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22 February 2023

Auckland Council
Private Bag 92300
Victoria Street West
Auckland 1142
Attention: Ben Willis

Sent via email to ben.willis@aucklandcouncil.govt.nz

Dear Ben,

SH16 Brigham Creek to Kumeu Stage 2 - Notice of Requirement Section 92 Response

The following sets out our response to Auckland Council's RMA Section 92 request (dated 23/01/2023), in relation to the Notice of Requirement to Alter Designations 6740 and 6766 for State Highway 16 (Stage 2) Brigham Creek to Kumeū Safety, Capacity and Walking and Cycling Improvements, on behalf of Waka Kotahi New Zealand Transport Agency ("Waka Kotahi").

The response is supported by the following attachments:

- Attachment 1 – Drawings – Dwellings within 25m of Proposed Construction Works dated 10/02/2023
- Attachment 2 – Traffic Assessments – Flow Transportation Specialists, SH16 Safe Roads Alliance SH16 Corridor Option Evaluation Report dated August 2017 and the Beca Coatesville Riverhead Highway Roundabout Traffic Volume Update and Safety Check at Crossings Memorandum dated 15 March 2021
- Attachment 3 – Flow Transportation Specialist SH16 Brigham Creek to Waimauku SSBC Economic Update dated 28 April 2020
- Attachment 4 – Flow Transportation Specialist SH16 Brigham Creek Road to Waimauku Update to Economic Analysis dated December 2021
- Attachment 5 – Waka Kotahi Crash Analysis System (CAS) data - CAS output file SH16 Stage 2 CAS Output Data.xlsx dated 09/02/2023
- Attachment 6 – Drawings - Vehicle tracking SH16/Coatesville Roundabout dated July 2022
- Attachment 7 – Preliminary Design Road Safety Audit SH16 - Safety Improvements Stage 2 Brigham Creek to Kumeu dated 29 April 2021
- Attachment 8 – SH16 Safety Improvements Stage 2 Brigham Creek to Kumeu Detail Design Road Safety Audit dated 21 September 2022
- Attachment 9 – Pre-application Meeting Minutes with Heritage New Zealand Pouhere Taonga dated 9 February 2022 and Pre-application Meeting Notes with Heritage New Zealand Pouhere Taonga (email) dated 18 February 2022 and General Arrangement Plans (attachment to email) dated 26 March 2022.

Noise and Vibration

1. Related to the assessment of construction effects please confirm:

a. How many dwellings are within 25m of the proposed construction works; and

Based on the existing residential environment, the following 32 dwellings are located within 25m of the proposed construction works (Refer to Drawings in Attachment 1):

Site Number	Address
1	171 State Highway 16, Kumeū
2	173 State Highway 16, Kumeū
3	175 State Highway 16, Kumeū
4	177 State Highway 16, Kumeū
5	179 State Highway 16, Kumeū
6	181 State Highway 16, Kumeū
7	183 State Highway 16, Kumeū
8	218 State Highway 16, Kumeū
9	222A State Highway 16, Kumeū
10	185 State Highway 16, Kumeū
11	238 State Highway 16, Kumeū
12	264 State Highway 16, Kumeū
13	300 State Highway 16, Kumeū
14	291 State Highway 16, Kumeū
15	299 State Highway 16, Kumeū
16	324 State Highway 16, Kumeū
17	340 State Highway 16, Kumeū
18	315 State Highway 16, Kumeū
19	315 State Highway 16, Kumeū
20	1411 Coatesville-Riverhead Highway, Kumeū

21	1409 Coatesville-Riverhead Highway, Kumeū
22	1397 Coatesville-Riverhead Highway, Kumeū
23	1404 Coatesville-Riverhead Highway, Kumeū
24	393 State Highway 16, Kumeū
25	418 State Highway 16, Kumeū
26	436 State Highway 16, Kumeū
27	407 State Highway 16, Kumeū
28	429 State Highway 16, Kumeū
29	451 State Highway 16, Kumeū
30	464 State Highway 16, Kumeū
31	507 State Highway 16, Kumeū
32	550 State Highway 16, Kumeū

b. Which properties (or how many properties) are close enough for relocation to be expected to be required due to night-works.

Section 5.1 of the Acoustic Assessment states “For dwellings located closer than 25m from works, management and mitigation would need to be implemented.” These measures will be addressed via a Construction Noise or Vibration Management Schedule (Schedule) to the Construction Noise and Vibration Management Plan (CNVMP) (see draft proposed designation condition CNVM.4A and CNVM.4B).

Please refer to Acoustic Assessment, Section 5.3.4 Site Specific Construction Noise and Vibration Management Schedule. At present, only potential effects have been assessed, based on potential worst-case scenarios. However, when a contractor has been appointed and equipment, timing and staging is better understood, these facts will be included in the CNVMP. Temporary relocation is not required for any specific dwelling along the project alignment but rather can be offered in exceptional circumstances. This will be dependent on the night works location and duration. For example, if road resurfacing occurs for one night outside someone’s house, this would unlikely result in an offer of relocation as such works occur as of right as a maintenance issue. However, if sustained (more than one night in a row) and high noise (e.g. piling) night works were to be required, then an offer of temporary relocation may be made if the bedrooms of a house face the works. As mentioned above, these measures will be addressed via a Schedule to the CNVMP (see draft proposed designation condition CNVM.4A and CNVM.4B).

2. **The potential acoustic screening efficacy was not provided for 436 SH16 before noting no screening is proposed. Could screening be effectively implemented to reduce to this property Cat A as has be proposed for other properties?**

   Please refer to Acoustic Assessment, Section 6.4.4 Assessment Areas for which mitigation was investigated, specifically refer to Assessment Area West 6.

   The dwelling at 436 SH16 currently receives noise levels of 66.1 dB LAeq. 436 SH16 is predicted to receive a noise level of 64.8 dB LAeq with the Project in place (Do-Minimum Scenario) which would be marginally within Category B. This assessment area is at an intersection of SH16 with Taupaki Road. The existing road surfacing is High Strength OGPA (with low air void, not considered a low noise surfacing). This surfacing is required in this area with horizontal curve radius of 200m. The use of an alternative road surface material (Mitigation Option: Standard PA10 surface) will result in short surfacing life and high risk of pavement failure and was not considered a feasible option due to safety reasons.

   It is also noted that as 436 SH16 is a double storey dwelling a barrier would not be a suitable mitigation option and was not considered as part of the Noise Mitigation Best Practical Option (BPO) Assessment. A 2m noise wall would not reduce predicted noise levels to Category A at the lower or upper level of the dwelling. The predicted noise level is at the most affected façade, i.e. the upper floor of the dwelling. In addition, the noise level is already predicted to reduce by 2 dB, to the low end of Category B. Upon completion of the Project works, the dwelling will reduce from 66.1 dB to 64.8 dB, which is considered an improvement from the current situation.

   With the Project implemented, the noise level is predicted to reduce at 436 SH16 (though still within Category B). As stated in the Acoustic Assessment (Section 6.4.1.), the Do-nothing scenario (where the Project is not built, but traffic changes over time) showed that noise levels would decrease by approximately one decibel along SH16 until the design year, due to the predicted decrease in traffic volume based on the assumption that projects[1] in the vicinity have been implemented.

3. **What height screening would be required to reduce the levels at 299 SH16 to Cat B?**

   The dwelling at 299 SH16 is close to the existing road and currently receives high noise levels of 70.2 dB LAeq (and is within Category C). 299 SH16 is predicted to receive a noise level of 71.3 dB LAeq with the Project in place (Do-Minimum Scenario) which is still within Category C.
   A noise level change of 1 decibel is an insignificant/imperceptible change.

   299 SH16 is a double storey dwelling, as such a barrier is not a suitable mitigation option and was not considered as part of the Noise Mitigation BPO Assessment. The predicted noise level is at the most affected façade, i.e. the upper floor of the dwelling. A 2m barrier is recommended to reduce noise levels for the ground floor.

   To reduce the noise level at the upper floor into Category B, more than 3 dB noise level reduction are required. A barrier would need to be in excess of 5m.

[1] Projects in the area include those administered by Te Tupu Ngātahi Supporting Growth Alliance, on behalf of Auckland Transport and Waka Kotahi. Some of these projects are not currently consented or funded, but are expected to be implemented by 2048.

4. **What further extent of screening would be required to reduce 218 SH16 to Cat A?**

   The dwelling at 218 SH16 is close to the existing road and currently receives very high noise levels of 70.1 dB LAeq (and is within Category C). The predicted noise level with the Project in place (Do-Minimum) remains unchanged at 70.1 dBLAeq.

   The dwelling at 218 SH26 is in an unusual location, within a commercial site with driveways either side of the house. To achieve further noise level reduction, a barrier would need to be 2.5 – 3m high and have returns away from SH16 either side of the dwelling. This would result in several adverse effects: shading from a high barrier very close to the dwelling (this can create a microclimate that reduces light and ventilation.), a barrier outside the designation (i.e. the returns), the need for a (higher) gate in the fence for the driveway. Therefore, this option was not considered the BPO.

5. **Please confirm whether the recommendations in Section 6.6 of the acoustic assessment related to avoiding ATP within 100m of dwellings and providing signage or design to avoid engine braking form part of the proposed design.**

   No Audio Tactile Profiled (ATP) road markings are proposed as part of the project due to the impacts of ATP generated noise on residents as per Waka Kotahi Guidelines for using audio tactile profiled (ATP) roadmarkings. The Land Transport Act 1998 allows all road controlling authorities, including Waka Kotahi, to prohibit or restrict engine braking in any area where the permanent speed limit does not exceed 70km/h. Given the permanent speed limit is 80km/h for a majority of the Project extent and there is no existing 'no engine braking' signage within the Project extent, this signage is not proposed as part of the design.

Transport

6. **Details of the performance of the intersections between SH16 and adjoining side roads are not included within the NoR application. Some brief indication of intersection performance of the SH16 / Coatesville Riverhead Highway are provided in Appendix B - Assessment of Alternatives but this is insufficient to compare the relative performance of the intersections. It is necessary to understand the effects of the changes on the operation of the network, including any changes to the operation of the SH16 and of side road approaches (including the Coatesville Riverhead Highway intersection, Old North Road roundabout and the Brigham Creek Road roundabout). The information is required to demonstrate that the layout proposed is appropriate and the effect on the side road approaches.**

   Please provide traffic modelling reports that demonstrate the forecast operation of the intersections within the Notice of Requirement. The modelling should include specific performance related parameters for the intersections (queues, delays, level of service, degrees of saturation). The modelling should take into account the effects of any pedestrian crossings on the operation of the intersections.

   Details of the forecast operation of the SH16 / Coatesville Riverhead Highway intersection, SH16 / Old North Road roundabout and the SH16 / Brigham Creek Road roundabout should be provided as these will be directly affected by the proposals.

   Please refer to Attachment 2 reports including Flow Transportation Specialists, SH16 Safe Roads Alliance SH16 Corridor Option Evaluation Report dated August 2017 and the Beca Coatesville Riverhead Highway Roundabout Traffic Volume Update and Safety Check at Crossings Memorandum dated 15 March 2021.

7. **Details of the assumptions in the traffic modelling in terms of what development and wider traffic upgrades have been included in the assessment have not been provided. For instance Plan Change 69 Spedding Block includes development that was out of sequence from that envisaged in the Whenuapai Structure Plan with the development occurring earlier than envisaged. There is also a plan change that has recently been lodged with Council for development in Riverhead which would directly impact on the SH16/Coatesville Riverhead Highway intersection.**

   Please provide details of the assumptions used in the traffic modelling, including what traffic upgrades were included and what development has been allowed for, including whether PC69 and development in Riverhead was included in the traffic modelling.

   Waka Kotahi does not consider the proposed future development in Riverhead to form part of the existing environment because at the time traffic modelling was undertaken (March 2021), Plan Change 69 was not notified (notified October 2021) and therefore was not considered as part of the existing environment for which this traffic modelling is based on.

8. **Details of forecast traffic volumes on each section of the corridor and the turning movements at each intersection have not been provided. These are required to assist in confirming that the appropriate number of lanes (and capacity) along the corridor have been provided.**

   Please provide details of the forecast traffic volumes along links and turning movements at key intersections (including Kennedy Road).

   Please refer to Attachment 2 reports including Flow Transportation Specialists, SH16 Safe Roads Alliance SH16 Corridor Option Evaluation Report dated August 2017 and the Beca Coatesville Riverhead Highway Roundabout Traffic Volume Update and Safety Check at Crossings Memorandum dated 15 March 2021.

   Kennedy Road has not been specifically included in the traffic modelling given the low traffic volumes currently recorded. Latest Average Daily Traffic Counts from Auckland Transport dated 22 March 2021 are shown in Figure 1.

