britomart Station; and - Making Britomart Station into a through station
<b>S6</b> To enable the operation of enhanced rail services across the region, to and from the CBD, as an integrated part of the wider Rapid transport Network
<b>S7</b> To not preclude a potential interchange between the CBD rail link and a future North Shore passenger rail line

## Appendix 2 – Karangahape Station Option Overview

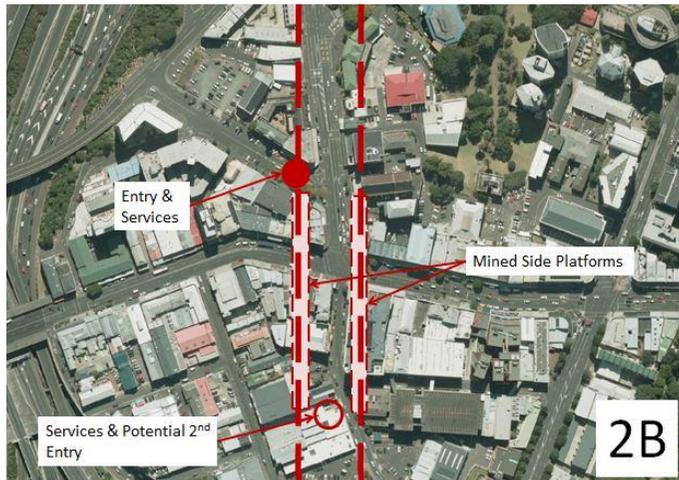
**OPTION 1**



**OPTION 2A**



**OPTION 2B**



### Appendix 3 – Newton Station Option Overview

**OPTION 1**



**OPTION 2A**



**OPTIONS 2B-D**

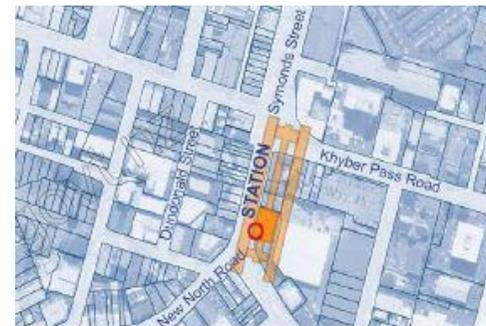


Figure 5-81 Option 2b Plan



Figure 5-82 Option 2c Plan



**OPTION 3**



## Appendix 4 – Station Workshop Criteria, Scores and Commentary (Karangahape)

- Notes:
- The criteria below have been divided into two groups, those focused on outcomes (e.g. stimulating economic development) and those focused on effects (e.g. the impact on heritage buildings). Each group has then been sub-divided into groups that align with the overarching Project Objectives.
  - Workshop notes have been colour coded to reflect the particular workshop the comments originated in.
  - There are a number of criteria which were assessed in both Karangahape Workshop 1 and Karangahape Workshop 2 due to inherent overlap in the disciplines of attendees. Criteria considered at both workshops is noted with this mark: \*\*

### Outcome Focused Criteria

1.0	Transport	Measures and Indicators for Scoring Criteria	Karangahape Rd Workshop Scores			Workshop Notes
			1	2A	2B	
			BLACK Text = Karangahape Rd Workshop 1 (3 and 7 May 2012) RED text = Karangahape Rd Workshop 2 on 9 May 2012			
1.	The extent to which the option design provides maximum operational flexibility and service reliability between the City Centre and the wider regional network	Travel time as a result of train speed	3	3	3	<ul style="list-style-type: none"> <li>No discernable difference between the three options.</li> </ul>
2.	The extent to which the option provides for flexibility in design and construction form (e.g. number and size of station entrance and exit points) **	Station construction methodology (i.e. cavern vs. cut and cover construction)  Footprint requirements  Whether only one location “pops out”	5	2	4	<ul style="list-style-type: none"> <li>A ‘big box’ station design (i.e. Option 1) is inherently flexible. Option 1 clearly provides the most flexibility with three potential entry/exit portals.</li> <li>A mined station within constrained sites (i.e. Option 2A) is inherently inflexible. Option 2A scores lowest with only one entry/exit portal.</li> <li>A mined station with one end on a constrained site and the other on a relatively unconstrained site (i.e. the Mercury Lane area) is more flexible than Option 2A.</li> </ul>
2.	The extent to which the option provides for flexibility in design and construction form (e.g. number and size of station entrance and exit points) **	Station construction methodology (i.e. cavern vs. cut and cover construction)  Footprint requirements  Whether only one location “pops out”	4	2	3	<ul style="list-style-type: none"> <li>It was noted that overall Option 1 had the greatest flexibility followed by 2B then 2A.</li> </ul>
3.	The travel time taken from ground level to platform including consideration of: <ul style="list-style-type: none"> <li>Waiting time (if lifts)</li> <li>Number of different escalators (if escalators) – length of time on escalator / speed</li> </ul>	Quantitative assessment	3	5	3	<ul style="list-style-type: none"> <li>In general terms lifts perform better than escalators in terms of travel time to surface.</li> <li>Lifts require more land take however as the shafts need to be located outside of the platform/station area.</li> <li>In terms of passenger amenity, escalators provide passengers with a perceived sense of constant movement, notwithstanding the fact that travel time to surface may be quicker overall with lifts.</li> <li>The rating for Option 2B is based on a single exit/entrance portal at Beresford St.</li> </ul>
4.	Station dwell times (island vs. side platform)	Quantitative assessment	5	3	3	<ul style="list-style-type: none"> <li>A central, island platform provides passengers with more space when exiting trains. Side platforms are smaller in area and therefore offer less space to passengers.</li> </ul>

2.0	Economic	Measures and Indicators for Scoring Criteria	Karangahape Workshop Scores			Workshop Notes
			1	2A	2B	
<p><b>BLACK Text</b> = Karangahape Rd Workshop 1 (3 and 7 May 2012)  <b>RED text</b> = Karangahape Rd Workshop 2 on 9 May 2012</p>						
1.	<p>The extent to which the option assists economic development through ensuring an integrated and coordinated approach to land use and transport. Key considerations include:</p> <ul style="list-style-type: none"> <li>The employment density within 500m and 1000m now and in 2031</li> <li>The composition of employment within 500m and 1000m (by Australian and New Zealand Standard Industrial Classification [ANZSIC] code)</li> <li>The location and number of stations enhances potential for population and employment growth</li> <li>Current realisable potential for development near to the stations to generate patronage (e.g. 250m, 500m and 1000m radius for commercial. 500m and 1000m radius for residential)</li> <li>Potential exists (in the form of underdeveloped sites in close vicinity) for public/private partnerships which may aid in the provision of enhanced public realm and mixed use development around the station precinct</li> </ul>	Auckland Council City Centre Station Analysis	3	3	5	<ul style="list-style-type: none"> <li>Option 2B <u>only</u> scores 5 if it incorporates a second entry/exit portal (i.e. in addition to Beresford Square) in the southern section of Mercury Lane. The cost of this secondary portal is an important consideration going forward.</li> <li>It was noted that it is essential that this criterion align with the goals of the City Centre Masterplan.</li> <li>This criterion requires specific consideration of the balance to be struck between (1) user experience and (2) future development potential.</li> </ul>

