APPENDIX 2
PROJECT OPTIONS ANALYSIS

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Appendix 2 - Project Options Analysis

1. Introduction and methodology

1.1. Purpose of this Appendix

This Appendix sets out the options assessment methodology and detailed options analysis undertaken in relation to the project options set out in Chapter 7 of this Business Case.

1.2. Scope of project options analysis

This Appendix focuses on significant scope and alignment issues including material differences in horizontal and vertical tunnel alignments, whether certain stations should be included or excluded and where certain stations should be located rather than on matters related to construction methodology (for example, tunnelling techniques) or more detailed scope issues (such as station entrances, refinement of tunnel alignments or the potential range of engineering requirements or systems options).

While early planning for Melbourne Metro considered options that would link the tunnel with alternative rail lines (for example, the Werribee, Craigieburn or Upfield lines in the north west or the Frankston or Sandringham lines in the south east), this Business Case does not revisit this analysis.[1] As outlined in Chapter 6, the Sunbury, Cranbourne and Pakenham lines will need to operate with extended HCMTs in the future to meet demand while enabling network expansion. The new Melbourne Metro tunnel offers the opportunity to introduce extended HCMTs through the central area of the network, and this capacity is best used by connecting the tunnel with the busiest lines.

1.3. Options assessment methodology

1.3.1. Overview of approach

The Department has worked in collaboration with PTV, MMRA and other relevant stakeholders to undertake a comprehensive project options analysis. A base case scope and alignment (the **Baseline**) has been developed for the purposes of assessing whether alternative approaches might deliver improved outcomes. The scope and alignment from the most recent previous detailed studies in 2012 - 13 has been adopted as a starting point for testing key aspects of the assumed solution to assess whether alternative approaches might deliver improved outcomes. The Baseline comprises:

- Western tunnel entrance (portal) at South Kensington, connecting to the Sunbury Line tracks west of South Kensington station, with an eastern portal at South Yarra.
- Five stations to be located at:
  - Arden, located under railway land, near the corner of Laurens and Queensberry Streets, to stimulate and support major urban development
  - Parkville, located under Grattan Street within the Royal Melbourne Hospital / Melbourne University precinct

[1] Earlier analysis set out in the East West Link Needs Assessment (2008) also considered an alignment that would involve portals at West Footscray and Caulfield. The need for a tunnel from West Footscray towards the city has been addressed by the Regional Rail Link project, which delivered an at-grade solution with a bridge over the Maribyrnong River. As such, the focus of this options assessment is on a portal location east of the Maribyrnong River. However, multiple portal location options are considered in the south east.

  - CBD North, located under Swanston Street, broadly between Latrobe and Franklin Streets, interchanging with Melbourne Central station
  - CBD South, located under Swanston Street, broadly between Flinders and Collins Streets, interchanging with Flinders Street station
  - Domain, located under St Kilda Road, broadly between Domain and Toorak Roads
- An alignment along the route of Swanston Street over the existing Melbourne Underground Rail Loop (City Loop).

1.3.2. Study Areas

Given the scale and complexity of Melbourne Metro, the project options analysis has not involved a simple comparison of several mutually exclusive options, but rather a multifaceted analysis – with particular focus paid to key decision points along the alignment and the impacts of these decisions on the ability to address the Problems and achieve the Benefits set out in the ILM. To enable options to be considered and decisions to be made on a more manageable basis, options analysis has been undertaken for five identified geographical areas (**Study Areas**) as illustrated in Figure 1.

Figure 1 – Study Area Options

Study Area A
- Decision A1: What is the preferred corridor through South Kensington / Arden-Macaulay?
- Decision A2: Is a South Kensington station investment justified?
- Decision A3: What is the preferred alignment, including Arden station location and portal configuration, at South Kensington?
- Decision A4: Is an Arden station investment justified?

Study Area B
- Decision B1: What is the preferred alignment and station location at Parkville?
- Decision B2: Is the station investment justified?

Study Area C
- Decision C1: What is the optimal horizontal alignment through the CBD?
- Decision C2: What is the optimal vertical alignment?

Study Area D
- Decision D1: What is the preferred alignment and station location at Domain and South Melbourne?
- Decision D2: Is the station investment justified?

Study Area E
- Decision E1: What is the preferred alignment and station location options for South Yarra?
- Decision E2: Is the station investment justified?

For the purposes of undertaking this holistic assessment, the options analysis process has sought to:

- Identify the key decision points along the alignment
- Identify relevant project options for each decision point
- Assess the project options identified for each decision point
- Recommend the preferred project option for each decision point.

1.3.3. Interdependencies along the alignment

Key decisions in relation to the project options along the alignment cannot be made in isolation. Interdependencies between the options mean that certain decisions in one Study Area may constrain the options available in another Study Area. Accordingly, the assessment of project options has considered the extent to which certain project options would complement or constrain decision-making in relation to other decision points as well as the alignment as a whole. Where clashes arise between incompatible project options, the options analysis has sought to identify the best overall outcome for Melbourne Metro having regard to the relevant constraints.

1.3.4. Overview of key decisions and project options

The project options are summarised below.

Table 1 - Study Area – Project options summary

Study Area	Summary Description
Study Area A: South Kensington & Arden-Macaulay	Decision A1: What is the preferred corridor through South Kensington / Arden – Macaulay? • Project option A1-1: Central to the Arden precinct (Baseline) • Project option A1-2: North Melbourne interchange station • Project option A1-3: Macaulay interchange station Decision A2: Is a South Kensington Station investment justified? • Project option A2-1: No additional station platforms (Baseline) • Project option A2-2: New station platforms for Sunbury line services Decision A3: What is the preferred alignment, including Arden station location and portal configuration, at South Kensington? • Project option A3-1: Arden Street Station • Project option A3-2: Viaduct Solution • Project option A3-3: Queensberry Street Station (Baseline) Decision A4: Is an Arden station investment justified? • Project option A4-1: New station (Baseline) • Project option A4-2: No Station
Study Area B: Parkville	Decision B1: What is the preferred alignment and station location at Parkville? • Project option B1-1: Grattan Street (Baseline) • Project option B1-2: Flemington Road Decision B2: Is the station investment justified? • Project option B1-1: New station (Baseline) • Project option B1-2: No station
Study Area C: CBD	Decision C1: What is the optimal horizontal alignment through the CBD? • Project option C1-1: Spring Street • Project option C1-2: Exhibition Street • Project option C1-3: Russell Street • Project option C1-4: Swanston Street – two stations (Baseline) • Project option C1-5: Swanston Street – one station • Project option C1-6: Swanston Street 'offset' – two stations

Study Area	Summary Description
	• Project option C1-7: Swanston Street – two stations, CBD South station under the Yarra River • Project option C1-8: Elizabeth Street • Project option C1-9: William Street Decision C2: What is the optimal vertical alignment? • Project option C2-1: Shallow (Baseline) • Project option C2-2: Optimised deep
Study Area D: Domain and South Melbourne	Decision D1: What is the preferred alignment and station location at Domain and South Melbourne? • Project option D1-1: Domain (Baseline) • Project option D1-2: South Melbourne Decision D2: Is the station investment justified? • Project option D2-1: New station (Baseline) • Project option D2-2: No station
Study Area E: South Yarra	Decision E1A: What is the preferred alignment and station location for South Yarra? • Project option E1A-1: No direct interchange (Baseline) • Project option E1A-2: Direct interchange Decision E1: Is the station investment justified? • Project option E1-1: No station (Baseline) • Project option E1-2: New interchange station

1.3.5. Evaluation criteria

The evaluation framework for the project options analysis builds on the evaluation criteria adopted for the assessment of capital investment options (as described in Chapter 6) and maintains the same focus on addressing the Problems and achieving the Benefits identified in the ILM.

However, as the key points of differentiation between project options are different to those considered for the capital investment options, the evaluation criteria have been adjusted as follows:

Table 2 – Changes to capital investment options evaluation criteria

Capital Investment Options Evaluation Criteria	Description of changes
Increasing rail capacity and improving reliability	The first evaluation criterion in Chapter 6 is a distinguishing feature for only a limited number of options, in particular some options relating to the CBD Study Area. Where it is relevant for a particular option or Study Area, this criterion has been discussed within the criterion 'Improving access to jobs and stimulating urban renewal'.
Improving access to jobs and stimulating urban renewal	The second evaluation criterion in Chapter 6 has been expanded to give additional consideration to certain issues, such as the extent to which the project options affect Melbourne's productivity and liveability through factors such as journey times and customer experience.
Deliverability and minimising productivity impacts caused by disruption	• No change.
Cost	• No change.

Based on this approach, three evaluation criteria have been identified for the purposes of this options assessment.

Table 3 - Evaluation Criteria

Evaluation Criteria	Description
1. Improving access to jobs and stimulating urban renewal	This criterion includes consideration of: • Improved rail access to Central Melbourne (including reducing crowding at CBD stations) • Increased the overall capacity and service reliability of the rail network • Support for the long term development of the overall transport network • Improved connectivity between transport modes, including relief of road and tram congestion • Improved productivity and liveability by minimising journey times (including improving access to key employment, residential and employment growth areas) • Improved liveability by enhancing customer experience • Provision of development opportunities and support for urban renewal initiatives.
2. Deliverability and minimising productivity impacts caused by disruption	This criterion includes consideration of: • The extent to which the options are deliverable • The extent of rail disruptions • The extent of road and other disruptions (including property acquisitions).
3. Cost	This criterion includes consideration of: • Upfront capital costs. • Operating and maintenance costs. • Longer term costs relating to future network development.

As with the capital investment options assessment, where important issues have not been captured specifically in these criteria or the key considerations, it is because these issues, while important, are not considered to be key differentiating factors in the comparison between options. For example, safety issues have not been captured because all options would need to be safe.

1.3.6. Evaluation approach

All options were assessed against the criteria outlined in Table 3 The interdependencies for each option (for example, the impact on station locations and alignments in other Study Areas) have also been considered.

Each project option has been assessed relative to the Baseline, rather than based on its absolute impact. The absolute impact of the Recommended Project Solution is provided in Part C of this Business Case.

Comments are expressed as positive (+ve) or negative (-ve) relative to the Baseline. All costs are indicative, based on design and technical work that is preliminary in nature and would require more detailed development if an option other than the Baseline were to be preferred; however, the concepts are sufficiently developed to support an options assessment. For the purposes of this options analysis, costs are expressed in nominal terms based on the P90 estimates.

3. Study Area A: South Kensington & Arden-Macaulay

As outlined in Chapter 3, the Arden – Macaulay Precinct within North Melbourne is potentially one of Melbourne's biggest urban renewal projects and a key strategic area for the proposed future employment expansion of Central Melbourne, as well as significant residential intensification. Historically, the Arden – Macaulay Precinct has consisted of primarily industrial land use, supporting Melbourne's economy through manufacturing and production. In recent decades, as manufacturing has moved to outer urban areas and Central Melbourne has expanded, the Arden – Macaulay Precinct has become relatively underutilised, given it still consists predominantly of industrial land uses (including light manufacturing, warehousing and service industrial).

A significant amount of land within the area is owned by State and Local Government, with the key landholding being a large parcel of VicTrack land of approximately 14 hectares, (referred throughout as the Arden Government Land). Plan Melbourne identifies the Arden – Macaulay Precinct as an expanded central city urban renewal area and City of Melbourne has identified the southern part of the Arden – Macaulay Precinct as Arden Central, a job intensive extension of Central Melbourne focused on a new metro station. For the purposes of this document, it is referred to as the Arden Precinct.

As Government and the market makes a decision to make more efficient and productive use of the land in the inner city, the former industrial uses that once characterised the precinct move out providing opportunity to create a new employment centre to support both the CBD and the growing western region of greater Melbourne. As such, the role of a station central to the Arden – Macaulay Precinct would be to attract and concentrate significant urban renewal and investment. The large government land holdings in the precinct provide the opportunity to specifically support the development of a commercial activity centre. In particular, there is significant demand for commercial office space in the Arden – Macaulay Precinct, focused in and around the Arden Government Land, commencing from 2026. A station could reposition Arden as a significant destination that can be easily accessed from the wider metropolitan area, enabling the development of a substantial new commercial precinct, as part of the broader growth and expansion of Central Melbourne.

Further west, the Dynon Precinct is also identified in Plan Melbourne as an urban renewal opportunity. Redevelopment of this precinct depends on the longer term decentralisation of port-related activities that currently occupy this land. The Dynon Precinct would be supported by South Kensington Station to the north, and potential options are available for tram connections. The north side of South Kensington Station consists of medium density residential and recreational land uses.

3.1. Decision A1: What is the preferred corridor through South Kensington / Arden – Macaulay?

3.1.1. Options identification

Three broad corridor options have been identified through South Kensington and Arden-Macaulay, as summarised in Table 4 below and depicted in Figure 1. The corridors are broadly defined by the location of the Study Area A station and the resulting connections between that station and its connectivity with the proposed Western Portal location to the west and Study Area B optionality (regarding CBD tunnel alignment and Parkville station location) to the east.

Table 4 – Corridor Options for South Kensington / Arden-Macaulay

Project Option	Description
Station central to the Arden Precinct (Baseline)	A station central to the Arden Precinct, focused on stimulating and supporting major urban redevelopment, with a commercial core proximate to Arden Street

Project Option	Description
North Melbourne interchange station	A new station interchanging with the existing North Melbourne Station, reinforcing transport links at the southern edge of the Arden Precinct and to E Gate, supporting redevelopment in the southern extent of the Arden – Macaulay Precinct
Macaulay interchange station	A new station interchanging with the existing Macaulay Station, supporting redevelopment in the northern extent of the Arden – Macaulay Precinct

The Study Area A project options are illustrated in Figure 2 below.

Figure 2 – Study Area A – South Kensington and Arden-Macaulay

With respect to the options outlined above, several alternate alignments were considered around both the North Melbourne and Macaulay interchange stations, summarised as follows:

- **North Melbourne interchange station** – This option has a level of interdependency with the Parkville and CBD Study Areas, in that the North Melbourne Interchange Station would require a significantly longer tunnel and additional curves to support a station in Parkville and the preferred Swanston Street alignment
- **Macaulay interchange station** – A Macaulay Station Interchange would involve constructing a portal in Footscray and tunnelling under the Maribyrnong River, north under Kensington Road and east along Macaulay Road, Canning Street to Flemington Road and Parkville. It would be necessary to start tunnelling from Footscray in order to avoid the severance involved with turning out the elevated tracks from the Sunbury line at South Kensington and thereby creating a decline structure and portal in JJ Holland Park. Under this option, the proposed station would need to be constructed underground to the east of Macaulay Station to provide an interchange and support urban renewal in the northern extent of the Arden Macaulay Precinct. A second sub-option was also considered involving the construction of the underground station below Macaulay Road between Kensington and Macaulay Stations. The distance and the Moonee Ponds Creek between the stations made it difficult to create a seamless interchange between all three stations and created additional construction costs.

3.1.2. Options assessment

The North Melbourne interchange station would have some minor advantages for some customers on the Upfield, Craigieburn and Seymour Lines in respect of interchange opportunities and travel time. However in almost all regards an alternative interchange option is available two stops further along the line in the CBD, and the travel time savings are relatively

minor (see Table 5). The Macaulay interchange station provides fewer such advantages, as it would only interchange with the Upfield Line.

The North Melbourne and Macaulay interchange stations would generate lower land use benefits than the Baseline and, because they are positioned at locations already serviced by a station, would have a significantly smaller role in stimulating redevelopment, and miss the major redevelopment opportunity in the central Arden Precinct. The large parcel of government owned land in Arden Precinct makes it easier to deliver on the policy objectives of focussing employment uses around the station.

