Memo

From: Auckland Light Rail Group
Date: 14 September 2021
Re: Heavy Rail Option Assessment Overview

1. Purpose

The Long List assessment process for the City Centre to Māngere (CC2M) project included assessment of both Mode and Route options. The option selection process took several potential configurations of Heavy Rail through the first sieve to progress towards the short list for the CC2M corridor. However, the further assessment of Heavy Rail against the investment objectives and impacts criteria concluded that only the Light Rail Transit and Light Metro Rail modes should proceed to the Short List assessment.

This note documents the relative opportunities and risks associated with a Heavy Rail solution and the reasons why this solution did not progress to the short list for the corridor.

The findings, based on the information presented in this note, are that:

- Heavy Rail has some unique benefits, with existing infrastructure and rolling stock, and ability to also transport freight
- Heavy Rail options (depending on the configuration) can positively address all CC2M project objectives to some extent. However overall, they are similar to but less beneficial than Light Metro options which also have fewer negative impacts.
- Hence, if a new high capacity grade separated rail corridor through the central isthmus was pursued, Light Metro would be chosen as the mode ahead of Heavy Rail, due to its ability to better serve urban development in the areas needed. Alternatively, if a spur from the existing Heavy Rail network was pursued, this would also require additional investment in new rapid transit (e.g. if the Onehunga Line was extended southwards, a new busway or Light Rail system would still be needed to serve areas on the isthmus, due to expected demand leaving the current public transport system unable to provide sufficient capacity in the isthmus).
- Whilst there are many benefits in expanding and enhancing the existing Heavy Rail system throughout Auckland, Heavy Rail was assessed lower than Light Rail or Light Metro in being able to meet the specific requirements of the corridor.

2. Development of Heavy Rail options

For the purposes of assessment, Heavy Rail has been assumed to have the characteristics of the existing Auckland Heavy Rail network, including the sharing of passenger train operations with freight services.

The assumed capacity is 750-1,100 passengers per vehicle, again based on current operations. Capacity of a Heavy Rail line is a function of vehicle capacity multiplied by train frequency, which is managed on a system wide basis and currently the highest frequencies operated are 5 minute headways.

Figure 1: Example of existing Heavy Rail system (source Wikipedia)

3. Modal assessment of Heavy Rail

A wide range of modal options were assessed at a Long List stage and many were culled for failing to achieve basic project criteria, such as sufficient capacity or supporting urban uplift. After the first sieve of modal options, Light Rail, Light Metro and Heavy Rail modes were found to perform well and were all assessed further.

These assessments were based on a new corridor being implemented through the central isthmus and onwards to the airport. Section 4 discusses alternative approaches whereby a spur is created from the existing Heavy Rail network.

At a pure modal level, with no specific alignment for a new corridor through the isthmus chosen, both the Light Metro and Heavy Rail options were given the highest assessment score for access and environmental objectives, as they provided the highest capacity and accessibility enhancement for key movements within the corridor (i.e. they were able to move the most people for the demands of the corridor). Both Rail modes are also highly compatible with the future Auckland Rapid Transit Plan (ARTP) network, given the high demands expected on the North Shore and Northwest corridors that will leverage off the infrastructure the project will provide.

The Heavy Rail and Light Metro options with the highest capacity, were assessed to have the ability to unlock the greatest urban development potential. The high capacity stations required for these modes also provide opportunity for focused land use intensification to deliver the urban and transport integration outcomes sought. The highest score for potential urban uplift was given to the Light Metro option. The Heavy Rail option was scored lower due to the expected reduction in urban outcomes as a result of large freight trains potentially using the line and running through high density urban areas. (Note that the assumption of

freight operations is based on the fact that the existing Heavy Rail network mixes passenger and freight train operations, which is a differentiator compared to the Light Metro and Light Rail modes. It is possible that a Heavy Rail project could be developed which does not include freight operations. However this would have to be a specification developed further at a detailed design phase and would reduce the economic benefits of the investment).

