Sensitivity: General

CVL Feasibility Report

Design Report

Prepared for

New Zealand Transport Agency Waka Kotahi (NZTA)

Prepared by

Tonkin & Taylor Ltd

Beca Ltd

Commute Transportation Consultants Ltd

May 2025

CVL.RPT.DM.1059.E

Document Control

Document History and Status

Title: CVL Feasibility Study					
Date	**Version**	**Description**	**Prepared by:**	**Reviewed by:**	**Authorised by:**

S7(2)(b)(i)

[redacted]

Revision Details

Provide a brief statement on what the updates are for each revision.

Revision	Details
0.1	50% Design Report for internal review and alignment with wider project team. Specific feedback sought on overall content, structure, level of detail and any misalignment with overarching investment case report.
1	**First Issue of 100% Design Report incorporating all internal review comments.**

Distribution:

New Zealand Transport Agency Waka Kotahi (NZTA) 1 electronic copy

Contents

Appendices

APPENDIX A: S7(2)(e) [redacted]

APPENDIX B: **Geotechnical Context and Interpretation**

1 Background and Context

The Government Policy Statement on Land Transport (GPS) 2024-34 has identified the Cross Valley Link (CVL) as part of the Roads of National Significance (RoNS) programme. It is identified as a RoNS to "unlock housing growth". The primary strategic priority of the GPS is to support economic growth and productivity.

This design report was prepared for the Feasibility level design of the Cross Valley Link (CVL) project.

The purpose of the design report is to provide an overview of the design constraints, assumptions and the form of key assets required for the transport corridor. Furthermore, the design report aims to collate background information used for the Business Case and provide overarching design direction for future stages of the project. The report should be read in conjunction with the Project Scope and Outcomes Philosophy Statement[1] (PSOPS) which includes a summary of project objectives.

2 Preferred Alignment

The options considered and process to select the preferred alignment is set out in separate reports prepared for the Feasibility Study.

CVL proposes a number of discrete sections that form an arterial corridor linking SH2/Hutt Road into the Southern Lower Hutt/Seaview area; connecting industrial and commercial activities with the wider strategic network.

The alignments making up the CVL corridor are shown in **Figure 1** below and in detail in drawings in Appendix A.

The proposed alignments consist of:

1. Option 5A – Upgrading of Randwick Road and Seaview Road corridors.
2. Option1E – Upgrading of Wakefield Street and Whites Line West corridors with a new bridge over the Hutt River.
3. Hutt Road Widening – 4 laning of Hutt Road between Udy Street and Nelson Street, connecting to P2G at Udy Street.

The section of Hutt Road between Nelson Steet and Wakefield Street which includes the existing rail overbridge, is to remain a 2-lane corridor (single lane in each direction). Upgrading this section to a 4-lane corridor has not been considered at the investment case stage, other than to identify that at the next project phase we would recommend investigating options for a new duplicate bridge on the south side of the existing bridge if it is shown to release significant benefits.

[1] DRAFT Project Scope and Outline Philosophy Statement (PSOPS), Cross Valley Link, V1 May 2025

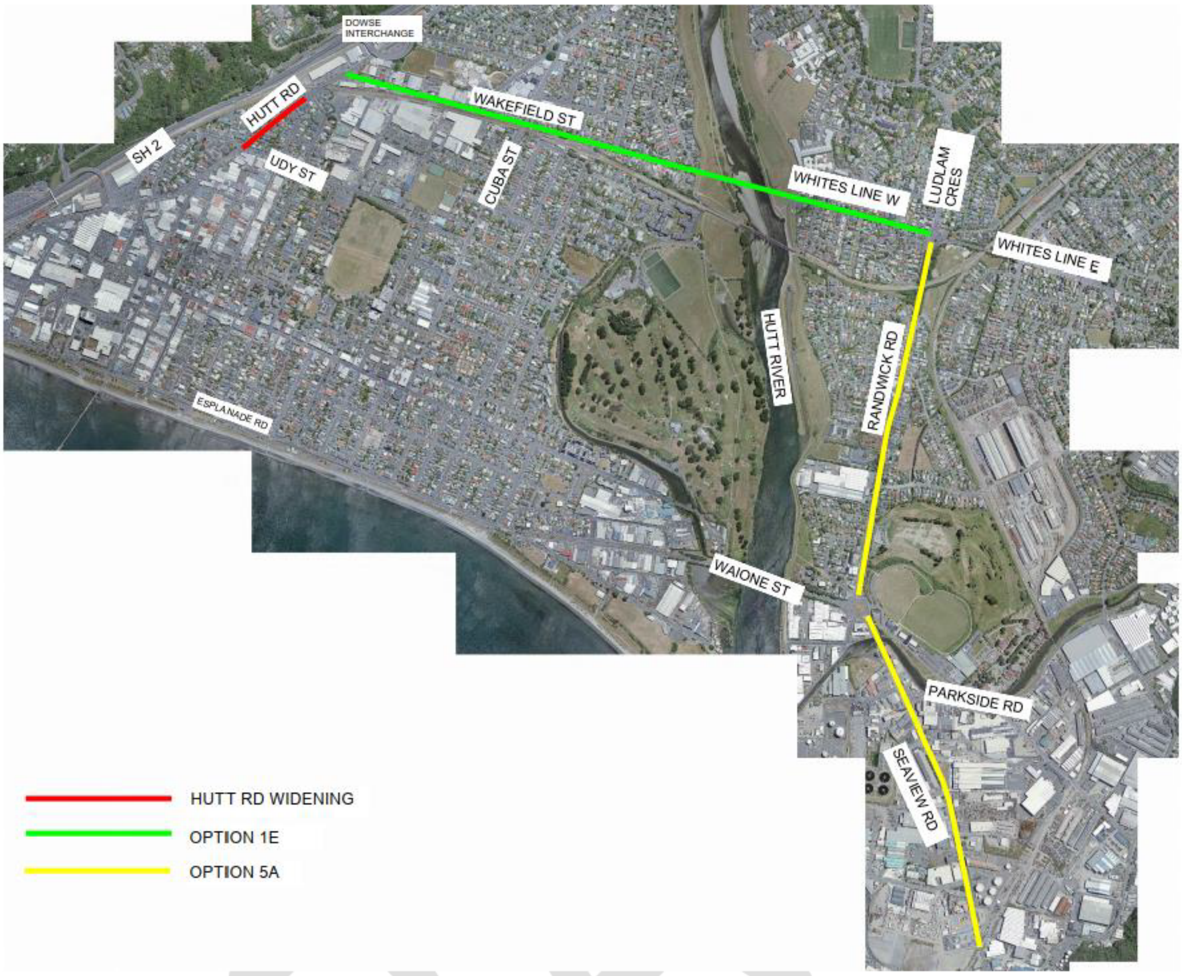

Figure 1 - CVL preferred alignments corridor.

A brief summary of the alignment options is provided below.