Both the North Melbourne and Macaulay interchange stations would involve significantly higher cost than the Baseline station, at an increase of approximately $880m and $1.9bn, respectively (P90, nominal). The cost associated with a North Melbourne interchange station accounts for a deep station box as well a connection to the existing North Melbourne station concourse. This interchange station would also require significant property acquisition.

The Macaulay interchange station option is particularly expensive, in part because it would either require the tunnel to continue west under the Maribyrnong River to a portal in Footscray (assumed in cost above) or would involve a new permanent structure bisecting JJ Holland Park (excluded from consideration).

The North Melbourne and Macaulay interchange stations would both require a much greater degree of urban disruption compared to the Baseline, which positions the station in a predominantly industrial area, within the Government owned Arden Government Land. It is also proposed that the Arden Government Land site form the largest single construction site for the Melbourne Metro, including provision of supporting tunnelling operations for the entire project. Accordingly, station construction and potential TBM launches at alternative sites available for other options, would result in considerably more disruption to local communities.

A summary analysis for each corridor option in Study Area A is provided in Table 5.

Decision A1: What is the preferred corridor for this Study Area?

It is recommended that the project adopt a corridor option that supports a station central to the Arden Precinct (Baseline).

Table 5 - Assessment of travel options for customer markets who may use a new North Melbourne interchange station, compared to Baseline

Passenger access to the following areas (per the Baseline)	ORIGINS OF PASSENGERS WHO MAY INTERCHANGE WITH MELBOURNE METRO AT NORTH MELBOURNE (IF INTERCHANGE PROVIDED)		
	UPFIELD LINE	CRAIGIEBURN LINE	SEYMOUR LINE
Parkville	• Even with an interchange station at North Melbourne, most customers would be better off catching Route 19 tram there directly. • For those customers outside the Route 19 tram catchment, also have the option of changing to Route 55 tram at Royal Park, Route 401 Bus at North Melbourne or to Melbourne Metro tunnel in CBD. • **(slight +ve)**: Compared to today: additional option provided. • **(neutral):** Saving if North Melbourne Interchange is provided.	• Change to Route 401 Bus at North Melbourne (as occurs today) or to Melbourne Metro tunnel in CBD. • **(slight +ve):** Compared to today: additional option provided. • **(+ve):** Saving if North Melbourne Interchange is provided.	• Change to Route 401 Bus at North Melbourne (as occurs today). • (**neutral):** Compared to today • **(+ve):** Saving if North Melbourne Interchange provided.
Melbourne Central or Flinders Street	• Upfield Line operates via City Loop, can travel direct (with more services). • **(+ve):** Compared to today. • **(neutral):** Saving if North Melbourne Interchange provided.	**(+ve):** Craigieburn Line operates via City Loop, can travel direct (with more services). • **(+ve):** Compared to today. • **(neutral):** Saving if North Melbourne Interchange provided**.**	• Interchange to City Loop or Flinders Street train at North Melbourne or Southern Cross (as occurs today). • **(neutral):** Compared to today. • **(neutral):** Saving if North Melbourne Interchange provided.
Domain	• Interchange to Melbourne Metro tunnel in CBD (improved travel time compared to existing tram service). • **(+ve):** Compared to today.	• Interchange to Melbourne Metro tunnel in CBD (improved travel time compared to existing tram service). • **(+ve):** Compared to today**.**	• Interchange twice (as occurs today), but option of Melbourne Metro tunnel rather than tram (improved travel time compared to exiting tram service). • **(+ve):** Compared to today.

Passenger access to the following areas (per the Baseline)	ORIGINS OF PASSENGERS WHO MAY INTERCHANGE WITH MELBOURNE METRO AT NORTH MELBOURNE (IF INTERCHANGE PROVIDED)		
	UPFIELD LINE	**CRAIGIEBURN LINE**	**SEYMOUR LINE**
	• **(neutral):** Saving if North Melbourne Interchange provided.	• **(neutral):** Saving if North Melbourne Interchange provided**.**	• **(neutral):** Saving if North Melbourne Interchange provided.
North-west destinations (e.g. future Melbourne Airport link)	• Interchange to Sunbury-Cranbourne Pakenham line in City Loop. • **(-ve)**: Compared to today: interchange in CBD compared to North Melbourne. • **(+ve):** Saving if North Melbourne Interchange provided**.**	• Interchange to Sunbury-Cranbourne Pakenham line in City Loop. • For most customers destined for Melbourne Airport, catching a SmartBus service from Broadmeadows would be quickest route, even once rail link in place • **(-ve):** Compared to today: interchange in CBD compared to North Melbourne**.** • **(+ve):** Saving if North Melbourne Interchange provided.	• Interchange twice for destinations between Middle Footscray and Sunbury (currently one interchange). • For customers destined for Melbourne Airport, catching a SmartBus service from Broadmeadows would be quickest route, even once rail link in place. • **(-ve):** Compared to today. • **(+ve):** Saving if North Melbourne Interchange provided**.**
South-east destinations (e.g. Monash cluster)	• Interchange to Sunbury-Cranbourne Pakenham line in City Loop. • **(neutral):** Compared to today. • **(neutral):** Saving if North Melbourne Interchange provided**.**	• Interchange to Sunbury-Cranbourne Pakenham line in City Loop • **(neutral):** Compared to today. • **(neutral):** Saving if North Melbourne Interchange provided**.**	• Interchange twice (currently one interchange) to Sunbury-Cranbourne Pakenham line. • **(-ve):** Compared to today**.** • **(+ve):** Saving if North Melbourne Interchange provided**.**

Table 6 - Summary analysis for Decision A1: corridor options

Project Option	EVALUATION CRITERIA		
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST
Central to the Arden Precinct (Baseline)	• Development of 14 hectares of government land in close proximity to the CBD provides a significant urban development opportunity that supports commercial development and the future expansion of Central Melbourne. • Provides greater urban linkages to the northern CBD area (including Parkville precinct through to E-gate) to support urban renewal.	• Less disruption risk associated with the ability to commission a new station independently of the existing rail network. • In the future, the TBM launch site can be used for the station box, minimising the need for further works. • The VicTrack site is available for 'set down' use and the site's proximity to the construction area supports optimal workflows.	• Base case. The capital cost of a station located central to the Arden Precinct is already included in the capital cost of the Baseline.
North Melbourne Interchange Station	• **(neutral):** Provides marginal increase in interchange opportunities with limited travel time savings, as summarised above. • **(-ve):** Smaller catchment not otherwise serviced by an existing station when compared with the Baseline option and large part of the catchment occupied by rail corridor. • **(-ve):** Stimulates a smaller urban development uplift due to a large proportion of non-developable land parcels within the catchment and high levels of accessibility to the existing North Melbourne station. • **(-ve)**: Increases travel time for all Sunbury line commuters due to increased length of alignment.	• **(-ve):** Requires a higher number of property acquisitions near North Melbourne Station in order to build a station box in addition to those required at South Kensington for a portal. • **(-ve):** Generates increased construction disruption for the local community and to access to North Melbourne Station. • **(-ve):** Requires increased tunnelling compared to baseline.	• **(-ve):** Increases the Project cost by $880m (P90, nominal).

Project Option	EVALUATION CRITERIA		
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST
Macaulay Interchange Station	• **(-ve):** Stimulates a smaller urban development uplift. • **(-ve):** Smaller catchment not otherwise serviced by an existing station when compared with the Baseline option. • **(-ve):** Provides even smaller increase in interchange opportunities and travel time savings than North Melbourne option (interchanges with Upfield line only). • **(-ve):** Increases travel time for all Sunbury line commuters due to increased length of alignment. • **(-ve):** Whilst there is significant redevelopment potential in the area east of Moonee Ponds Creek, more of the land is privately controlled making it more difficult to ensure policy outcomes for employment destination are realised.	• **(-ve):** Increases construction complexity and risk by requiring an additional river crossing at the Maribyrnong River and significant additional tunnelling compared to baseline. • **(-ve):** Requires increased private land acquisition to create a major construction site at Macaulay and the portal at Footscray.	• **(-ve):** Increases the project cost by $1.90bn (P90, nominal).

3.2. Decision A2: Is a South Kensington Station investment justified?

3.2.1. Options identification

Two options have been identified on this matter: retaining the status quo (Baseline) or adding additional Sunbury line platforms at South Kensington station, as summarised in the table below.

Table 7 – South Kensington Station options

Project Options	Description
No additional station (Baseline)	South Kensington Station remains as it is currently configured, serviced by the Werribee and Williamstown lines as it is today, and receiving the service boost to those lines as a result of the Melbourne Metro project.
New South Kensington station	A new station (pair of platforms) is provided next to the existing station, enabling Sunbury line services to also start servicing the South Kensington area.

3.2.2. Options assessment

The existing South Kensington Station provides a suitable level of service to support the existing medium density residential catchment and JJ Holland Park. The station will receive an uplifted service on the Werribee corridor as a result of the Melbourne Metro. The current station is not DDA compliant and would require a total rebuild including realignment of the Werribee line tracks to provide improved accessibility to the station in approximately the same location. The design of the Western Portal can ensure this rebuild is possible at a future point in time when future growth in patronage warrants.

The existing intermodal freight uses on the southern side the rail corridor requires a long term investment in the Western Intermodal Freight Terminal and its connecting freight rail infrastructure before this use can be relocated from this site. This accordingly means the future redevelopment of the Dynon Precinct is a longer term proposition for which the scale, form and transport planning is relatively undetermined. Consideration has been given to an extension of tram services along the Dynon corridor given its length and for moving South Kensington Station to better connect to the future redevelopment of the area.

Adding a new pair of platforms at the existing South Kensington Station would entail rebuilding the existing station and track work to create a connection from the underground station platforms and concourse to above ground platforms. The space required for Melbourne Metro platforms would force the portal for the tunnel back to just east of Footscray Station and require tunnelling under the Maribyrnong River and would add in the order of $1.65bn (P90, nominal) in costs.

A summary analysis for the option of providing an additional South Kensington Station is provided in Table 8.

Decision A2: Is a South Kensington Station investment justified?

It is recommended that the project retain the Baseline in this area, with no additional South Kensington station (Baseline).

Table 8 - Summary analysis for Decision A2: South Kensington Station option

Project Option	EVALUATION CRITERIA			
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION[=]	3. COST	4. ECONOMIC
No additional station (Baseline)	• Sufficient service level for existing land uses. • Existing station gains a service boost with Melbourne Metro. • Dynon precinct opportunity currently has an indeterminate, long term time frame in terms of generating new demand which would require the station infrastructure and access to be upgraded and or relocated further west. • Baseline design can make provision for future upgrade in current location.	N/A	N/A	N/A
New South Kensington station	• **(+ve):** Significantly higher number of train services stopping at South Kensington (compared to relatively modest demand from medium density catchment). • **(-ve):** Adds 1 minute travel time for Sunbury Line passengers due to additional stop, for limited local benefit at South Kensington given the timing of the future Dynon Precinct redevelopment.	• **(-ve):** Increases construction complexity and risk by requiring an additional river crossing at the Maribyrnong River and with significant additional tunnelling compared to baseline. • **(-ve):** Requires increased private land acquisition to construct the portal at Footscray. • **(-ve):** Requires much higher levels of rail disruption to the Werribee, Sunbury and RRL services given the rebuild of South Kensington Station and the realignment of tracks.	• **(-ve):** Increases the project cost by $1.65bn (P90, nominal).	• Detailed economic appraisal not undertaken due to poor strategic case for station.

3.3. Decision A3: What is the preferred alignment, including Arden Station location and portal configuration at South Kensington?

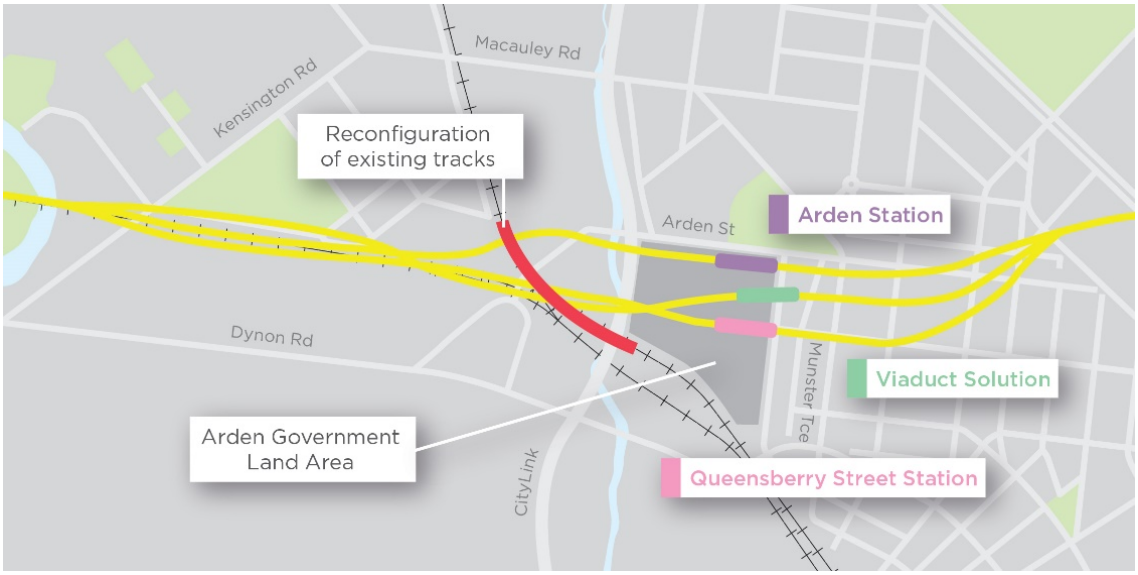
Given the primary role of a station within the Arden-Macaulay Precinct would be to stimulate significant land use change, a number of potential station entrance locations and supporting alignments were considered to identify the best technical solution to catalyse urban renewal and support a significant new commercial destination. An initial high level option filtering process identified the three potential solutions summarised in the table below.

Table 9 - Arden-Macaulay station and alignment options

Project Option	Description
A3-1:Arden Street (Option A1)	This option involves the construction of an underground station on the Southern side of Arden Street in private land immediately adjacent to the Arden Government Land, west of the Laurens Street intersection. This option assumes a western portal location proximate to Childers, Tennyson and Bakehouse Drive.
A3-2: Viaduct Solution (Option B1)	This option assumes a viaduct rail alignment, with a partial at grade and underground station between Barwise St and Munster Terrace, across Laurens Street. Laurens Street where the driven tunnel commences under Munster Terrace to go to Parkville. This option also requires the reconstruction of the existing Essendon flyover and assumes a new Craigieburn viaduct over the new Melbourne Metro viaduct tracks.
A3-3: Queensberry Street (Option D - Baseline)	This option involves the construction of an underground station within the Arden Government Land, consistent with the Queensberry Street alignment. This option assumes a western portal location proximate to Childers, Tennyson and Bakehouse Drive.

Figure 3 illustrates the Arden-Macaulay station and alignment options.

Figure 3 - Arden-Macaulay station and alignment options



These options have been assessed according to the evaluation criteria, with key findings summarised as follows:

- Although the viaduct solution avoids significant disruption to South Kensington residents and businesses by not requiring a South Kensington portal, the costs are expected to be

similar to the costs of constructing an underground station within the Arden Government Land and the benefits are considered outweighed by its compromised urban renewal outcomes. The viaduct solution would likely result in the dislocation of Arden Government Land development outcomes, which would require significant additional investment in urban integration initiatives (offsetting the project savings), as well as continuing noise and light impacts on surrounding land users. Further, the construction requires a greater number of occupations and the reconfiguration of additional tracks when compared with the beneath ground solutions (only impacting the Sunbury services)

- The Arden Street station option represents a minor cost saving as a result of a more direct alignment, when compared with an underground station within the Arden Government Land, in the order of $30m. However, the proposed station box location does require acquisition of existing commercial properties on the southern side of Arden Street, resulting in greater disruption. The projected development outcomes are greatest under this option due to its station entrance on the northern boundary of the Arden Government Land, best supporting development further north within the Arden – Macaulay Precinct and facilitating early activation of the Arden street frontage. This option also provides the least overlap within 800 metre catchments of existing stations.
- The Queensberry Street station option assumes a station entrance in the centre of the Arden Government Land, creating an internal development focus that is considered to have less reliance on the development and activation of private land, hence providing the opportunity for greater Government control of development outcomes.