3.0	Environmental and social	Measures and Indicators for Scoring Criteria	Karangahape Workshop Scores			Workshop Notes
			1	2A	2B	
<p><b>BLACK Text</b> = Karangahape Workshop 1 (3 and 7 May 2012)  <b>RED text</b> = Karangahape Workshop 2 on 9 May 2012</p>						
1.	<p>The extent to which the option aligns with the Draft Auckland City Centre Masterplan outcomes:</p> <ul style="list-style-type: none"> <li>The extent to which the option will provide positive impacts on the built environment in the environs of the option location</li> <li>The extent to which the option has the potential to enhance pedestrian access and connectivity across physical barriers</li> <li>Station is within a 250m radius to existing or planned public and community facilities, services and centres</li> </ul>	Qualitative assessment	3	3	5	<ul style="list-style-type: none"> <li>See discussion under "extent to which the option assists economic development" above.</li> </ul>
2.	<p>The extent to which the option provides for general passenger amenity e.g.:</p> <ul style="list-style-type: none"> <li>The height of ceiling above platform – feeling of spaciousness</li> <li>The seating areas provided</li> </ul>	Qualitative assessment	5	3	4	<ul style="list-style-type: none"> <li>Overall Option 1 would offer the most flexibility in terms of providing for passenger amenity. This is because the 'station box' design would offer good sight lines and larger, more open spaces through which passengers would travel.</li> <li>Escalators would offer better amenity potential than lifts (hence Option 2A getting the lowest score). However, it is possible to make lifts open, light and high in amenity.</li> <li><b>It was noted that escalators were preferable to lifts as escalators gave the impression of constant movement.</b></li> </ul>
3.	<p>Passenger safety and security (i.e. the extent to which the option provides for a safe and secure passenger environment via CCTV, lighting, station layout etc.)</p>	Qualitative assessment	5	3	4	<ul style="list-style-type: none"> <li>Overall Option 1 would offer the most flexibility in terms of providing for passenger safety and security. This is because the 'station box' design would offer larger, more open spaces proving passengers with larger spaces and less confined areas.</li> </ul>

**Effects Focused Criteria**

Notes:

- Construction related effects are shaded in blue
- Operational effects are shaded in green

4.0	Transport	Measures and Indicators for Scoring Criteria	Karangahape Workshop Scores			Workshop Notes
			1	2A	2B	
<p><b>BLACK Text</b> = Karangahape Rd Workshop 1 (3 and 7 May 2012)  <b>RED text</b> = Karangahape Rd Workshop 2 on 9 May 2012</p>						
1.	The extent of potential impacts on the surrounding transport network (e.g. roads, public transport routes, pedestrian connections and access) and the CMJ **	Construction methodology allows for roads to stay open (even in a reduced form) during construction period	1	2	2	<ul style="list-style-type: none"> <li>• It was noted that all 3 options would have adverse effects but that Option 1 would clearly have the most impact with cut and cover construction over Pitt St.</li> <li>• Option 2A would have the least effects on the transport network overall but would still involve some cut and cover at the northern part of the construction envelope.</li> <li>• Option 2B would have marginally less effects than Option 2A due to the location of the elevator shaft located within the road reserve. The difference in effect between 2A and 2B was not sufficient however to warrant a different evaluation score.</li> </ul>
1.	The extent of potential impacts on the surrounding transport network (e.g. roads, public transport routes, pedestrian connections and access) and the CMJ **	Construction methodology allows for roads to stay open (even in a reduced form) during construction period	1	3	2	<ul style="list-style-type: none"> <li>• It was noted that the reduction in road capacity in Option 1 meant it would clearly score lower. 2A scored slightly higher than 2B as 2A would involve less cut and cover impact.</li> <li>• The impact, post construction, of closing Beresford St was discussed. It was noted that this was not a significant connecting street and therefore the impact would be minimal.</li> </ul>

5.0	Economic	Measures and Indicators for Scoring Criteria	Karangahape Workshop Scores			Workshop Notes
			1	2A	2B	
<p><b>BLACK Text</b> = Karangahape Rd Workshop 1 (3 and 7 May 2012)  <b>RED text</b> = Karangahape Rd Workshop 2 on 9 May 2012</p>						
1.	The on-going maintenance and operational cost of the option	Quantitative assessment	3	4	4	<ul style="list-style-type: none"> <li>• In general terms, Option 1 is a larger station requiring more spend overall in terms of ongoing maintenance and operational cost.</li> <li>• While lifts have lower power consumption than escalators, over a whole life assessment escalators are more cost-effective.</li> <li>• During a power failure independent backups would ensure lifts remained operational.</li> </ul>

6.0	Environmental and social	Measures and Indicators for Scoring Criteria	Karangahape Workshop Scores			Workshop Notes
			1	2A	2B	
<p><b>BLACK Text</b> = Karangahape Rd Workshop 1 (3 and 7 May 2012)  <b>RED text</b> = Karangahape Rd Workshop 2 on 9 May 2012</p>						
1.	The extent of potential visual impact of surface structures (e.g. vent shafts) on underlying residential zones and on other activities sensitive to visual impact **	Identification of sensitive activities (existing environment analysis via desk top and walk around study area) Identification of future site opportunities and development potential	5	3	4	<ul style="list-style-type: none"> <li>• While all three options have an exit portal at Beresford St, the size of the exit portal will be determined by whether the exit is via escalator or lift. Lift exits are necessarily larger. Option 2A therefore scores lower than the other two options.</li> <li>• Option 2B scores higher than 2A as 2B includes the potential for venting to occur at the southern, less intensive, end of the station footprint.</li> </ul>
1.	The extent of potential visual impact of surface structures (e.g. vent shafts) on underlying residential zones and on other activities sensitive to visual impact **	Identification of sensitive activities (existing environment analysis via desk top and walk around study area) Identification of future site opportunities and development potential	3	3	3	<ul style="list-style-type: none"> <li>• It was noted that it is difficult to differentiate the three options at this high level.</li> <li>• The venting shafts would be approx. 3.5m tall for all three options – any visual impacts could be addressed in the design phase with reference to urban design principles.</li> <li>• It was noted that 2B may have better impacts with a second, southern exit/entry portal “catching more people” and because the southern area surrounding Mercury Lane would have greater future development potential. This was an issue for detailed design however.</li> <li>• On the issue of lifts exits / escalator exits, it was noted that this again was a matter for detailed design as it may be possible to produce good design with either portal type.</li> <li>• It was noted that it was important not to privatise the whole of the affected streetscape – the final design needs to compliment the streetscape.</li> </ul>
2.	The extent of potential impacts on air discharge (i.e. dust) above ground on underlying residential zones and on other activities sensitive to air discharge	Identification of Rail Link activities that would impact on air quality: construction methodology cut and cover greater impacts on air quality during construction, cavern construction significant less impacts on air quality	3	4	4	<ul style="list-style-type: none"> <li>• While Option 1 would have more air discharge effects by virtue of the cut &amp; cover methodology, the expected adverse effects could all be managed.</li> </ul>
3.	The extent of potential construction noise impacts	Auckland District Plan (Central Section and Isthmus Section) – Noise controls Identification of noise effects	2	3	3	<ul style="list-style-type: none"> <li>• While Option 1 would have greater noise impacts during construction than 2A and 2B (due to cut and cover methodology), the scale of those effects could not currently be assessed as they would be based on the final construction methodology.</li> </ul>