Greater challenges arose when the modal options were assessed for their potential impacts. All modes would result in significant capital projects and would have planning, design and implementation challenges. The Light Metro and Heavy Rail modes were assumed to largely be underground in the dense urban areas, with resulting ground condition and station access challenges. Although specific costs were not known, it was expected that Heavy Rail would be more expensive than Light Metro, which itself was expected to be more expensive than Light Rail options, with differences between the modes in the range of billions of dollars.

All modal options were considered to have a similar impact on the environment, and there would be long term environmental benefits associated with the mode shift and carbon reduction.

All options were considered to have an adverse impact on communities during construction and implementation, with issues such as noise and vibration. However this was considered to be offset by the expected benefits in increased accessibility and community connection. Due to the potential for freight trains operating on the service through dense urban areas and the resulting loss of amenity, the Heavy Rail option scored lower. The Light Metro and Heavy Rail options were assessed as having a lesser property impact than the Light Rail option due to the fact that much of the route would be underground.

Based on this initial assessment on modal issues, it was found that all three modal options could provide sufficient capacity for demand, that all would have implementation impacts, and that the Light Metro and Heavy Rail options were likely to cost more but delivered slightly greater outcomes.

The Heavy Rail option was found to achieve lesser outcomes for the corridor than the Light Metro option and the impacts were found to be greater. Within this initial assessment, the Heavy Rail option was therefore not the preferred mode for this corridor, on the basis that a Light Metro option was similar but performed better.

4. Route assessment of Heavy Rail options

Following the mode assessment and despite not being the preferred mode, Heavy Rail was also assessed at a route level to determine if there was still merit in taking it forward for further consideration.

This step involved the development and consideration of specific network options, including extending the existing Onehunga Line further south to the airport, adding a spur to the airport from Puhinui Station, and an option to add a line from the Western Line along the Avondale-Southdown KiwiRail corridor to Onehunga and on to the airport. These are each discussed in more detail below.

Southern Rail Line spur from Puhinui to the Airport

A Heavy Rail option connecting from Puhinui on the Southern Line to the airport was considered but found to not provide the accessibility outcomes sought for the corridor (i.e. it did not support urban development in Māngere, Onehunga or Mt Roskill and did not address travel demand in the central isthmus). This option would also restrict the number of trains able to operate on the rail network south of Puhinui, as existing and planned infrastructure

has a limited number of timetable slots available. This would reduce the rail network's ability to serve demand from South Auckland. Further, a new bus based rapid transit service is already commencing along this corridor. Hence this Heavy Rail option was not pursued.

Onehunga Rail Line extension to the Airport and a bus based solution north of Onehunga to the City Centre

The genesis of this option was that bus based options were discounted due to the lack of capacity, particularly near the city centre. The Onehunga Line Heavy Rail option was not progressed in part due to the fact that it did not serve the Mt Roskill development area. However, combining these two elements potentially has the ability to work well. The extension of the Onehunga line would serve demand from the corridor south of Onehunga (approximately 40% of total demand). This allows the consideration of a bus based system north of Onehunga, as it is more likely to have sufficient capacity for the lower demand in this area.

A key consideration for this option is the ability for additional train services to be provided on the Onehunga line into the city centre. This issue was explored in detail with the AT Train Operations team who have confirmed that an alternative train plan would be able to be accommodated, that would result in six trains/hour from Onehunga to the Airport at peak times.

Additional bus services to the present day volumes would be required to service the area north of Onehunga. To cater for approximately 60% of the demand forecast (the remaining 40% being carried on the Onehunga rail line) a segregated busway style corridor (or even Light Rail) would be required, which would not support urban development objectives in the isthmus or (if a busway was used) address bus congestion in the city centre. It is expected that to provide for six trains/hour, the Onehunga rail spur would require double tracking and level crossing removal (at significant cost).

Western Rail Line extension to the Airport and a bus based solution from Mt Roskill to the City Centre

This option was developed based on the Onehunga Line option above and adding another Heavy Rail section using the existing Avondale-Southdown rail corridor to serve Mt Roskill. This option appears attractive due to the ability to make use of existing infrastructure (i.e. the existing Western Line and the latent Avondale-Southdown corridor).