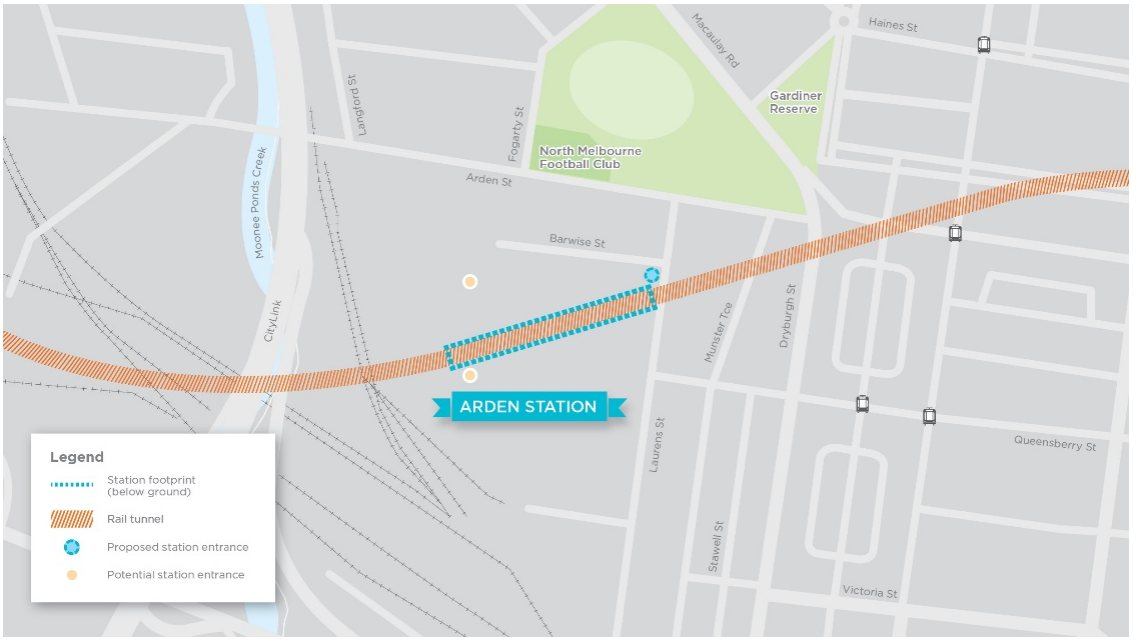
In support of this recommendation, further work has been undertaken to identify the final station location and alignment which has included continuing consideration of the Arden Street and Queensberry Street alignment options as well as a potential alignment located in between those two options, to best support proposed station entrances that:

- Optimise urban renewal throughout the precinct, including land to the North of Arden Street
- Support a significant new commercial destination central to the Arden Government Land
- Provide an appropriate day one access and egress point which appropriately connects with existing land use, capable of operating independently of the future significant development to occur within the Arden Government Land.

The final alignment that was determined to best support station entrances on the extensions of Fogarty and Queensberry Street as well as a day one entrance on Laurens Street, while continuing to perform well against the technical requirements is identified in Figure 4. It is recommended that a day one station entrance be provided near the corner of Barwise and Laurens Street, south of Arden Street. It is also recommended that provision be made to the western end of the station box to facilitate future entrances that optimise development outcomes, with exact entrance locations to be determined as the area develops.[2]

[2] Masterplanning of the Arden Government Land is yet to occur and as such the initial entrance should allow sufficient flexibility to accommodate eventual design and development outcomes, as well as be designed to facilitate minimal disruption to the Arden station operations, during the future development of the precinct.

Figure 4 - Arden station location and associated alignment



Decision A3: What is the preferred alignment, including Arden station location and portal configuration at South Kensington?

It is recommended that the project proceed with a new underground station within the Arden Government Land, south of Arden Street in the vicinity of Laurens St. It is proposed that Arden station will initially be accessed from a day one entrance near the corner of Barwise and Laurens Street, between Queensberry and Arden Street.

A summary of the analysis for the preferred station and alignment option within the Arden – Macaulay Precinct is provided in Table 10.

Table 10 - Summary analysis for Decision A3: Arden Station and portal configuration at South Kensington option

Project Option	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST
A3-1:Arden Street **(Option A1)**	• **(+ve):** Provides the greatest opportunity to catalyse urban renewal with highest commercial demand and fastest timing of commercial development supported by entrances on and project land fronting Arden Street. • **(+ve):** Best positioned to provide heavy rail services within walk-up catchment to land users not currently serviced (given existing Macaulay and North Melbourne stations and planned Parkville station). • **(neutral):** There are no significant transport benefits/disbenefits when compared with the Baseline as stations are reasonably proximate and travel times are within seconds of one another. • **(-ve):** Part reliance of the development on private land development controls for the core creates less certainty of urban renewal outcomes when compared with the Baseline with development centred on the Arden Government Land site.	• **(neutral):** Consistent with the Baseline - some significant disruption to South Kensington land users (residential and commercial acquisitions) during the construction of the proposed Western Portal. • **(neutral):** Western portal location requires relocation of high pressure gas main and high voltage power lines. • **(-ve):** Requires the acquisition of some commercial properties on Arden St for station box.	• **(+ve):** Provides some cost savings against the Baseline (approximately $30m). • **(-ve):** Requires some additional acquisition of commercial properties for station box location.
A3-2: Viaduct Solution **(Option B1)**	• **(+ve):** Provides the opportunity to build a station more cost effectively at a later date to support future urban renewal (however demand projections assume 2026). • **(neutral):** There are no significant transport benefits/disbenefits when compared with the	• **(+ve):** Above ground station and portal in Arden results in the avoidance of construction and permanent impacts on South Kensington residents and businesses associated with the Western Portal..	• **(neutral):** Costs are expected to be similar to the Baseline after inclusion of a number of additional interventions to integrate the station and viaduct into the surrounding development to support urban renewal, removing some/all of this benefit.

Project Option	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST
	Baseline as stations are reasonably proximate and travel times are within seconds of one another. • **(-ve):** Urban renewal outcomes are most limited given dislocation of Arden Government Land site due to elevated rail. • **(-ve):** Not supported by MPA or City of Melbourne due to its impact on the development potential and connectivity of Arden VicTrack land as a key urban renewal opportunity. • **(-ve):** Viaduct permanently impacts the amenity of the Moonee Ponds Creek environs.	• **(-ve):** Major property acquisition and disruption to residential and commercial properties in Munster Terrace and Laurens Street. • **(-ve):** Disruption of additional services compared with underground options, impacting Craigieburn, Werribee and Upfield rail services with additional impacts on VLine and freight services, stabling and Macaulay light maintenance depot. • **(-ve):** Environmental works impacts and approvals for Moonee Ponds Creek environs due to viaduct pylons. • **(-ve):** Continuing permanent station operation noise and light disruption for surrounding land users and permanent severance of Laurens Street and Queensberry Street truncation.	
A3-3: Queensberry Street **(Option D - Baseline)**	• **(+ve):** Activates the centre of the Arden VicTrack land where Government has greater ability to control the development outcome (given land in Government ownership). • **(-ve):** Centrally located station entrance may impact timing of station opening due to requirement for flood to support development.	• **(-ve):** Some significant disruption to South Kensington land users (residential and commercial acquisitions) during the construction of the proposed Western Portal. • **(-ve):** Western portal location requires relocation of high pressure gas main and high voltage power lines.	• Cost is incorporated within the Baseline.

3.4. Decision A4: Is an Arden station justified?

The analysis in relation to this decision is summarised in the table below.

Table 11 – Station investment, Arden: justification against evaluation criteria

Evaluation Criteria	Summary Analysis
1. Improving access to jobs and stimulating urban renewal	• The Arden - Macaulay Precinct is currently well serviced by the existing North Melbourne and Macaulay stations and proposed Parkville station as well as tram routes (along Flemington Road and Abbotsford Street) and the 401 and 402 bus routes. Accordingly, a station is required to support land use change, rather than provide additional transport to the existing land uses. • The inclusion of a new station at Arden will stimulate significant urban renewal, catalysing the creation of a new commercial activity centre supported by a direct mass transit solution in turn improving Melbourne's economic competitiveness. A commercial redevelopment outcome will not be achievable without the CBD and Parkville connectivity provided by a station. Further the creation of a commercial activity centre will attract increased residential development within the Arden-Macaulay Precinct and surrounding areas. The station has the potential to catalyse an end development value of over $7bn.
2. Deliverability and disruption	• The construction of a new station at Arden would result in a marginal and manageable increased disruption to surrounding land users given the Arden Government Land will be the primary construction site for the project and TBM launch site for the northern section of the project regardless of whether a station is included.
3. Cost	• The capital cost of a station located within or immediately proximate to the Arden Government Land in the Arden – Macaulay Precinct is already included in the capital cost of the Baseline. • Savings generated by not including a station at Arden are in the order of $200m (P90, nominal), assuming an alignment optimised to not include, nor future proof, an Arden Station.

Decision A4: Is an Arden station justified?

It is recommended that the project proceed with a new underground station within the Arden Government Land, south of Arden Street in the vicinity of Laurens Street. It is proposed that the station initially be accessed from a day one entrance near the corner of Barwise and Laurens Streets, between Queensberry and Arden Street. It is also recommended that provision be made to accommodate future entrances to the west of the station box, to facilitate the renewal of Arden and specifically the development of the Arden Government Land over time.

The inclusion of a new station at Arden will facilitate the development of significant urban renewal, allowing the Arden – Macaulay Precinct to fulfil its designation as a key strategic area for the proposed future employment expansion of Central Melbourne, as well as support significant residential intensification.

4. Study Area B: Parkville

4.1. Context

As a designated national employment cluster under Plan Melbourne, Parkville is an eminent internationally recognised education, health and research precinct. Development in the area has been targeted towards improving growth of business activity (and therefore jobs) of national significance, and improving the ability of businesses to leverage export and innovation potential in order to grow jobs in a number of industry sectors. The cluster has a critical mass of nationally leading institutions and organisations including Australia's highest-ranking university (The University of Melbourne), Victoria's second largest university (RMIT University), Monash University's Pharmacy Faculty, global biotherapy industry leader CSL Limited, Royal Melbourne Hospital, Royal Children's Hospital, Royal Women's' Hospital, the Walter Eliza Health Institute, Florey Institute, Peter Doherty Institute, the Australian Medical Association and the Bio21 Institute.

Many leading institutions and organisations are expanding, or plan to expand, within the precinct. This includes the $1bn Victorian Comprehensive Cancer Centre (opening 2016), which will have world-leading cancer research and treatment activities and facilities. Increasingly, the two universities (The University of Melbourne and RMIT) are expanding their facilities to incorporate greater collaboration and joint projects with industry. This blend of education and biomedical industry generates significant economic activity for the nation. The universities and research institutes are expected to continue to develop and expand around these existing nodes, drawing users from across the metropolitan area and Victoria, and attracting firms, researchers and investors from national and global marketplaces. Approximately 32,700 people are currently employed in the cluster, which is centrally located and has access to a wide catchment of workers across metropolitan Melbourne. The cluster also has access to a range of knowledge industries and professional services, essential to driving innovation.

The growth and consolidation of the Parkville precinct is not only important to the success of an expanded central city, it is also critical to Victoria's and Australia's leadership in industries such as biotechnology, medical research, education and health services. Parkville station will provide access to around 45,000 jobs, 14,000 residents and 70,000 tertiary students (within 800 metres of the station) in 2031.

The Parkville precinct is serviced by a series of north-south tram routes that run via Elizabeth, William and Swanston Street, which are subject to increasing pressure from crowding. It is not currently serviced by rail; however, the route 401 bus is a popular connection to North Melbourne station.

The Baseline includes a Melbourne Metro station located under Grattan Street, close to the intersection with Royal Parade, and alternative potential station options (including removal of the station from Parkville entirely) have been considered to ensure inclusion of the new station would be justified.

4.2. Decision B1: What is the preferred alignment and station location in Parkville?

The alignment through Parkville is largely determined by the location of the station, the alignment in South Kensington and Arden-Macaulay and the compatibility of the various station locations with the proposed alignment through the CBD.

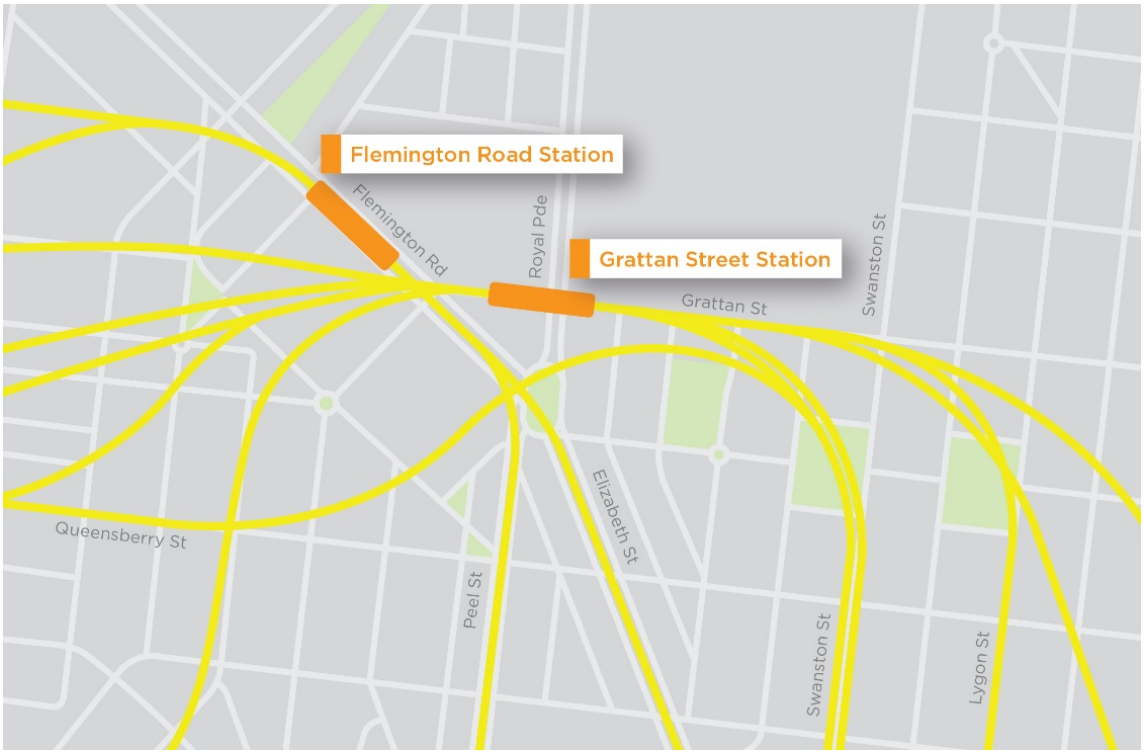
Two options have been considered for the purposes of this current options assessment – the construction of an underground station on Flemington Road or on Grattan Street.[3] These are described below.

Table 12 - Parkville station options

Project Option	Description
B1-1: Grattan Street (Baseline)	This option involves the construction of a station on Grattan Street, in the Royal Melbourne Hospital / University of Melbourne precinct, under the intersection of Royal Parade. The Grattan Street Station is on the Swanston Street alignment connecting to a CBD North Station in Swanston Street. It would also be compatible with more easterly alignments through the CBD, but none of the more westerly alignments (e.g. Elizabeth Street or William Street).
B1-2: Flemington Road	This option involves the construction of a station on Flemington Road, between Grattan Street and Park Drive. This option is compatible with a William Street or Elizabeth Street alignment through the CBD, but not the Swanston Street alignment or any more easterly alignment than Swanston Street.