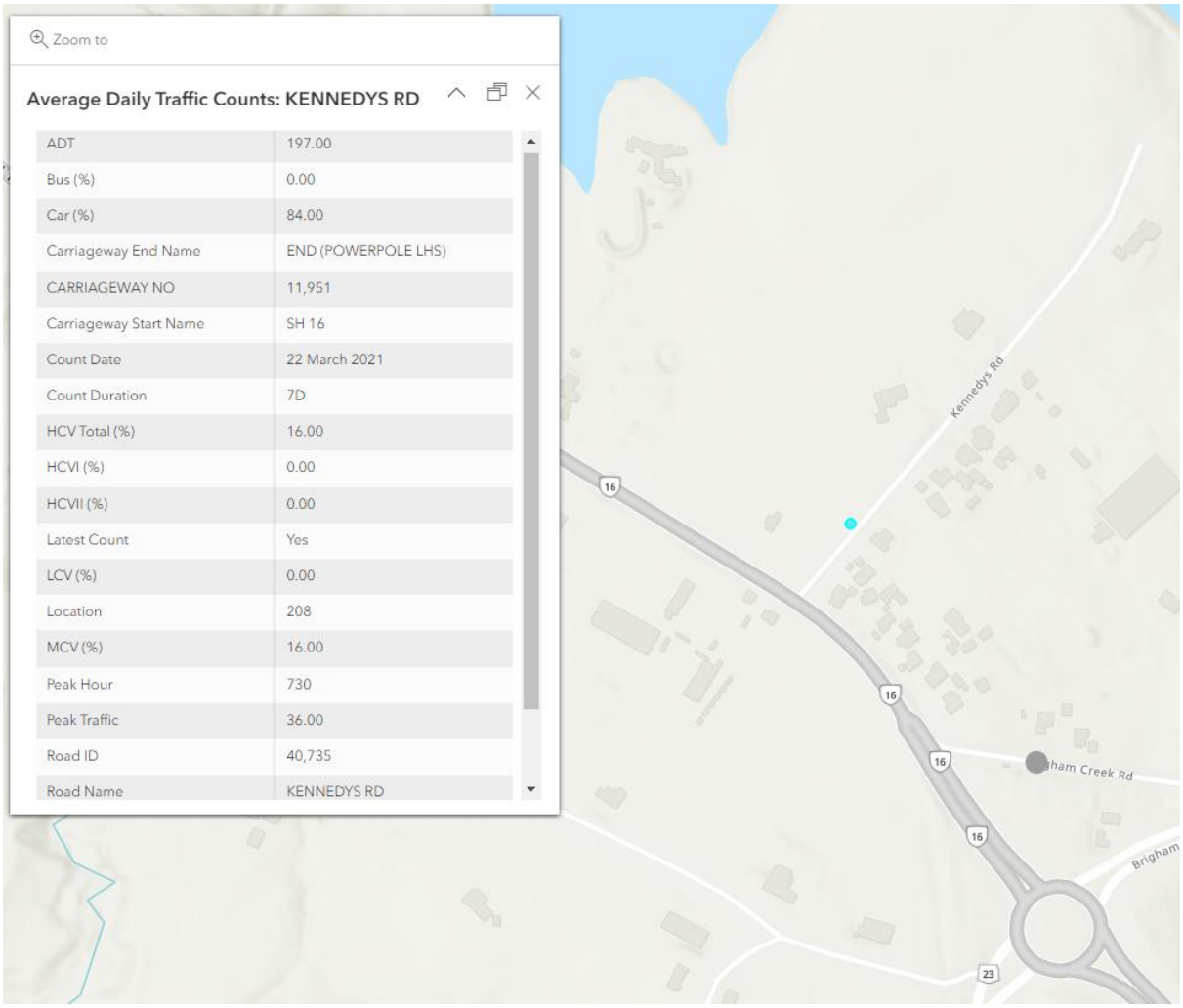

Figure 1: Latest Average Daily Traffic Counts from Auckland Transport dated 22 March 2021.

9. **The reporting does not include sufficient detail of the performance of different options for the intersection layouts assessed in deriving the NoR layout. This information is required to demonstrate that the most appropriate layout (and associated designation area) has been chosen.**

   Please provide details of traffic modelling (including outputs) on alternative intersection layout options considered, including the SH16 / Coatesville Riverhead Highway intersection.

   The traffic modelling analysis for the Project has been provided in Attachment 2. This was undertaken on a corridor section-by-section basis, including for the SH16/CRH intersection (which is Section B). This informed the evaluation (under the 'Efficiency' criteria within the MCA Framework) of the various options within each corridor section. For assessment of the options against the efficiency criterion, a high level analysis (using SIDRA INTERSECTION software) was undertaken for design and evaluation.

   Traffic modelling was undertaken for the SH16/CRH intersection (i.e. Section B, which was proposed to be upgraded), however not specifically for the other local road intersections with SH16. Notwithstanding this, none of the treatments were considered to greatly alter the traffic modelling outputs. The MCA option evaluation was the process used to evaluate and determine the most appropriate treatment for improving safety and efficiency for multiple transport modes.

Alternative intersection options were developed and assessed as part of Single Stage Business Case Stage (SSBC) as summarised within the SH16 Brigham Creek to Waimauku Project: Stage 2 Assessment of Alternatives dated 3 November 2022 that was lodged with the application in Appendix B. The Assessment of Alternatives further assessed various design options along the alignment. Please refer to Assessment of Alternatives and the appendices for more detail on the analysis of the efficiency of the individual options considered.

Kennedy's Road

This existing intersection is located on SH16 at RP 0.300. It is a "T" intersection with a "Stop" control. There is a flush median along SH16 with a "Right Turn Bay" for vehicles to turn into and out of Kennedys Road. There are five residential accesses and two commercial accesses with 100m of the intersection. Street lighting is available along this part of the corridor and flag lighting at this intersection. There are two bus stops within 50m of the intersection. This intersection requires a safe intersection sight distance of 214m. It is estimated that vehicles turning left into SH16 from Kennedys Road achieve this minimum distance to the west however due to the geometry to the east, this minimum distance cannot be achieved. There is 165m of sight distance to the east. There is an AADT of 33,140 near this intersection which is considered high for a rural road. Kennedys Road had an AADT of 151 vehicles per day (at time of business case in 2017). The AADT near the intersection has been gradually increasing every year with a growth rate of 7%. As noted above, it had increased to ADT of 197 at time of design and further option evaluation in 2021). The intersection crash risk has potential to increase with this growth as exposure increases.

Kenney's Road is located within section A of the Project corridor so the design of this intersection was altered as a result of the whole of Section A safety treatment option. The design selection process is summarised within the Assessment of Alternatives.

Taupaki Roundabout

The existing two lane roundabout intersection at Taupaki Road and Old North Road is not proposed to be altered. However, proposed safety and efficiency improvements either side of the roundabout on SH16 will improve the functionality of the intersection.

As detailed above, the treatment option for Section C is to provide two lanes each way plus the installation of a median barrier.

For Section D (Taupaki Roundabout to Kumeū) the selected safety treatment is the existing single lane each way layout of the corridor with the addition of a flush median. The options assessment for this selection is detailed in the Assessment of Alternatives.

10. **The assessment notes that the proposed mitigation measures for Plan Change 69 Spedding Block does not affect the forecast operation of the Stage 2 works. It is not clear whether the assessment of the NoR includes or excludes the PC69 mitigation measures.**

    Please clarify whether the assessment of the operation of the corridor includes or excludes the PC69 mitigation measures (roundabout metering).

    If the mitigation measures have not been included, please provide an assessment of the effects of these mitigation measures on the performance of the corridor.

It is assumed the 'assessment' referred to is Appendix G of the Assessment of Alternatives Report (dated 3 November 2022), Section A-C: Brigham Creek Road to Taupaki Road Options Assessment. Under the option assessment against the efficiency criterion for Section A-C shortlisted options it was stated that "Plan Change 69 has proposed transport efficiently upgrades along Brigham Creek Road, the plan change will not affect the scores", this was as the upgrades are located approx. 700m away from the Project corridor.

The Brigham Creek Roundabout is not within the Project extent (which covers the SH16 corridor north of the Brigham Creek Roundabout to Weza Lane). Therefore, the effects of an entirely separate project on this roundabout are irrelevant.

11. **The Alternatives Assessment – Appendix G provides a table that summarises the changes in travel times by direction for the whole of Section A to C. The summary table does not enable an assessment of how the various sections of the proposals contribute to these travel times, noting that not all traffic will travel along the entire length of Section A to C; for instance, a significant volume of traffic will only travel through sections A and B.**

    Please provide details of traffic modelling (including outputs) on the operation of the Stage 2 corridor as a whole. This should include the journey times for the whole route (by direction) and for each section of the corridor.

    The output should be provided for the identified option and any alternatives considered.

    Please refer to the reports in Attachment 2 including Flow Transportation Specialists, SH16 Safe Roads Alliance SH16 Corridor Option Evaluation Report dated August 2017 and the Beca Coatesville Riverhead Highway Roundabout Traffic Volume Update and Safety Check at Crossings Memorandum dated 15 March 2021.

12. **Details of the traffic modelling for travel times along the corridor have not been provided. It is therefore not clear over what length the travel times have been reported. For instance, for northbound travel times, it is not known whether the travel time has been taken from north or south of the Brigham Creek Roundabout.**

    Please provide details of the location of the start and finish positions of the travel times reported along the corridor.

    Please refer to the reports in Attachment 2 including Flow Transportation Specialists, SH16 Safe Roads Alliance SH16 Corridor Option Evaluation Report dated August 2017 and the Beca Coatesville Riverhead Highway Roundabout Traffic Volume Update and Safety Check at Crossings Memorandum dated 15 March 2021. The Brigham Creek Roundabout is not within the Project extent (which covers the SH16 corridor north of the Brigham Creek roundabout to Weza Lane) as such travel times are reported excluding the Brigham Creek Roundabout.

13. **Turning movements at the Kennedy Road intersection are to be restricted to left-in and left-out only. Right turn movements would be required to U-turn at the roundabouts at either Brigham Creek Road or the Coatesville Riverhead Highway intersection. No details of the volumes of vehicles affected or the additional travel times are provided. To understand the effect on these vehicle movements details of the volumes affected and the change in travel times should be provided.**

Please provide details of the turning volumes affected by the right turn bans at the Kennedy Road intersection, and the resulting additional travel times for these affected vehicles.

As noted above Latest Average Daily Traffic Counts from Auckland Transport dated 22 March 2021 indicate an Average Daily Traffic (ADT) of 197 for Kennedy Road. Further vehicle count information is not available from either Auckland Transport or Waka Kotahi to determine the turning volumes which would be affected by the removal of the right turn into Kennedy Road.

Additional travel times resulting from the right turn removal are impacted by a number of factors including the time of travel and operation of the proposed road network upgrades. As noted above Kennedy Road has not been specifically included in the traffic modelling to date given the low traffic volumes currently recorded and as such modelled travel times are not available.

The additional travel distance as a result of the removal of the right turn into Kennedys Road is 2.56 km.

The installation of median barriers resulting in the removal of the right turn into Kennedys Road (which is within Waka Kotahi existing designation), could be undertaken any time as of right by the Road Controlling Authority (RCA) being Waka Kotahi via an Outline Plan of Works.

14. **Details of the existing crash record and the forecast crash savings have not been provided except at a high level. This information is required to confirm the claimed improvements in the safety record of SH16 and associated intersections.**

    Please provide details of the locations of the crashes, including crash types along the corridor, and details of the assessment of the crash savings forecast with the proposed NoR for these crash types. The assessment should also be provided for any alternative options considered. Details should be provided for the individual sections and key intersections.

    Please refer to Flow Transportation Specialist SH16 Brigham Creek to Waimauku SSBC Economic Update dated 28 April 2020 (Attachment 3) and Flow Transportation Specialist SH16 Brigham Creek Road to Waimauku Update to Economic Analysis dated December 2021 (Attachment 4) which further details the assessment of the crash savings forecast for the Project.

    A Crash Analysis System (CAS) search has recently been completed and data is provided. Refer to Attachment 5 CAS output file SH16 Stage 2 CAS Output Data.xlsx. This data can also be viewed visually here https://maphub.nzta.govt.nz/cas/

    The data extracted per intersection for the most recent injury crashes recorded (2010 to present) for the SH16 – Stage 2 corridor is summarised as below.

    CRH:

    - 12 crashes recorded between 2010 to present, 1 was serious injury and remainder were no injury crashes

    Taupaki Roundabout:

    - 16 crashes are recorded at this intersection between 2010 to present, 6 being minor injury crashes with 10 non-injury crashes.