2.1 Hutt Road Widening

A 4-way signalised intersection is proposed at Udy St/Hutt Rd/Riddlers Crescent, where the proposed P2G ramps connect to Hutt Rd.

Addition lanes are required on Udy St and Hutt Rd to cater for turning movements at the signalised intersection. Minor land acquisition is required to accommodate the additional lanes. The final layout and requirements of these will be determined at the next project phase, using detailed traffic modelling.

East of the Udy Street intersection, the existing layout of Hutt Rd generally consists of a single lane in each direction, with a flush median and on-road parking on each side.

The proposed layout consists of 4 x 3.5 m wide lanes (2 in each direction), with a 2.0 m wide flush median and a 2.0 m wide footpath/berm on each side, giving a total corridor width of 20 m which matches the existing corridor width. There is no on-street parking proposed over this section and existing footpath widths have been reduced in some locations. Refer to **Figure 2** below for typical mid-block cross section.

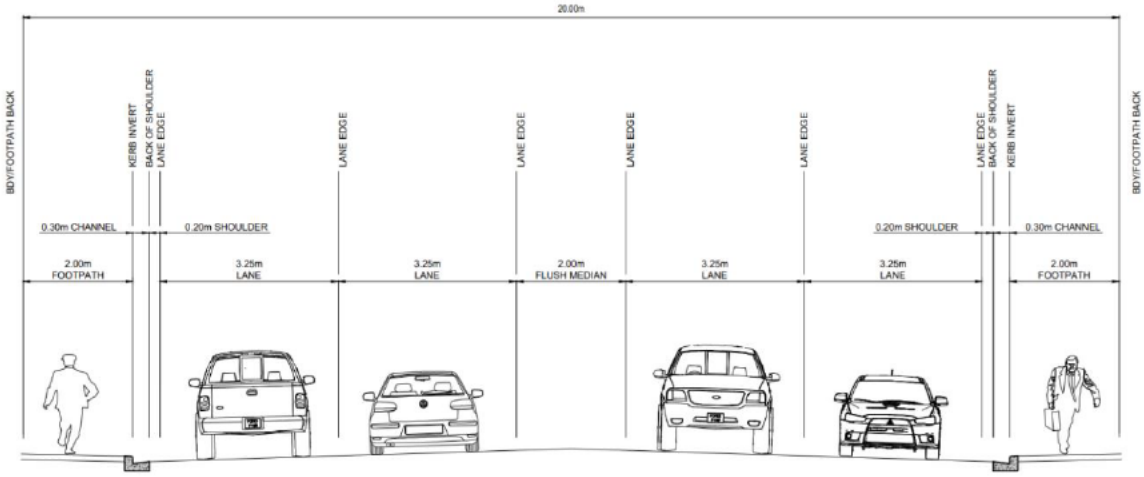

Figure 2 - Hutt Road Widening typical mid-block section.

West of Nelson St, it is not possible to continue 4 lanes on Hutt Rd to Wakefield St without replacing the rail over bridge. To avoid this cost, Hutt Rd reverts to the current 2 lane layout at Nelson St, through to Wakefield St.

2.2 Option 1E – Wakefield St/Hutt River Bridge/White Lines West

The existing layout of Wakefield St and White Lines West typically consists of 1 single lane in each direction with on-street parking on both sides. A footpath is provided on the north side of the road for the full length, and on the south side of the road east of Ava Station. There is currently no flush median over this section.

The proposed 1E corridor generally consists of a single lane 3.5m wide in each direction, with a 2.0 m wide flush median, and on-street parking and footpaths on each side. Refer to **Figure 3** below for typical mid-block cross section.

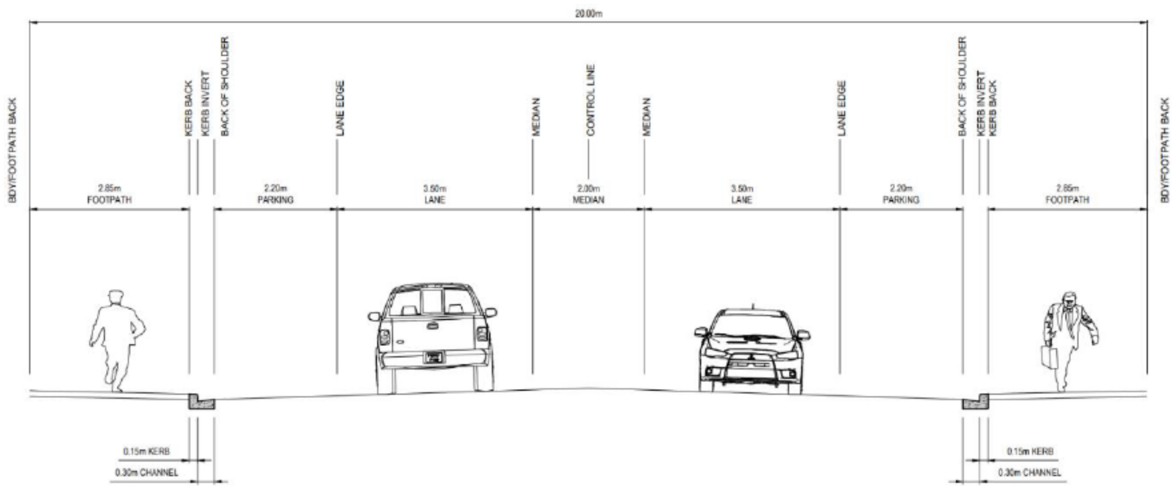

Figure 3 - Option 1E typical mid-block section.

A new 3-way signalised intersection is proposed at Hutt Rd/Wakefield St. Additional lanes are required on Hutt Rd and Wakefield St to cater for turning movements at the signalised intersection. Minor land acquisition is required to accommodate the additional lanes. The final layout and requirements of these will be determined at the next project phase, using detailed traffic modelling.

A new 3-way signalised intersection is proposed at Victoria St/Wakefield St. Additional lanes are required on Victoria St and Wakefield St to cater for turning movements at the signalised intersection. No land acquisition requirements have been identified. The final layout and requirements of these will be determined at the next project phase, using detailed traffic modelling.

At the Cuba St overbridge, the Cuba St connections to Wakefield St are reduced to left in / left out only to improve traffic flows. The proposed signalised intersection at Fitzherbert St provides an alternative option access to Wakefield St.

A new 3-way signalised intersection is proposed at Wakefield St/Fitzherbert St. Addition lanes are required on Hutt Rd to cater for turning movements at the signalised intersection. Minor land acquisition is required to accommodate the additional lanes. The final layout and requirements of these will be determined at the next project phase, using detailed traffic modelling.

A new 325 m long bridge is proposed across the Hutt River, connecting Wakefield St and White Lines West. The bridge height approximately 5m higher that the existing road, which will require ramps of approximately 120 m length, on MSE fill embankments at each end.