Figure 5 illustrates the Parkville station options.

Figure 5 - Parkville station options



4.2.1. Options assessment

These options have been assessed according to the evaluation criteria outlined earlier. The interdependencies for each option (for example, the impact on station locations and alignments in other Study Areas) have also been considered. A summary of this analysis is outlined in Table 13.

The Grattan Street location is preferable on the basis that this location places the highest number of workers, students and residents in the station catchment Further, Flemington Road is located furthest away from the central part of the University of Melbourne (e.g. Engineering faculty and Faculty of Business and Economics), potentially increasing the travel time of students and teaching staff. Flemington Road is also positioned on the periphery of the Parkville precinct, away from key areas of demand and detracts from the developing role of Grattan Street as the central spine for the Parkville precinct as envisaged by the City of Melbourne's CBD North Structure Plan.

From an engineering and cost perspective, there is no significant difference between the Grattan Street and Flemington Road station locations. However a station at Grattan Street is closer to Lygon Street (which is a key destination in its own right) and Carlton South districts, and offers favourable interchange with tram route 19 (North Coburg) and a reasonable walk-interchange with Flemington Road and the Swanston Street tram routes. This location is likely to minimise journey times, maximise relief to trams, and lead to an increased number of private vehicle trips to be diverted from road.

As a result, the Grattan Street location is best placed to meet forecast demand attributable to the University of Melbourne (the largest single trip attractor in the Parkville precinct) and the commuter needs of those employed at the various hospitals and research facilities in the area. By servicing a larger catchment, the Grattan Street option would also provide greater relief to north-south trams.

Decision B1: What is the preferred alignment and station location in Parkville?

It is recommended that the project retain the Baseline in this area, with the Grattan Street station location identified as the preferred horizontal alignment.

Table 13 – Summary analysis for Decision B1: Parkville station location

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
B1-1: Grattan Street **(Baseline)**	• Provides a direct rail connection to the heart of the university, hospital and research precinct, enabling more efficient access to employment located in this area. • Provides an underground pedestrian link across Royal Parade and may potentially enable direct access to adjacent facilities via the concourse level. • A station entrance positioned opposite Barry Street and University Square would provide direct access to the University of Melbourne (the largest single trip attractor in the precinct) thereby providing an optimal and minimised journey time for students and teaching staff. • A station at this location is closer to Lygon Street (a key destination in its own right) and Carlton South districts, and offers favourable interchange with tram route 19 (North Coburg) and a reasonable walk-interchange with Flemington Road and the Swanston Street tram routes. This location is likely to minimise journey times, maximise relief to	• Less impact on busy commuter thoroughfare of Flemington Road. • Makes use of University Square and the City Ford site for a construction site. • Support from stakeholders for this location (over other locations in Parkville) indicates greater community support. • Impacts on surrounding major arterial roads and some impact on tram services during construction, as Grattan Street will be closed. • Located close to the Royal Melbourne Hospital (RMH), the Victorian Comprehensive Cancer Centre (VCCC) University of Melbourne and Peter Doherty Institute, which are sensitive receptors of construction and operational noise and vibration. • Impacts emergency access to the Royal Melbourne Hospital as a result of road closures.	• Base case. The capital cost of a station located on Grattan Street in Parkville is already included in the capital cost of the Baseline. (Savings resulting from exclusion of a station are discussed in under the next decision, below).	▪ Arden: Compatible with an Arden station option (preferred). ▪ CBD: Compatible with the Swanston Street (preferred) and more easterly alignments.

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
	trams, and lead to an increased number of private vehicle trips to be diverted from road. • Good urban renewal potential as the surrounding area will be redeveloped by the university, research entities and hospitals. • Opportunity for high quality interchange with potential future Clifton Hill – Newport rail link, indicatively planned to be aligned under Royal Parade.			
B1-2: Flemington Road	• **(+ve):** Provides comparable access to hospitals within the Parkville precinct, but would enable more direct access to the Royal Children's Hospital located on Flemington Road. • **(neutral)**: Development opportunities are significant, as the surrounding Flemington Road area is being redeveloped/earmarked for high density housing in addition to surrounding developments planned by education, research and medical institutions. • **(-ve):** Located furthest away from the central part of the University of Melbourne (e.g. Engineering faculty and Faculty of Business and Economics), potentially increasing the travel time of students and teaching staff.	• **(+ve)**: Traffic diversions would be required during construction. • **(+ve):** Similar construction activity impact on the operation of sensitive land uses and community facilities (including RMH, RCH and the University of Melbourne) to the Grattan Street option, but those institutions fronting Grattan Street in the vicinity of Royal Parade would be less affected by noise and vibration. • **(neutral):** Some impacts on surrounding major arterial roads requiring traffic diversions and moderate impact on tram services.	• **(neutral):** No material discrepancy in constructing a station at Flemington Road as opposed to Grattan Street location.	• Arden: Compatible with an Arden station option (preferred). • CBD: Compatible with a William Street or Elizabeth Street, incompatible with Swanston Street (preferred) or any more

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
	• **(-ve):** This location is less likely to divert customers away from crowded north-south tram routes which provide more direct access. • **(-ve):** This option is positioned on the periphery of the Parkville precinct, away from key areas of demand and detracts from the developing role of Grattan Street as the central spine for the Parkville precinct. • **(-ve):** Poorer or more complex interchange with potential future Clifton Hill – Newport rail link.	• **(-ve):** Land acquisition would be required for a construction site. • **(-ve):** Additional land acquisition may be required for ventilation purposes as verges are likely to be too narrow for such use. • **(-ve):** Heightened need to carefully manage the impact on Flemington Road traffic as this road provides an important connection to CityLink and the airport, and any detrimental impacts would have a significant adverse impact on the wider community. • **(-ve):** Location of station would significantly impact access and deliveries to the VCCC and Royal Women's Hospital.		easterly CBD alignments.

4.3. Decision B2: Is the station investment justified?

4.3.1. Options assessment

The analysis in relation to this decision is summarised in the table below, and the impact of excluding Parkville Station assessed in Table 14.

Table 14 – Station investment, Parkville: justification against evaluation criteria

Evaluation Criteria	Summary Analysis
1. Improving access to jobs and stimulating urban renewal	• The Parkville precinct is currently well serviced by tram routes (along Flemington Road and Swanston Street) and the 401 bus route which provides a vital intermodal link between North Melbourne station and the precinct. However, tram services between Parkville and the CBD, including the St Kilda Road – Swanston Street corridor, are currently congested (influencing unreliability, crowding and overall decline in customer experience) and this is projected to worsen • The provision of a new station at Grattan Street would benefit: – Students, employees and members of the public by providing direct access to the University of Melbourne and hospitals within the precinct, thereby improving productivity, social inclusion and journey times – Tram congestion relief by providing a high speed, high capacity transport alternative to tram services travelling north-south between Parkville and the CBD – Customers travelling from the western suburbs, who would otherwise need to interchange at either North Melbourne or Melbourne Central and then travel via a tram or bus to reach the Parkville precinct – Customers from western Victoria, who would otherwise need to interchange to a bus at Footscray or interchange twice to access Parkville by tram. • Customers passing through Footscray (i.e. travelling from the west to the CBD) would save in the order of 1 minute if Parkville Station was excluded • The inclusion of a new station at Parkville supports planned redevelopment and renewal of facilities within the precinct by health, research and education facilities. It improves connection between the University of Melbourne's Southbank campus and medical training facilities at Sunshine Hospital, as well as connections to RMIT, Victoria and Monash Universities • The inclusion of a Parkville Station also enables patients and visitors to access key hospitals that provide treatments only available in this location • Ultimately, the Parkville Station will connect the Precinct to Melbourne Airport further improving its international competitiveness.
2. Deliverability and disruption	• The construction of a new station at Parkville would result in moderate and manageable disruption to services (predominantly educational and medical) and amenities in the Parkville precinct. For example, the construction of a new station is expected to involve: – Some temporary disruption to amenity and access for the Hospitals in the precinct – Traffic diversions – major impacts on surrounding major arterial roads requiring traffic diversions – Tram service disruptions – moderate impact on tram services (for instance, on Royal Parade) – Limited property acquisition at surface, with use of part of University Square and Barry Street minimising reliance on private land occupation.
3. Cost	• The capital cost of a station located on Grattan Street in Parkville is already included in the capital cost of the Baseline. • Capital cost savings generated by not including a station at Parkville are in the order of $400m, assuming an alignment optimised to not include, nor future proof, a Parkville Station.

Removing a station at Parkville from the project scope would reduce the overall capital cost of the project, but materially reduce the benefits of the project. Based on the analysis above, the

long-term benefits of including a station at Parkville outweigh the limited, short-term cost savings achievable by removing this station from the scope.

Decision B2: Is the station investment justified?

It is recommended that the project retain the Baseline in this area, including a Parkville Station.

4.3.2. Conclusion

It is recommended that Melbourne Metro proceed with a new station at Parkville (located at Grattan Street) as per the Baseline. The provision of a station at Parkville is expected to provide significant connectivity benefits for people, including students, patients and employees, seeking to access this education and hospital precinct, and relieve the congested St Kilda Road – Swanston Street corridor.

5. Study Area C: CBD

5.1. Context

The CBD is Melbourne's business and financial centre, and encompasses the Hoddle Grid and the area between Victoria and Latrobe Streets. The CBD is a hub for retail, financial, educational, recreational, tourist and entertainment activities of State and national importance and services a variety of residents, workers and visitors. In recent years, the area has also experienced high density residential development in the centre of the CBD and surrounding suburbs.

The area also serves as a vital interchange point for many public transport users, particularly those with destinations in the broader central Melbourne area (including St Kilda Road and Parkville). The CBD is well serviced by public transport, including five existing train stations (Southern Cross, Flagstaff, Melbourne Central, Parliament and Flinders Street) and numerous major tram routes (notably along La Trobe, Bourke, Collins and Finders Street and along Spencer, William, Elizabeth and Swanston Street). However, as discussed in Chapter 3, this public transport is increasingly under strain.

5.2. Decision 1: What is the optimal horizontal alignment through the CBD?

5.2.1. Options identification

Melbourne has a distinct advantage over many other world cities in that its CBD streets are relatively wide and straight, set out in a grid. The opportunity to tunnel under road reserves through the CBD significantly reduces the constraints associated with tunnelling under tall buildings, and a variety of alignment options have been identified, with most exploiting this opportunity.

The key points of differentiation between options for this decision include:

- Relieving rail crowding and enabling more people to travel to and from the city in an efficient and effective manner (captured in Evaluation Criterion 1)
- Improving connectivity between rail services (for example, interchange with the City Loop) and other public transport modes, including encouraging interchange to access new stations at Arden, Parkville and Domain (captured in Evaluation Criterion 1)
- Minimising disruption during construction – including the existing public transport network (rail and tram), roads, pedestrian access, businesses and residents (captured in Evaluation Criterion 2)
- Cost – the capital costs of the construction works (Evaluation Criterion 3).

Nine materially different horizontal alignments and station location options have been identified and considered for this Study Area.[4]

[4] These nine options have not previously been developed to the same level of detail. Three options (C1-1: Spring Street, C1-2: Exhibition Street, and C1-6: Offset Swanston Street) were considered at a high-level and deemed to be suboptimal based on an initial review. Concepts were prepared and more detailed analysis undertaken for the remaining six options. The original options assessment (DOT, 2010) identified the William Street alignment as most worth of detailed comparison against the Swanston Street Scheme (which adopts the same alignment as the Baseline in this Business Case), so more extensive investigations of the impacts of this alignment are available than for the other options. All nine options are included in this Appendix for completeness and revised analysis undertaken by AJM during the development of this Business Case has re-examined these options in light of the current project scope and alignment. While it is noted that alternative street alignments through the west of the CBD could have been considered too (e.g. Queen Street or King Street), the William Street option has a substantial advantage over these options due to the interchange opportunity it offers with Flagstaff Station, so they were not considered worthy of detailed assessment. Note also that alignments that interchange with Spencer Street Station were assessed in Chapter 6.

Table 15 - Options identification for Decision C1: CBD horizontal alignment

Project Option	Description
C1-1: Spring Street	From the Parkville Station located beneath Grattan Street, the tunnels would extend along Grattan Street and then veer south-east before Rathdowne Street to follow a curved alignment, to align with Spring Street between LaTrobe and Flinders Street. The tunnels would then run underneath Birrarung Marr before following a curved alignment underneath the Yarra River and the Botanical Gardens. This alignment proposes one station near the corner of La Trobe and Spring Street, and a second station near the corner of Spring and Flinders Street.
C1-2: Exhibition Street	From the Parkville Station located beneath Grattan Street, the tunnels would extend along Grattan Street and then veer south-east before Swanston Street to follow a curved alignment to align with Exhibition Street between LaTrobe and Flinders Street. The tunnels would then run underneath Birrarung Marr to the Yarra River. This alignment proposes one station near the corner of La Trobe and Exhibition Street, and a second station near the corner of Exhibition and Flinders Street.
C1-3: Russell Street	From the Parkville Station located beneath Grattan Street, the tunnels would run along Grattan Street to Bouverie Street and then follow a curved alignment to align with Lygon Street near Argyle Place South. The tunnels would then run beneath Lygon Street and Russell Street to the Yarra River on the eastern side of Federation Square. New CBD stations would be located between Latrobe and Lonsdale Streets beneath Russell Street and at Flinders Street to the east of Federation Square.
C1-4: Swanston Street – two stations (Baseline)	From the Parkville Station located beneath Grattan Street, the tunnels would extend along Grattan Street and then follow a curved alignment to align with Swanston Street near Queensberry Street. The tunnels would then run beneath Swanston Street to the Yarra River. A new interchange station is proposed to be located adjacent to Melbourne Central Station in Swanston Street. The main station entrance would be located at the corner of LaTrobe Street with a second northern entrance near Franklin Street. A second CBD station would be located between Collins and Flinders Street beneath Swanston Street. An interchange entrance would be provided with a direct link to Flinders Street Station with additional entrances north of Flinders Street and near Collins Street.
C1-5: Swanston Street – one station	Following a similar alignment to the Baseline (project option C1-4), this option would instead provide a single CBD station, either in the central CBD (mid-way between La Trobe and Flinders Street) or to enable direct interchange with Flinders Street Station. For the purpose of this assessment, the latter option has been assumed to be superior due to the interchange opportunity.
C1-6: 'offset' Swanston Street – 2 stations	Following a similar alignment to the Baseline (project option C1-4), in this option stations and tracks would run under properties to the east of Swanston Street, rather than under the road carriageway. This option would involve tunnelling at significant depth under private property adjoining Swanston Street to the east, as well as the Town Hall and St Paul's Cathedral. CBD North would be located under RMIT/State Library lawns and the CBD South station would be located under Federation Square and the Yarra River (refer to C1-7 below for further detail on the CBD South station location).