    Kennedy's Road:

- 2 crashes are recorded here, 1 being a serious crash in 2016 and 1 being a non-injury crash in 2014

15. **Vehicle tracking has not been provided at any of the intersections or vehicle crossings. Vehicle tracking is required to demonstrate that design and check vehicles are able to be accommodated with the proposed design and within the designation area.**

    Please provide vehicle tracking of design and check vehicles at the following locations:

    - **SH16 / Coatesville Riverhead Highway intersection,**
    - **Vehicle crossing for 1411 Coatesville Riverhead Highway intersection (all turning movements into and out of the vehicle crossing)**
    - **Turning movements into Soljans Estate Winery**

    Please refer to Attachment 6 for the requested vehicle tracking.

16. **The proposals will significantly change the design of the existing corridor and intersections. With such significant changes it is important that the design operates safely. No details of safety audits have been provided. Should modifications to the design be required to address safety audit comments, this may alter the designation requirements or alter the operation of the corridor. Areas which could be of concern include the use of the double left turn from Coatesville Riverhead Highway to SH16 southbound, the use of courtesy pedestrian / cycle crossings at the roundabouts where these cross multiple traffic lanes and the use of shared cycle/footpaths rather than separated facilities.**

    Please provide road safety audits of the proposed design, including designers response and Client Decisions.

    Please refer to the Preliminary Design Road Safety Audit SH16 - Safety Improvements Stage 2 Brigham Creek to Kumeu dated 29 April 2021 (Attachment 7) which includes designers' responses and Client Decisions.

    Please also refer to the SH16 – Safety Improvements Stage 2 Brigham Creek to Kumeu Detail Design Road Safety Audit dated 21 September 2022 (Attachment 8). It is noted that Detail Design Road Safety Audit has been reviewed in terms of impacts on the operation and designation requirements and outcomes from the Detail Design Road Safety Audit are not expected to require changes to the operational or designation requirements.

17. **The NoR does not provide details of how the proposed works are constructed and the associated traffic management. As this section of SH16 is the only arterial that serves the area north west of Whenuapai, traffic management may adversely affect the operation of the corridor, including side roads connecting to SH16.**

    Please provide details of the planned Construction Traffic Management Plan.

    Please provide an assessment of the effects of construction on the operation of SH16.

Any potential effects will be appropriately managed through the Construction Traffic Management Plan (CTMP).

A CTMP will be prepared during the outline plan stage. A CTMP based on the Code of Practice for Temporary Traffic Management, will be prepared by the contractor prior to construction, which will set out specific details of construction traffic management. This will also include site specific Traffic Management Plans (TMP) tailored to manage specific site constraints. Refer to Section 8.3.5 Transport Effects of the AEE for full details and draft proposed designation condition DC.4.

Ecology

18. **Currently the ecology report concludes that the magnitude and level of effects on herpetofauna and bats 'cannot be assessed'. It is inappropriate for an ecological impact assessment to conclude that some ecological effects cannot be assessed. These effects can be assessed and have been for other similar past projects (e.g. SH20B upgrades). Recommending a condition of consent requiring surveys of lizards to determine if native lizards are present, and thus the effects on lizards is not appropriate. For bats, static loggers can also be deployed in key locations to determine if bats are using the area. Tree assessments can be done as a minimum from the ground to identify obvious roost features. These trees would be flagged for further inspection prior to felling.**

    Please undertake the required assessments to determine the magnitude and level of effect on herpetofauna and bats.

    This is not an NOR (land use) matter but rather request for information relating to the application for resource consents. A response will be provided as part of the response to the S92 request for further information on the application for regional resource consents (BUN60412291).

Urban Design

19. **The consistent design along the corridor means that it does not appear to be responsive to local place-making or locally significant features.**

    Please provide information and context on why this design approach has been taken and why a context-based design (including views out of the corridor) wasn't.

    Please refer to Appendix K of the lodged NOR package entitled Urban and Landscape Design Masterplan (ULDMP) for further information. The overarching Corridor Strategy is set out in Section 2.3.

20. **In addition, confirmation is required that the species selection is consistent with WF7, WF8 or WF11 where appropriate.**

    We understand prior to human settlement, the SH16 Project corridor is likely to have been covered by puriri dominated broadleaf forest, kahikatea-pukatea dominated forest, and Kauri, podocarp, broadleaved forest. We have integrated some of these specimen tree species within the canopy tree mix where appropriate.

21. **The Ecological assessment refers to restoration planting but it is not clear if this is included on the Landscape and Ecological Plans.**

    Restoration planting is integrated within the Landscape and Ecological Planting Plans along the riparian margins and in new stormwater areas.

22. **The proposed roundabout design at the Coatesville-Riverhead Highway does not appear to reference the local rural environment.**

    Provide explanation for in particular the usage of stones/boulders in the design.

    Please refer to ULDMP (Appendix K of the lodged NOR package) for further information. Page 18 explains the design response and rationale for the roundabout design.

Shared Path

23. **The general arrangement drawings show the shared path labelled as having a 1m berm either side. This does not appear to be consistent with the typical sections and landscape plans that show narrower strips with planting on one side and chipseal on the other.**

    Please provide clarification on these inconsistencies within the plans and what should we be expecting to see on the ground.

    The shared path generally maintains the stated 1m wide berm either side along the alignment. In several locations the berms vary in treatment type and width in response to the existing site constraints or infrastructure such as bus stops, crossings etc. Typically the front berm will be a 1.3m berm (including 300mm kerb) which is proposed to be chip sealed to provide required separation and reduce high risk maintenance activities adjacent to the corridor. The back berm is generally 1m wide with low level amenity planting and provides for lighting and other infrastructure where required. Fall restraint fencing is also provided where retaining or steep batters are required. In other locations such as at proposed bus stops, crossings and the existing Taupaki Roundabout the shared path width is increased and extends to the kerb.

Noise Walls

24. **Reference is made to replicating the pattern and colour used on the noise walls from Lincoln Road to Westgate –it is considered that this is an urban area.**

    What information do you have to justify the use of noise walls and their design in a rural environment.

    Please refer to the SH16 Safety Improvements Stage 2: Brigham Creek Road to Kumeū Assessment Of Acoustic Effects dated 3 Nov 2022 (Appendix X of the AEE) for the justification of noise walls within the design. Please also refer to ULDMP (Appendix K of the lodged NOR package) for further information. Page 17 explains the design response and rationale for the noise wall treatments.

    The purpose of the ULDMP was to set a framework of options to consider during the design of noise walls should they be required; it was not to provide the final solution. It is acknowledged that Lincoln Road to Westgate is more of an urban environment. The reference to the noise walls in this location was intended to refer to their textures and surface patterns rather than the exact material. The actual proposed noise wall design includes a timber material (with landscape planting in front where practicable), which is considered to be more appropriate for the rural context of the Project area, despite the fact this area will urbanise over time.

25. **It is also noted that the proposed material for the noise walls is ply, which has been shown to deteriorate badly. A simple robust and rural design is recommended. Consideration should also be given to requiring noise walls to be removed when future subdivision or development occurs.**

Have you done any analysis of ply as a building material and have any conditions been thought about for removal of noise walls following future development?

The durability and maintenance of the proposed timber noise walls has been considered during the design. Timber noise walls have been utilised in serval other locations on the state highway network and when maintained appropriately have been successful in their implementation. The proposed timber design is considered to be 'a simple robust and rural design' and is considered to be in keeping with the rural environment. Please refer to ULDMP (Appendix K of the lodged NOR package) for further information. Page 17 explains the design response and rationale for the noise wall treatments.

Potential future removal of noise walls would need to be considered within the context of any proposed future development which is unknown at this point in time.

26. **While the majority of noise walls are suitably screened, the following are not and consideration should be given to mitigating effects: 218 SH16, 315 SH16, 340 SH16, and 550 Sh16 (low amenity planting only).**

    Please provide justification for why these areas are not screened?

    Space constraints along the corridor have limited the opportunity to provide larger screen planting in these areas.

Retaining Walls

27. **Provide review of the retaining walls at Ch190900 and 191630 to ensure visual impacts are mitigated/screened**.

    Retaining wall SRW1 at CH190900 on the Westbound side of the alignment retains the Shared Use Path and will not be visible from the highway corridor. The recommendation from the Arborist to protect the existing established large trees at Ch190900 and the proposed planting will limit visual impact of this retaining wall to adjacent properties.

    Retaining wall GRW2A at CH190900 on the Eastbound side of the alignment retains the embankment and adjacent property. Space constraints along the corridor including existing critical services have limited the opportunity to provide larger areas for planting/screening in this area and has resulted in a retaining wall close to the corridor.

    Retaining wall GRW3 at CH191630 on the Westbound side of the alignment retains the embankment and adjacent property. Space constraints along the corridor in relation to minimising land requirements have limited the opportunity to provide larger areas for planting/screening in this area and has resulted in a retaining wall close to the corridor.

Built Heritage

28. **The sites of the Sinton Houses, two of which are identified as being pre-1900 and the third scheduled property, more than likely pre-1900. As a group these houses are of immense importance to the area. The name Sinton is synonymous with the development of Brigham Creek.**

    Has there been any communication with NZHPT on the sites of the Sinton Houses?

Please refer to AEE Section 10.2 Heritage New Zealand Pouhere Taonga Act 2014 and Section 7.4 Summary of key stakeholder consultation and engagement. A pre-application meeting was held on 9th Feb 2022 with Robin Byron, Tharron Bloomfield and Greg Walter from NZHPT. The meeting minutes detailing the key matters discussed are included as Attachment 9.

In parallel to the planning applications under the RMA, General Authority from Heritage New Zealand Pouhere Taonga was sought on 19/01/2023 and is currently processing.

Parks

29. **Recently the Rodney Local Board has implemented street tree planting from the corner of SH16 and Kennedy's Road, and along the road frontages of the Kumeu Centre. The project identified available gaps in the road reserve berm and intends to improve the amenity and environmental outcomes.**

    The application arboricultural report identifies street trees as groups along the road corridor. Specific trees and locations are not shown however descriptions of the tree groups are provided. The Landscape and Ecological Plan drawings key "Existing Tree – To be protected and retained where practicable during construction". However, it appears that individual trees worthy of retention (for example, street trees planted recently by the local board) are not identified on the landscape drawings for protection/retention. There appear to be locations where the existing street trees could be retained within the proposed design and are within garden bed footprints. For example, trees identified as '108' are stated in the arboricultural report to be unaffected by the works, but the landscape drawing (Sheet 2) does not identify the specific trees to be retained.

    Please explain why these existing street trees are not identified to be retained on the landscape drawings?

    It is the intent along the design alignment to limit vegetation removal as far as practicable and that existing trees would be retained and protected where practicable. Trees identified in group 108 are intended to be retained and integrated into the proposed landscaping design where existing tree species are healthy, appropriate and consistent with the project landscaping approach. The works in proximity to this tree group are limited to installation of new street light poles so the trees will likely not be impacted significantly by the works and can be retained and protected.

Healthy Waters

Basis of Design (Section 3.4)

30. **The imperviousness of rural zones has been stated as 10%; however, there is no information provided on how this assumption has been defined. Runoff from large rural areas can be difficult to model definitively due to the maximum permitted imperviousness set out in E8.6.2.4 of the Auckland Unitary Plan (AUP).**

    Please provided some sensitivity analysis on the imperviousness of the rural area to assess potential impacts of development over the life span of Waka Kotahi Infrastructure to ensure that safety is maintained.

    This is not an NOR (land use) matter but rather request for information relating to the application for regional resource consents, we have therefore the answer to this question is provided in the section 92 response for the regional consents (BUN60412291).

31. **An allowance of 60% imperviousness has been allowed residential areas, which is lower than would be anticipated considering the extent of Terrace Housing and Apartment Blocks (THAB) that is currently zoned and the extent of FUZ that is present in the Redhills catchment.**

    Please provide details on how the Future Urban Zone (FUZ) is included in the runoff assessment.

    This is not an NOR (land use) matter but rather request for information relating to the application for regional resource consents, we have therefore the answer to this question is provided in the section 92 response for the regional consents (BUN60412291).

    Stormwater Discharge and Diversion (Section 4.3)

32. **Table 4-2: Changes in impervious areas at Discharge Points states that the post development impervious area draining to Outfalls Q and R will increase; however, Table 4-3: Proposed Stormwater Discharge Points and Conveyance Systems state that there is no change to the road pavement or drainage.**

    Please provide clarification.

    This is not an NOR (land use) matter but rather request for information relating to the application for regional resource consents, we have therefore the answer to this question is provided in the section 92 response for the regional consents (BUN60412291).