This option has been considered previously (in the SWAMMCP study), with an Onehunga Line option preferred at that time. One of the main changes since this earlier assessment is the prominence of the Mt Roskill urban development opportunity. This option services this area very well.

One of the risks with this option was the inability for the post City Rail Link train network to accommodate the additional train services required for this option to provide a sufficient service.

Investigations with the AT Train Operations team have confirmed that there is sufficient capacity within City Rail Link through the diversion of six/eight trains/hour in each direction that were otherwise heading out further on the Western Line to make use of this new line.

There is also the opportunity to run the proposed two trains/hour on the Onehunga line through to the Airport, giving up to a ten trains/hour peak service to/from the Airport. This could have implications for future demand from west of Mt Albert Station; fewer timetable slots would be available if capacity on the inner Western line was being shared with a line to Māngere.

Additional busway type (or even Light Rail) services would still need to be delivered to provide for demand along the central isthmus, to a lesser degree than the Onehunga line extension option.

To determine if these two Heavy Rail options were to be short listed along with the Light Rail and Light Metro options, they were first compared to each other. This confirmed that whilst both options had merits, the Western Line Option was considered to outperform the Onehunga Line option for the following reasons:

- The Western line option provided a higher quality rapid transit connection to the development area of Mt Roskill
- The Western line option provided an additional rail connection, creating an increased network resilience
- The Western line option provided an ability to run freight on an alternative route
- The Western line option also provided the ability to connect with the Onehunga Line, giving greater travel choice and accessibility to customers south of Onehunga
- The Western line option provides the ability to run an increased service (8 trains/hour vs 6 trains/hour)
- The Onehunga line option would still require a dedicated busway style corridor through the central isthmus section of the route, as well as double tracking and level crossing removal along the Onehunga rail spur

Noting that the Western line option has been assessed as the stronger performer of the two Heavy Rail options, makes good use of existing and future infrastructure and has a comparable cost profile, this option was taken forward for further investigation as the best Heavy Rail solution (along with Light Rail and Light Metro) to understand the benefits and challenges of this option in more detail.

5. Detailed assessment of best Heavy Rail option

This Heavy Rail option was assumed to require a high quality bus based system (or possibly even Light Rail) from Mt Roskill, through the central isthmus to the city centre. This two mode response is different to the Light Rail and Light Metro options, which are a single mode solution along the entire route of the project.

There were two key considerations for the further assessment of this option:

- The level of the accessibility for communities along the entire route
- The potential urban development response of the option

The accessibility improvements of this option are considered to be strong. The Māngere, Onehunga and Mt Roskill communities would have access to the Heavy Rail network, which would make a step change in accessibility at these locations. However, the Heavy Rail route is longer than the other modal options. Also depending on station numbers and locations, it would therefore be expected to be similar or slower than those alternatives and this would slightly reduce the accessibility benefits.

The section of the route through the central isthmus north of Mt Roskill would need to be served by a busway type service, which would not provide the desired step change in capacity, and would not address bus congestion issues within the city centre as much as the Light Rail or Light Metro alternatives. The level of accessibility provided in the central isthmus was considered to therefore be less than the Light Metro or Light Rail options. If a Light Rail service was instead provided for the central isthmus, it begs the question why that system was not simply extended to the airport.

Urban development along the route is a key driver for the project. This Heavy Rail option would provide urban uplift opportunities at the three important communities of Māngere, Onehunga and Mt Roskill. The scale of this uplift is assessed as being similar to that of the Light Metro option, given the similarities in the two modes.

The impact of providing Heavy Rail through these communities is considered to be greater than that for Light Metro, due to the more onerous design standards and likely need to carry freight.