Project Option	Description
C1-7: Swanston – 2 stations, 1 of which is under the Yarra River	Following a similar alignment to the Baseline (project option C1-4), this option would involve shifting the CBD South station south of Flinders Street under Federation Square and the Yarra River. The station would be formed in a construction box using a staged cofferdam construction method across the Yarra River. Station entrances would be located on Batman Avenue (Northbank) and in Alexandra Park (Southbank), with facilities to interchange with Flinders Street Station subject to further investigation.
C1-8: Elizabeth Street	From the Parkville Station located beneath Flemington Road, the tunnels would extend along Flemington Road, beneath Haymarket Roundabout on a curved alignment, to align with Elizabeth Street. The tunnels would then run beneath Elizabeth Street to the Yarra River. A new interchange station would be located adjacent to Melbourne Central Station beneath Elizabeth Street. A station entrance would be located at Melbourne Central Station and a northern entrance near Franklin Street. A second CBD station would be located between Flinders Lane and the Yarra River partially beneath Swanston Street and partially beneath the properties on the west side of Elizabeth Street north of Flinders Street. An interchange entrance would be provided with a direct link to Flinders Street Station at the end of Elizabeth Street, with additional entrances near Flinders Lane. To minimise the need to acquire and possibly demolish large multistorey buildings south of the Yarra, the tunnels and the proposed Flinders Street Station, south of Collins Street, would need to be constructed on the same horizontal alignment, with the first tunnel constructed directly above the second tunnel (i.e. 'double stacked').
C1-9: William Street	From the Parkville Station located beneath Flemington Road, the tunnels would extend along Flemington Road, beneath commercial properties on the west side of the Elizabeth St Roundabout on a curved alignment to align with Peel Street. The tunnels would then run beneath Peel Street and William Street to the Yarra River. A new interchange station could be located adjacent to Flagstaff Station in William Street. A station entrance would be located at Flagstaff Station and a southern entrance near Lonsdale Street. A second new station could be provided at Southbank.

Figure 6 - Illustrates the CBD horizontal alignment options.

Figure 6 - CBD horizontal alignment and station options

5.2.2. Options assessment

The nine CBD horizontal alignment options have been assessed according to the evaluation criteria outlined earlier. The interdependencies for each option (for example, the impact on station locations and alignments in other Study Areas) have also been considered. A summary of this analysis is provided below and in further detail in Table 16.

Alternative street alignments to Swanston Street offer a less optimal outcome

The Swanston Street alignment is expected to involve the lowest capital cost of all options for the creation of two CBD stations.

Swanston Street (Baseline) provides a materially better outcome than most alternative options in terms of providing improved CBD access, for example, providing better station locations (in terms of catchment) and offering better interchange opportunities with trams. (Note: the Elizabeth Street alignment provides similar benefits, and while the William Street alignment has a smaller catchment, it would support the growing western parts of the CBD.) The Swanston Street alignment offers direct interchange with both Melbourne Central Station and Flinders Street Station, maximising the use of the new Arden, Parkville and Domain stations by making it easy for passengers from all lines to interchange to access them, both now and in the future. The only other option offering direct interchange with these stations is Elizabeth Street, which would involve significantly higher capital costs due to complex ground conditions and interaction with tall buildings in Southbank.

In terms of interdependencies with other key decision points, the Baseline is compatible with the preferred station locations in Parkville.[5] The Elizabeth Street and William Street options would require suboptimal outcomes at adjacent decision points along the alignment.

[5] Further analysis would be required to assess compatibility of Arden station.

The Baseline's stations at CBD South and CBD North offer greater transport outcomes to alternative solutions

The single station option on the Swanston Street alignment offers negligible savings as the very high number of passengers using this station would mean that it would need to be substantially larger than either of the two stations under the Baseline. However, this option offers significantly reduced benefits for the network both now and into the future. A single central CBD station would have much less convenient interchange opportunities with other rail services, affecting access to employment and other activities, and reducing the number of customers using Melbourne Metro (with people more likely to use existing rail lines, tram lines and cars). A single station would also be problematic in the event that the City Loop Split were to be implemented into the future, as some lines would no longer have an interchange with the Sunshine-Dandenong line.

The option to shift CBD South Station under the Yarra River would add significant capital cost to the project and 1 year to the construction program. While it would reduce impacts on Swanston Street, it would significantly increase impacts on the Yarra River and poses much greater construction complexity, including greater risk of work in the complex Yarra River ground precinct resulting in settlement and damage to structures.

Decision C1: What is the optimal horizontal alignment through the CBD?

It is recommended that the project retain the Baseline in this area: an alignment beneath Swanston Street with two stations.

Table 16 - Summary analysis for Decision C1: CBD horizontal alignment

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
C1-1: Spring St	• **(neutral):** Would allow Sunbury to Dandenong services to bypass the MURL tunnels, releasing capacity for other lines within the existing network. • **(neutral):** Potential for project to act as catalyst for CBD growth by providing increased capacity and access to the CBD. • **(neutral):** Supports renewal in the Parkville precinct with new underground railway station. • **(neutral):** Capable of providing a fast and reliable service through end-to-end running. • **(-ve):** Limits benefits of new stations to eastern end of CBD, with a smaller catchment than more central alignments. • **(-ve):** Smaller catchment than more central alignments would result in fewer passengers using the tunnel, with more opting to change to other train lines (e.g. at Footscray and Caulfield), reducing the	• **(+ve):** Spring St less busy than Swanston St. • **(-ve):** Significant impacts to Parliament Station and likely to have some impact on City Loop (constructability has not been assessed). • **(neutral)**: Tunnel alignment is dictated by the need to pass under the City Loop (due to complexities associated with a shallower route around Parliament Station) which would result in deep stations. With the lower level of Parliament Station being more than 40 metres deep, the new stations would need to be deeper.	• **(-ve):** Likely to involve significantly higher capital costs than Baseline due to constructability challenges around Parliament station.	• Parkville: only compatible with Grattan Street station option (preferred). • Domain: not assessed in detail, but maintaining a Domain Station likely to result in longer journey times due to tunnel length and curved alignment which could restrict line speeds.

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
	crowding and capacity benefits offered by the tunnel. • **(-ve):** Provides potential for paid direct rail interchange only at Parliament station, limiting the attractiveness of interchanging to the new tunnel from other lines to access Arden, Parkville and Domain Stations, therefore reducing use of these stations and relief to road and tram network. • **(-ve):** Unlikely to significantly reduce congestion on the existing tram corridors along St Kilda Road and Swanston Street. • **(-ve):** Increased tram crowding, with large numbers of passengers expected to interchange to Collins and Bourke Street trams for access to central CBD locations, boarding these routes at their peak loading point on the CBD edge. • **(-ve):** The City Loop Split would lead to some lines operating only via the existing underground stations while also increasing the number of lines operating only via Flinders Street and Southern Cross Stations. A single interchange at			

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
	Parliament would mean some lines would not have a direct interchange to the Sunshine-Dandenong line, requiring passengers to interchange twice (including for access to Melbourne Airport, should that future rail link be constructed).			
C1-2: Exhibition St	• **(neutral):** Would allow Sunbury to Dandenong services to bypass the MURL tunnels, releasing capacity for other lines within the existing network. • **(neutral):** Potential for project to act as catalyst for CBD growth by providing increased capacity and access to the CBD. • **(neutral):** Supports renewal in the Parkville precinct with new underground railway station. • **(neutral):** Capable of providing a fast and reliable service through end-to-end running. • **(-ve):** Limits benefits of new stations to eastern end of CBD. • **(-ve):** No paid direct interchange to other CBD stations, being a city block from	• **(+ve):** Exhibition St is less busy than Swanston St which has disruption benefits. This advantage is somewhat offset by Exhibition St (including Exhibition St extension) having a more important traffic role. • **(+ve):** Some reduction in disruption at Parkville. • **(-ve):** Poorer ground conditions expected at the southern CBD station. • **(-ve):** Greater complexity of construction due to proximity to high rise buildings. • **(-ve):** Potential impact on Exhibition Street extension bridge and rail tracks east of Flinders Street Station.	• **(-ve):** Likely to involve significantly higher capital costs than the Baseline. The complexity of constructing close to tall buildings also adds to cost.	• Parkville: only compatible with Grattan Street station option (preferred). • Domain: not assessed in detail, but maintaining a Domain Station likely to result in longer journey times due to tunnel length and curved alignment which could restrict line speeds.

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
	Parliament Station and two city blocks from Flinders Street and Melbourne Central Stations. Connection would involve an extended distance via the existing street network. This would significantly limit the attractiveness of interchanging to the new tunnel from other lines to access Arden, Parkville and Domain Stations, therefore reducing use of these stations and relief to road and tram network. • **(-ve):** Unlikely to significantly reduce congestion on the existing tram corridors along St Kilda Road and Swanston Street. • **(-ve):** Increased tram crowding on Collins and Bourke Streets for central CBD access.			
C1-3: Russell St	• **(neutral):** Would allow services on the Sunshine – Dandenong Line to bypass the MURL tunnels, releasing capacity for other lines within the existing network.	• **(+ve):** Russell Street is less busy than Swanston Street. • **(-ve):** Poorer ground conditions expected at the southern CBD station.	• **(-ve):** Estimated to involve higher capital costs due to constructability challenges and proximity to buildings.	• Parkville: only compatible with Grattan Street station option (preferred).

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
	• **(neutral/+ve):** Potential for project to act as catalyst for CBD growth by providing increased capacity and access to the CBD. Also benefits of new stations slightly east of central CBD support CBD growth. • **(neutral):** May contribute to reducing congestion along St Kilda Road, by providing connectivity between Domain precinct and CBD. • **(neutral):** Supports renewal in the Parkville precinct with new underground railway station. • **(neutral):** Capable of providing a fast and reliable service through end-to-end running. • **(-ve):** No paid direct interchange to other CBD stations, being a city block from Flinders Street and Melbourne Central Stations. Connection would involve an extended distance via the existing street network. This would significantly limit the attractiveness of interchanging to the new tunnel from other lines to access Arden, Parkville and Domain Stations, therefore reducing	• **(-ve):** Greater complexity of construction due to proximity to high rise buildings. • **(-ve):** Potential for CBD South station to impact on Federation Square and rail tracks east of Flinders Street Station (also adding complexity to any future project to deck over rail yards). • **(-ve):** Russell St declines steeply towards the Yarra River and hence a station positioned north of Flinders Street would be very deep at its northern end. Mined construction towards the river is likely and will enable the station to be situated under the rail yard, however this increases cost and risk due to poorer ground conditions adjacent to the river.		• Domain: compatible with both the Domain and South Melbourne station options

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
	use of these stations and relief to road and tram network.[6] • **(-ve):** Catchment marginally reduced compared to Swanston Street, due to less central location.			
C1-4: Swanston – 2 stations (Baseline)	• Would allow services of the Sunshine - Dandenong Line to bypass the MURL tunnels, releasing capacity for other lines within the existing network. • Potential for project to act as catalyst for CBD growth by providing increased capacity and access to the CBD. • Provides 2 new stations in the centre of the CBD. • Provides direct paid interchange with Flinders and Melbourne Central stations, thereby providing access to all lines now and in the future. • Reduces tram congestion on St Kilda Road and to Parkville by providing an	• Ground conditions generally most favourable. • Minor impact to Swanston Street associated with optimised deep alignment and cavern stations. • Minimal-no tram disruption during construction. • Construction of the two stations within Swanston Street (busiest pedestrian environment in the CBD) has potential for some limited business disruption during construction. • Relatively limited rail disruption as CBD South Station is clear of the rail yards east of Flinders Street Station.	• Given this is the Baseline, the cost of this option is the Base Case cost that all other options have been compared against in the first instance.	• Parkville: only compatible with Grattan Street station option (preferred). • Domain: compatible with both the Domain and South Melbourne station options.

[6] While a long underground tunnel for passenger interchange between a CBD South Station at Russell Street and Flinders Street Station may be feasible, it would be a much poorer outcome than an interchange with the Swanston St alignment. A similar underground interchange with Melbourne Central is unlikely to be feasible due to the clash with the City Loop tunnels.

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
	attractive (frequent, high capacity, high speed) heavy rail alternative. • Provides immediate connectivity with numerous tram routes along Swanston St and with east-west tram routes at the mid-point of the CBD, where crowding on services is lower. • Provides connectivity with the City Loop at the mid-point of the CBD (Melbourne Central), where crowding on services is lower. • Supports renewal in the Parkville precinct with new underground railway station. • Capable of providing a fast and reliable service through end-to-end running.			
C1-5: Swanston – 1 station	• **(neutral):** Would allow services of the Sunshine - Dandenong Line to bypass the MURL tunnels, releasing capacity for other lines within the existing network. • **(neutral):** Potential for project to act as catalyst for CBD growth by providing	• **(+ve):** Ground conditions generally most favourable. • **(neutral):** Potential to reduce disruption due to need to construct only one station box. However, to accommodate required customer numbers the station would need to be very large,[7] leading to	• **(+ve/neutral):** Indicative similar cost to Baseline, as single station would need to be very large.	• Parkville: only compatible with Grattan Street station option (preferred). • Domain: compatible with both the Domain and South Melbourne station options.

[7] DOT, *Melbourne Metro One Options Assessment,* (2010).

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
	increased capacity and access to the CBD. • **(neutral):** Reduces tram congestion on St Kilda Road and to Parkville (including Swanston Street and Elizabeth Street) by providing an attractive (frequent, high capacity, high speed) heavy rail alternative. • **(neutral):** Supports renewal in the Parkville precinct with new underground railway station. • **(neutral):** Capable of providing a fast and reliable service through end-to-end running. • **(-ve):** Only provides one new CBD station. This is projected to reduce CBD-bound passengers on the Melbourne Metro corridor by approximately 25% (indicative reduction of economic benefits would be in the order of $400 – 500m). More passengers would opt to change to other train lines (e.g. at Footscray and Caulfield), reducing the crowding and capacity benefits offered by the tunnel.	additional disruption and property acquisitions at the station location. • **(-ve)**: Despite there being only one station, significant and complex work is still required to construct a very large station with capacity for in the order of 50% more customers than would use either of the two CBD stations under the Baseline. This would likely require two platform faces per track to handle crowds without requiring trains to stop for several minutes, which would otherwise compromise the capacity of the line.		

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
	• **(-ve):** Customer experience would be impacted due to increased crowding at and around the single CBD station. • (**neutral):** Provides immediate connectivity with numerous tram routes along Swanston St and with east-west tram routes at the mid-point of the CBD, where crowding on services is lower. • **(-ve):** The City Loop Split would lead to some lines operating only via the existing underground stations while also increasing the number of lines operating only via Flinders Street and Southern Cross Stations. A single paid interchange at Flinders Street would mean some lines would not have a direct interchange to the Sunshine - Dandenong Line, requiring passengers to interchange twice (including for access to Melbourne Airport, should that future rail link be constructed).			
C1-6: 'offset'	• **(+ve):** Potential for a Southbank entrance at CBD South, which would provide access to this key cultural precinct (including the Arts Centre,	• **(neutral):** Generally ground conditions most favourable. • **(-ve):** Both CBD stations are likely to require a very deep vertical alignment to pass beneath existing buildings, the	• **(-ve):** Likely higher cost relative to Baseline, due to constructability challenges and/or acquisitions costs.	• Parkville: only compatible with Grattan Street station option (preferred).

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
Swanston – 2 stations	restaurants on Southgate and the National Gallery of Victoria. • **(neutral):** Would allow services of the Sunshine - Dandenong Line to bypass the MURL tunnels, releasing capacity for other lines within the existing network. • **(neutral):** Potential for project to act as catalyst for CBD growth by providing increased capacity and access to the CBD. • **(neutral):** Reduces tram congestion on St Kilda Road and to Parkville by providing an attractive (frequent, high capacity, high speed) heavy rail alternative. • **(neutral):** Direct paid rail interchange with Melbourne Central and Flinders Street station provides access to all lines now and in the future. • **(neutral):** Provides immediate connectivity with numerous tram routes along Swanston St and with east-west tram routes at the mid-point of the CBD, where crowding on services is lower. • **(-ve)**: CBD South station is located further away from most CBD activities	MURL tunnels and beneath the complex aquifers of the Yarra River precinct. Indicative station depths from surface would be as a minimum: CBD North 40m, CBD South 55m (i.e. very deep). • **(-ve):** Alignment runs directly beneath tall buildings, highly sensitive structures and buildings of significant heritage and cultural importance. Extensive works would be required to protect the structural integrity of existing structures that are tunnelled under (including Town Hall, St Pauls Cathedral and QV). • **(-ve):** Likely that the entry to the CBD North station would be located in the 'core' RMIT buildings, requiring demolition of a section of the core block and causing profound disruption to RMIT operations. • **(-ve)**: CBD North may require occupation of the State Library lawns and CBD South station may require the demolition of part of Federation Square.		• Domain: compatible with both the Domain and South Melbourne station options.