33. **The treatment efficacies stated for swales in Table 4-3 appear to be meaningless (for example 436% treatment achieved for discharge point N). It is not clear within the report how this efficacy has been calculated and it is probably more realistic to state that the swale is larger than the minimum required length.**

    Please provide clarification.

    This is not an NOR (land use) matter but rather request for information relating to the application for regional resource consents, we have therefore the answer to this question is provided in the section 92 response for the regional consents (BUN60412291).

    Cross Drainage (Section 4.6)

34. **The section states that as this is a safety project there isn't a requirement to upgrade existing culverts that comply with current design standards and if the flooding effects are not worse than the current situation. Healthy Waters considers that flooding of the SH16 would be considered to be a significant safety issue, particularly at chainage 192570 where there is expected to be 1.55m of water on the carriageway (Table 4-5 Chang in HWL at culverts with capacity for 10% AEP rainfall event).**

    - This is not an NOR (land use) matter but rather request for information relating to the application for regional resource consents, we have therefore the answer to this question is provided in the section 92 response for the regional consents (BUN60412291).

35. **The memorandums that have been provided in Appendix E of the Stormwater Report provide an assessment of flows for a range of events and development scenarios associated with the Kumeū No.1 Bridge and the Brigham Creek Culvert (Ngongetepara Stream).**

    It appears that a simple TP108 graphical analysis has been undertaken to establish upstream flows in the watercourses, and a 1D HEC-RAS model completed to identify the potential effects of flows on the proposed works.

    The memorandums present level information within the document; however, it is not clear whether Beca have presented all levels with respect to a single vertical datum. LiDAR downloaded from the LINZ website is in New Zealand Vertical Datum 2016, whilst Healthy Waters model results are generally in Auckland 1946. The difference between these datums is not significant but could potentially have significant impacts on performance of infrastructure. Beca have undertaken an assessment of the flows upstream of the Brigham Creek Culvert. There is no information provided on the calculations undertaken, but it is assumed to be a TP108 Graphical analysis based on the catchment information provided throughout the Flood Report.

    Healthy Waters has undertaken a TP108 graphical check on the flows presented by Beca in the memo, based on the catchment data. The results of this review indicate that the Beca flows are significantly lower than the Healthy Waters figures.

    Please provide details of the calculations that have been undertaken.

    The variation noted in the flows could result in SH16 being overtopped in the 100-year event and this will have an impact on the proposed footbridge to be constructed on the northern side of the bridge.

    The table below presents the variation in flow calculations:

100-year flow estimates at the Brigham Creek Culvert			
	ED Scenario	MPD + 2.1° climate change	MPD + 3.8° climate change
Beca Flow (m^3/s)	74.9	107.3	124.2
Healthy Water Flow (m^3/s)	86.1	139.1	166.4
Percentage difference	+15%	+30%	+34%

    Latest Regionwide Rural Rapid Flood modelling results (Healthy Waters, 2022) indicates that 100-year flows for 2.1 degrees and 3.8 degrees upstream of the Brigham Creek Culvert could be 136.9 m3/s and 183.9 m3/s respectively. Whilst this model is considered conservative due to the high-level nature, these flows are considerably higher than those presented in the Beca memo.

    This is not an NOR (land use) matter but rather request for information relating to the application for regional resource consents, we have therefore the answer to this question is provided in the section 92 response for the regional consents (BUN60412291).

General notes from specialists (not requiring response)

1. Ecology

a. **The Wetland/Riparian Planting schedule shown on landscape plan 3235084-AL-6300 contains sedges, rushes and flax. Very limited numbers of specimen trees are shown to be within the riparian planting zones. The inclusion of trees and shrubs into this mix will provide a more diverse ecological structure as opposed to the current low stature planting.**

   Please consider including trees suitable to riparian areas into this planting mix.

   Noted

b. **Passive reestablishment of vegetation has been noted in the EIA. Passive reestablishment of vegetation is only possible if there is a seed source located nearby of sufficient size and diversity. In this instance passive reestablishment should not be a recommended restoration technique.**

   Passive restoration is not intended to be a proposed restoration mitigation measure but is noted as a possible benefit of the Project.

2. Urban Design

a. **It is noted that Kanuka is a representative species that is not included in the palette. Pseudopanx arboreus and Melicytus ramiflorus are specified as 45L but are not readily available at this size.**

   Noted – we will check suitability of plant grades of these species.

   Species were selected in collaboration with Mana whenua.

   Kanuka was avoided because at the time of putting together a plant palette the disease Myrtle rust was prevalent in the nearby area and greatly affecting Kanuka plantations. We will explore the opportunity of reintroducing Kanuka into the planting mix.

b. **The inclusion of Chionochloa rubra is queried as this prefers a cool wet climate.**

   We will investigate a substitute for this species.

c. **It should be confirmed that Phormium cookianum Emerald Green is suitable for swales, and this species should be substituted for Phormium cookianum where visibility sightlines are required.**

   Phormium cookianum ‘Emerald Green’ is proposed on the upper banks of the swale only. This plant species was chosen for it is lower growing than the Phormium cookianum species which may impact sight lines particularly near driveways and the shared path.

d. **Planting details should be checked against Waka Kotahi Standard Specifications (which should be referenced on the drawings or added as a condition).**

   Noted, planting details are consistent with Waka Kotahi standard specifications which will be referenced in the Construction Tender Issue drawings.

3. Built Heritage

a. **The main concern is the demolition of the farm building (former barn or stables) at 222A State Highway 16. I note that the heritage impact assessment assesses the building is more likely mid-20th century, identifying reused earlier weatherboards and internal framing. Without physically inspecting the building, it is difficult to assess the age. However, based on the images provided in this assessment, noting the earlier timber framing and walls and the style of the barge boards, it is more than probable that this building was built in the late 19th early 20th century and modified progressively more than once. Given the history of the Sinton family and the produce they provided to the settlers in Brigham Creek from their land, I would say this was an important part of that production. I suggest it has been extended over time, but it appears the essence of the earlier building is still there, altered to accommodate the needs of the Sinton production at the time. I concur that the c1902 image indicates a much higher pitched roof. However, the building has been extended and a new roof span with a lower pitch to accommodate the extension would explain the change. Internal images also suggest this. Currently, without inspecting the building, I would favour its retention.**

   A site visit to see the interior of this building will be necessary.

   As per the assessment contained within in the Heritage Impact Assessment lodged with the Notice of Requirement, a desktop study and site inspection determined the contribution of the shed to the subject site is of low-moderate value in terms of its historic heritage. The surviving ancillary farming structure is considered to have limited historical connections to the Sinton Family. Furthermore, the Heritage Impact Assessment also notes that the central interior weatherboard wall (which is the only remaining feature of the original shed) is aged and riddled with borer and visually appears to be in very poor condition (See Figure 2 to Figure 5). The borer has caused the wall to become deteriorated and compromised the structural integrity such that the wall is unlikely to be able to be relocated/reused in a safe manner.

   Additionally, a pre-application meeting was held with Council Built Heritage and Archaeology specialists on 28 October 2021. It is noted, Rebecca Fox's (Heritage Team Leader) initial view was that demolition would be ok, yet if the shed was assessed to have more value than thought initially then relocation would be preferred over demolition (if feasible). Waka Kotahi has already commissioned a very extensive Heritage Impact Assessment which included a detailed site inspection, and is confident that the expert's conclusions regarding demolition will not change.

Figure 2: Photograph of the shed taken from outside

Figure 3: Photograph of the central interior wall

Figure 4: Photograph of from inside the shed

Figure 5: Photograph of the central interior wall

Given the current state of the shed (which is in a very poor condition and not able to be relocated safely), we maintain that demolition is the most appropriate outcome. As per draft proposed designation condition BH.1, Waka Kotahi has proposed that the shed shall be recorded photographically and to a standard equivalent to Level 3, as set out in Heritage New Zealand Pouhere Taonga 2018 Archaeological Guidance Series 1: Investigation and Recording of Buildings and Structures to ensure the Sinton Family history is recorded.

A site visit has been organised for 23 February 2023.

b. The former Janet Sinton property at 191 State Highway 16, has a group of notable trees on the property. I agree with the arboricultural report in its recommended action which has led to changes in the proposed road alignment and underground stormwater connection away from the trees limiting the levels of alterations within the root zones of the trees and minimising the potential adverse effects. I agree with Plan Heritage that Tree Protection Methodologies be followed to avoid adverse effects.

Noted.

c. **Council's Heritage Unit shall be involved in the detailed design of the cycleway and shared path in the vicinity of the Sinton properties. This is to be addressed via the Urban Design and Landscaping conditions.**

Minor adverse effects arising from the Project due to the construction of the Shared Use Path will be adequately addressed through replanting along new boundaries in accordance with the Landscaping and Ecological Planting Plan and the design response outlined in the ULDMP. Whilst we consider the landscaping and design proposed is sufficient to mitigate effects, any proposed conditions will be considered if necessary.

d. **Interpretation will be necessary to mitigate the adverse effects of the cycleway and shared path in the vicinity of the Sinton properties. This shall be managed via the Historic Heritage Management Plan conditions.**

As mentioned within the AEE a separate future project will explore opportunities to incorporate locations for heritage interpretation. Whilst we consider the landscaping and design proposed is sufficient to mitigate effects, any proposed conditions can be considered if necessary.

e. **Should demolition of the former barn/stable be unavoidable, a condition will be required to manage its deconstruction and reuse of salvaged materials within the project footprint.**

As detailed above in point 3.a. the condition of the shed and in particular the central interior weatherboard wall, means that it is unlikely to be able to be relocated/reused in a safe manner. Any proposed conditions of consent to reuse salvaged materials will be reviewed considering the state of the materials.

f. **Mitigative planting and landscape features may be necessary to address the adverse effects of the project on the setting of the built heritage places.**

Planting is proposed within the Landscape and Ecological Planting Plans to sufficiently mitigate adverse effects on heritage values. Additional mitigation planting above that proposed can be considered if necessary.

g. **There are other historic built places on the CHI along State Highway 16 that will be affected by the works that will progress under Stage 2. However, the effects appear to be of minor impact to the built structures and mainly affects the boundary where established trees are present. If any changes are made to the current proposal that changes this, then the heritage unit should be notified to address any concerns. These places are -**

- **37 Main Road Kumeu – Former Kumeu railway goods shed – CHI 13242**
- **7 Main Road Kumeu – Transitional bungalow – CHI 16385 –The 1940 aerial indicates that this has been relocated to this site.**
- **183 State Highway 16 – Early shop -CHI 3713 - There is an error in the Clough report table on page 21 for this place which is an early commercial building (early shop) rather than a transitional villa. Topsoil stripping and possible clearance of existing vegetation and trees is occurring within the proposed new designation boundary adjacent and very close to this**

building. This is deemed to be of minor impact to the building at present. However, if the scope of the work changes within the proposed new designation a specified management plan should be put in place to minimise that impact.

- **Places of Interest - 1411 Coatesville Riverhead Highway, Kumeu – early bungalow. This is a place of historic interest that has not been identified by the CHI, that will be affected by the works that will progress under Stage 2. The works appear to mainly affect the boundary where established trees are present. There is some intervention in the entrance to the property, which is part of a new proposed designation boundary. This is close to the house and vibration effects on the house, from the earthworks should be taken into account as part of the management plan of this property to avoid adverse effects.**

- **There is a villa at 393 State Highway 16, but 1940 aerials indicate this has been relocated to the site.**

We will note the additional sites identified above where effects on built heritage may arise. Should there be any changes to the project alignment or construction works that will affect these sites we will advise Council and include relevant measures within the management plan to mitigate effects.

4. Healthy Waters

a. The report states that overall, 90% of the Stage 2 alignment will be able to receive treatment, which is a significant increase over what is currently provided. Whilst Healthy Waters acknowledges an overall improvement in the quality of discharges from the alignment, water quality management should not be considered at the end of the design process but should be thought of throughout the process.

We agree and confirm that treatment has been considered throughout the design process.