Access roads are required on the south side of the western ramp, and north side on the eastern ramp, to provide property access.

White Lines West does not currently connect to the existing Randwick Rd roundabout. A new connection is proposed which will require acquisition of property and removing Trevethick Grove access to White Lines West. A new access for Trevethick grove is proposed, connecting to the southern end of Saulbrey Grove, which will require property acquisition.

2.3 Option 5A – Randwick Rd/Seaview Road

Randwick Road and Seaview Road typically consist of a single lane in each direction with a flush median, except for the section of Seaview Road between the Randwick/Seaview Rd roundabout and Parkside Road, where Seaview Road consists of 2 northbound and 1 southbound lane. Refer to **Figure 4** below for typical mid-block cross section.

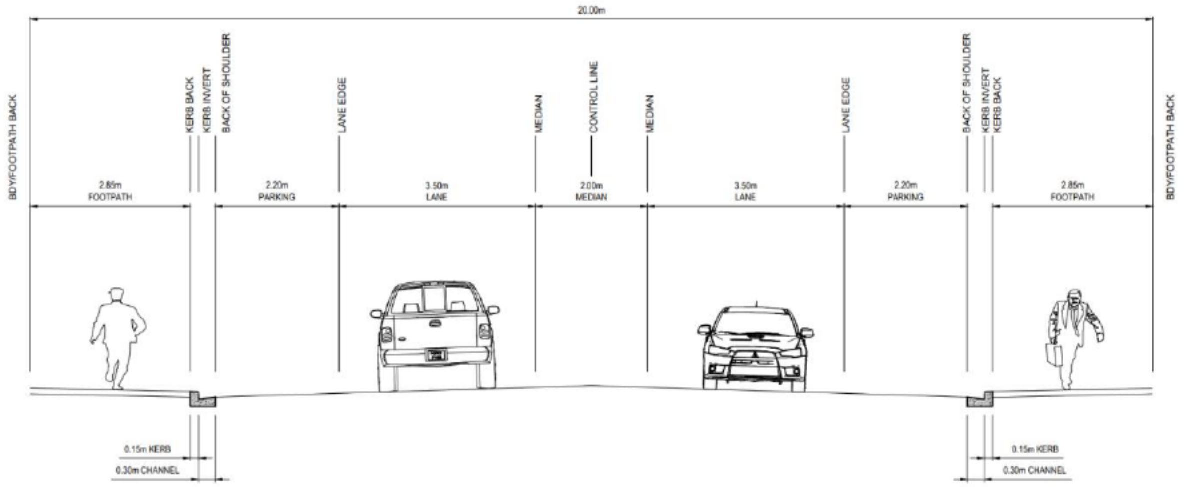

Figure 4 - Option 5A typical mid-block section.

No changes are proposed to the general configuration of the alignment over this section. The works will typically be limited to pavement milling/resurfacing and lane marking works, and signalising of 2 existing at grade pedestrian crossings at Randwick Crescent and outside Randwick School.

3 Design Assumptions and Base Information

3.1 General

The following sections describe the key assumptions and base information that has been used to inform the preferred corridor alignment and form.

The compressed nature of this phase of the project programme has not allowed for a detailed investigation of identified constraints and risks. Section 4 provides an overview of the design uncertainties and is presented as an outline of Future Design Development requirements. This is not an exhaustive list but serves as a register of residual risk and uncertainty to inform and accelerate future stages of design work.

The form of the corridor described in this section is indicative only for the purposes of developing an indicative cost estimate and establishing the feasibility of the CVL corridor. Further analysis and design is required to confirm the scope of physical works required for the CVL corridor.

3.2 Road and Geometrics

The RoNS Standard[2], does not appropriately cater for the speed environment and route category for CVL. Further discussion on the alignment with the RoNS standard is provided in the PSOPS.

The CVL route is designated as an Urban connector in accordance with NZTA's One Network Framework (ONF) classification.

Secondary local roads and routes of other transport modes were considered as base reference information in selecting routes, as summarised in the CVL PSOPS.

[2] NZTA Standardised design solutions for use on State Highway Roads of National Significance. V2.0 August 2024

Base information used to develop the road and geometrics consisted of:

- Secondary local road identification (refer PSOPS),
- Routes of other transport modes in the area (refer PSOPS),
- Petone long term plan 2040 (for strategic alignment),
- Latest accurate aerial imagery (HCC, 2021),
- LINZ property boundaries,
- Land requirement plans to inform refinements, and
- Pricing information to inform refinements.

The design standards adopted are described in detail in the PSOPS. The assumptions underlying the design standards prescribed for the road and geometrics are as follows:

- A speed environment of 50 km/ h was adopted under the ONF guidelines, as a median barrier with a separated walking facility were provided. Different speed environment zones along the route have not been considered at this stage.
- Stopping and approach sight distances have not been considered at this stage. Given the flat topography, and the CVL route largely following already formed roads, sight distance is not expected to be a major issue for the given speed environment.
- The desirable minimum horizontal curve radius adopted is 120m, and this was assumed based on design standards for arterial roads to allow for adaptability as either one lane each way or two lanes each way could be specified with little effect on road safety.
- The desirable minimum vertical curve gradient of 0.5% was adopted, for effective road drainage purposes. At this stage, the maximum vertical curve gradient was not considered other than the Hutt River bridge approaches which assumed a 5% gradient.
- Standard vehicle dimensions were assumed to apply as the design vehicle at this stage where the maximum width is 2.55 metres, maximum height is 4.3 metres, and maximum length is 20 metres. Design vehicle tracking and vertical clearance checks have not been done at this stage.

3.3 Pavement

No ground or site-specific investigation data was obtained, or used, to develop the pavement design. The design was informed by a traffic modelling assessment. As such, only one pavement design for the whole CVL alignment, including all junctions & interchanges, was completed at this stage.

Similarly to the road and geometrics section, the RoNS Standard, which was used for the P2G mainline alignment, was not considered appropriate for the CVL pavement design.

In line with general assumptions for P2G, it was assumed that no subgrade improvement layer was to be considered at this stage. However, as CVL is not considered a Road of National Significance (RoNS), it is assumed that a subgrade CBR ≥ 10 is not required.

The base information and design assumptions used to develop the pavement design consisted of:

- The design traffic loading was calculated in accordance with the Austroads guide to pavement structural design, Part 2, AGPT02-24.
- T+T Geotechnical Investigations web map server was used to obtain reference borehole and scala penetrometer test data near to the road corridor to estimate high-level design conditions, refer Appendix B section.