6.0	Environmental and social	Measures and Indicators for Scoring Criteria	Karangahape Workshop Scores			Workshop Notes
			1	2A	2B	
<p><b>BLACK Text</b> = Karangahape Rd Workshop 1 (3 and 7 May 2012)  <b>RED text</b> = Karangahape Rd Workshop 2 on 9 May 2012</p>						
4.	The extent of potential operational noise impacts	Auckland District Plan (Central Section and Isthmus Section) – Noise controls Identification of noise effects	3	3	3	<ul style="list-style-type: none"> <li>While operational noise effects would be largely dependent on the location of ventilation towers, there was little to differentiate the three options as all potential adverse effects could be mitigated.</li> <li>It was noted that Option 2B may have marginally greater effects due to the lesser tunnel depth from the surface at the southern part of the station.</li> </ul>
5.	The extent of potential construction vibration impacts	Auckland District Plan (Central Section and Isthmus Section) – Noise controls Identification of vibration effects	3	2	2	<ul style="list-style-type: none"> <li>The cavern construction aspects of Options 2A and 2B would have more vibration impacts due to:                             <ul style="list-style-type: none"> <li>Option 2A passing beneath the apartment complex on Beresford St and</li> <li>Option 2B passing below the Mercury Theatre building.</li> </ul> </li> <li>Concern noted that vibration may have structural impacts on these buildings (although further analysis would be needed to determine if this was in fact a valid concern).</li> <li>Scores provided do depend on which construction methodology is used.</li> </ul>
6.	The extent of potential operational vibration impacts	Auckland District Plan (Central Section and Isthmus Section) – Noise controls Identification of vibration effects	3	2	3	<ul style="list-style-type: none"> <li>While there was little to differentiate Options 1 and 2B, Option 2A scored lower due to potential effects on the residential buildings located on Beresford St (e.g. people sleeping at night).</li> </ul>
7.	The number of sensitive receivers located within the affected area	Identification of existing activities known to be sensitive to noise	3	2	3	<ul style="list-style-type: none"> <li>It was noted that while there was little to differentiate Options 1 and 2B, Option 2A scored lower due to potential effects on the residential buildings located on Beresford St.</li> <li>It was also noted that the alignment of the tunnels was a consideration for vibration effects as different alignments would impact different buildings.</li> </ul>
8.	The extent of potential impacts from contaminants to the receiving environment	Desktop site investigation	3	4	4	<ul style="list-style-type: none"> <li>Generally speaking all effects could be mitigated and that at present there was no indication that any of the three options would uncover contamination concerns.</li> <li>To date only one bore has been done in the Karangahape Rd area.</li> <li>Option 1 scored lower as it was agreed that the cut and cover methodology would by definition involve a greater quantum of land disturbance than Options 2A and 2B (and therefore greater potential for encountering contaminated material).</li> </ul>
9.	The extent of potential impacts on groundwater/settlement on buildings	Known geological conditions Construction methodology	2	2	2	<ul style="list-style-type: none"> <li>It was noted that while all three options would have effects, those effects would be minor in the sense that they are likely to be cosmetic rather than of structural significance. These effects could therefore be mitigated.</li> <li>Option 2B would have more significant effects than Options 1 and 2A but the effects could still be mitigated.</li> <li>Consideration was given to sites of particular sensitivity like Scheduled Heritage Buildings (e.g. Hopetoun Alpha, Old Ambulance Building and George Courts).</li> <li>Salmond Reed Architects is to provide further analysis of impacts on heritage buildings.</li> </ul>
10.	The extent of potential impacts on significant/major stormwater, network services and utilities	Identification of known public services and utilities as per Auckland Council, Metrowater, Watercare and other relevant records	2	2	2	<ul style="list-style-type: none"> <li>It was noted that the Karangahape Rd environment as a whole had less utility impacts than other stations on the CRL (e.g. Aotea).</li> <li>While all three options were scored the same, Option 2A has marginally less impact than the other two options.</li> <li>Option 2B would have additional impacts if it incorporates a second entry/exit portal (i.e. in addition to Beresford Square) in the southern section of Mercury Lane.</li> <li>It was noted that in terms of evaluating the options, scores need to compare any adverse effects against a 'business-as-usual' baseline.</li> </ul>
11.	The extent to which the option requires private land take	Location of the station and station portals in terms of: <ul style="list-style-type: none"> <li>Placement in road reserve</li> <li>Public open space</li> <li>Public property vs. placement in private property</li> </ul>	4	3	1	<ul style="list-style-type: none"> <li>In terms of the NOR process it is important to consider both above-ground and sub-strata land take (and in particular the number of properties the sub-strata land take may impact). This is also an issue in terms of possible costs.</li> <li>As impacts on other factors (e.g. impacts on heritage buildings) will be considered under other criteria, the focus of the land take criteria is one the quantum of land required (both permanent take and temporary). When the evaluation is completed, the Project Team can then take an overall holistic view of the options based on all criteria.</li> </ul>
12.	The extent to which the option requires temporary land take (i.e. construction lay-down areas, material removal sites)	Identification of land required as a result of construction methodology	4	3	1	<ul style="list-style-type: none"> <li>See discussion under "The extent to which the option requires private land take" above.</li> </ul>
13.	The extent of potential impacts on the operation of emergency services **	Construction methodology allows for roads to stay open (even in a reduced form) during construction period	1	2	3	<ul style="list-style-type: none"> <li>Option 1 will impact on both the St Johns Ambulance depot <u>and</u> on the Pitt St Fire station.</li> <li>Option 2A will impact <u>only</u> on the St Johns Ambulance depot.</li> <li>Option 2B will impact <u>neither</u> the St Johns Ambulance depot nor the Pitt St Fire station.</li> <li>While it is clear that Options 1 and 2A will affect the operation of St Johns and the Pitt St Fire station, the significance of the effects (and therefore the extent to which the effects can be mitigated) requires further assessment. The first stage in progressing this further assessment will be direct consultation with the affected parties to ascertain their operational requirements.</li> </ul>
13.	The extent of potential impacts on the operation of emergency services **	Construction methodology allows for roads to stay open (even in a reduced form) during construction period	1	3	2	<ul style="list-style-type: none"> <li>Option 2B would score the highest <u>if an acceptable arrangement can be made with regard to the ambulance station. It was noted however that at the time of scoring the effects of moving the ambulance station are unknown.</u></li> <li>It was noted that the focus should be on managing effects i.e. process with a working assumption that the ambulance station may need to be relocated.</li> <li>On that basis Option 1 scores the lowest followed by 2B then 2A.</li> </ul>
14.	The extent of potential impacts on adjacent businesses/shops (i.e. ability to operate) **	Construction methodology allows for roads to stay open (even in a reduced form) during construction period	1	2	2	<ul style="list-style-type: none"> <li>Option 1 will require virtually all of the Pitt St road reserve, including the footpath areas. As such, businesses along the affected road frontage would need to be either compensated or relocated for the construction period. Access to the rear of buildings on the eastern side of Pitt St may be possible from either Queen St or Greys Ave.</li> <li>Options 2A and 2B will impact the roadway on Beresford St but will still allow for pedestrian access to businesses. The likely business impacts of options 2A and 2B would be very similar.</li> </ul>
14.	The extent of potential impacts on adjacent businesses/shops (i.e. ability to operate) **	Construction methodology allows for roads to stay open (even in a reduced form) during construction period	1	3	2	<ul style="list-style-type: none"> <li>A key consideration was the extent to which Poynton Terrace could be utilised to allow access to the rear of the buildings on the eastern part of Pitt St.</li> <li>Access to these properties via the fire station site to the north was discussed but the general view was that the operational requirements of the fire station would preclude this.</li> <li>It may be possible to retain access via Pitt St via keeping an access way open during construction. It was noted however that this had yet to be determined. [Further investigation indicated this was not possible]</li> <li>Access from Upper Queen St (i.e. behind the Auckland Baptist Tabernacle) was also discussed. [Further investigation indicated this was not possible]</li> </ul>