Yours sincerely

A. Carlyle

Ashlie Carlyle

Senior Associate - Planning

on behalf of

Beca Limited

Phone Number: +64 9 3009 272
Email: ashlie.carlyle@beca.com

Copy
Tessa Robins, Waka Kotahi
Andria D'Souza, Waka Kotahi

Attachment 1 – Dwellings within 25m of Proposed Construction Works

Drawing Plotted: 10 Feb 2023 2:37 pm

NOTES:

1. FOR CIVIL WORKS GENERAL NOTES AND LEGEND REFER TO DRAWING 3235084-CA-1200.

KEY PLAN

FRED TAYLOR DRIVE

BRIGHAM CREEK ROAD

EXTENT OF WORKS

CH1900000

TC 190045.518

CH1900422

CH1901000

TC 190147.818

212

PROPOSED CONSTRUCTION WORKS BOUNDARY

25.00

TO KUMEU

CH1902000

CH1903000

WR3

SH16

NW 2.5

171

173

175

177

179

181

183

25.00

EXTENT OF WORKS

MATCHLINE-REFER TO SHEET 2

KENNEDYS ROAD

PROPOSED CONSTRUCTION WORKS BOUNDARY

5

2

4

1

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No.	Revision	By	Chk	Appd	Date
A	FOR INFORMATION	RH			

Drawing Originator: Beca

Original Scale (A1) 1:500
Reduced Scale (A3) 1:1000

Design	G. CLAYTON	10.02.23
Drawn	R. HIDALGO	10.02.23
Dsg Verifier		
Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: DWELLINGS WITHIN 25m OF PROPOSED CONSTRUCTION WORKS - SHEET 1

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-SK-8601 Rev. A

Document No. 3235084-SK-8601.DWG

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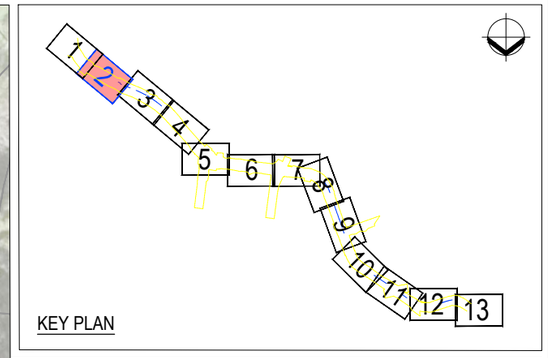
Drawing Plotted: 10 Feb 2023 2:37 pm

NOTES:

1. FOR CIVIL WORKS GENERAL NOTES AND LEGEND REFER TO DRAWING 3235084-CA-1200.



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Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: DWELLINGS WITHIN 25m OF PROPOSED CONSTRUCTION WORKS - SHEET 2

Discipline: CIVIL ENGINEERING

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Rev.: A

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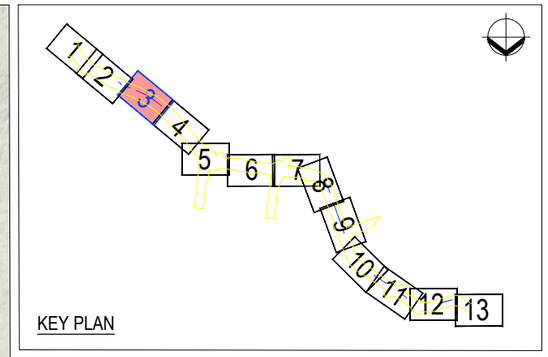

PROPOSED CONSTRUCTION WORKS BOUNDARY

TO KUMEU

TO BRIGHAM CREEK

SH16

CH190900

CH191000

CH190800

CH190700

TC 190705.355

256

238

238A

239

11

25.00

MATCHLINE-REFER TO SHEET 2

MATCHLINE-REFER TO SHEET 4

PROPOSED CONSTRUCTION WORKS BOUNDARY

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No.	Revision	By	Chk	Appd	Date
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Design	G. CLAYTON	10.02.23	
Drawn	R. HIDALGO	10.02.23	
Dsg Verifier			
Dwg Check			Date

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Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: DWELLINGS WITHIN 25m OF PROPOSED CONSTRUCTION WORKS - SHEET 3

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-SK-8603

Rev.: A

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Drawing Plotted: 10 Feb 2023 2:38 pm

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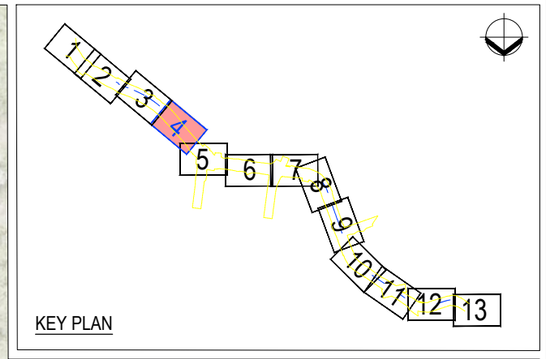

KEY PLAN

PROPOSED CONSTRUCTION WORKS BOUNDARY

25.00

TO BRIGHAM CREEK

CH19100

CH19106.96

CH19200

CH19300

TO KUMEU

TC 19139288

SH16

MATCHLINE-REFER TO SHEET 3

MATCHLINE-REFER TO SHEET 5

264

300

291

299

12

13

14

15

WR3

NW-2.0

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Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: DWELLINGS WITHIN 25m OF PROPOSED CONSTRUCTION WORKS - SHEET 4

Discipline: CIVIL ENGINEERING

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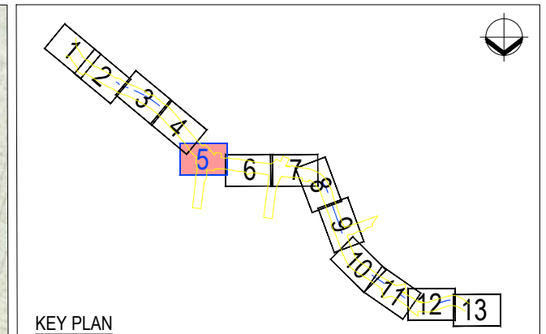
KEY PLAN



PROPOSED CONSTRUCTION WORKS BOUNDARY

MATCHLINE-REFER TO SHEET 4

TO BRIGHAM CREEK

25.00

SH16

WR3

312

315

324

340

1409

1411

1404

1397

COATESVILLE-RIVERHEAD HWY

BORIC SUPERMARKET

BLOSSOMS CAFE

CH0

CH20

CH40

CH60

CH80

CH100

CH120

CH140

CH160

CH191.500

CH191.540

CH0.000

CH172.149

CH191.600

CH191.700

CH198

16

17

18

19

20

21

22

23

REFER INSET A

TO KUMEU

MATCHLINE-REFER TO SHEET 6

PROPOSED CONSTRUCTION WORKS BOUNDARY

INSET A

SCALE 1:1000 (A1)

EXTENT OF WORKS

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No.	Revision	By	Chk	Appd	Date
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Design	G. CLAYTON	10.02.23
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Dsg Verifier		
Dwg Check		

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Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: DWELLINGS WITHIN 25m OF PROPOSED CONSTRUCTION WORKS - SHEET 5

Discipline: CIVIL ENGINEERING

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Rev.: A

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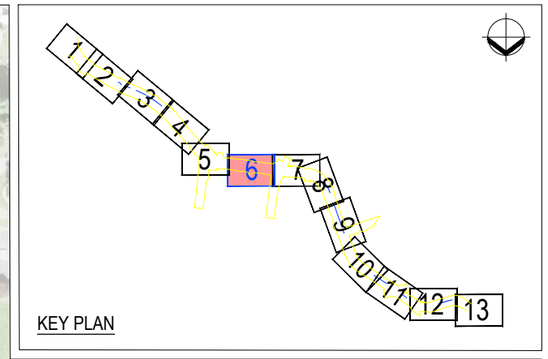

PROPOSED CONSTRUCTION WORKS BOUNDARY

SOLJANS ESTATE WINERY

350

366

449

1368

1368

16

25.00

25.00

CH 191800

CT 191878/52

TC 191878/40

CH 191900

CH 192000

TC 192013/241

CT 192073/160

WR3

TO BRIGHAM CREEK

SH16

TO KUMEU

MATCHLINE-REFER TO SHEET 5

MATCHLINE-REFER TO SHEET 7

ORIGINAL DRAWING IN COLOUR

FOR INFORMATION
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
A	FOR INFORMATION	RH			

Drawing Originator: Beca

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Reduced Scale (A3) 1:1000

Design	G. CLAYTON	10.02.23	Approved For Construction*
Drawn	R. HIDALGO	10.02.23	
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Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: DWELLINGS WITHIN 25m OF PROPOSED CONSTRUCTION WORKS - SHEET 6

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-SK-8606

Rev.: A

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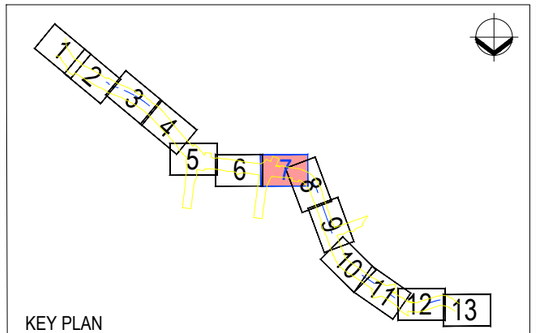
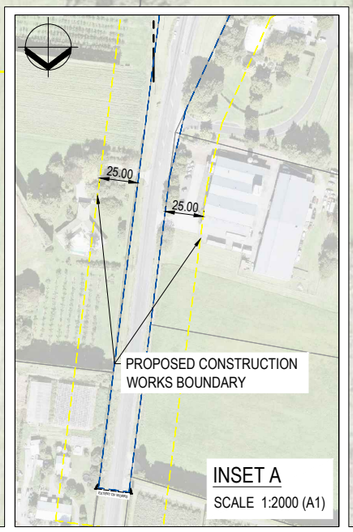
KEY PLAN



455
449
466
454
393
393

TAUPAKI ROAD
EXTENT OF WORKS
PROPOSED CONSTRUCTION WORKS BOUNDARY
TO BRIGHAM CREEK
CH192180
CH192200
CH192300
CH192400
CT 192073
CH 192096
SH16
25.00
25.00
25.00
ALLELY ESTATE
24
KUMEU PRODUCE MARKET
TO KUMEU
MATCHLINE-REFER TO SHEET 6
OLD NORTH ROAD
REFER INSET A
MATCHLINE-REFER TO SHEET 8



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Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: DWELLINGS WITHIN 25m OF PROPOSED CONSTRUCTION WORKS - SHEET 7

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-SK-8607

Rev.: A

Document No. 3235084-SK-8607.DWG

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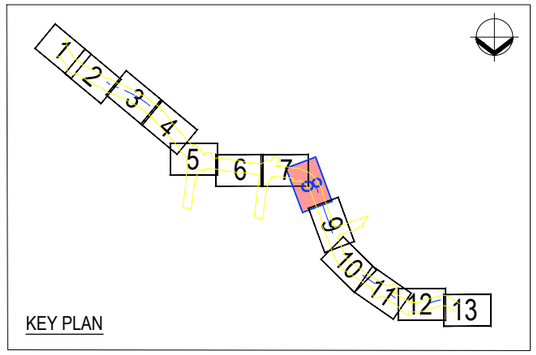

KEY PLAN

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PROPOSED CONSTRUCTION WORKS BOUNDARY

436

418

25.00

CT 192600.8
CH192600

CH192700

26

SH16

CH192500

25

TO KUMEU

28

429

25.00

MATCHLINE-REFER TO SHEET 9

PROPOSED CONSTRUCTION WORKS BOUNDARY

CH192400

407

454

TC 192389.303

KUMEU PRODUCE MARKET

MATCHLINE-REFER TO SHEET 7

27

TO BRIGHAM CREEK

CH192300

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Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: DWELLINGS WITHIN 25m OF PROPOSED CONSTRUCTION WORKS - SHEET 8

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-SK-8608

Rev.: A

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Document No. 3235084-SK-8608.DWG