- An average indicative design subgrade CBR of 4 was assumed for the CVL road corridor, except for where new road corridor was proposed over existing undeveloped areas where an assumed CBR of 3 was used. These values are inferred only at this stage and based on our understanding of the residential and other infrastructure development in the area, underlying geology with cross-reference to the historical borehole and Scala penetrometer data mentioned above.
- The mill and replace pavement option was primarily developed to capture near certain pavement cost savings involved in rebuilding pavement over existing road surfaces. As no in-situ pavement conditions are known, it was assumed that there is sufficient depth of existing granular pavement layer below the new asphalt where new road was proposed over existing road.
- 25,000 vehicles per day (vpd) and 6% heavy vehicles (%HV) were obtained from the preliminary traffic modelling results and were used for the traffic loading assessment.
- 2% per year Heavy Vehicle Growth Rate over a 25-year design period was assumed at this stage, based on a consultation with the traffic modellers.
- The Upper Hutt City Council engineering standards, footpath construction typical sections, revision 7, July 1998, was used in-lieu of Hutt City Council (HCC) footpath design standards which were not referenceable.
- Circly 6.0 was used to prepare a high-level preliminary pavement design based on the following assumptions:
  - Weighted Mean Annual Pavement Temperature = 22 degrees Celsius.
  - Design speed for temp adjusted design modulus = 50 kph.
  - AC20 layer properties:
    - Based on asphalt mix design from Fulton Hogan Wellington asphalt plant AC20 2022 design (report #: WEL22O-0007[2], issued on 28/08/2023).
    - Resilient modulus 5000 MPa.
  - SMA10 surfacing properties:
    - Based on asphalt mix design from the Fulton Hogan Nelson Laboratory SMA10 PMB 2023 design (report #: NSN22O-0050[2], issued on 27/07/2023).
    - Resilient modulus 1900 MPa.
- For Hutt Rd widening and Opt 1E sections of CVL it has been assumed that 50% of the existing pavement will require full reconstruction and 50% will consist of milling and replacing surfacing. This is likely to be conservative and should be revisited at future stages of the project, after pavement testing has been undertaken.
- For the Option 5A section it has been assumed that 10% of the existing pavement will require full reconstruction and 90% will consist of milling and replacing surfacing. This has been adopted as the works within this corridor primarily consist of remarking within the existing road carriageway.

3.4 Geotechnical

This section sets out a high-level summary of the key Geotechnical hazards and geotechnical structures for the preferred CVL corridor. More detail on the geological background and context used to inform the design is set out in Appendix B.

Specific geotechnical material properties and detailed geotechnical assessments have not been defined and undertaken as part of this feasibility level design. Our knowledge of the site geology, the (limited) investigation information available, and geotechnical solutions and construction techniques developed for nearby projects, particularly the RiverLink project, have been used to identify key geotechnical hazards and determine mitigation measures that could be required.

Geotechnical risks relating to the majority of the CVL corridor are typical for roading development projects and are not the focus of this feasibility study. Key geotechnical hazards and constraints identified for the CVL corridor include:

- Liquefaction and lateral spreading of alluvial and marine deposits underlying the corridor, and
- Protection of the Hutt aquifer (during investigation and physical works that penetrate the aquitard).
- Slope stability for Bridge Abutments.
- Seismic stability of retaining structures.
- Rupture of the Wellington Fault and associated splay.
- Uncontrolled Fill associated with the Historic Ava Park Landfill.
- Settlement of Bridge Abutments.

The corridor sections and assets most impacted by these geotechnical hazards are:

- the Hutt River bridge.
- the grade separated approaches to the Hutt River Bridge.
- the widening of the existing grade separated section of Hutt Road at the intersection of Wakefield Street.

3.4.1 Liquefaction and Lateral Spreading Hazard

The site geology includes alluvial and marine deposits comprising predominantly gravel, sand and silt with some organic layers. A recent regional study (Dellow, Perrin, & Ries, 2018) has indicated soils within the project area to have between a moderate to high susceptibility (potential) to triggering liquefaction.

Further assessment of the liquefaction and cyclic softening risk and consequence (i.e. liquefaction vulnerability) should be undertaken at future design stages after sub surface investigation of the corridor alignment have been undertaken.

3.4.1.1 Historical Liquefaction Events

In the past, land damage was observed along the river during the Wairarapa earthquake in 1855. During this earthquake, large fissures were formed along banks of rivers and streams within the Hutt Valley, and a bridge across the Te Awa Kairangi/Hutt River was destroyed when the abutments sank (the location of this bridge is not clear). This damage has been attributed to earthquake ground shaking resulting in liquefaction and lateral spreading (Townend, Langridge, & Jones, 2005).

The historic evidence of the 1855 Wairarapa earthquake shows that liquefaction and lateral spreading has occurred in the Hutt Valley, possibly including the Project area. The design earthquake scenarios assessed in this report may not trigger liquefaction and lateral spreading to the extent of the much larger 1855 Wairarapa earthquake, however liquefaction is expected to occur and has been considered in our design.

3.4.1.2 Liquefaction Vulnerability

A liquefaction vulnerability assessment was undertaken for the RiverLink project's proposed Hutt River bridge approximately 1.6 km upstream of the proposed CVL bridge. This assessment indicated variable liquefaction vulnerability ranging from low to high under a range of design earthquake loads.

3.4.1.3 Lateral Spreading

Lateral spreading is the movement of ground down slope or toward a free edge (towards the Te Awa Kairangi/Hutt River) as a result of shearing of weak liquefied ground under seismic and/or gravity forces.

A lateral spreading assessment was also undertaken for the proposed RiverLink bridge. For RiverLink, potentially continuous layers have been assessed to be liquefiable using borehole and CPT results. These continuous layers of liquefiable material could result in lateral spreading.

There is not enough CPT and borehole data close enough to the proposed Hutt River bridge to carry out a site-specific lateral spreading assessment for the CVL project. The closest available CPT to the proposed bridge was assessed to have liquefiable layers, which, if identified as potentially continuous, would signal a risk of lateral spreading in the area of the proposed bridge. For the purpose of the Feasibility level design, it is assumed that lateral spreading will occur in seismic events between SLS and DCLS load cases requiring ground improvement to mitigate the effects and minimise damage to the bridge structure during and after seismic loading.

3.4.2 Slope Stability Hazard

Global stability of the proposed Hutt River bridge approach embankments and associated MSE walls and stopbanks has not been directly assessed as part of the Feasibility level design. Ground improvement is expected to be required beneath the approach embankments and abutments to mitigate risks and expected displacements caused by lateral spreading under seismic loading. This ground improvement will also significantly reduce the risk of slope instability.

Slope stability should be assessed in detail at later design stages and should consider the effects of the proposed ground improvement.

3.4.3 Geotechnical Structures

3.4.3.1 Fill Materials

Fill material used for embankment and mechanically stabilised earth (MSE) construction is likely to comprise locally sourced granular fill, if possible.

Deposits from the Te Awa Kairangi/Hutt River could be considered for use as fill material. These deposits are predominantly sandy gravel and cobbles. No testing of the river gravels is available at the time of writing; however, these gravels have been observed to be typically rounded and poorly graded. Crushing to improve grading and increase angularity will improve compaction, and is likely required if the material is to be used for general structural fill. Any large cobbles or boulders may need to be removed before material could be placed as fill.