6.0	Environmental and social	Measures and Indicators for Scoring Criteria	Karangahape Workshop Scores			Workshop Notes
			1	2A	2B	
						<p><b>BLACK Text</b> = Karangahape Rd Workshop 1 (3 and 7 May 2012)</p> <p><b>RED text</b> = Karangahape Rd Workshop 2 on 9 May 2012</p>
15.	The extent of potential impacts on pedestrian connections and access	Area wide study of PT & cycle networks Constraints analysis Topography analysis Identification of existing and potential desire lines	1	3	2	<ul style="list-style-type: none"> <li>It was noted that this criteria was largely based on keeping footpaths operating. With that in mind, the closing of Pitt St's footpaths in Option 1 would have the most significant impact on pedestrian movement / access.</li> <li>Option 2A scores better than 2B because 2B would involve more pedestrian impacts.</li> </ul>
16.	The extent of potential impacts on scheduled heritage buildings **	Identification of current scheduled heritage buildings with Auckland Council and New Zealand Historic Places Trust	2	2	2	<ul style="list-style-type: none"> <li>See discussion under "The extent of potential impacts on groundwater/settlement on buildings" above.</li> </ul>
16.	The extent of potential impacts on scheduled heritage buildings **	Identification of current scheduled heritage buildings with Auckland Council and New Zealand Historic Places Trust	2	4	4	<ul style="list-style-type: none"> <li>It was noted that Option 1 was the only one of the three that directly affects a scheduled building [George Courts].</li> <li>All options will involve removal of the Beresford toilets.</li> <li>It was considered that overall options 2A and 2B would have the least impacts due to tunnel depths.</li> </ul>
17.	The extent of potential impacts on known archaeological sites	Identification of current known archaeological/cultural sites with Auckland Council and New Zealand Historic Places Trust	2	3	3	<ul style="list-style-type: none"> <li>More likely to find unrecorded archaeology in Option 1 because of earthworks footprint and the proximity to northern side of old firestation.</li> </ul>
18.	The extent of potential impacts on known cultural sites	Identification of current known archaeological/cultural sites with Auckland Council and New Zealand Historic Places Trust	3	3	4	<ul style="list-style-type: none"> <li>Option 1: requires significant cut and cover to a north facing slope which is likely to have been a traditional living or gardening site. Mitigated somewhat by the minimal private land required for permanent works.</li> <li>Option 2A: Deep side platform mining only required so less on ground disturbance however a relatively large amount of private north facing land (compared to Option 1) required for redevelopment.</li> <li>Option 2B Minimal ground level disturbance in creating platforms. Large amount of private land required for the permanent works however this is south facing and unlikely to have been a garden or living site – may possibly involve ground water / traditional creek or spring.</li> <li>All options provide the opportunity to redevelop Beresford Square as a positive urban space where Maori cultural landscapes can be explored and appropriate interpretation and landscape development can occur.</li> <li>The full name 'Karanga a Hape' should be used as this name has significance for mana whenua relating to the ancestor 'Hape' associated with the Tainui waka.</li> </ul>
19.	The extent of potential impacts on areas of open space, biodiversity and/or significant vegetation/trees and/or habitat of significant fauna	Identification of: <ul style="list-style-type: none"> <li>Current listed areas of open space</li> <li>Known future areas of open space</li> <li>Any scheduled trees (not generally protected)</li> <li>Any listed areas of significant vegetation or fauna</li> </ul>	3	3	3	<ul style="list-style-type: none"> <li>Up to five trees are potentially affected by the options - none are protected.</li> <li>Option 2A appears to provide the greatest likelihood of avoiding the removal of the larger London plane tree near the Pitt St/Beresford St intersection.</li> </ul>

## Appendix 5 – Station Workshop Criteria, Scores and Commentary (Newton)

Notes:

- The criteria below have been divided into two groups, those focused on outcomes (e.g. stimulating economic development) and those focused on effects (e.g. the impact on heritage buildings). Each group has then been sub-divided into groups that align with the overarching Project Objectives.

### Outcome Focused Criteria

1.0	Transport	Measures and Indicators for Scoring Criteria	Newton Workshop Scores						Workshop Notes
			1	2A	2B	2C	2D	3	
1.	The extent to which the option provides for flexibility in design and construction form (e.g. number and size of station entrance and exit points)	Station construction methodology (i.e. cavern vs. cut and cover construction)	5	3	3	2	2	4	<ul style="list-style-type: none"> <li>A “big box” station design - as per Option 1 - is inherently flexible, while mined platform stations - as per Options 2(A-D) and 3 - are less flexible.</li> <li>Option 1 provides two entrances/exits (all other options have access from only one end of the station).</li> <li>Option 2C and 2D appear to be the least flexible design as pedestrians enter the station on the east side of Symonds Street, then need to cross under the street before being able to descend to the station platforms.</li> <li>The Option 3 station building appears to be the largest, providing flexibility in the aboveground elements of the station.</li> </ul>
		Footprint requirements Whether only one location “pops out”							
2.	Station dwell times (island vs. side platform)	Quantitative assessment	5	3	3	3	3	3	<ul style="list-style-type: none"> <li>Option 1 involves construction of a central island platform. This provides more space when exiting trains and direct access to trains travelling in the opposite direction.</li> <li>Options 2(A-D) and 3 involve constructing side mined platforms connected together via short tunnels and a central passageway. This provides less space for passengers and a slightly more indirect connection to trains travelling in the opposite direction.</li> </ul>

3.0	Environmental and social	Measures and Indicators for Scoring Criteria	Newton Workshop Scores						Workshop Notes
			1	2A	2B	2C	2D	3	
1.	The extent to which the option provides for general passenger amenity including safety and security (actual and perceived)	Qualitative assessment	4	3	3	3	3	4	<ul style="list-style-type: none"> <li>Option 1 will be a larger cut and cover box with island platform. This allows the most flexibility to provide underground passenger amenity (for example good sight lines and constant passive surveillance from other passengers in the station). This option is marked down from a possible five as the two smaller entrances/exits provided are expected to have less passenger amenity and perceived levels of safety than the single larger entrances anticipated under Options 2(A-D) and 3.</li> <li>Options 2(A-D) and 3 provide less opportunity for enhanced passenger amenity and perceived safety underground due to their side platform forms.</li> <li>Option 3 involves constructing a large single station entrance at the busy intersection of Mt Eden and New North Roads. It is anticipated that this will provide greater aboveground passenger amenity and an enhanced sense of perceived safety when entering/exiting the station (via passive surveillance etc).</li> </ul>

### Effects Focused Criteria

Notes:

- Construction related effects are shaded in blue
- Operational effects are shaded in green