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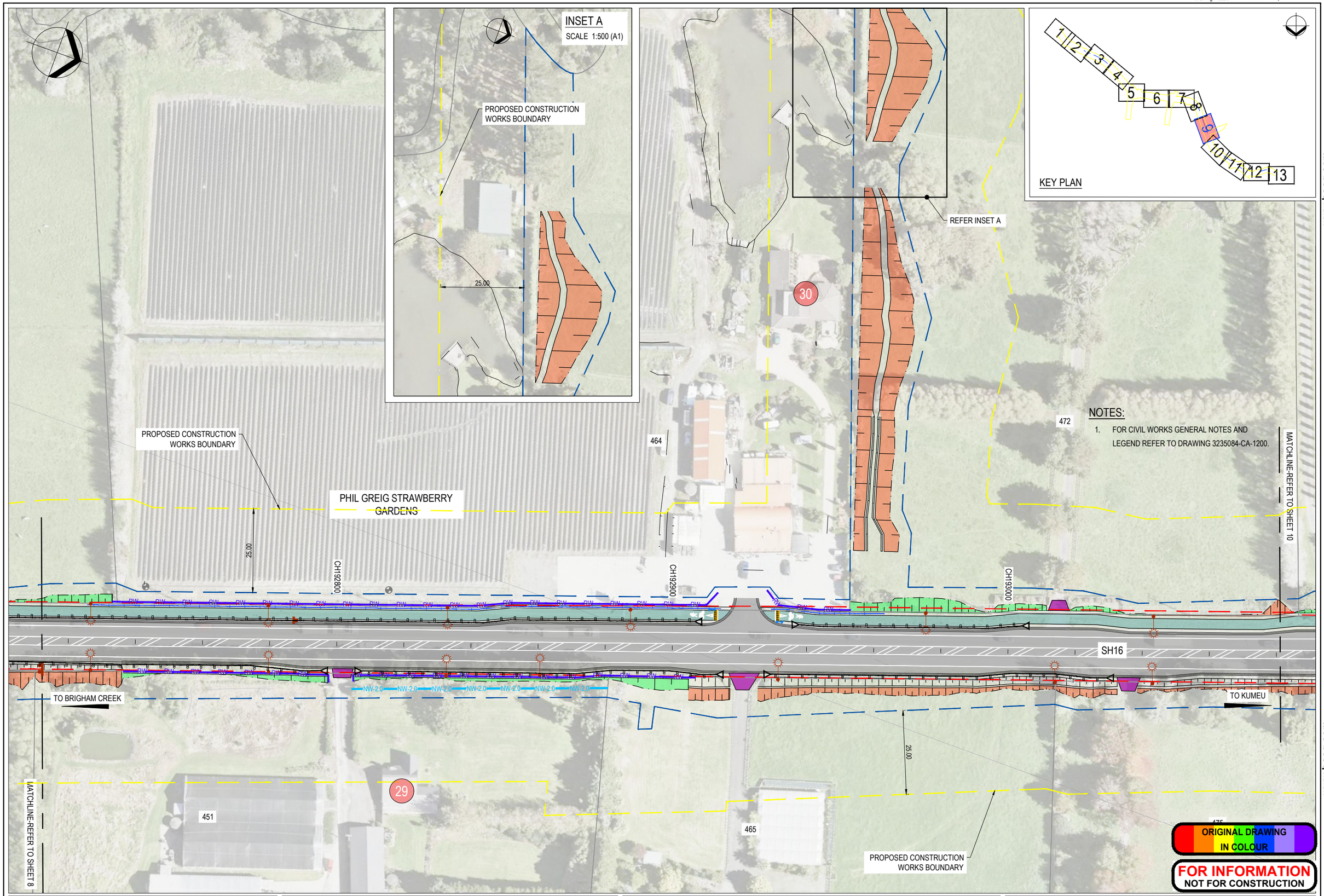

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Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: DWELLINGS WITHIN 25m OF PROPOSED CONSTRUCTION WORKS - SHEET 9

Discipline: CIVIL ENGINEERING

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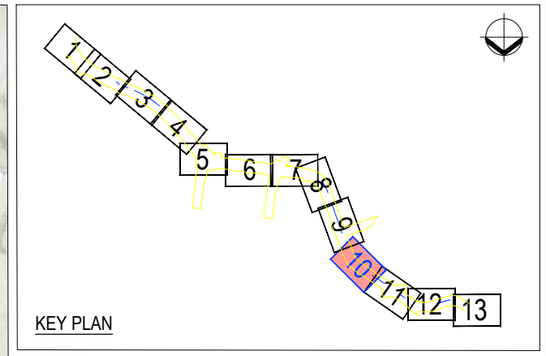

MATCHLINE-REFER TO SHEET 9

CH193100

TO 1931453462

TO BRIGHAM CREEK

482

PROPOSED CONSTRUCTION WORKS BOUNDARY

25.00

CH193200

CT 193271.4111

CH193300

506

CH193400

MATCHLINE-REFER TO SHEET 11

SH16

TO KUMEU

31

KUMEU VILLAGE REST HOME

507

HEART AND SOUL EARLY LEARNING CENTRE

491

505

PROPOSED CONSTRUCTION WORKS BOUNDARY

25.00

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Drawing Originator: Beca

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Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: DWELLINGS WITHIN 25m OF PROPOSED CONSTRUCTION WORKS - SHEET 10

Discipline: CIVIL ENGINEERING

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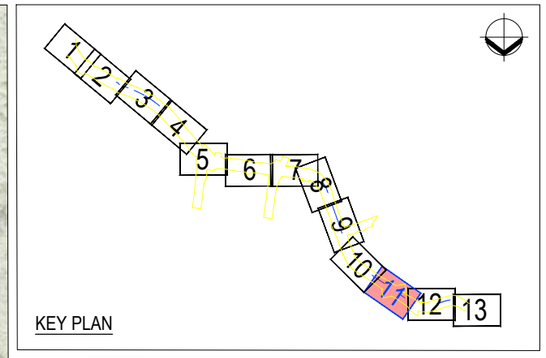

PROPOSED CONSTRUCTION WORKS BOUNDARY

522

25.00

MATCHLINE-REFER TO SHEET 10

CH193500

TP 193600.000

CH193600

BP SERVICE STATION

538

CH193700

550

32

TC 193794.330

CH193800

MATCHLINE-REFER TO SHEET 12

SH16

TO BRIGHAM CREEK

TO KUMEU

25.00

KUMEU VILLAGE REST HOME

507

OLD RAILWAY ROAD

550

PROPOSED CONSTRUCTION WORKS BOUNDARY

ORIGINAL DRAWING IN COLOUR

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No.	Revision	By	Chk	Appd	Date
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Drawing Originator: Beca

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Reduced Scale (A3) 1:1000

Design	G. CLAYTON	10.02.23	Approved For Construction*
Drawn	R. HIDALGO	10.02.23	
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Dwg Check			Date

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Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: DWELLINGS WITHIN 25m OF PROPOSED CONSTRUCTION WORKS - SHEET 11

Discipline: CIVIL ENGINEERING

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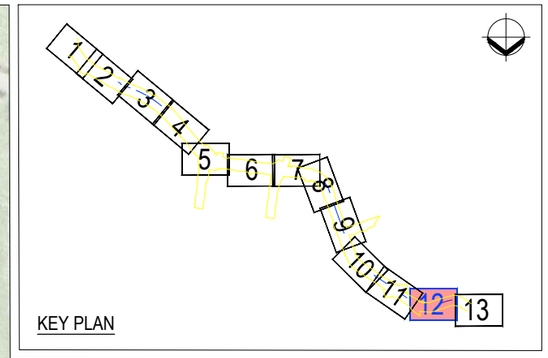

KUMEU RIVER

KUMEU RIVER WINERY

TO BRIGHAM CREEK

TO 193700

CH193800

MATCHLINE-REFER TO SHEET 11

PROPOSED CONSTRUCTION WORKS BOUNDARY

2500

CH193900

CH194000

CH194100

TS 194064.143

SC 194144.148

SH16

TO KUMEU

RIVERHEAD ROAD

PROPOSED CONSTRUCTION WORKS BOUNDARY

MATCHLINE-REFER TO SHEET 13

3
5
7
16
14
2-12
12
14

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A	FOR INFORMATION	RH			

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Reduced Scale (A3) 1:1000

Design	G. CLAYTON	10.02.23
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Dsg Verifier		
Dwg Check		

Approved For Construction* Date

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Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: DWELLINGS WITHIN 25m OF PROPOSED CONSTRUCTION WORKS - SHEET 12

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-SK-8612

Rev.: A

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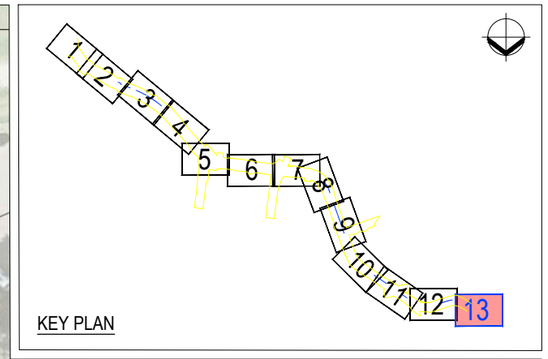

KEY PLAN

PROPOSED CONSTRUCTION WORKS BOUNDARY

CS 194208.548

CH 194200

ST 194248.548

25.00

TO BRIGHAM CREEK

WEZA LANE

EXTENT OF WORKS

WAITAKERE ROAD

ACCESS ROAD

SH16

MATCHLINE-REFER TO SHEET 12

PROPOSED CONSTRUCTION WORKS BOUNDARY

CH 194400

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No.	Revision	By	Chk	Appd	Date
A	FOR INFORMATION	RH			

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	Name	Date
Design	R HIDALGO	10.02.23
Drawn		
Dsg Verifier		
Dwg Check		

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Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: DWELLINGS WITHIN 25m OF PROPOSED CONSTRUCTION WORKS - SHEET 13

Discipline: CIVIL ENGINEERING

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Rev.: A

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Attachment 2 – Flow Transportation Specialists, SH16 Safe Roads Alliance SH16 Corridor Option Evaluation Report dated August 2017 and the Beca Coatesville Riverhead Highway Roundabout Traffic Volume Update and Safety Check at Crossings Memorandum dated 15 March 2021

SH16 Safe Roads Alliance

SH16 Corridor Option Evaluation

August 2017

flow
TRANSPORTATION SPECIALISTS

flow
TRANSPORTATION SPECIALISTS

Project:	**SH16 Safe Roads Alliance**
Title:	**SH16 Corridor Option Evaluation**
Document Reference:	**P:\BECA\006 SH16 Safety Alliance\4.0 Reporting\4.2 Main Reports\R1E170831_SH16 Safe Roads_Inc Option 5_UpdateBCR.docx**
Prepared by:	**Qing Li**
Project Manager	**Terry Church**
Reviewed by:	**Terry Church**

Revisions:

Date	Status	Reference	Approved by	Initials
25 May 2017	A – DRAFT	R1A170525	Terry Church	
30 May 2017	B - DRAFT	R1B170530	Terry Church	
29 June 2017	C	R1C170629	Terry Church	
18 August 2017	D	R1D170818	Terry Church	
31 August 2017	E	R1E170831	Terry Church	

CONTENTS

APPENDICES

1 INTRODUCTION

Flow Transportation Specialists has been commissioned to provide traffic modelling and economic evaluation support with regard to the SH16 Safety Alliance project. The project focuses on providing safety and efficiency improvements along SH16 between Brigham Creek Road (to the east) and Kumeu (to the west).

To complete the traffic assessment and obtain predicted outputs for the purposes of evaluating options, a spreadsheet model was created which considers the following:

- Traffic Volumes from the 2015 Calibrated Base Transport for Future Urban Growth (TFUG) SATURN traffic model. This model has been through a peer review process, and shows good validation along SH16
- Traffic Volumes from the TFUG SATURN Do Minimum network scenario for 2026. This scenario considers Scenario I10 land use. We understand the land uses proposed in the Future Urban Land Supply Strategy (FULSS) are preliminary, and that estimated values may be subject to change following an update to the FULSS in mid-2017
- Spreadsheet bottleneck model
- Intersection SIDRA traffic models for the SH16/Tuapaki Road/Old North Road intersection, and the SH16/Coatesville Riverhead Highway intersection
- Option layouts.

2 ASSESSMENT METHODOLOGY AND FORECASTS

A spreadsheet model for SH16 (SH16 model) has been used to assess the performance of options proposed along the SH16 corridor, rather than the existing TFUG SATURN traffic model.

The SH16 model, which comprises of formulas and SIDRA model outputs was selected as the preferred assessment method as the existing SATURN traffic models do not enable subtle corridor differences to be assessed, in particular where a downstream short lane impacts on lane utilisation and therefore the performance of the upstream intersection. While the SH16 model does not use the TFUG SATURN model to derive operational differences between options, traffic predictions are still sourced from the TFUG SATURN model to ensure consistency.

2.1 Model Scenarios

A base model which reflects the existing traffic conditions in 2015 has been created and compared to actual 2015 traffic observations. The assessment also considers 2026 forecasts to evaluate the impacts of the project.

The statistics predicted by the SH16 model have been used to predict the benefit/dis-benefit of each option.

2.2 Forecast Years

The assessment has not considered forecasts beyond 2026, on the basis that the performance of the SH16 corridor in 2036 is saturated, and that a larger investment response is required to cater for anticipated transport patterns beyond 2026/31, as summarised by the TFUG project and the preferred investment package that this work has presented.

The SH16/Access Road intersection located in Kumeu, and the environment through Kumeu is the primary reason why the assessment has not considered further forecast horizons (namely 2036). As reflected through the TFUG project, more significant capacity and additional transport solutions are required to serve development about the wider North West. Until additional capacity is provided to the Kumeu/Huapai area, traffic demands through the SH16 corridor (Kumeu to Brigham Creek Road) will be managed/controlled by the capacity of the road entering and exiting Kumeu. These constraints are accounted for in the SATURN traffic model, which in turn pushes traffic away from the corridor.