Imported fill may be required for structural fill, low permeability stopbank fill, drainage and graded filter materials. Nearby sources include the Horokiwi Quarry and Belmont Quarry. Quarry overburden material (residual soils and highly weathered greywacke rock) are likely to be suitable for structural fill and low permeability liner material.

3.4.3.2 MSE Walls

At the Hutt Rd/Wakefield St intersection, on the Hutt Rd west leg, retaining walls with an average height of 1.5 m are expected to be required on both sides of the road to accommodate the lane widening and to avoid encroaching into adjacent property.

A total 140 m length (70m each side of road) of Mechanically Stabilised Earth (MSE) retaining walls are expected to provide the best value solution that provides greatest resilience to local fault splay effects, allowing rapid repairs (when compared to a stiff cantilevered structure for example).

Alternatives solutions, if there are service clashes identified, could include gravity block walls or similar and these should be explored in future stages of design.

3.4.3.3 Hutt River Bridge Approach Embankments

The eastern and western approach embankments for the Hutt River bridge are expected to be approximately 16 m wide and up to 4.5 m high, with a maximum grade of 5%. They are proposed to be laterally supported by vertical MSE walls with concrete facing panels to limit the required footprint and property take.

The eastern approach embankment includes a grade raise of a short portion of Richmond Grove. MSE walls will be used to support the full length of the raised eastern approach, which includes the section of Richmond Grove.

A preliminary settlement assessment has been undertaken for the Hutt River approach embankments, based on limited nearby ground investigation data. If no ground improvement is undertaken beneath the bridge approach embankments, our assessment indicates total settlement in the order of 100 mm may occur which will be able to be managed during construction.

Some local ground improvement under the highest section of the approach embankment are expected to be required as set out in Section 3.4.3.4 below and will reduce this settlement. Preloading or improved drainage could be explored in future stages to accelerate settlement and minimise secondary creep effects.

3.4.3.4 Ground Improvement

It is expected that some local, targeted ground improvement may be required under part of the approach embankment and under the bridge abutment 3.5.4 to limit the liquefaction effects and expected seismic displacements in accordance with the performance set out in the PSOPS and SRP.

This will need to be confirmed following ground investigations and analysis in later stages of design.

Ground improvement in the form of square section 300 x 300 mm driven precast concrete piles or cells of jet grouted columns are proposed directly beneath the approach embankments where the height of the approach embankments is greater than 3 m above the existing ground level. The piles could be positioned on a 1.0 m triangular grid and advanced to an elevation of -4 mRL with pile lengths of approximately 6.6 m. The width of the ground improvement will match the width of the approach embankment.

The form and extent of ground improvement may change as the design progresses, and as investigation and analysis is undertaken. The proposed ground improvement has been selected to represent what is likely required to meet the minimum requirements, by limiting displacement and damage caused by lateral spreading. The ground improvement will also reduce the settlement that is expected to occur under the load of the approach embankments and limit the loading on the adjacent bridge abutments.

3.4.3.5 Stopbanks

The Hutt River stopbanks at the proposed locations of the of the bridge abutments form an important part of the river flood protection infrastructure.

The feasibility level design proposes a solution that will temporarily excavate and remove a short section of the stopbank to allow for construction of the local cell of ground improvement at the bridge abutment before reinstating an MSE abutment to support the bridge. Temporary flood protection via sheet piles is expected to be required. Alternative ground improvement techniques such as jet grouting, that avoid the need to remove the stopbanks, could be explored in later stages of design. Alternatively, longer end spans on the bridge and a repositioning of the approach structure may allow the bridge to span the stopbanks without disturbing them.

The stopbanks will be replaced with mechanically stabilised earth that matches the geometry of the original stopbank. The stopbanks will be reinforced with geogrids at 0.5 m vertical increments.

3.5 Structures (Hutt River Bridge)

The Hutt River bridge is the only bridge structure required for the preferred CVL corridor.

The feasibility stage design is based on a 325 m long bridge with five spans across the waterway and flood plain, varying in length from 50 m to 75 m.

The selection of this bridge form is aligned to the philosophy set out in the SRP which is to seek high value solution by minimising the overall number of stiff piles and limit the number of piers in the Hutt River channel to one. Variability in span length could be adjusted in future to optimise the design.

3.5.1 Structural Form

The bridge will consist of a structural steel through truss with a concrete deck. The slab will consist of 150 mm thick ribbed precast, prestressed concrete panels with a 150 mm thick in-situ reinforced concrete topping. The overall deck width is approximately 17 m.

The substructure elements are to be of concrete construction. Concrete piers and hammerhead style piercaps will be supported on large diameter cast-in-situ concrete bored pile foundation. Concrete abutment beams will be supported on approximately two rows of 6 no. steel 310UC158 driven piles.

3.5.2 Span and Structural Depth Arrangements

It is very expensive to advance piles into the Waiwhetu aquifer. The Hutt River Bridge superstructure has been selected to optimise (maximise) the span length and minimise the number of piles required. This comprises two five spans steel through trusses using SHS section. Span lengths vary from 50 m to 75 m length as shown below in the typical elevation.

The deck slab will be a total 300 mm (minimum) thick in-situ reinforced concrete deck slab and total 1.1 m structural depth between underside of bridge and carriageway level. This structural depth and the minimum soffit level of the bridge deck slab needs to be refined early in the next stage of design to set the road geometry.

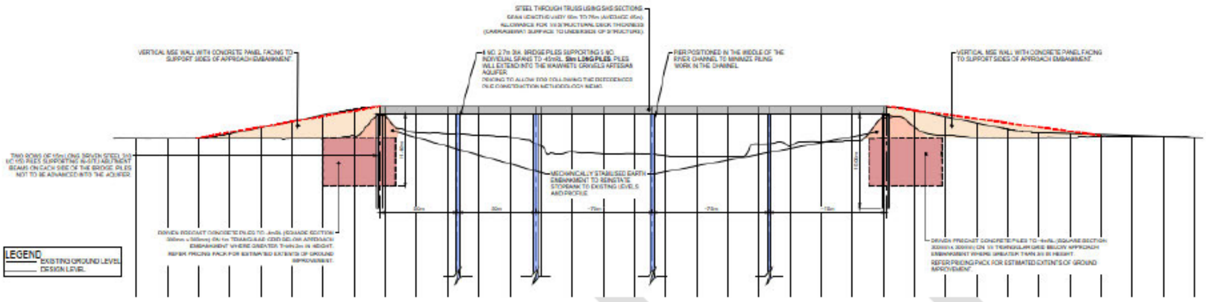

Figure 5 - Typical bridge elevation.

Figure 6 - An indicative example elevation of a steel truss vehicle bridge.