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
	thereby decreasing accessibility to jobs and services.			
C1-7: Swanston – 2 stations, CBD South station located under the Yarra River	• **(+ve):** Potential for a Southbank entrance which would provide access to this key cultural precinct (including the Arts Centre, restaurants on Southgate and the National Gallery of Victoria). • **(-ve)**: CBD South station is located further away from most CBD activities thereby decreasing accessibility to jobs and services. • **(neutral):** Direct rail interchange with Melbourne Central station and Flinders Street station provides access to all lines now and in the future. • **(neutral):** Provides immediate connectivity with numerous tram routes along Swanston St and with east-west tram routes at the mid-point of the CBD, where crowding on services is lower.	• **(-ve)**: Involves significant impacts to the Yarra River and surrounding area. • **(-ve)**: Complex hydrogeology in the area creates a number of construction risks: Presence of extensive basalt would complicate installation of cofferdams, likely requiring blasting techniques; effects of piling on aquifers and the Moray Street gravels and other sands and silts creates a higher risk of dewatering and settlement, impacting structures in the local area. • **(-ve)**: Likely to extend the overall project construction by approx. 1 year due to the complex Yarra River works required.	• **Not assessed**.	• Parkville: only compatible with Grattan Street station option (preferred). • Domain: compatible with both the Domain and South Melbourne station options.

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
C1-8: Elizabeth St	• **(neutral):** Would allow Sunbury to Dandenong services to bypass the MURL tunnels, releasing capacity for other lines within the existing network. • **(neutral):** Capable of providing a fast and reliable service through end-to-end running. • **(neutral):** Potential for project to act as catalyst for CBD growth by providing increased capacity and access to the CBD. • **(neutral):** Direct paid rail interchange with Melbourne Central and Flinders Street stations provides access to all lines now and in the future. • **(neutral):** May contribute to reducing congestion on St Kilda Road by providing connectivity between Domain precinct and CBD. May also reduce congestion on other tram routes (if any) (e.g. Elizabeth Street, Park Street etc.) • **(Neutral):** Provides immediate connectivity with numerous tram routes	• **(+ve):** Elizabeth St marginally less busy than Swanston St and therefore potentially less disruptive during construction. • **(-ve):** More extensive and disruptive early works would be required to relocate services, particularly the large drain that carries the former Williams Creek. • **(-ve):** As the site of the former Williams Creek, the geotechnical conditions along Elizabeth Street are particularly complex for construction, and the potential for flooding would need careful management both in construction and operation of the new stations. • **(-ve):** Potential for CBD South station to impact on Flinders Street Station and rail operations. • **(-ve):** Greater complexity of construction due to proximity to high rise buildings, particularly through Southbank where	• **(-ve):** Likely to involve significantly higher cost relative to Baseline due to constructability challenges and/or acquisition costs.	• Parkville: only compatible with Flemington Rd station option (not preferred). • Arden[8] • Domain: compatible with both the Domain and South Melbourne station options.

[8] Further analysis would be required to assess compatibility of Arden station.

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
	along Swanston St and with east-west tram routes at the mid-point of the CBD, where crowding on services is lower. • **(-ve):** Parkville station moved to Flemington Road – unlikely to support future precinct development as effectively as more central location along Grattan Street. • **(-ve):** Deep stations require additional travel time for access to trains.	the tunnels must "weave" around deep structures.		
C1-9: William St	• **(neutral):** Would allow Sunbury to Dandenong services to bypass the MURL tunnels, releasing capacity for other lines within the existing network. • **(neutral):** Capable of providing a fast and reliable service through end-to-end running. • **(+ve):** Supports access to the growing western parts of the CBD. • **(+ve)**: A new station at Southbank strengthens rail accessibility and customer dispersion within Central	• **(+ve):** William Street less busy than Swanston Street (including only one tram route), therefore less disruption, and limited impact on Flinders Street precinct, given the southern station would be in Southbank. • **(-ve):** Construction of Southbank station would involve localised disruption. • **(-ve):** Southbank station situated in particularly poor ground, creating greater construction complexity than the more easterly alignments.	• **(-ve):** Likely higher cost relative to Baseline due to constructability challenges.	• Parkville: only compatible with Flemington Rd station option (not preferred). • Arden[9] • Domain: broadly compatible with both the Domain and South Melbourne station options.

[9] Further analysis would be required to assess compatibility of Arden station.

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
	Melbourne. Visitors and workers based in this area would directly benefit from reduced travel times leading to improved productivity and customer experiences. • **(-ve):** Less central to existing major CBD activity which is projected to impact on patronage on the Melbourne Metro corridor (indicative economic impact). • **(-ve):** Provides direct rail interchange only at Flagstaff station, limiting the attractiveness of interchanging to the new tunnel from other lines to access Arden, Parkville and Domain Stations, therefore reducing use of these stations and relief to road and tram network. • **(-ve):** Unlikely to significantly reduce congestion on existing tram corridors along St Kilda Road and Swanston Street. • **(-ve):** The City Loop Split would lead to some lines operating only via the existing underground stations while also increasing the number of lines operating only via Flinders Street and Southern Cross Stations. A single paid interchange at Flagstaff would mean some lines			

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
	would not have a direct interchange to the Sunshine -Dandenong Line, requiring passengers to interchange twice (including for access to Melbourne Airport, should that future rail link be constructed). • **(-ve):** More limited tram connectivity (i.e. immediate access to fewer routes). • **(-ve):** Parkville station moved to Flemington Road – unlikely to support future precinct development as effectively as more central location along Grattan Street.			

5.3. Decision C2: What is the optimal vertical alignment?

5.3.1. Options identification

The proposed vertical alignment of the Melbourne Metro tunnels through the CBD presents a number of complexities and challenges, in particular:

- Any impact of the depth of the tunnels and new stations on journey times and customer experience
- The need to minimise the interface risks associated with the existing City Loop tunnels which run underneath La Trobe Street
- Structuring to minimise river spoil, groundwater disposal and contamination of river sediments, all of which have environmental implications
- The potential constraints of the Princes Bridge, Federation Square and The Vaults' foundations. Some uncertainty exists around the foundation depths of Princes Bridge and The Vaults. The Federation Square Piled Foundations are also likely to require underpinning works for the current alignment
- The need to avoid and minimise the interface risks associated with the existing CityLink tunnels which cross underneath St Kilda Road in the vicinity of Grant Street
- The construction challenges posed by the Yarra River crossing, given the complex geology in this area. One of the key hydrogeological risks identified is the potential impact the project may have on the connectivity between water systems in this area (including potential blockages or unintended pressure release at the Moray Street Gravel aquifer near the Yarra River crossing).

Note that the issues and complexities with selecting the optimal vertical alignment are particularly significant through the CBD and under the Yarra River. As a result, analysis of the issues around the vertical alignment in this Business Case have been confined to the section focussing on decisions relating to the CBD.

Two vertical alignment options have been considered to address these (and other) challenges, which are depicted in the figure below and summarised in in Table 17.

Table 17 - Options summary for Decision C2: vertical alignment

Project Option	Description
C2-1: Shallow **(Baseline)**	This alignment option would involve the tunnels travelling over the City Loop, with a shallow alignment under the Yarra River, and is expected to involve: • Cut and cover construction of the two station boxes. • A mined tunnel solution underneath Swanston Street between the station boxes.[10] • Tunnel Boring Machine (TBM) construction either side of the CBD, including under the Yarra River.[11]

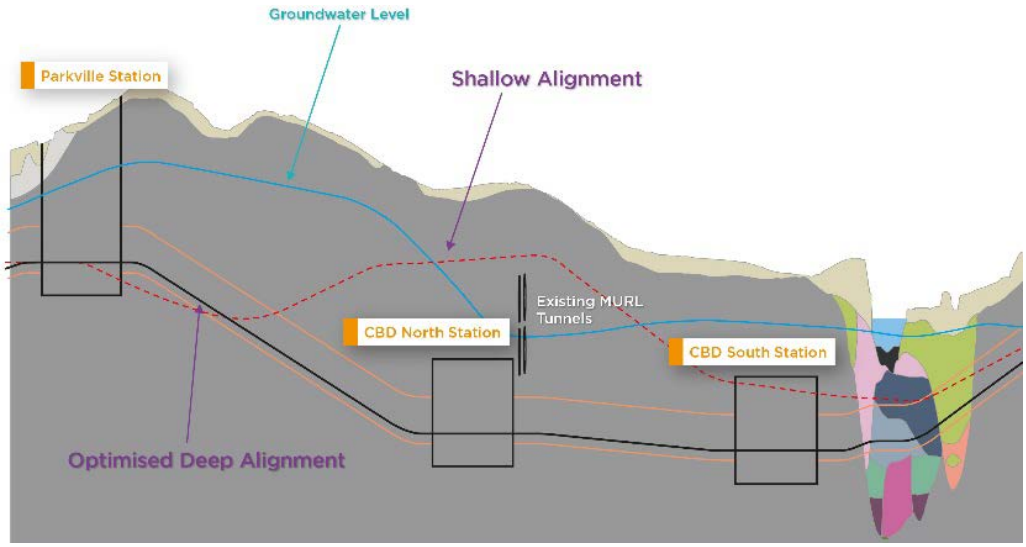
[10] Note that while the mined tunnel solution is currently proposed under the Baseline Scheme, alternative construction methodologies (including use of Tunnel Boring Machines (TBM) for the length of Swanston Street are currently under review. A TBM is a mechanically operated machine used to excavate a tunnel with a circular cross section through a variety of soil and rock and constructs the tunnel's structural lining as it progresses"

[11] A TBM is a machine used to excavate tunnels through soil or rock using a mechanical cross section rather than blasting or drilling.

Project Option	Description
C2-2: Optimised deep	This alignment option would involve the tunnels travelling under the City Loop and is expected to involve: • Cavern stations involving a reduced extent of cut and cover construction of the two station boxes. • A mined solution underneath Swanston Street and the Yarra River, and either side of the CBD.

Figure 7 illustrates the CBD vertical alignment options.

Figure 7 – CBD vertical alignment options



5.3.2. Options assessment

The two CBD vertical alignment options have been assessed according to the evaluation criteria outlined earlier. A summary of this analysis and the interdependencies for each option is found in Table 18.

The key considerations are outlined below:

- The cost of the optimised deep alignment is not expected to be materially different to the project capital cost of a shallow alignment along Swanston Street, due to significantly less impact on utility services and disruption on Swanston Street (refer below).
- The Baseline provides a better outcome than the alternative option in terms of walking journey times, access and egress.
- The optimised deep alignment involves significantly less surface disruption than the Baseline. This alignment offers no major extended disruptions to Swanston Street, with no major tram diversions along Swanston Street during construction and minimal impact on the Swanston Street and La Trobe Street landscapes. While some impacts associated with the optimised deep alignment (including truck traffic to station construction sites along Swanston Street and soil excavation, and major service relocations) are inevitable, the degree of disruption to pedestrians, road traffic and business owners is significantly less than under the Baseline.
- Similar ground and hydrogeological conditions exist for both the shallow and deep alignment and are considered manageable.

Decision C2: What is the optimal vertical alignment?

It is recommended that the project adopt the optimised deep alignment through the CBD.

5.3.3. Conclusion

The optimised deep Swanston Street alignment with two new CBD stations is the preferred solution for this Study Area. This is consistent with the Baseline for the purposes of the horizontal alignment, but recommends deviating from the Baseline in relation to the vertical alignment through the CBD for the reasons outlined above.

Table 18 - Summary assessment for Decision C2: Vertical alignment

Project Option	EVALUATION CRITERIA			
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	Interdependencies
C2-1: Shallow **(Baseline)**	• Provides highly accessible stations, which would be attractive for interchange to access new stations at Arden, Parkville and Domain, relieving trams.	• Cut and cover construction along full length of both CBD North and CBD South stations, involving significant disruption of pedestrians, road users and major services across the CBD, and in particular around the station footprints and along the length of Swanston Street for a number of years. • Major utility diversions – diversions will require disruption of streets adjacent to Swanston St • Impacts between La Trobe and Collins from services affected by shallow tunnelling • Longer program duration due to working restrictions and significant number of interfaces with the public. • Diversion of 10 tram routes from Swanston Street during construction. • Significant business disruption costs associated with the shallow alignment. • Some level of hydrogeological risk associated with tunnelling.	• Base case. • Note potential for significant 'unknown' risks in current estimates for both services and business disruption.	• Base case

Project Option	EVALUATION CRITERIA			
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	Interdependencies
C2-2: Optimised deep	• **(-ve):** Some increase in travel time to access platforms, particularly at CBD North. • **(-ve):** May result in less congestion relief to trams, due to some increase in travel time to access train platforms.	• **(+ve):** No major extended disruptions to Swanston Street. • **(+ve):** Swanston Street and La Trobe Street landscape treatments are retained. • **(+ve):** Maintains existing tram operations on Swanston Street during construction and significant reduction in the services requiring diversion. • **(+ve):** Reduces business disruption costs significantly. • **(+ve):** Ability to work around the clock for underground works. • **(+ve):** Fewer interfaces between construction activities and the public. • **(+ve):** Shortens program to complete CBD stations and overall project. • **(+ve):** Alignment may be able to take advantage of better quality Melbourne formation, which provides good tunnelling conditions. • **(-ve):** Involves more complex although still common construction techniques.	• **(neutral):** Not expected to be materially different to the shallow alignment, due to significantly less impact on utility services and disruption on Swanston Street.	• Parkville Station deepened as compared to the Baseline.

Project Option	EVALUATION CRITERIA			
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	Interdependencies
		• **(-ve):** Slight increase in hydrogeological risks associated with this alignment, although these risks can be managed by appropriate design / operations.		

6. Study Area D: Domain and South Melbourne

6.1. Context

The Domain precinct is of significant strategic importance to the planning and urban development of Melbourne. This area incorporates St Kilda Road, which is acknowledged as a 'change area' by the Melbourne Planning Scheme and a growth corridor by Plan Melbourne, and is surrounded by a mix of high and lower density office, educational and residential uses, which generate a significant volume of road, public transport, walking and cycling trips. The Kings Way precinct of South Melbourne is surrounded by a mix of high and lower density office space and high density residential development owing to its proximity to the CBD.

Domain is serviced by eight tram routes currently operating through the Domain tram interchange onto the St Kilda Road – Swanston Street corridor, which is the busiest tram corridor in the world and is currently experiencing significant crowding issues, as described in Chapter 3. The Kings Way precinct of South Melbourne is serviced by one tram route (which also travels to Domain) which is largely reflective of the historical transport demands of this precinct.

The Baseline assumes a Melbourne Metro station at Domain, located under St Kilda Road near the intersection of Albert Road and Domain Road.

6.2. Decision D1: What is the preferred alignment and station location at Domain and South Melbourne?

6.2.1. Options identification

The alignment through either Domain or South Melbourne is largely determined by the location of the station and the alignment in the previous Study Area (CBD). The options in this Study Area therefore relate primarily to the station location.

The identification and analysis of the two options considered for the purposes of this current options assessment were originally undertaken and documented in a technical study[12] prepared for the former 2011 Melbourne Metro 1 business case. The analysis below builds on previous analysis, reassessing the options for Domain and South Melbourne in light of the current scope and requirements of this Business Case.

The two potential options considered for the purpose of this current options assessment are described below.