In noting the above constraint, the assessment considers a 5% increase in corridor traffic volumes. This increase is on the basis that through the provision of corridor improvements, additional traffic will be attracted to the corridor, albeit the additional traffic will be managed by the wider network constraints.

It is likely that the true demand through the corridor exceeds the 5% assumed. At this time however, the demand is being redistributed or retimed as a means for commuters to avoid the current delays experienced through the corridor.

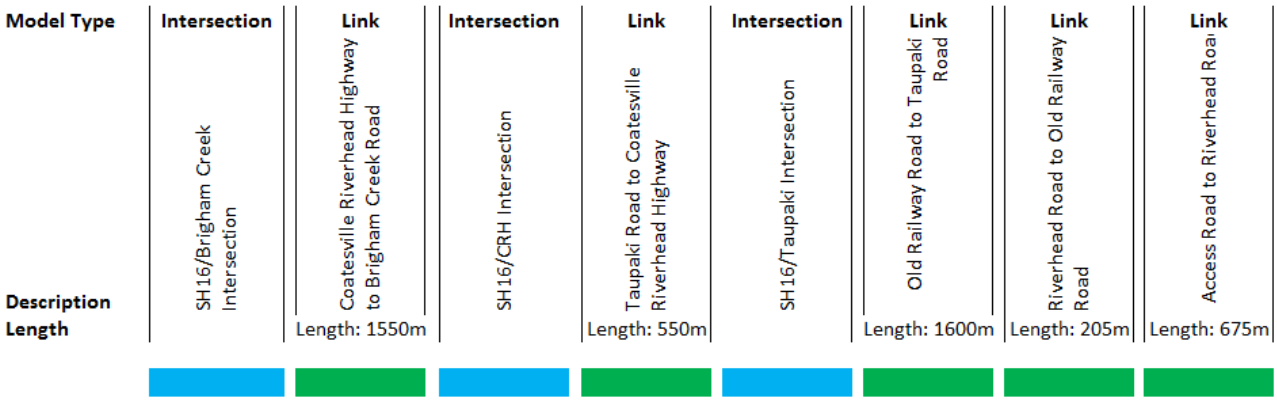
3 MODEL DESCRIPTION

The spreadsheet model considers three transport performance elements, being:

- A bottleneck model which reflects impacts associated with capacity constraints about the corridor, in particular those downstream from an intersection
- The speed flow relationship model which considers the travel time of road mid-blocks (ie between intersections)
- Isolated intersection SIDRA models which consider the delay associated with intersection delays. While downstream constraints impact on lane utilisations, SIDRA results primarily address the delay experienced/predicted on the intersection approach, as opposed to that experienced downstream at a capacity constraint (such as a two lane to one lane merge).

A simplified diagram of the spreadsheet model is shown in Figure 1.

Figure 1: SH16 Corridor Project Model



The study corridor includes five midblock sections, and three intersections.

4 MODEL CALIBRATION

As part of the SATURN traffic model development, 2015 traffic counts were sourced from the NZ Transport Agency Traffic Management System (TMS) database, with travel times being sourced from TomTom data, again through the NZ Transport Agency.

4.1 Traffic Volumes

Traffic volume calibration sites included in the North West TFUG SATURN traffic model are shown in Figure 2. The values presented represent the absolute difference between what the traffic model predicts and the volumes observed on site for the morning, midday and evening peak periods, based on a 2015 base year.

Figure 2: Absolute Traffic Flow Differences

The absolute traffic volume differences presented for the SH16 corridor generally represent a percentage difference between -4% to +10%, with only one site on SH16 having a difference outside of this range (13%). We are of the view that the traffic volumes represented in the TFUG SATURN model through the corridor are suitably robust, and as such have used these as inputs to the SH16 model.

4.2 SH16 Corridor Travel Times

The operation of the SH16 model has been checked by comparing the predicted travel times along SH16 with TomTom data obtained in 2015. The morning and evening modelled travel times are summarised in Figure 3. The results indicate that the SH16 model is suitably reflecting traffic conditions (as observed in 2015), with the SH16 model having travel times within 8% of those reported by TomTom.

Figure 3: Journey Time Comparison

Model Type	Link	Link	Link	Intersection	Link	Intersection	Link	
Description	Access Road to Riverh	Riverhead Road to Old Railway Road	Old Railway Road to Taupaki Road	SH16/Taupaki Intersection	Taupaki Road to Coatesville Riverhead Highway	SH16/CRH Intersection	Coatesville Riverhead Highway to Brigham Creek Road	
Length	Length: 675m	Length: 205m	Length: 1600m		Length: 550m		Length: 1550m	
EASTBOUND								
Observed (Cummulative Eastbound)								
TOMTOM 7-9	59			159		208	309	
TOMTOM 4-6	46			141		183	273	
Modelled (Cummulative Eastbound)								
Spreadsheet 7-8	32			274		303	404	
Spreadsheet 8-9	31			184		210	288	**-7%**
Spreadsheet 12-2	31			128		154	226	
Spreadsheet 4-6	31			150		176	252	**-8%**
WESTBOUND								
Observed (Cummulative Westbound)								
TOMTOM 7-9		217				119		
TOMTOM 4-6		236				119		
Modelled (Cummulative Westbound)								
Spreadsheet 7-8		190				72		
Spreadsheet 8-9		191				73		**-12%**
Spreadsheet 12-2		189				72		
Spreadsheet 4-6		229				101		**-3%**

Weekday morning peak, inter peak and evening peak period models have been developed to reflect 2015 traffic conditions. The model periods represent the average hours during the two hour morning peak (07:00 to 09:00am), inter peak (12:00 to 2:00pm) and evening peak (4:00 to 6:00pm) periods.

With regards to the interpeak, the travel times are similar to or less than the times observed in the counter peak direction. For example, the interpeak eastbound travel time is similar to or less than the lighter evening peak eastbound travel time, with the interpeak westbound travel time being similar to or less than the lighter morning peak westbound travel time.

5 FORECAST YEAR ASSUMPTIONS

5.1 Traffic Demands

Forecast traffic demands for 2026 have been obtained from the TFUG SATURN traffic model, which assumes Scenario I10 land use and a "do minimum" network scenario. This network scenario includes minimum network improvements in the North West area.

As with the 2015 SH16 model (which sources traffic demands directly from the 2015 SATURN model), traffic volumes for 2026 have been directly sourced from the 2026 SATURN traffic model.

Traffic plots from the base Auckland Regional Transport model and TFUG SATURN traffic model for the morning and evening peak periods are provided in **Attachment A** for the base year (2013 ART and 2015 SATURN) and 2026, for the Do Minimum investment scenario, with Scenario I10 land use. Table 1 summarises the predicted traffic volumes on SH16 between Taupaki Road and Coatesville Riverhead Highway.

Table 1: Current and Predicted SH16 Traffic Volumes (between Taupaki Road and Coatesville-Riverhead Highway)

	Regional Model Base 2013 (Two Hour Volume)	Regional Model Forecast 2026 (Two Hour Volume)	TFUG SATURN Base 2015 (One Hour Volume)	TFUG SATURN Forecast 2026 (One Hour Volume)
Morning Peak				
Eastbound	2,350	2,500	1,250	1,200
Westbound	2,050	2,350	800	950
Evening Peak				
Eastbound	2,200	2,450	1,000	1,000
Westbound	2,450	2,500	1,350	1,250

Both the Regional Transport and TFUG models show minimal change being predicted between the base year and forecast year, which is a result of no significant roading improvements. The Regional Model however does suggest an increase of some 5% in traffic demands between the base year and 2026, whereas the SATURN model does not.

As such, a sensitivity test has been completed in the assessment which increases the 2026 forecast flows, a SATURN output, by 5%. This therefore provides a slight increase in corridor traffic volumes as projected in the Regional Model.

6 SH16 OPTION EVALUATION

6.1 Option Description

Three options have been considered by the Safe Roads Alliance, with each being represented within the SH16 model. The section of SH16 between Brigham Creek Road and Riverhead Road has been broken into sections, being:

- Section A: SH16 between Brigham Creek Road and Coatesville Riverhead Highway
- Section B: Coatesville Riverhead Highway Intersection with SH16
- Section C: SH16 between Coatesville Riverhead Highway Intersection and Taupaki Road
- Section D: SH16 between Taupaki Road and Kumeu Town Centre.

The SH16 Safe Roads project also considers the section of SH16 between Huapai and Waimauku. As the road capacity through this section is good, and with the project considering safety improvements more so than improvements that impact capacity, we have not considered this western section within the analysis.

A map identifying each of the projects study sections is included in Figure 4.

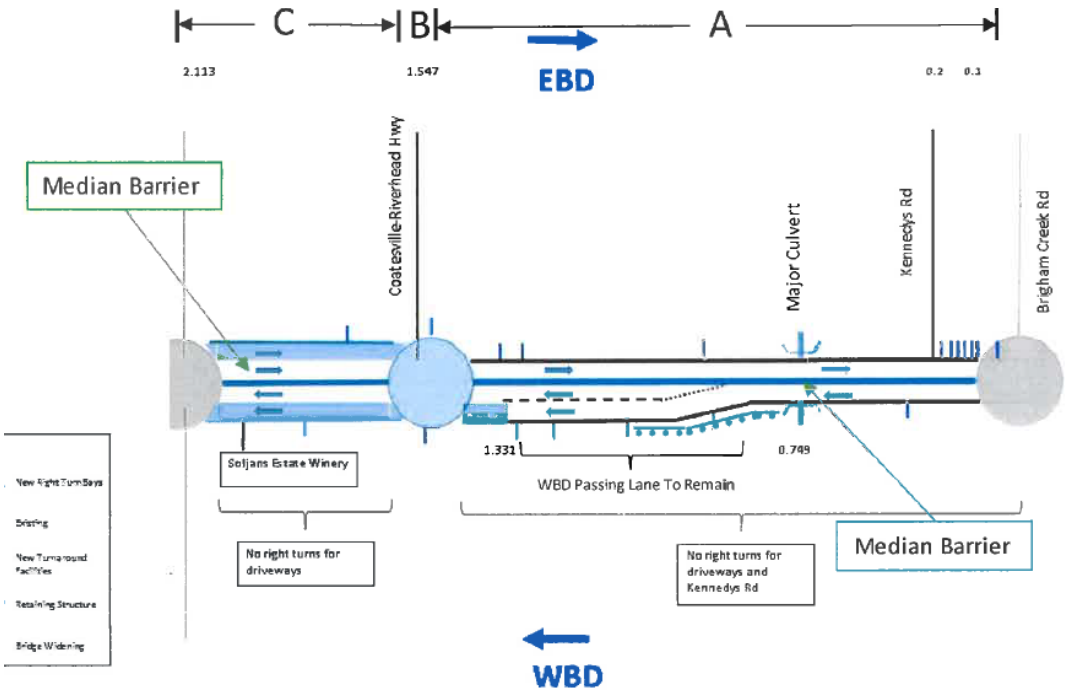
Figure 4: SH16 Safe Roads Project Study Sections

The options proposed on each of the sections above are briefly described as follows:

6.2 Option 1

Option 1 consists of the following:

- Section A, B and C – includes pavement widening, median barriers and new structures as well as a roundabout at the SH16/Coatesville-Riverhead Highway intersection, as presented below.

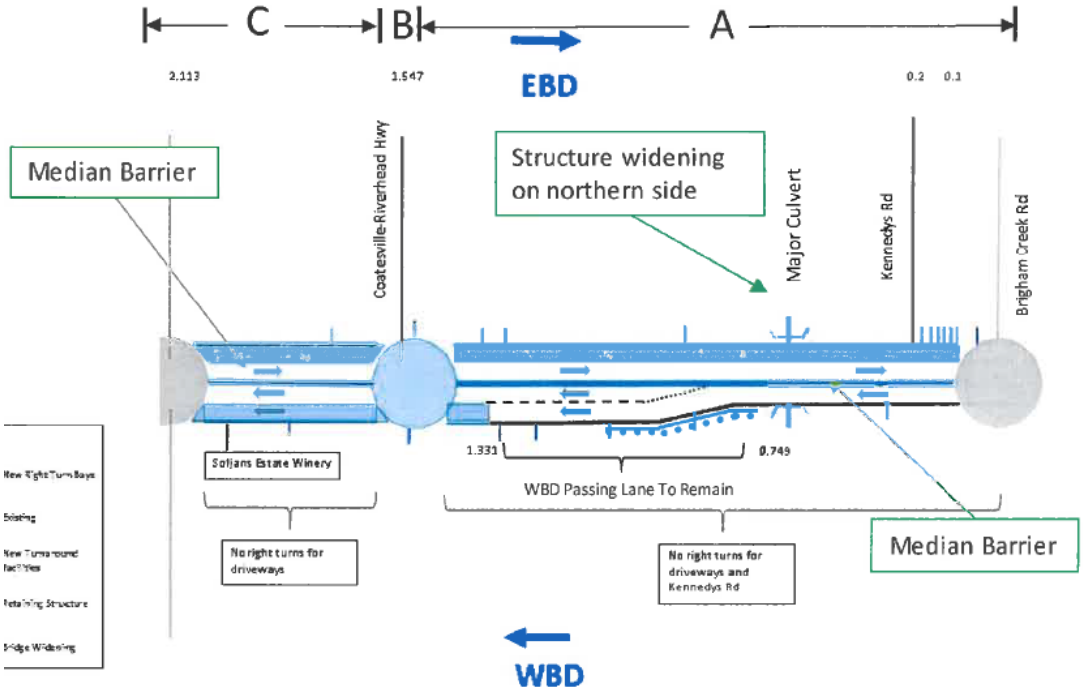


- Section D – Includes a double yellow line median

6.3 Option 2

Option 2 consists of the following:

- Section A, B and C – includes shoulder widening, median barriers and structure widening. Includes four-laning of SH16 between Coatesville Riverhead Highway and Taupaki Road as well as the widening of SH16 to two lanes in the eastbound direction only between Coatesville Riverhead Highway and Brigham Creek Road, as presented below.