3.5.3 Articulation Arrangement

The bridge steel through trusses will be supported on

- Sixteen (16) numbers of elastomeric bearings with top and bottom attachment plates to support the bride deck at four bridge pier locations.
- Four (4) numbers of sliding Pot Bearings with top and bottom attachment plates to support the bride deck at abutment locations.

Finger expansion joints will be provided at each abutment location to allow the movement of steel trusses due to temperature variation.

3.5.4 Pier Type

The bridge will have four piers. Each pier will consist of a crosshead supported by a single 2200mm diameter reinforced concrete column on a single 2700 mm diameter bored pile with sacrificial casing. Piles are expected to be approximately 50 m long with a founding depth of approximately -45 mRL.

The pile diameter and length are preliminary only based on approximate anticipated bridge loads and our understanding of the subsurface conditions near the bridge location.

It is very expensive to advance piles into the Waiwhetu aquifer. The arrangement of the bridge structure and pier foundations have been selected to minimise the number of piles required to be advanced into the Waiwhetu gravels. Larger diameters and greater depths were adopted in favour of increasing the number of piles.

3.5.4.1 Abutment Type

The abutments will consist of MSE wall embankments. At each abutment a cast in situ abutment beam will be provided to support the superstructure steel through trusses. The bridge abutment beams will be supported on two rows of 15 m long driven steel 310 UC 150 piles located at the crest level of the existing stopbanks. The piles will be driven through the MSE stopbank and the cell of improved ground. Abutment piles are not proposed to be driven into Waiwhetu Aquifer gravels.

Proposed pile types, pile lengths, and the numbers of piles are preliminary. This abutment foundation arrangement has been selected to represent a design solution that is expected to meet the performance expectation in the PSOPS and SRP.

At each abutment, a surface level approach settlement slab will be provided to accommodate differential settlement between the approaches and the abutment.

3.5.5 Cross Section

The bridge deck width, face to face of TL5 barriers, will be 17 m to accommodate:

- 1 no. 2 m (or 2.5 m) wide footpath on each side.
- 1 no. 2 m (or 1.5 m) wide shoulder between footpath and traffic lane on each side.
- 1 no. 3.5 m wide traffic lane on both sides.
- 1 no. 2 m wide central median.

3.5.6 Tolerance of the Structure to Seismic Effects, Including Liquefaction

The simply supported deck over the elastomeric bearings has the ability to redistribute loads and accommodate differential settlement. Sufficient seating place to be provided to accommodate a seismic event displacement larger than the design event without collapse.

3.6 Stormwater Management

In general, the stormwater design aims to provide effective drainage for the road corridor through:

- Utilising the existing stormwater network where the road corridor width is unchanged. Allowance has been made for relocating catchpits and catchpit leads due to slight changes in the kerb alignment.
- Installation of new catchpits and pipework connecting to the existing stormwater network where the road corridor has changed substantially, mainly at intersections.
- Installation of bridge drainage for the Hutt River bridge consisting of bridge catchpits connecting to new pipework.

- Runoff from the bridge and surrounding areas which increase the impervious area will be attenuated and treated through new stormwater wetlands on each side of the Hutt River.
- Existing stormwater networks adjacent to the Hutt River bridge will be diverted where required with Opahu Stream being culverted to provide access to the stormwater pump station at the SW end of Whites Line W.

3.6.1 Base Information

The HCC 3 Waters Underground Services layer on the Wellington Water Limited (WWL) GIS portal has been used to determine stormwater infrastructure that requires diversion or replacement.

The existing stop bank levels that currently contain the 440 ARI flood (including allowance for climate change) have been used to set the height of the Hutt River Bridge deck.

3.6.2 Longitudinal Drainage

Bridge drainage consists of bridge catchpits and pipework that discharge to the attenuation and treatment wetlands located on either side of the bridge. Allowance has been made to relocate two existing stormwater pipes which are 750 dia and 1050 dia that outfall to the true right bank of the Hutt River at the bridge location.

At other locations it has been assumed that the existing network can be utilised with no carrier pipe upgrades where the alignment remains within the existing road corridor. Allowance has been made to relocate catchpits and catchpit leads and household service connections through the kerb where the kerb line has changed and for new catchpits and catchpit leads connecting to the existing network at intersections.

3.6.3 Attenuation and Treatment

Stormwater attenuation and treatment has been allowed for via wetlands located adjacent to the Hutt River for the bridge due to the increase in impervious area. The wetlands have been sized based on a fixed ratio between catchment area and the total wetland footprint area (wetland area is 6% of the total catchment area). It is expected that the works on Hutt Road, Wakefield St and Whites Line W will not increase the impervious area significantly and hence attenuation and treatment will not be required.

3.6.4 Opahu Stream Culvert

The Opahu Stream culvert has been sized based on the current stream cross section and upstream and downstream culvert sizes to match the level of service currently provided. This approach will need to be discussed with Wellington Water and other stakeholders.

Fish passage has not been allowed for within the proposed culvert or culvert extension as it is unclear if the flood gate at the Hutt River allows fish passage or not.

3.6.5 Localised Flooding

There may be some changes in localised flooding due to the increased height of the road at the Hutt River bridge abutments. It is expected that flooding at other locations will be generally unchanged from the present situation as the road elevation is generally unchanged and there are only minor increases in impervious area.

3.7 Landscape and Environmental Design

The minimum requirements for landscape and environmental design will need to be determined in future stages.

3.8 Urban Design and Multi Modal Transport

The minimum requirements for urban design and multi-modal transport will need to be determined in future stages.

3.9 Utilities and Services

Existing assets such as local power, gas (other than PowerCo), communications etc. have not been considered in detail at this stage. A general contingency was allowed for works within existing intensified areas.

Refer to the utilities and services section of the CVL PSOPS document for design standards, scope of work, as well as constraints and assumptions.

The base information used in the assessment consisted of:

- All publicly available data incorporated into the T+T GIS web map viewer,
- "before u dig" application data for the full extent of the works provided by utility providers,
- and google street view pan-throughs to identify above ground assets and valve boxes etc. (where applicable).

The key design assumptions consisted of:

- Only utilities and services considered to be of major or critical importance were identified in the applicable drawings as well as any mitigations required.
- A general price allowance was considered to mitigate the risk on other less critical identified assets.
- Not all "before u dig" application data was interpretable and/ or of sufficient detail for cost estimation. In these instances where not enough detail as available but a mitigation was expected as required, the mitigation was assumed for price estimation based on engineering judgement and the assumption was noted in applicable documentation.

3.10 Intelligent Transportation Systems

ITS infrastructure has not been designed at this stage of the project. However, allowance was made for the cost of intersections that require signalisation.

Given the Urban Connector classification of this road, it is likely that no further ITS investment is required above and beyond intersection signalisation. This would match the status of the existing network in this area.

3.11 Furniture and Lighting

Refer to the furniture and lighting section of the CVL PSOPS document for design standards, constraints, assumptions and potential departures.