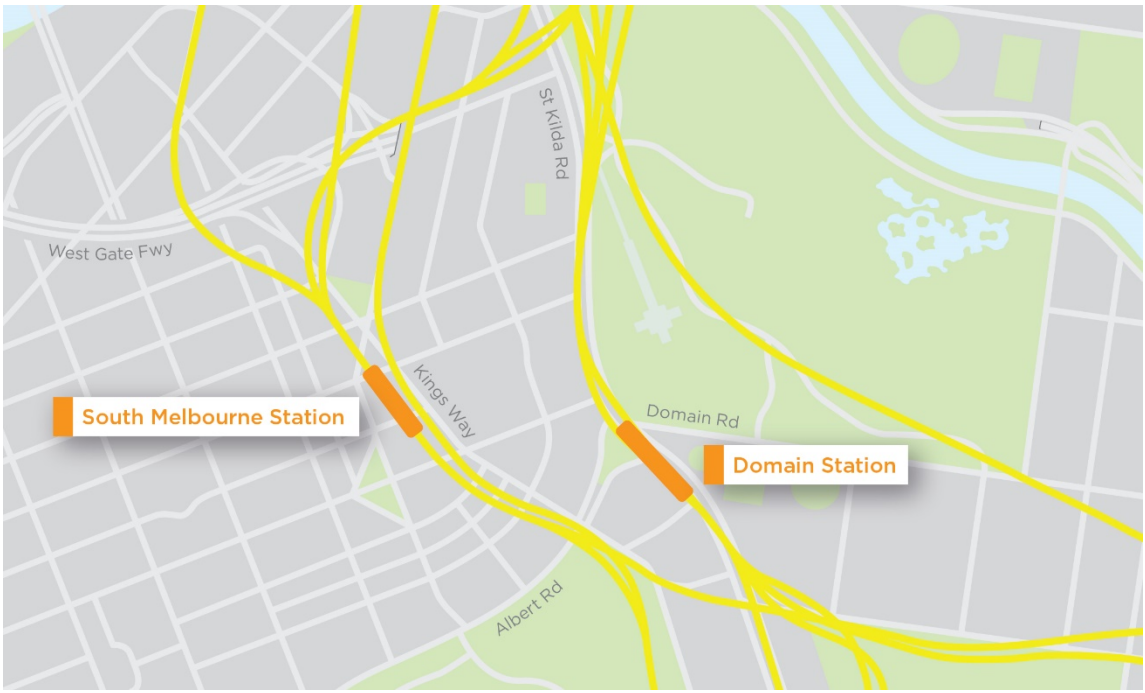
[12] Department of Transport, *MM1 Options Assessment,* (2010).

Table 19 – Station location options for Domain and South Melbourne

Project Option	Description
D1-1: Domain (Baseline)	This option involves the construction of a station located under St Kilda Road near the intersection of Albert Road and Domain Road. The station scope also includes surface works which are primarily associated with relocating the existing Domain interchange to a new tram super stop located south of Park Street, with direct access to the new station.
D1-2: South Melbourne	This option involves the construction of a new station along Kingsway, near Sturt Street.

Figure 8 illustrates the potential station locations for Domain and South Melbourne.

Figure 8 - Potential station locations for Domain and South Melbourne



6.2.2. Options assessment

These options have been assessed according to the evaluation criteria outlined earlier. The interdependencies for each option (e.g. the impact on station locations and alignments in other Study Areas) have also been considered. A summary of this analysis is provided in Table 20.

A station at Domain would support existing business, tourism and cultural uses and provide significant congestion relief to the St Kilda Road – Swanston Street tram corridor, generating a range of productivity, liveability and customer experience benefits. It will also be an important interchange station between train and tram services for the area's residential and business catchment.

The South Melbourne location would also support existing business, tourism and cultural uses, however this location is estimated to cost approximately $1.4bn[13] (P90, nominal) more than Domain. This cost is driven by the complex ground conditions around the location of the proposed South Melbourne station (which worsen to the west of the ridge on which St Kilda Road is situated, with much of South Melbourne originally consisting of swamp lands),

[13] AJM, *Melbourne Metro Rail Project Alternatives and Options cost review*, (2015).

additional property acquisition costs, the need to navigate existing structures (including the aboveground section of CityLink), and the additional tunnel length. Further, South Melbourne would also benefit from the proximity of a station at Domain and improved access through tram network changes that would be enabled by a station at Domain.

Decision D1: What is the preferred alignment and station location – South Melbourne or Domain?

It is recommended that the project retain a station at Domain (Baseline).

Table 20 – Summary assessment for Decision D1: Domain or South Melbourne Station

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
D1-1: Domain (Baseline)	• Station location provides a significant train/tram connectivity opportunity. • Provides material crowding relief to St Kilda Road – Swanston Street tram corridor congestion. • Station location provides access to jobs along St Kilda Road and also in South Melbourne; four secondary schools; the Victoria Barracks, and major cultural and tourism facilities including the Shrine of Remembrance and Botanic Gardens. • A new station at Domain would further consolidate the significant redevelopment and investment already occurring in the precinct. • A new station at Domain would provide a direct link between Domain and Melbourne's north-west and south-eastern suburbs. • Offers connectivity through to existing business precincts further south on St Kilda Road and along Albert Road, and redevelopment opportunities in South Melbourne.	• Moderate construction risk as the geological surrounds are not overly complex and could use a standard TBM. • Minimises interaction with CityLink infrastructure and other major buildings and structures in this area. • Impacts tram operations along St Kilda Road which will require appropriate management strategies during construction. • Impacts traffic operations and cyclists along St Kilda road and surrounding local roads during construction. • Visual impacts on State significant heritage assets during construction (e.g. Shrine of Remembrance) and relocation of the Boer War Memorial. • Moderate impacts on commercial and residential uses and potential impacts on access to the Royal Botanic Gardens and Shrine of Remembrance during construction. • Key stakeholder support for this location, including the cooperation of the Shrine of Remembrance Trustees (on the basis that encroachment onto Shrine grounds is minimised),	• Given this is the Baseline, the cost of this option is the Base Case cost that all other options have been compared against in the first instance.	▪ CBD: Compatible with all options, but more westerly options may require a different station orientation.

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
	• Proximity to parkland potentially limits both the existing station catchment area and opportunities for urban renewal in the immediate vicinity of the station. The area is also constrained by overlays that protect vistas to the Shrine of Remembrance and the nearby parklands, although noting that significant redevelopment of the precinct has successfully occurred within these overlays.	may help minimise disruption (for example, if use of reserve land such as Edmund Herring oval was used as a construction site).		
D1-2: South Melbourne[14]	• **(+ve):** Potential to create a new employment node adjacent to Kings Way that will help create a more attractive destination for residents and workers south of the CBD. • **(-ve):** Would not provide the significant train/tram interchange that Domain would deliver. • **(-ve):** Provides limited, if any, tram crowding relief on the congested St Kilda Road – Swanston Street tram corridor.	• **(-ve)**: Complex geology and deep foundations are expected to be encountered through Southbank and for City Link resulting in this option being significantly more costly and risker compared to the baseline alignment. • **(-ve):** Greater tunnelling costs associated with the use of tailored equipment for the complex ground conditions. • **(-ve):** Major soil contamination and acid sulphate disposal issues.	• **(-ve):** Estimated to cost approximately $1.4bn[15] (P90, nominal) more than Domain (Baseline), largely associated with addition land acquisition costs, additional tunnel length with connection remaining at South Yarra, improvement measures needed at cross passages and additional tailored tunnelling equipment costs.	▪ CBD: Compatible with all options, but more easterly options may require a different station orientation.

[14] This assessment has been based on a South Melbourne station at Kings Way. Earlier scans of the alignment options also identified the possibility of stations in Moray Street or Sturt Street, however the Kings Way option posed the greatest potential to support urban development, so was taken forward for more detailed assessment.
[15] AJM, *Melbourne Metro Rail Project Alternatives and Options cost review*, (2015*).*

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
	• **(-ve):** Would not provide the same degree of enhanced access to the Shrine of Remembrance and Botanic Gardens. • **(neutral):** A new station at South Melbourne is likely to catalyse significant redevelopment in the precinct. • **(neutral):** A station in South Melbourne will provide direct access to jobs in this location from a wider employment catchment than exists today. • **(neutral):** Station location provides access to existing concentration of jobs in South Melbourne, St Kilda Road North and the Southern part of Southbank within walking distance; four secondary schools; the Victoria Barracks; speciality retail in Clarendon Street and South Melbourne Market, and major cultural and tourism facilities including the Arts precinct in Sturt Street. • **(neutral):** Areas of South Melbourne already have access to significant public transport through tram routes. South Melbourne would also benefit from the proximity of a station at Domain and improved access through tram	• **(-ve):** May require longer construction period. • **(-ve):** Greater social impacts associated with the possibility of building and infrastructure damage resulting from tunnelling through poorer ground conditions, from the Victorian College of Arts to Kings Way. • **(-ve):** Likely to require significant property acquisition. • **(-ve):** Significant interface risk with CityLink structures and water management due to the greater length of interface with CityLink (alignment would run parallel to this structure). • **(-ve):** Significant interface risk with Power Street Bridge as the alignment would cross between the piles of this structure. • **(neutral):** Avoids impacts on St Kilda Road during construction. However, construction of a station at South Melbourne would instead materially impact the operation of Kings Way (a high capacity, strategic arterial route servicing the M1, CityLink, Port of Melbourne, CBD and West Melbourne) and may also cause disruption to public transport operations along Kings Way including trams.		

Project Option	EVALUATION CRITERIA			Interdependencies
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST	
	network changes that would be enabled by a station at Domain.			

6.3. Decision D2: Is the station investment justified?

6.3.1. Options assessment

The impact of excluding Domain Station is assessed in Table 21.

Table 21 – Station investment for Domain and South Melbourne: justification against evaluation criteria

Evaluation Criteria	Summary Analysis
1. Improving access to jobs and stimulating urban renewal	The following key benefits would be lost if a station at Domain was excluded from the project: • Domain Station would provide access to 33,000 jobs and 17,000 residents (within 800 metres of the station). When also taking into account the jobs accessible with a short tram interchange, the job catchment is over 110,000 jobs (excluding jobs in the CBD on William and Spencer Streets). It would be used by almost 40,000 people each day in 2031, making it about as busy as Flagstaff Station is today. The majority of people arriving via Domain Station would do so in the morning and inter-peak periods. This is reflective of the station's function as a destination for workers travelling to jobs along St Kilda Road. • While Domain is already serviced by tram and bus, providing train access means that many people will have shorter travel times to the precinct, more public transport options and will better manage patronage demand growth and therefore provide tram crowding relief to those tram and bus services, particularly north-south trams currently concentrated on the St Kilda Road – Swanston Street and Elizabeth Street corridors. The reduction in passenger loads on outbound trams on the St Kilda St Kilda Road – Swanston Street corridor is expected to be approximately 25-35%. • Even for areas which are already well served by other public transport services, such as Domain, providing a new station delivers a step change in the number of public transport users able to travel to these areas in peak times, as well as providing more efficient travel options from an increased range of locations. The step change delivered by a station at Domain is likely to underpin change in public transport demand to this precinct. In addition, by providing a new north-south public transport trunk route, trams currently meeting the heavy public transport demand along this spine can be freed up and deployed to other tram routes to better balance the availability of services with demand. • Domain Station would serve as a gateway to the south of the city. Passengers would use the new interchange point to access tram services to Southbank and South Melbourne, as a result of the proposal to divert selected St Kilda Road tram services to Park Street, Kingsway/William Street and Clarendon/Spencer Street. There will also be an increase in the number of travellers using the tram travelling south along St Kilda Road from Domain Station to access employment and education destinations, such as the Alfred Hospital Precinct and schools. • A new station at Domain would also further consolidate the significant redevelopment and investment already occurring in the precinct.
2. Deliverability and disruption	The impact of excluding Domain Station from the project with respect to deliverability and disruption is summarised below: • The construction of a new station at Domain would result in disruption to the local community. For example, the construction of a new station that enables direct interchange with the tram network is expected to involve the following during construction: – Impacts on tram operations along St Kilda Road. – Impacts on road (including cyclists). – Impacts on residential and commercial properties in the vicinity of the construction site. – No private title acquisition at the surface level – public land impacted only. • Therefore, excluding Domain Station from the project would avoid this disruption. • However, some degree disruption is typical of major infrastructure projects delivered in inner urban environments and the State will ensure that contractors are commercially incentivised to mitigate and effectively manage disruption impacts.

Evaluation Criteria	Summary Analysis
3. Cost	The capital cost impacts of excluding Domain Station from the project are summarised below (noting a station located on St Kilda Road at Domain is already included in the capital cost of the Baseline): . • Savings generated are in the order of $350m (P90, nominal), assuming an alignment optimised to neither include nor 'future proof' a Domain Station. • This cost saving does, however, need to be considered within the context of the very significant transport congestion, access and community benefits that would be lost if no Domain Station was delivered (as outlined above).

Based on the analysis above, the long-term benefits of including a station at Domain outweigh the limited, short-term cost savings achievable by removing this station from the scope.

For completeness, a range of alternative alignments were assessed to explore options should a station not be constructed at Domain (D2-2).[16] These included consideration as to whether it would be more cost effective in the absence of a Domain Station for the eastern portal to be moved closer to the CBD. However, due to the complexities involved in linking to the existing railway in the vicinity of Richmond Station, it was identified that the optimal alignment in the absence of a Domain Station would still involve a portal at South Yarra.

Decision D2: Is the investment in Domain Station justified?

It is recommended that the project retain the Baseline in this area, including a Domain Station.

6.4. Conclusion

It is recommended that a new station should be located at Domain per the Baseline. This location is preferred on the basis that this option will relieve tram congestion on the St Kilda Road – Swanston Street tram corridor, will operate as a key interchange point with tram routes serving South Melbourne, Southbank and growing western CBD and is $1.4bn cheaper than a station on Kings Way. In addition, the benefits of including a station at Domain outweigh the capital cost savings achieved by removing this station from the project scope.

7. Study Area E: South Yarra

7.1. Context

South Yarra is a mature and well-developed residential area and activity centre that incorporates significant commercial activity around the Chapel Street precinct and along Toorak Road. Although South Yarra's population is forecast to grow at a slower rate than Greater Melbourne it is an important residential area and activity centre. By 2046, the area within walking distance of South Yarra station is projected to gain around 10,000 jobs and 12,000 residents.

South Yarra is currently well serviced by public transport, including by trains at the existing South Yarra station (Pakenham, Cranbourne, Frankston and Sandringham Lines), tram routes (currently routes 8, 72 and 78) and buses (including major routes along Commercial Road and Punt Road).

The Baseline does not include a Melbourne Metro interchange station at South Yarra. However potential station options along the Toorak Road alignment have been considered to assess whether the inclusion of a new interchange station would be justified.

[16] AJM, *Melbourne Metro Rail Project Parkville and Domain Station High Level Options Assessment* (2015).

7.2. Decision E1A: What is the preferred alignment and station location in this Study Area?

7.2.1. Options identification

The preferred station location in South Yarra is largely determined by the Domain Station location identified in Study Area D.

A broad range of potential South Yarra station locations have been considered for the purposes of the project, including:

- A new station south of Toorak Road
- The provision of new platforms under or adjacent to the existing station
- A new station at the Jam Factory (no interchange with existing station).

The key findings of the various assessments were as follows:

- Compared to options located under or adjacent to the existing station, options south of Toorak Road were found to be less disruptive to build and better able to preserve an alignment that supports the preferred location for a station at Domain
- A new station at the Jam Factory is less desirable than options that are proximate to the existing South Yarra Station as it would not provide for an interchange with the Sandringham line, would be in close proximity to the existing Hawksburn station and the small incremental land development opportunities would not justify the capital cost premium associated with this option

The current options assessment process has therefore focused on options to the south of Toorak Road, specifically in the vicinity of the current station. Four potential options were identified and considered for the purpose of this options assessment.[17] All four of these options involve the provision of two new platforms at South Yarra, with the new Melbourne Metro lines connecting to the existing Dandenong rail lines south of the existing South Yarra Station. Two of the options provide suitable examples to set out the range of potential capital costs and other key implications for the purposes of assessing the merits of adding an interchange station at South Yarra. This assessment therefore focuses on these two potential options.