4.0	Transport	Measures and Indicators for Scoring Criteria	Newton Workshop Scores						Workshop Notes
			1	2A	2B	2C	2D	3	
1.	The extent of potential impacts on the surrounding transport network (e.g. roads, public transport routes, pedestrian connections and access)	Construction methodology allows for roads to stay open (even in a reduced form) during construction period	1	2	2	2	2	4	<ul style="list-style-type: none"> <li>• All options would have adverse effects during the construction phase, with Option 1 having the most significant effects due to the proposed cut and cover construction methodology.</li> <li>• Option 2(A-D) involve constructing mined side platforms, however limited at grade works are anticipated in the Symonds Street road reserve. The more limited effects from construction under Option 2(A-D) will be able to be managed via the staging of works etc.</li> <li>• Option 3 scores highest in this criteria as construction is expected to occur off road.</li> </ul>

5.0	Economic	Measures and Indicators for Scoring Criteria	Newton Workshop Scores						Workshop Notes
			1	2A	2B	2C	2D	3	
1.	The on-going maintenance and operational cost of the option	Quantitative assessment	3	4	4	4	4	4	<ul style="list-style-type: none"> <li>• Option 1 is anticipated to be a larger station requiring more spend overall in terms of ongoing maintenance and operational cost.</li> <li>• Options 2(A-D) and 3 are assumed as utilising high speed lifts, meaning no differentiation between the alternatives from this perspective.</li> </ul>

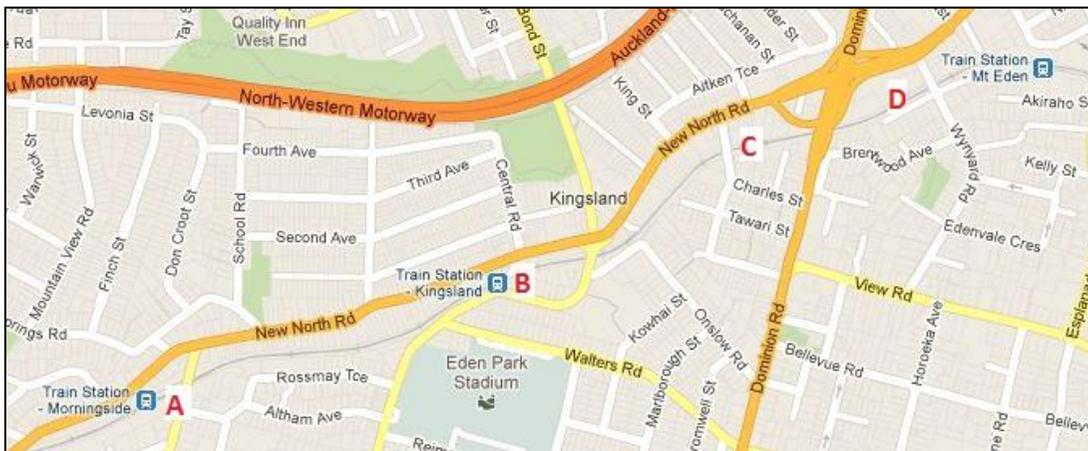
6.0	Environmental and social	Measures and Indicators for Scoring Criteria	Newton Workshop Scores						Workshop Notes
			1	2A	2B	2C	2D	3	
1.	The extent of potential visual impact of surface structures (e.g. vent shafts) on underlying residential zones and on other activities sensitive to visual impact	Identification of sensitive activities (existing environment analysis via desk top and walk around study area) Identification of future site opportunities and development potential	4	4	4	4	4	4	<ul style="list-style-type: none"> <li>• All options are anticipated as having an overall positive impact on the local built environment via the provision of a new station in this area.</li> <li>• Aboveground structures will be designed to integrate and complement the existing heritage character.</li> <li>• Option 3 appears to have the largest aboveground buildings (i.e. potential impact), however these will be designed to complement existing structures in the area.</li> </ul>
2.	The extent of potential impacts on air discharge (i.e. dust) above ground on underlying residential zones and on other activities sensitive to air discharge	Identification of Rail Link activities that would impact on air quality: construction methodology cut and cover greater impacts on air quality during construction, cavern construction significant less impacts on air quality	3	4	4	4	4	4	<ul style="list-style-type: none"> <li>• Option one would have more air discharge effects by virtue of the proposed cut and cover construction methodology.</li> <li>• The potential effects are common in significant construction projects and expected adverse effects can all be managed / mitigated.</li> </ul>
3.	The extent of potential construction noise impacts and the effect on any sensitive receivers	Auckland District Plan (Central Section and Isthmus Section) – Noise controls Identification of noise effects	2	3	3	3	3	2	<ul style="list-style-type: none"> <li>• Option 1 would have greater noise impacts during construction due to the proposed cut and cover methodology.</li> <li>• Option 3 involves construction of a tunnel / shaft adjacent to 151 Newton Road (which houses Roundhouse Studios). Noise effects will be largely based on the final construction management, methodology and techniques used.</li> </ul>
4.	The extent of potential operational noise impacts and the effect on any sensitive receivers	Auckland District Plan (Central Section and Isthmus Section) – Noise controls Identification of noise effects	3	3	3	3	3	3	<ul style="list-style-type: none"> <li>• Operational noise effects will largely be dependent on the location of ventilation towers.</li> <li>• There is considered little to differentiate the options as all potential adverse effects could be mitigated.</li> </ul>
5.	The extent of potential construction vibration impacts and the effect on any sensitive receivers	Auckland District Plan (Central Section and Isthmus Section) – Noise controls Identification of vibration effects	2	2	2	2	2	3	<ul style="list-style-type: none"> <li>• Options 1 and 2(A-D) involve construction of underground works in close proximity to the existing Watercare reservoir.</li> <li>• Option 3 rates higher in this criteria as construction of the station building, shaft and underground platforms is shifted further away from the reservoir. It is noted that this option involves constructing a shaft adjacent to 151 Newton Road (a building housing Roundhead Studios and the Sharonelier chandelier shop). However on balance the size and scale of the risks and associated potential effects on the reservoir are considered greater than that on the Newton Road building.</li> </ul>
6.	The extent of potential operational vibration impacts and the effect on any sensitive receivers	Auckland District Plan (Central Section and Isthmus Section) – Noise controls Identification of vibration effects	3	3	3	3	3	3	<ul style="list-style-type: none"> <li>• This is considered similar for all options.</li> <li>• It is noted that the rail tunnels and station is very deep at this point.</li> <li>• Roundhouse Studios is identified as a sensitive receiver (Option 3), but any operational vibration effects will be able to be mitigated, and construction effects short term.</li> </ul>
7.	The extent of potential impacts from contaminants to the receiving environment	Desktop site investigation	3	4	4	4	4	4	<ul style="list-style-type: none"> <li>• Option 1 scored lower as it was agreed that the cut and cover methodology would by definition involve a greater quantum of land disturbance (and therefore a greater potential for encountering contaminated material).</li> </ul>
8.	The extent of potential impacts on groundwater/settlement on buildings	Known geological conditions Construction methodology	2	3	3	3	3	3	<ul style="list-style-type: none"> <li>• The cut and cover construction methodology anticipated under Option 1 is expected to have more widespread effects.</li> <li>• It is noted that construction of the mined side platform tunnels and underground station for Options 2(A-D) and 3 is relatively deep at this point, and therefore effects should be less than those arising at Karangahape Station.</li> </ul>
9.	The extent of potential impacts on significant/major stormwater, network services and utilities	Identification of known public services and utilities as per Auckland Council, Metrowater, Watercare and other relevant records	2	2	2	2	2	4	<ul style="list-style-type: none"> <li>• The Watercare reservoir is noted as a significant utility located in the vicinity of the proposed station.</li> <li>• Option 3 rates highest in this criteria as it relocates construction works further away from the reservoir, reducing the potential impact from construction works.</li> </ul>