As noted above, the central isthmus section north of Mt Roskill would continue to be serviced by buses, expanding to a busway type system. This would be expected to reduce the potential urban uplift in this section of the corridor, potentially of a lower quality due to being served by a rapid transit service of lower perceived quality and capacity. Whilst additional uplift (beyond what is already expected and will be enabled) could be anticipated around the existing rail stations along the Western line, this is not considered to be of the transformational scale that could be achieved running through the central isthmus.

Compared to the other modal options in modelling projections, Heavy Rail sometimes performs well on some metrics, as it typically has higher speeds and capacities. For some longer distance trips it appears an attractive option, however across the overall assessment it has limitations. As the corridor is serving a range of often shorter distance trips which are within the capacity of the other modal options, the assessment showed that Heavy Rail had the lowest mode share outcomes and annual boardings and didn't perform as well in providing access to jobs and employment from key parts of the corridor (e.g. from Mt Roskill and Onehunga).

It is noted that utilising the existing Heavy Rail network has some efficiency benefits in terms of the use of existing infrastructure. However unlike a Light Rail or Light Metro solution, it would not introduce a new rapid transit corridor to better serve the city centre (especially the University precinct).

Finally the potential opportunity to run freight trains along a new Heavy Rail route (if connected at some point to an inland port) could have additional economic benefits for Auckland. However those may need to be balanced with the likely constraints this would put upon passenger train operations (in terms of scheduling competition between passenger and freight trains) as well as implications for the design of the system (amenity/safety impacts of freight trains passing through busy and often underground train platforms).

Overall the best performing Heavy Rail option was found to have a number of benefits, including improved accessibility and some urban uplift potential. However compared to the Light Rail and the Light Metro options, the level of outcome achieved in these two areas is

forecast to be substantively smaller. This is predominantly through the central isthmus section of the corridor.

6. Conclusion

In summary a Heavy Rail solution, compared to the Light Metro and Light Rail options would:

- Deliver less of an improvement in accessibility
- Deliver smaller urban uplift in desired locations
- Result in an urban form to a lesser quality
- Have a larger impact along the route during implementation, if added as a new corridor

The findings, based on the information presented above are that:

- Heavy Rail has some unique benefits, with existing infrastructure and rolling stock, and ability to also transport freight.
- Heavy Rail options (depending on the configuration) can positively address all project objectives to some extent. However overall, they are similar to but less beneficial than Light Metro options which also have fewer negative impacts.
- Hence, if a new high capacity grade separated rail corridor through the central isthmus was pursued, Light Metro would be chosen as the mode ahead of Heavy Rail due to its ability to better serve urban development in the areas needed. Alternatively, if a spur from the existing Heavy Rail network was pursued, this would also require additional investment in new rapid transit (e.g. if the Onehunga Line was extended southwards, a new busway or Light Rail system would still be needed to serve areas on the isthmus, due to expected demand leaving the current public transport system unable to provide sufficient capacity in the isthmus).
- Whilst there are many benefits in expanding and enhancing the existing Heavy Rail system throughout Auckland, Heavy Rail was assessed lower than Light Rail or Light Metro in being able to meet the specific requirements of the corridor.

So whilst Heavy Rail has a number of positive attributes, for this project and when compared to the other two Short List modal options, it does not deliver as strongly against the objectives of the project. Heavy Rail as a mode was therefore not taken forward as part of the business case process.

In addition to the factors considered above, it is worth noting that from a rapid transit network integration perspective, Heavy Rail options (as considered in this note) do not preclude an extension to the North Shore and Northwest, but they also don't enable one. An isthmus only rapid transit corridor in addition to the Heavy Rail intervention could be extended (if it was Light Rail), but this would require building two new systems to do a job one alone could have done.

If a Heavy Rail option was chosen (and a bus based solution was found for the central isthmus) then a standalone North to Northwest rapid transit service could also be built, but this would not enable an efficient service pattern, given that passenger volumes from the North significantly outweigh those from the Northwest.

Integrating all three corridors is the best way to develop Auckland's rapid transit network and whilst building the project as Light Rail or Light Metro appears to enable that, Heavy Rail does not.