There is very limited existing street furniture along the proposed CVKL corridor. A minor allowance has been made to reinstate existing street furniture where affected. No significant items such has bus shelters were identified as requiring reinstatement.

No allowance has been made for new street furniture beyond the provision of new directional signage for the CVL route. Consideration of any requirements for new bus stop shelters will be undertaken at future stages.

Street lighting is present on all the proposed CVL corridor. An allowance has been made to relocated existing lighting and a further allowance for upgrading the lighting where the proposed carriageway width is being increased.

3.12 Noise

A preliminary road traffic noise calculation was completed for the selected pavement design using NZTA's online road traffic noise calculator Road traffic noise calculator. Average and assumed parameters were input at this stage to obtain an indicative average range of equivalent noise levels at nearby habitable buildings. The indicative noise range obtained was compared against the allowable noise level in NZTA's state highway guide to acoustic treatment of buildings, version 1.0, June 2015. No acoustic treatments, other than change of surfacing type, has been investigated at this stage.

A summary of the CVL noise assessment results between SMA and EPA surfacing is shown in Table 1.

Table 1 - NZTA Road Traffic Noise Calculator - Preliminary Indicative Results.

Surfacing Scenario	Calculated Average Indicative Noise Level (dB)	Expected Average Indicative Noise Level Range at Sensitive Receptors (dB)
SMA	58	53-69
EPA	57	52-68

The allowable noise level, LAeq(24h), for buildings near roads in New Zealand, as defined by the NZTA and NZS 6806, is 40 dB. This limit applies to habitable rooms within buildings and is intended to protect residents from excessive traffic noise. Unless the traffic modelling estimates significantly reduce, acoustic treatment devices could possibly be required at sensitive receptors (refer to Section 4 for future design development).

3.13 Resource Efficiency and Sustainability

This aspect has not been specifically considered at the investment case stage, except in so far as the investment case design has been driven by a minimum viable product design philosophy. Refer to the PSOPS document for comments on risk of resource availability in the region.

3.14 Land Use and Property/Corridor Assets Management

The NZTA Property team has been involved with the options assessment and design to date to ensure we are avoiding property that is problematic to obtain. Assessment of property requirements to date has focused on temporary and permanent project footprint with the assumption that within the land parcels marked for full acquisition there will be enough area to allow for asset management considerations at the next design stage.

3.15 Design Audits and Reviews

Refer to the PSOPS document for a description of Design Audits and Reviews to date. The PSOPS documents covers headings for:

- Design,
- Consents and approvals, and
- Partnership and agreement.

4 Future Design Development

4.1 General

The design has been developed to a level that supports the high level cost estimate and to confirm the feasibility of the corridor. The maturity of the design is insufficient to support a resource consent application.

Future design development should focus on:

1. Risk Reduction

Risk reduction is expected to first focus on consenting risk. However, this should also focus on constructability / affordability risk.

2. Improved confidence in the form of the design solutions

Design developed should be informed by site specific subsurface investigations and analysis to consider expected performance against the agreed design criteria. Design should first focus on confirming local road treatments, water quality approach and refinement of the Bridge structure.

4.2 Road and Geometrics

The CVL geometric alignment work to date has largely been a 2d exercise, except for the Hutt River Bridge and approaches. Future design development will require a full 3d geometric design model for the full CVL corridor.

Vehicle tracking has not been assessed in any detail to date and the layout has largely been based on the existing road layout. Vehicle tracking will need to be undertaken at future design stages to confirm kerb line locations which may have a minor effect on land acquisition requirements in some location.

Traffic modelling was not completed to a sufficient level to fully inform the layouts at the new signalised intersections. Some refinement of these layouts may be required which could affect the number and length of lanes at the intersections.

Confirmation of the height of the Cuba St bridge where Wakefield St passes underneath will be required to inform any requirements for lowering of the Wakefield St road levels in this area.

4.3 Pavement

Undertake in-situ ground investigations along the alignment to refine the pavement design inputs and optimise the outputs. This investigation data would also inform the design and extent of the mill and replace option which at this stage has been estimated based on engineering judgement alone. Refine the pavement re-construction design layers to reduce the material and/ or cost requirements.

4.4 Geotechnical

4.4.1 Proposed Geotechnical Investigations

Error! Reference source not found. Additional geotechnical investigations are expected to be r equired to support further stages of design. Resource consents for the investigations are expected to be required because of the presence of the aquifer.

Key focus of investigations would be to determine the ground conditions for approach embankment MSE wall and Hutt River bridge abutment foundations and Hutt River Bridge Pier Piles. Also, determination of the extent of the Ava Park Closed Landfill.

4.4.2 Proposed Geotechnical Analysis and Design

No site-specific analysis and design has been undertaken. A liquefaction and lateral spreading assessment of the site will be required to inform the next stage of design.

A site geological model is required including the nature of the alluvium and marine deposits at the bridge piles and the extent of any historical landfill or other site modification that may influence the design form for the bridge.

The expected seismic performance of the bridge needs to be aligned to the design criteria set out in the final form of the SRP and PSOPS. This will define the key details for the bridge pier, pile and spans.

The construction method for the bridge piles will need to be further developed so that the effects assessment and impact on the aquifer, requiring GWRC approval, are well managed.

The feasibility of removing the existing stop banks for bridge abutment works needs to be confirmed in the next stage.

4.5 Structures

As set out in Section 4.4, the bridge seismic performance and pile / pier arrangement needs to be further developed in the next stage of design. As set out in Section 4.6 the bridge soffit levels need to be defined and the structural depth so that the road vertical geometry can be more accurately modelled.

4.6 Stormwater

Discussions with WWL and potentially flood modelling of the Hutt River and tributaries is required to confirm the minimum height of the Hutt River Bridge, wetland bund heights and sizing of the Opahu Stream Culvert.

Flood modelling of the Hutt River and tributaries to confirm the impact of the bridge abutments on local flooding.

Confirmation of wetland locations and any design restrictions with GWRC is required, as the proposed wetlands are located on the river side of the Hutt River stopbanks.

Preliminary design of the wetlands to confirm wetland extents and outfalls.

Confirmation of any fish passage requirements and stream impact mitigation required for Opahu Stream Culvert and Opahu Stream Culvert extension.

Survey of the existing network including catchpit and manhole locations, pipe sizes, culvert locations and sizes, invert levels, and the Opahu Stream flood gate detail.

4.7 Utilities and Services

Consult with the affected asset owners to obtain agreement in principle of proposed protection/ relocation plans.

Obtain detailed plans from asset owners on the local networks, particularly power, gas (other than PowerCo), and communications.

Plan for service investigations as required to manage any risks to affected assets which are deemed unacceptable pre-construction.

4.8 Noise

Undertake a detailed acoustic assessment once the road alignment is confirmed and the traffic modelling estimates are finalised, to determine if there are any noise sensitive receptors on-route and ultimately if any acoustic treatments are required to mitigate noise effects.