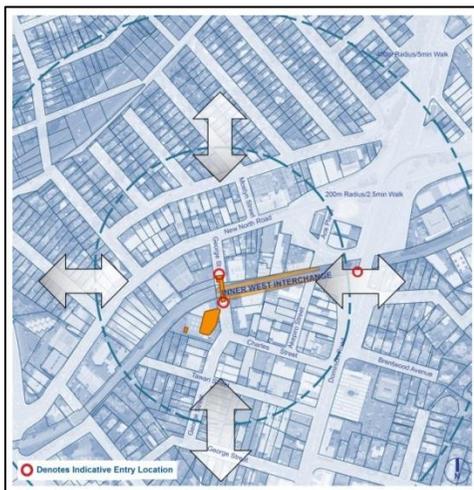
6.0	Environmental and social	Measures and Indicators for Scoring Criteria	Newton Workshop Scores						Workshop Notes
			1	2A	2B	2C	2D	3	
10.	The extent to which the option requires private land take	Location of the station and station portals in terms of: <ul style="list-style-type: none"> <li>Placement in road reserve</li> <li>Public open space</li> <li>Public property vs. placement in private property</li> </ul>	4	2	2	2	2	1	<ul style="list-style-type: none"> <li>In terms of the NoR process it is important to consider both aboveground and sub-strata land take (and in particular the number of properties the sub-strata land take may impact). This is also an issue in terms of possible costs.</li> <li>Option 1 provides for the station in the road reserve, while all other options will require private land take.</li> <li>Option 3 appears to require the largest quantum of private land take, for both surface and sub-surface.</li> </ul>
11.	The extent of potential impacts on the operation of emergency services	Construction methodology allows for roads to stay open (even in a reduced form) during construction period	2	3	3	3	3	4	<ul style="list-style-type: none"> <li>The importance of Upper Symonds Street and the intersections with Khyber Pass, Mt Eden and New North Roads was noted as a key route for emergency services.</li> <li>Option 1 scores the lowest in this criteria due to the impact on Symonds Street from the proposed cut and cover construction methodology.</li> <li>Option 2(A-D) also involve ground level construction works in the Symonds Street road area. These effects are expected to be able to be mitigated (e.g. through staging) but will still have an effect on any emergency services attempting to use this route.</li> <li>Option 3 scores the highest in this criteria as construction will be undertaken outside of the road area.</li> </ul>
12.	The extent of potential impacts on adjacent businesses/shops during construction (i.e. ability to operate)	Construction methodology allows for roads to stay open (even in a reduced form) during construction period	2	3	3	3	3	3	<ul style="list-style-type: none"> <li>Option 1 will require virtually all of the Symonds Street road reserve, including footpath areas. As such, businesses along the affected road frontage will need to be either compensated or relocated for the construction period.</li> <li>Option 2(A-D) will impact Symonds Street but still allow for pedestrian access to businesses.</li> <li>Option 3 will allow for pedestrian access to businesses along Symonds Street as construction works are located off road. It is noted that this option will impact businesses on Newton Road adjacent to the proposed northern shaft (i.e. Roundhead Studios and the Sharondelier chandelier shop located in 151 Newton Road).</li> </ul>
13.	The extent of potential impacts on pedestrian connections and access during construction	Construction methodology allows for footpaths to stay open during construction period	2	3	3	3	3	4	<ul style="list-style-type: none"> <li>Option 1 scored lowest in this criteria due to the need to close Symonds Street footpaths to facilitate cut and cover construction of the station.</li> <li>Option 2(A-D) was expected to have lesser effects, but construction in the road area will none the less affect footpaths and pedestrian access.</li> <li>Option 3 scored highest in this criteria as construction works are located off road and will therefore have the least impacts on footpaths and pedestrians.</li> </ul>
14.	The extent of potential impacts on heritage/character buildings	Identification of current scheduled heritage buildings with Auckland Council and New Zealand Historic Places Trust	2	3	3	3	3	2	<ul style="list-style-type: none"> <li>The locality is covered by the district plan's Cultural Heritage Overlay 31 and is a Registered Historic Area (no 7376) with NZHPT.</li> <li>Option 3 has an impact on the character buildings along Symonds Street as the back annex of some will need to be removed for the shaft.</li> <li>Option 1 would require the removal of verandas along Symonds Street to allow construction in the road area.</li> </ul>
15.	The extent of potential impacts on known archaeological sites	Identification of current known archaeological/cultural sites with Auckland Council and New Zealand Historic Places Trust	2	3	3	3	3	2	<ul style="list-style-type: none"> <li>Options 1 and 3 rated lower as they require larger areas of cut and cover construction – more likely that archaeological remnants may be found.</li> </ul>
16.	The extent of potential impacts on known cultural sites	Identification of current known archaeological/cultural sites with Auckland Council and New Zealand Historic Places Trust	3	3	3	3	3	3	<ul style="list-style-type: none"> <li>The following sites of cultural significance have been noted, although none appear to be differentially impacted by the options:                             <ul style="list-style-type: none"> <li>Te Ipu Pakore (an ancient spring) is located approximately where Mt Eden Rd crosses over the railway line</li> <li>Te Wai a Te Ao is the stream which links to Waiorea or Western Springs which begins in Newton Gulley</li> <li>Te Uru Karaka (a grove of significant Karaka Trees) is located on Newton Ridge overlooking the Newton Gulley.</li> </ul> </li> </ul>
17.	The extent of potential impacts on areas of open space, biodiversity and/or significant vegetation/trees and/or habitat of significant fauna	Identification of: <ul style="list-style-type: none"> <li>Current listed areas of open space</li> <li>Known future areas of open space</li> <li>Any scheduled trees (not generally protected)</li> <li>Any listed areas of significant vegetation or fauna</li> </ul>	3	3	3	3	3	3	<ul style="list-style-type: none"> <li>There are street trees on the eastern side of Symonds near the corner of Mt Eden Road. These will likely need to be reinstated post construction under all options due to the use of this area for temporary works.</li> </ul>

## Appendix 6 – Inner West Interchange Option Overview

### LOCATION OPTIONS



### OPTION C(ii)



## Appendix 7 – Inner West Interchange Workshop Criteria, Scores and Commentary

Notes:

- The criteria below have been divided into two groups, those focused on outcomes (e.g. stimulating economic development) and those focused on effects (e.g. the impact on heritage buildings). Each group has then been sub-divided into groups that align with the overarching Project Objectives.