Table 22 – South Yarra alignment and station location options

Project Option	Description
E1A-1: New station with no direct interchange	This option involves the provision of a new station located to the west of the existing South Yarra Station and south of Toorak Road. In this option, the track works are limited to the west of Chapel Street to avoid affecting Chapel Street Bridge, the Jam Factory and properties to the east of Chapel Street. This constrains track geometry, meaning that the station box cannot be constructed under the existing Sandringham line (mainly because the gradient would be too steep between the new underground platforms and the existing surface level Cranbourne/Pakenham line tracks to the west of Chapel Street). As a result, under this option there is no direct interchange connection with the existing South Yarra Station (customers interchanging would need to leave the paid station area and cross Toorak Road at street level).
E1A-2: New station with direct interchange	This option involves the provision of two Melbourne Metro platforms located to the south of the existing South Yarra Station. In this option, the eastern portal is shifted to the east so that the new station box can be positioned directly under the existing Sandringham line. The Sandringham line platforms would be relocated to south of Toorak Road, enabling a direct connection with the new platforms and therefore providing a direct interchange between Melbourne Metro and other services (without leaving the paid station area). This would involve impacts on properties to the east of Chapel Street, predominantly affecting the south side of the rail reserve (including potential for significant disruption to key commercial properties), and would require the Chapel Street Bridge to be rebuilt, limiting traffic access for significant periods of time.

[17] AJM, *South Yarra MM Platforms – Technical Options Study* (2015).

Figure 9 illustrates the South Yarra station options.

Figure 9 – *South Yarra station options*

7.2.2. Options assessment

These options have been assessed according to the evaluation criteria outlined earlier. A summary analysis for each key option to include a new South Yarra station is provided in Table 22[18], noting that neither of these options are included in the Baseline.

Whilst option E1A-1 involves less disruption and lower capital costs, option E1A-2 provides significantly better interchange and customer outcomes. Further analysis would be required to develop these options and identify which was preferred, should a station be included in the project. In order to give the station its most favourable assessment, option E1A-1 (lowest cost and disruption) has been assumed regarding deliverability & disruption and cost aspects and option E1A-2 (best interchange) regarding access and urban renewal aspects, for the purposes of the analysis in the following section.

Decision E1A: What is the preferred station location at Toorak Road?

A preferred station location has not been identified at this time, rather the best attributes of each option are retained for the purposes of assessment against an alignment that does not include a South Yarra interchange station.

[18] MMRA (2015) *South Yarra Station Options Assessment*.

Table 22 - Summary assessment for Decision E1: South Yarra station location

Project Option	EVALUATION CRITERIA		
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST
E1-1: New station with no direct interchange	• **(-ve):** To move between the old and new stations, customers would be required to exit the station and cross Toorak Road at street level, involving an estimated interchange time of approximately 6 minutes between the Sandringham and Melbourne Metro platforms and 7 minutes between the Frankston and Melbourne Metro platforms (centre of platform to centre of platform). This is suboptimal from a customer experience and connectivity perspective. • **(neutral):** The inclusion of Melbourne Metro platforms at South Yarra would not materially improve access to jobs. South Yarra is well serviced by public transport even without a new Melbourne Metro station, passengers at South Yarra will have access to improved capacity and more frequent services on the Frankston and Sandringham Lines, including short starter services in the South Yarra area which means these trains will be less crowded during peak periods. Local residents can also access tram services directly from South Yarra to Domain. In addition, a range of alternative interchange options exist (notably Caulfield, Flinders Street and Melbourne Central Stations) for passengers commuting on the Cranbourne and Pakenham Lines who wish to travel to South Yarra and other CBD stations. • **(neutral):** Including a new interchange station at South Yarra has limited impact on urban renewal given the extent of development that has already taken place or is currently underway.	• **(-ve):** This option would require numerous additional freehold property title acquisitions compared to the Baseline, affecting both residences and businesses. • **(-ve):** This option could require significant track realignment with a rail to rail grade separation near Caulfield, resulting in significant disruption to rail services during construction.	• **(-ve):** Estimated to involve an incremental capital cost increase of approx. $700m compared to the Baseline (which involves no new interchange station at South Yarra).

Project Option	EVALUATION CRITERIA		
	1. ACCESS & URBAN RENEWAL	2. DELIVERABILITY & DISRUPTION	3. COST
E1-2: New station with direct interchange	• **(-ve):** It is estimated that it would take approximately 1 minute and 30 seconds to travel between the Sandringham and Melbourne Metro platforms and 4 minutes to travel between the Frankston and Melbourne Metro platforms (centre of platform to centre of platform). • **(+ve):** This option would provide additional access to the South Yarra station from Chapel Street via Arthur Street. • **(neutral):** The inclusion of Melbourne Metro platforms at South Yarra would not materially improve access to jobs. South Yarra is well serviced by public transport even without a new Melbourne Metro station, passengers at South Yarra will have access to improved capacity and more frequent services on the Frankston and Sandringham Lines, including short starter services in the South Yarra area which means these trains will be less crowded during peak periods. Local residents can also access tram services directly from South Yarra to Domain. In addition, a range of alternative interchange options exist (notably Caulfield, Flinders Street and Melbourne Central Stations) for passengers commuting on the Cranbourne and Pakenham Lines who wish to travel to South Yarra and other CBD stations. • **(neutral):** Including a new interchange station at South Yarra has limited impact on urban renewal given the extent of development that has already taken place or is currently underway.	• **(-ve):** Although both options would involve significant rail disruption during construction, the rail disruption is likely to be more severe under this option as a result of the complexity of the track realignment works. • **(-ve):** It would be necessary to demolish and reconstruct Chapel Street Bridge. This could be undertaken in stages to maintain local access but would still involve significant disruption affecting the route 78 tram, road users, pedestrians and the Chapel Street precinct more broadly. • **(-ve):** This option would require numerous additional freehold property title acquisitions compared to the Baseline, affecting both residences and businesses (and more than option E1-1, including more residential properties). • **(-ve):** This option would impact the Jam Factory, requiring a partial acquisition of the site, causing significant disruption to a major commercial centre (or an alternative proposal could instead impact 147 additional residential titles mostly located within a new residential apartment block).	• **(-ve):** Estimated to involve an incremental capital cost increase of approx. $970m compared to the Baseline (which involves no new interchange station at South Yarra).

7.3. Decision E1: Is an investment in South Yarra station justified?

Further analysis would be required to develop the two options above and identify which was preferred, should a station be included in the project. As noted above, in order to give the station its most favourable assessment, option E1A-1 (lowest cost and disruption) has been assumed regarding deliverability & disruption and cost aspects and option E1A-2 (best interchange) regarding access and urban renewal aspects.

The analysis in relation to this decision is summarised in Table 23 below.

Table 23 – South Yarra investment analysis

Evaluation Criteria	Summary Analysis
1. Improving access to jobs and stimulating urban renewal	• South Yarra is well serviced by public transport, even without a new Melbourne Metro station. When Melbourne Metro services commence, the impact of the changes to the overall network and increased reliability of train services along the Dandenong corridor will mean that South Yarra residents will have frequent train services. Melbourne Metro will substantially reduce crowding on peak period services, including between South Yarra and the CBD. • PTV has undertaken analysis to assess customer outcomes of a new Melbourne Metro interchange at South Yarra.[19] This analysis found that the inclusion of a new interchange station at South Yarra would add to the journey times for passengers travelling on the Cranbourne and Pakenham lines to the CBD or other destinations beyond South Yarra (as a result of the additional stop), and that this is the largest group of people who would be affected by the inclusion of a new interchange station. Although the inclusion of a new interchange station would provide potential benefits for some customers, this group is smaller in number and there would be alternative travel options for these passengers if there is no interchange. Further details are provided in Table 24. • The inclusion of a new interchange station at South Yarra has limited impact on urban renewal given the extent of development that has already taken place or is currently underway.
2. Deliverability and disruption	• The construction of a new station at South Yarra would involve significant additional disruption for the local community and to rail services and significant land acquisition.
3. Cost	• The inclusion of a Melbourne Metro station at South Yarra is expected to add in the order of $700m to the capital cost of the Project (or in the order of $970m to deliver a direct passenger interchange with the existing station).

Table 24 provides a summary of the groups of passengers who would benefit or be negatively impacted by addition of a South Yarra interchange station to the Baseline.

[19] PTV, *Melbourne Metro Rail Project – South Yarra Metro Station Customer Outcomes and Economic Assessment Report* (2015).

Table 24 - Passenger interchange summary - South Yarra station assessment

Journey	Implications of South Yarra interchange station	Estimated market size (daily, 2031)	Approx. impact on travel time (compared to Melbourne Metro with no South Yarra interchange)
South Yarra to CBD	• Three different service routes through the CBD – via the City Loop, via Melbourne Metro or through Flinders Street and Southern Cross. Without a new station there would still be two service routes. • More frequent train services at South Yarra, with peak hour trains every 1.25 minutes compared to every 2 minutes under Melbourne Metro with no South Yarra platforms.	 6,700 – 7,400	• Average wait time reduced by approx. 23 seconds in peak periods • Average wait time reduced by approx. 34 seconds in off-peak periods.
South Yarra to Domain	• Direct rail access to Domain, rather than using Toorak Road tram.	 200 - 250	• 5-8 minute saving.
South Yarra to Parkville	• Direct rail access to Parkville, rather than needing to interchange at Flinders Street.	 600 - 700	• 5-8 minute saving.
West (e.g. Sunshine) to South Yarra	• Direct rail access to South Yarra, rather than needing to interchange at Flinders Street.	 800 - 900	• 5 minute saving.

Journey	Implications of South Yarra interchange station	Estimated market size (daily, 2031)	Approx. impact on travel time (compared to Melbourne Metro with no South Yarra interchange)
From Dandenong (or other stations on Cranbourne and Pakenham lines) to South Yarra	• These passengers can travel directly to South Yarra without changing trains, as is currently the case. Without new Melbourne Metro platforms at South Yarra these passengers will need to interchange at Caulfield.	 1,700 – 1,900	• 5 minute saving.
People travelling from the Sandringham or Frankston lines (bayside or inner south east) to the Domain precinct of St Kilda Road	• A new station would enable these passengers to interchange at South Yarra to catch the Melbourne Metro service to Domain. Without a new station these passengers will need to continue to catch a tram from South Yarra (or any of the six other tram routes connecting the Sandringham Line to St Kilda Road) or interchange at Flinders Street to travel south.	 8,000 – 8,800	• 0-8 minute saving.
People travelling between locations on the Sandringham line and the Cranbourne / Pakenham lines	• These passengers would have the option of travelling in and out with one change at South Yarra, as is currently the case. Without a new station these people will need to use one of the existing bus or tram services (as many people do today).	 1,200 – 1,300	• 0 - 10 minute saving (journey time saving for customers who travel by rail, but no change for tram or bus passengers)

Journey	Implications of South Yarra interchange station	Estimated market size (daily, 2031)	Approx. impact on travel time (compared to Melbourne Metro with no South Yarra interchange)
People travelling from the Cranbourne/ Pakenham lines to destinations beyond South Yarra (e.g. from the south east to Domain, the CBD, Parkville, or beyond) or vice versa	• These passengers will experience longer journey times as a result of the additional stop at South Yarra.	 93,000 – 102,000	• Additional 1 minute journey time
People travelling from the Frankston line to Domain, Parkville or other stations on the Sunbury line beyond the CBD	• These passengers can interchange at Caulfield under either scenario but will experience longer journey times if there is Melbourne Metro interchange at South Yarra due to the additional stop.	 8,400 – 9,200	• Additional 1 minute journey time

Source: PTV

As shown in Table 24, over 100,000 customers per day would be a minute worse off if the South Yarra Interchange Station is included, compared to less than 14,000 customers who would be between one and ten minutes better off. In aggregate (i.e. taking into account all journey time savings and all slower journey times), the addition of a new station at South Yarra would add an additional 1,500 hours of travel time per day for public transport users in 2031.[20]

Including a new station at South Yarra in the project scope would significantly increase the overall capital cost of the project (in the order of $700 – 970m) and would result in additional rail, road and other disruption, including additional property acquisitions.

The long-term benefits of including a station at South Yarra are therefore too limited to outweigh the additional cost and disruption associated with adding this station to the scope.

It is also noted that, even without a new Melbourne Metro station, South Yarra is well serviced by public transport. On completion of Melbourne Metro, passengers using South Yarra will benefit from improved capacity and more frequent services on the Frankston and Sandringham Lines, including short starter services in the South Yarra area which means these trains will be less crowded during peak periods. Local residents can also access tram services directly from South Yarra to Domain. In addition, a range of alternative interchange options exist (notably Caulfield, Flinders Street and Melbourne Central Stations) for passengers commuting on the Cranbourne and Pakenham Lines who wish to travel to South Yarra and other CBD stations.

Based on this analysis, the inclusion of a new interchange at South Yarra is not justified and Melbourne Metro should proceed without a new station interchange at this location.

Decision E1: Is the station investment justified?

It is recommended that a new station at South Yarra not be added and the Baseline be retained in this Study Area.

7.3.1. Conclusion

As reflected by the analysis above, it is recommended that the project should proceed along a Toorak Road alignment without a new interchange station at South Yarra.

8. Conclusions

8.1. Project Options assessment summary

A total of six Study Areas involving eleven key decisions were considered in the options assessment, with particular focus placed on each project option's ability to help address the Problems and achieve the Benefits identified in the ILM.

A high level summary of the key options assessment outcomes are set out in the table below.

Table 25 – Preliminary project options assessment summary

Study Area	Assessment outcome
Study Area A: Arden and North Melbourne	The project should proceed with a metro station at Arden, although further analysis is required to determine the preferred location of the Arden station.
Study Area B: Parkville	The project should proceed with a metro station located on Grattan Street.
Study Area C:	The project should proceed with an optimised deep Swanston Street alignment with two metro stations, one located broadly between Flinders Street and Collins Street

[20] PTV, *Melbourne Metro Rail Project – South Yarra Metro Station Customer Outcomes and Economic Assessment Report* (2015).

Study Area	Assessment outcome
CBD	(interchanging with Flinders Street Station) and the other broadly between LaTrobe Street and Franklin Street (interchanging with Melbourne Central station.
Study Area D: **Domain and South Melbourne**	The project should proceed with a metro station located under St Kilda Road between Domain Rd and Toorak Rd.
Study Area E: **South Yarra**	The project should proceed without a new metro interchange at South Yarra station.

8.2. Recommended Project Solution

Following the assessment of options across the five key decision points, the scope of the Recommended Project Solution includes:

- Western tunnel entrance (portal) at South Kensington, connecting to the Sunbury Line
- Five new underground stations, to serve major areas of activity in the city and interchange with existing transport services, as follows:
  - Arden station – Located to stimulate and support the Arden Urban Renewal Precinct
  - Parkville station – Located under Grattan Street within the Royal Melbourne Hospital / Melbourne University precinct
  - CBD North station – Located beneath Swanston Street, broadly between La Trobe and Franklin Streets, with a direct interchange to Melbourne Central station
  - CBD South station – Located beneath Swanston Street, broadly between Flinders and Collins Streets, with a direct interchange to Flinders Street station
  - Domain station – Located beneath St Kilda Road, broadly between Domain and Toorak Roads.
- An optimised deep alignment under the existing Melbourne Underground Rail Loop (City Loop).

Recommended Projection Solution is illustrated in Figure 10 below.

Figure 10 – Recommended Project Solution