Table 2 - Future Design Development Summary

Design Element	Purpose of Design Development (Risk Reduction or Design Certainty)	Future Design Development	Suggested Design Stage The Mahi is Undertaken	Why
Bridge and Approaches	Risk Reduction and Design Certainty	Geotechnical investigation. Boreholes and CPTs. Geotechnical analysis and design, including: Liquefaction, lateral spreading, slope stability, pile capacity, ground improvement, MSE wall design.	Consenting	Improve understanding of geotechnical risks and bridge structural performance. Improve estimate of pile requirements (diameter, depth, quantity) and ground improvement requirements. Improve cost estimation.
Bridge and Approaches	Risk Reduction and Design Certainty	Assess seismic performance against PSOPS and MR's/Design criteria to optimise bridge foundation (piles and abutment treatment).	Consenting	Early alignment on seismic performance presents critical project risk.
Bridge Abutment	Risk Reduction and Design Certainty	Explore abutment support/ ground improvement options that avoid the need to remove the existing stop banks.	Consenting	Large cost and risk associated with temporary works to provide flood protection, potential no GWRC approval received.

Table 2 - Future Design Development Summary

Design Element	Purpose of Design Development (Risk Reduction or Design Certainty)	Future Design Development	Suggested Design Stage The Mahi is Undertaken	Why
Road and Geometrics	Design certainty for existing Cuba St rail bridge clearance	Confirm minimum clearance envelope and vertical alignment corrections needed to maintain clearance envelope at the Cuba St overbridge.	Consenting	The current clearance is approximately 4.3 m. The minimum required for a semi-trailer is approximately 4.4 m.
Road and Geometrics	Design certainty for intersection configuration	Further traffic modelling could increase the number and length of lanes at the intersections.	Consenting	Required to manage traffic flows and increase the efficiency of the roading network.
Road and Geometrics	Design certainty for intersection configuration	Design vehicle swept path analysis at intersections to confirm layout.	Consenting	Identify any additional land acquisition requirements.
Pavement	Risk Reduction and Design Certainty	In-situ ground and pavement testing, including subgrade, along the full extent of the confirmed works area.	Consenting	Confirms design layers and importantly where designs may be applied to optimise time & cost to complete the pavement works.

Table 2 - Future Design Development Summary

Design Element	Purpose of Design Development (Risk Reduction or Design Certainty)	Future Design Development	Suggested Design Stage The Mahi is Undertaken	Why
Stormwater Management	Design Certainty	Treatment /attenuation wetlands for Hutt River bridge.	Consenting	Confirms location and size of the wetlands.
Stormwater Management	Design Certainty	Survey of existing network – invert levels, infrastructure locations, pipe sizes.	Consenting	Confirmation of diversions, extensions and connections to existing infrastructure. In particular infrastructure adjacent to the Hutt River.
Stormwater Management	Risk Reduction	Fish passage and stream impact mitigation design and requirements for Opahu Stream Culvert and Opahu Stream Culvert extension.	Consenting	Confirmation of stream impact offset mitigation and fish passage requirements.
Flood Management	Risk Reduction	Hutt River Modelling – discussions with WWL to confirm flood levels for different flood return periods for the Hutt River.	Consenting	Confirmation of bridge height including freeboard and wetland bund height.

Table 2 - Future Design Development Summary

Design Element	Purpose of Design Development (Risk Reduction or Design Certainty)	Future Design Development	Suggested Design Stage The Mahi is Undertaken	Why
Flood Management	Risk Reduction	Flood modelling – working with WWL to update existing flood model with bridge abutments included in the model.	Consenting	Confirms impact of the bridge abutments and soffit levels on local flooding and the size of the proposed culvert at Opahu Stream.
Landscape and Environmental Design	Design Certainty	Prepare Landscape and Environmental Design Framework for Consenting.	Consenting	Manages expectations for the landscape design aspects of the project.
Urban Design and Multi Modal Transport	Design Certainty	Prepare Urban Design Framework for Consenting. Undertaken consultation with HCC to confirm Minimum viable product and multi modal treatment of road corridor.	Consenting	Required as part of lodgement documentation
ITS	Design Certainty and Risk Reduction	Confirm ITS requirements (if any) for CVL. Confirm with NZTA and HCC. Obtain initial confirmation from power and fibre providers that ITS requirements can be serviced by the existing network infrastructure.	Consenting	Provides increased certainty on project scope and cost.

Table 2 - Future Design Development Summary

Design Element	Purpose of Design Development (Risk Reduction or Design Certainty)	Future Design Development	Suggested Design Stage The Mahi is Undertaken	Why
Utilities and Services	Risk reduction	Consult with the affected asset owners to obtain agreement in principle of proposed protection/ relocation plans. Obtain detailed plans from asset owners on the local networks, particularly power, gas (other than PowerCo), and communications.	Consenting	Reduce risk of compliance issues, and/ or asset owner negotiation failings. Provides increased certainty on project scope and cost.
Utilities and Services	Risk reduction	Plan for service investigations as required to manage any risks to affected assets which are deemed unacceptable pre-construction.	Detailed design	Reduce design and in-construction risk.
Furniture and Lighting	Risk Reduction	Confirm adequate power supply to streetlights.		Provides more certainty on project scope and cost.

Table 2 - Future Design Development Summary

Design Element	Purpose of Design Development (Risk Reduction or Design Certainty)	Future Design Development	Suggested Design Stage The Mahi is Undertaken	Why
Noise	Risk reduction	Undertake a detailed acoustic assessment once the road alignment is confirmed and the traffic modelling estimates are finalised.	Consenting	To determine if there are any noise sensitive receptors on-route and ultimately if any acoustic treatments are required to mitigate noise effects.
Resource Efficiency and Sustainability	Risk Reduction	Engage with NZTA resource efficiency and sustainability resource for consent design review.	Consenting	Provides confidence on any additional departures required for minimum viable product approach.
Land Use and Property/Corridor Assets Management	Risk Reduction	Confirm property requirements with maintenance and operations. Reconfirm property requirements for consent design. Engage with landowners early during consenting process.	Consenting	Provides more certainty on project scope and cost. Enables completion of draft consent conditions.

Table 2 - Future Design Development Summary

Design Element	Purpose of Design Development (Risk Reduction or Design Certainty)	Future Design Development	Suggested Design Stage The Mahi is Undertaken	Why
Design Audits and Reviews	Risk Reduction	It is likely that HCC will be the eventual asset owners or asset maintainers for this project. It is suggested that HCC be involved in consent design reviews to confirm the proposed bridge and road network is maintainable.	Consenting	To confirm no additional cost will be added post consenting for operations and maintenance requirements.

This report has been prepared for the exclusive use of our client New Zealand Transport Agency Waka Kotahi (NZTA), with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Report prepared by: Report reviewed by:

S7(2)(b)(i)

[redacted]