### Outcome Focused Criteria

1.0	Transport	Measures and Indicators for Scoring Criteria	Inner West Interchange Workshop Scores					Workshop Notes
			A	B	C(i)	C(ii)	D	
1.	The extent to which the option design provides maximum operational flexibility and service reliability between the city centre and the wider regional network	Travel time as a result of train speed	3	3	4	4	4	<ul style="list-style-type: none"> <li>The Morningside and Kingsland options (A and B) require that CRL trains travel further along the NAL before being able to turn around and re-enter the CRL on their return journeys.</li> <li>Options C and D are closer to the CRL portal, providing a closer turning point for trains before returning through the CRL.</li> </ul>
2.	The extent to which the option provides for flexibility in design and the number and size of entrance and exit points	Footprint requirements Provision of entrance/exit points	4	1	3	4	PB	<ul style="list-style-type: none"> <li>Option A - Morningside Station has some space within the existing NAL to facilitate the footprint of an interchange facility. However, some additional land take would be required.</li> <li>Option B - Kingsland Station is very constrained being geographically located between Sandringham Road to the south and Kingsland village to the north. There are also topographical constraints to consider as Kingsland village is situated above the NAL and Sandringham Road below.</li> <li>Option C(i) provides one entrance point, C(ii) provides two entrances/exits (in particular at Dominion Road).</li> <li>Option D is technically compromised due its proximity to the CRL portal. It did not meet the design requirements and technical parameters for the project and will not be evaluated further. The interchange's proximity to the CRL portal means that a facility located in this area would suffer from the following issues:                             <ul style="list-style-type: none"> <li>The platforms will not be flat as the CRL tracks are still ascending out of the portal at this point</li> <li>Platforms will not be on the same level (i.e. the NAL lines and CRL lines are at different grades at this point)</li> <li>There is no stretch of straight track to the east of this location available to provide the necessary crossovers/switches to make the interchange effective.</li> </ul> </li> </ul>

2.0	Economic	Measures and Indicators for Scoring Criteria	Inner West Interchange Workshop Scores					Workshop Notes
			A	B	C(i)	C(ii)	D	
1.	<p>The extent to which the option assists economic development through supporting an integrated and coordinated approach to land use and transport. Key considerations include:</p> <ul style="list-style-type: none"> <li>The employment density within 500m and 1000m now and in 2031</li> <li>The composition of employment within 500m and 1000m (by Australian and New Zealand Standard Industrial Classification [ANZSIC] code)</li> <li>The location enhances potential for population and employment growth</li> <li>Current realisable potential for development near to the facility to generate patronage (e.g. 250m, 500m and 1000m radius for commercial. 500m and 1000m radius for residential)</li> <li>Potential exists (in the form of underdeveloped sites in close vicinity) for public/private partnerships which may aid in the provision of enhanced public realm and mixed use development around the interchange precinct</li> </ul>	Facility Analysis	4	2	4	4	-	<ul style="list-style-type: none"> <li>Option A - Morningside is considered as having significant potential for redevelopment with increased connection to the central city. The St Lukes plan change is identified as a potential driver of future patronage growth and an example of the growth potential in this area.</li> <li>Option B - there is considered to be limited opportunity for stimulating growth in the Kingsland area given its heritage character and smaller parcels of land.</li> <li>Option C(i and ii) provides the opportunity for additional rail access points for passengers in the Dominion Road area. This facility is located in close proximity to a number of redevelopment opportunities and could act as a catalyst for growth and redevelopment in the locality. However it is noted that this facility is close to the existing Kingsland and Mt Eden Stations.</li> </ul>

3.0	Environmental and social	Measures and Indicators for Scoring Criteria	Inner West Interchange Workshop Scores					Workshop Notes
			A	B	C(i)	C(ii)	D	
1.	<p>The extent to which the option aligns with the following outcomes:</p> <ul style="list-style-type: none"> <li>The extent to which the option will provide positive impacts on the built environment in the environs of the option location</li> <li>The extent to which the option has the potential to enhance pedestrian access and connectivity across physical barriers</li> <li>Facility is within a 250m radius to existing or planned public and community facilities, services and centres</li> </ul>	Qualitative assessment	3	2	3	3	-	<ul style="list-style-type: none"> <li>The provision of an interchange facility in the Morningside and Newton areas (Options A and C) are considered as having potential positive effects on the built environment through the ability to foster redevelopment opportunities in the locality.</li> <li>Option C will require the closure of George Street, however pedestrian access would be reinstated through the pedestrian overpass.</li> <li>All options would provide pedestrian access across the NAL via raised pedestrian walkways.</li> </ul>

### Effects Focused Criteria

Notes:

- Construction related effects are shaded in blue
- Operational effects are shaded in green

4.0	Transport	Measures and Indicators for Scoring Criteria	Inner West Interchange Workshop Scores					Workshop Notes
			A	B	C(i)	C(ii)	D	
1.	The extent of potential impacts on the surrounding transport network (e.g. roads, public transport routes, pedestrian connections and access)	Construction methodology allows for roads to stay open (even in a reduced form) during construction period	1	1	2	2	-	<ul style="list-style-type: none"> <li>• Option A - Morningside Drive would need to be grade separated to allow for the required train services irrespective of the interchange location. This would affect the road network in the area, however through traffic would need to be maintained during these works. Consideration has also been given to the effect of the significant works and impact from widening the NAL between the CRL portal and Morningside Station.</li> <li>• Option B - significant adverse effects and disruption to Sandringham Road would be required to facilitate an interchange in this location (including the potential realignment of Sandringham Road to allow for the required footprint). The Sandringham Road overbridge would also need to be reconsidered.</li> <li>• Option C(i and ii) would also require modifications to Dominion Road and Sandringham Road bridges, however through traffic would be retained during these works. Option C would also require the permanent closure of George Street to through traffic.</li> <li>• Options C(ii) provides an opportunity to link in with Dominion Road buses in the future.</li> </ul>

5.0	Economic	Measures and Indicators for Scoring Criteria	Inner West Interchange Workshop Scores					Workshop Notes
			A	B	C(i)	C(ii)	D	
1.	The on-going maintenance and operational cost of the option	Quantitative assessment	2	2	3	3	-	<ul style="list-style-type: none"> <li>• Morningside &amp; Kingsland options (A and B) require running trains further west out of the CRL before being able to turn around and run back through the CRL / central city on their return journey. This would have an adverse effect on the operational costs of running the train network (including the need for additional trains to facilitate the necessary service frequencies).</li> <li>• All options require the provision, maintenance and operation of an additional or upgraded facility on the network (resulting in more on-going cost).</li> </ul>

6.0	Environmental and social	Measures and Indicators for Scoring Criteria	Inner West Interchange Workshop Scores					Workshop Notes
			A	B	C(i)	C(ii)	D	
1.	The extent of potential visual impact of surface structures on underlying residential zones and on other activities sensitive to visual impact	Identification of sensitive activities (existing environment analysis via desk top and walk around study area)  Identification of future site opportunities and development potential	3	1	2	2	-	<ul style="list-style-type: none"> <li>• Option A – the existing Morningside Station locality is considered better able to absorb, in terms of visual impact, a new facility and structures on the scale and size of the new interchange.</li> <li>• Option B – the Kingsland locality is considered least suitable for the construction of a facility on the scale and size of the new interchange. An interchange in this location will have a substantial visual impact on the area, in particular noting its existing heritage character and scale. It is also noted that the existing station is located in close proximity to residential zones, which have a much smaller scale and form than the proposed interchange.</li> <li>• The locality of Option C is a mixture of residential and commercial/light industrial. The visual impact of an interchange in this location is considered to be more than that at Morningside, but substantially less than at Kingsland.</li> </ul>
2.	The extent of potential impacts on air discharge (i.e. dust) above ground on underlying residential zones and on other activities sensitive to air discharge	Identification of Rail Link activities that would impact on air quality: Construction methodology	3	3	3	3	-	The impact of air discharge is anticipated to be similar for all options. The facility to be constructed at each location would be similar and would require similar construction methodologies (although it is noted that some options would require blasting – refer below for further discussion).
3.	The extent of potential construction noise impacts and the effect on any sensitive receivers	Auckland District Plan (Central Section and Isthmus Section) – Noise controls  Identification of noise effects	2	2	2	3	-	<ul style="list-style-type: none"> <li>• All four options involve similar surface construction methodologies, however it is noted that blasting would be required at Kingsland (if construction is required northwards into the existing embankment) and for Option C(i and ii).</li> <li>• It is noted that Morningside has an existing apartment complex overlooking the potential interchange site. There are also a number of residential properties in the vicinity of Kingsland Station (e.g. properties on the far side of Sandringham Road).</li> <li>• Under Option C(ii), it is assumed that the residential apartments at Tawari Street have been acquired – therefore reducing the number of residential properties affected by construction noise.</li> </ul>
4.	The extent of potential operational noise impacts and the effect on any sensitive receivers	Auckland District Plan (Central Section and Isthmus Section) – Noise controls  Identification of noise effects	3	3	3	3	-	Considered similar for all options. It is noted that trains running on the line will be new electric multiple units (EMUs) which are quieter than the existing diesel units.

6.0	Environmental and social	Measures and Indicators for Scoring Criteria	Inner West Interchange Workshop Scores					Workshop Notes
			A	B	C(i)	C(ii)	D	
5.	The extent of potential construction vibration impacts and the effect on any sensitive receivers	Auckland District Plan (Central Section and Isthmus Section) – Noise controls  Identification of vibration effects	3	3	3	3	-	All four options involve similar surface construction methodologies, however it is noted that blasting would be required at Kingsland (if construction is undertaken northwards into the existing embankment) and at Option C(i and ii).
6.	The extent of potential operational vibration impacts and the effect on any sensitive receivers	Auckland District Plan (Central Section and Isthmus Section) – Noise controls  Identification of vibration effects	3	3	3	3	-	Considered similar for all options.
7.	The extent of potential impacts from contaminants to the receiving environment	Desktop site investigation of existing land use activities at the time of the assessment	3	3	2	3	-	Existing land uses and recent land use consents considered: <ul style="list-style-type: none"> <li>Option A - neighbouring uses include retail, residential and commercial.</li> <li>Option B – neighbouring uses include retail (Kingsland shops) and residential.</li> <li>Option C(i) - Existing petrol station light and industrial activities in land required for the project.</li> <li>Option C(ii) - Recent residential consent on south side of NAL in land required for the project.</li> </ul>
8.	The extent of potential impacts on groundwater/settlement on buildings	Known geological conditions  Construction methodology	3	3	3	3	-	<ul style="list-style-type: none"> <li>Considered neutral for all options. No tunnelling required post CRL portals. Various earthworks would be required under each option (e.g. grade separation of Morningside Drive), however these would involve standard construction methodologies.</li> <li>The exception to this would be if the decision was made to extend Kingsland Station by way of excavating into the embankment under the existing Kingsland shops.</li> </ul>
9.	The extent of potential impacts on significant/major stormwater, network services and utilities	Identification of known public services and utilities as per Auckland Council, Metrowater, Watercare and other relevant records	3	3	3	3	-	No particular utilities known at the time of scoring. It is noted that the options and any rail infrastructure works are along the alignment of the existing NAL.
10.	The extent to which the option requires private land take	Facility location in terms of: <ul style="list-style-type: none"> <li>Placement in road reserve</li> <li>Public open space</li> <li>Public property vs. placement in private property</li> </ul>	1	1	2	3	-	<ul style="list-style-type: none"> <li>Option A - some existing land is available at Morningside Station to facilitate an interchange, however additional land take will be required.</li> <li>Option A - consideration also needs to be given to the land take required to widen the NAL to four tracks between the CRL portals and Morningside Station. A number of acquisitions would be required along the line to provide the space necessary for additional tracks.</li> <li>Option B - significant private land take would be required at Kingsland to facilitate a new interchange and the need for straight sections of track at either end to allow for turnouts/crossings.</li> <li>Option C: <ul style="list-style-type: none"> <li>C(i) will require widening on the northern side of the NAL and the indicative number of commercial properties that would be required to cater for the alignment totals seven.</li> <li>C(ii) will require widening to occur on the southern side of the NAL and this would require properties at Onslow Road and Tawari Street for both permanent works and temporary construction access.</li> <li>The impact of the southern alignment - Option C(ii) - is considered to be less than the north alignment when considering the number of properties that would need to be purchased and relocated on the north side.</li> </ul> </li> </ul>
11.	The extent of potential impacts on adjacent businesses/shops during construction (i.e. ability to operate)	Construction methodology allows for roads to stay open (even in a reduced form) during construction period						<ul style="list-style-type: none"> <li>For all options there are not considered to be significant adverse effects on businesses where the lands would not be acquired as part of the land take for the interchange.</li> <li>There may be smaller adverse effects from construction works but these are expected to be able to be mitigated.</li> </ul>
12.	The extent of potential impacts on pedestrian connections and access during construction	Construction methodology allows for footpaths to stay open during construction period	3	2	2	2	-	<ul style="list-style-type: none"> <li>Pedestrian connections between Sandringham Road (Eden Park) and the Kingsland village are expected to be temporarily disrupted should the interchange be built in this location. As noted elsewhere, there would also be significant disruption to Sandringham Road, affecting pedestrian / cycle users of this route.</li> <li>Option C(i and ii) will require the closure of George Street to through traffic including pedestrians during construction works.</li> </ul>
13.	The extent of potential impacts on heritage/character buildings	Identification of current scheduled heritage buildings with Auckland Council and New Zealand Historic Places Trust	2	1	2	2		<ul style="list-style-type: none"> <li>Option A – this is identified as having potentially positive impacts given that an interchange will be able to be located within this area without affecting any heritage character properties. However this is offset by the need to widen the NAL between the CRL portals and Morningside and the effects this will have on heritage and character buildings along the route (i.e. through Kingsland and the Seventh Day Adventist Church on Brentwood Ave).</li> <li>Option B – the location of the interchange in this area will have substantial negative effects on the built heritage character in the Kingsland area. The Kingsland village is covered by the district plan’s Character Overlay D07-32 and contains a number of buildings scheduled for protection. There are also significant numbers of residential 1 zoned properties in the vicinity.</li> <li>The Seventh Day Adventist Church on Brentwood Ave will need to be removed under all options, including C(i) and C(ii).</li> </ul>
14.	The extent of potential impacts on known archaeological sites	Identification of current known archaeological/cultural sites with Auckland Council and New Zealand Historic Places Trust	3	3	3	3	-	<ul style="list-style-type: none"> <li>There is considered little potential to find archaeological remains in the identified locations.</li> </ul>
15.	The extent of potential impacts on known cultural sites	Identification of current known archaeological/cultural sites with Auckland Council and New Zealand Historic Places Trust	3	3	3	3	-	<ul style="list-style-type: none"> <li>No known sites identified.</li> </ul>
16.	The extent of potential impacts on areas of open space, biodiversity and/or significant vegetation/trees and/or habitat of significant fauna	Identification of: <ul style="list-style-type: none"> <li>Current listed areas of open space</li> <li>Known future areas of open space</li> <li>Any scheduled trees (not generally protected)</li> <li>Any listed areas of significant vegetation or fauna</li> </ul>	2	2	2	2	-	<ul style="list-style-type: none"> <li>There are no areas of public open space adversely affected by the interchange options.</li> <li>It is noted that all options will require the removal of a number of trees along the existing rail corridor, either to facilitate the interchange or provide for additional tracks.</li> </ul>



## Appendix 8 – CRL Alignment