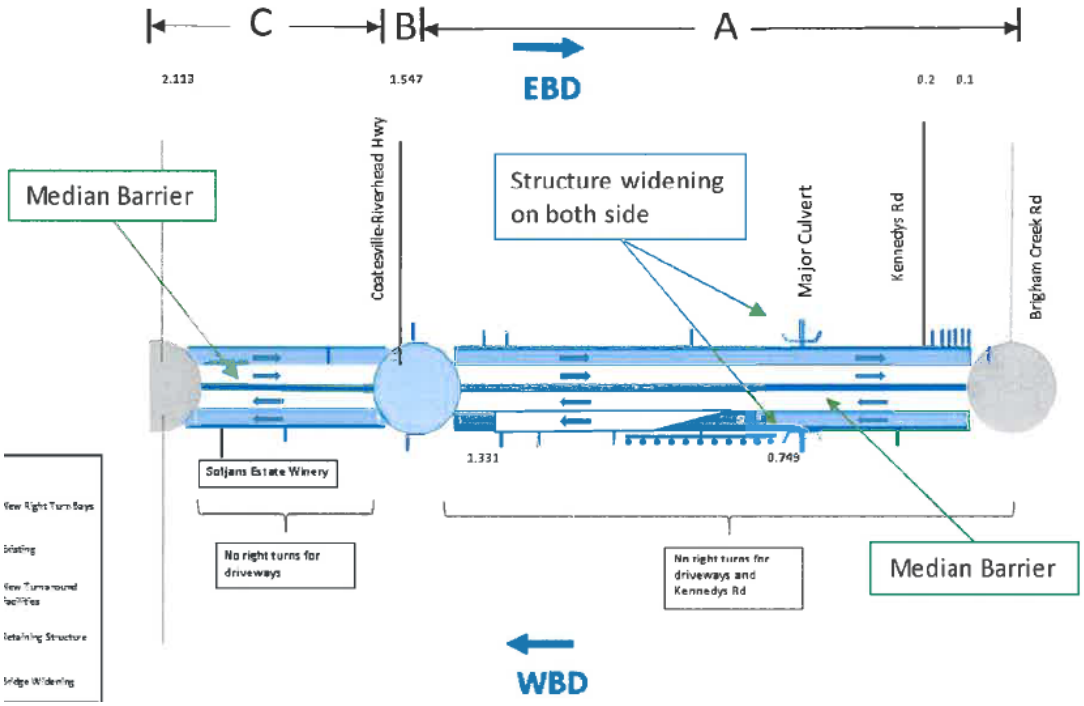


- Section D – includes a wide centreline.

6.4 Option 3

Option 3 consists of the following:

- Section A, B and C – includes median barriers and structure widening, as well as four-laning between Brigham Creek Road and Taupaki Road (two lanes in each direction), as presented below.



- Section D – includes a flush median.

6.5 Option 5

Option 5 retains the proposed layout of SH16 between Brigham Creek Road and Taupaki Road, as presented in Option 3, however includes two lanes eastbound through Section D, being between Riverhead Road and Taupaki Road.

7 TRAFFIC ASSESSMENT

The options have been assessed, with the primary output of the SH16 Model being travel times along each section, as well as predicted delays at the intersections located within the corridor.

7.1 Base Case – Existing Situation

The performance of the corridor considers delays and travel times for road sections and intersections.

The intersection analysis has focussed on the performance of the SH16/Taupaki Road and SH16/Coatesville Riverhead Highway intersections. To allow a comparison between the existing intersection performance and the options, the predicted operation of the two intersections is summarised below, for the 2015 base year and 2026 forecast year. We have used the sensitivity test volumes for 2026 as these reflect growth through the corridor as predicted in the Regional Transport model, as discussed above in Section 2.3 and Section 5.1.1.

Table 2: Base Option Intersection Performance (Delay (seconds) / Level of Service)

Intersection Approach	2015 Morning Peak (6-7am)	2015 Evening Peak (5-6pm)	2026 Morning Peak (6-7am)	2026 Evening Peak (5-6pm)
SH16 / Coatesville Riverhead Highway Intersection				
SH16 (East)	15 sec / LOS A	3 sec / LOS A	96 sec (LOS F)	3 sec / LOS A
Coatesville Riverhead Hway	1480 sec / LOS F	23 sec / LOS C	2570 sec (LOS F)	26 sec / LOS D
SH16 (West)	1 sec / LOS A	1 sec / LOS A	1 sec (LOS A)	1 sec / LOS A
TOTAL Intersection	**146 sec / LOS F**	**3 sec / LOS A**	**284 sec (LOS F)**	**4 sec / LOS A**
SH16 / Taupaki Road / Old North Road Intersection				
Taupaki Road	9 sec / LOS A	15 sec / LOS B	9 sec / LOS A	29 sec / LOS C
SH16 (East)	8 sec / LOS A	17 sec / LOS B	9 sec / LOS A	49 sec / LOS D
Old North Road	81 sec / LOS F	16 sec / LOS B	204 sec / LOS F	31 sec / LOS C
SH16 (West)	167 sec / LOS F	36 sec / LOS D	204 sec / LOS F	115 sec / LOS F
Total Intersection	**97 sec / LOS F**	**22 sec / LOS C**	**137 sec / LOS F**	**64 sec / LOS E**

The SIDRA results indicate that the Coatesville Riverhead approach to SH16 is congested today, and that this congestion will increase in the future. With regards to the 2015 base model performance, queues are predicted in SIDRA to extend some 690 metres along Coatesville Riverhead Highway. This is similar to onsite observations. With regards to the predicted delay on this approach however, we appreciate that the level of delay observed on site is slightly lighter than that predicted in SIDRA. This is on the basis that motorists in the slow moving queue on SH16 allow vehicles from Coatesville Riverhead Highway to enter the corridor. As such, while the approach delay predicted in SIDRA is some 7 minutes longer than site observations, the overall impact to the intersection operation is likely to be similar in that the gaps created by SH16 vehicles then increases the delay experienced to SH16 through movements which are not highlighted in SIDRA.

With regards to the predicted operation of the Coatesville Riverhead Highway intersection for the 2026 AM forecast, the economic evaluation uses the 2015 AM SIDRA results for the 6:00 am to 7:00 am period. This assumption reflects that the 2015 performance is somewhat capped, in that motorists will use an alternative route when the queue extends some 700 m along Coatesville Riverhead Highway, and that the predicted delay in 2026 is considered to be unreasonably high.

High delays are predicted on Old North Road and SH16 (West) approaches as a result of the downstream merge, and the need to give way to traffic entering the network at Taupaki Road.

Corridor travel times have been summarised for the morning and evening commuter peak periods. In Table 3.

Table 3: Base Option Predicted Corridor Travel Times (seconds)

Eastbound	Section D Riverhead to Taupaki	Section C Taupaki to CRH	Section B CRH Intersection	Section A CRH to Brigham	TOTAL (mm:ss)
Base Year 2015 Predicted Travel Time					
Morning Peak	250	30	0	100	380 (6:20)
Evening Peak	120	25	0	75	220 (3:40)
Forecast Year 2026 Predicted Travel Time					
Morning Peak	285	35	0	150	475 (7:55)
Evening Peak	195	25	0	80	305 (5:05)
Westbound	**Section A CRH to Brigham**	**Section B CRH Intersection**	**Section C Taupaki to CRH**	**Section D Riverhead to Taupaki**	**TOTAL (mm:ss)**
Base Year 2015 Predicted Travel Time					
Morning Peak	70	0	25	90	185 (3:05)
Evening Peak	150	0	30	100	280 (4:40)
Forecast Year 2026 Predicted Travel Time					
Morning Peak	70	0	25	90	185 (3:05)
Evening Peak	380	0	35	135	545 (9:05)

Travel times predicted by the SH16 model are consistent with that observed 2015, as discussed in Section 4.2. Travel times are predicted to increase as demand increases into the future, with the corridor travel times predicted to be some 8 to 9 minutes in the peak direction of travel. These times are already experienced on busy days through the corridor.

7.2 Option 1

The upgrades that Option 1 includes, which will impact on the performance of the corridor include:

- Upgrade the Coatesville Riverhead Highway intersection to a roundabout (Section B)
- Four-laning of SH16 between Taupaki Road and Coatesville Riverhead Highway (Section C)

In order to compare the performance of Option 1, the same outputs presented for the Base Case have been summarised for Option 1. That is, the intersection analysis has focussed on the performance of the SH16/Taupaki Road and SH16/Coatesville Riverhead Highway intersections, with predicted travel times through the SH16 corridor for each of the study sections also being presented.

Table 4 summarises the predicted intersection performance, with Table 5 summarising the predicted SH16 corridor travel times for Option 1.

Table 4: Option 1 Intersection Performance (Delay (seconds) / Level of Service)

Intersection Approach	2015 Morning Peak (6-7am)	2015 Evening Peak (5-6pm)	2026 Morning Peak (6-7am)	2026 Evening Peak (5-6pm)
SH16 / Coatesville Riverhead Highway Intersection				
SH16 (East)	6 sec / LOS A	17 sec / LOS B	7 sec / LOS A	15 sec / LOS B
Coatesville Riverhead Hway	29 sec / LOS C	15 sec / LOS B	38 sec / LOS D	18 sec / LOS B
SH16 (West)	37 sec / LOS D	17 sec / LOS B	64 sec / LOS E	17 sec / LOS B
TOTAL Intersection	**28 sec / LOS C**	**17 sec / LOS B**	**44 sec / LOS D**	**16 sec / LOS B**
SH16 / Taupaki Road / Old North Road Intersection				
Taupaki Road	8 sec / LOS A	15 sec / LOS B	9 sec / LOS A	29 sec / LOS C
SH16 (East)	8 sec / LOS A	17 sec / LOS B	9 sec / LOS A	51 sec / LOS E
Old North Road	105 sec / LOS F	16 sec / LOS B	231 sec / LOS F	36 sec / LOS D
SH16 (West)	121 sec / LOS F	30 sec / LOS C	158 sec / LOS F	78 sec / LOS F
Total Intersection	**80 sec / LOS F**	**20 sec / LOS C**	**122 sec / LOS F**	**54 sec / LOS E**

Option 1 upgrades the SH16/Coatesville Riverhead Intersection to a roundabout. While this reduces the sizeable delays predicted on Coatesville Riverhead Highway, a delay is introduced to the SH16 through movements. Overall, the Coatesville Riverhead Highway intersection performs acceptably, while noting that safety improvements are also obtained through the upgrade.

The performance of the SH16 Taupaki Road improves, albeit that the morning peak performance remains at LOS F. Delays reduce by some 45 seconds on the SH16 (west) approach.

Table 5: Option 1 Predicted Corridor Travel Times (seconds)

Eastbound	Section D Riverhead to Taupaki	Section C Taupaki to CRH	Section B CRH Intersection	Section A CRH to Brigham	TOTAL (mm:ss)
Base Year 2015 Predicted Travel Time					
Morning Peak	205	25	35	85	350 (5:50)
Evening Peak	110	25	15	75	225 (3:45)
Forecast Year 2026 Predicted Travel Time					
Morning Peak	245	25	65	95	430 (7:10)
Evening Peak	160	25	15	75	280 (4:40)
Westbound	**Section A CRH to Brigham**	**Section B CRH Intersection**	**Section C Taupaki to CRH**	**Section D Riverhead to Taupaki**	**TOTAL (mm:ss)**
Base Year 2015 Predicted Travel Time					
Morning Peak	70	5	25	90	190 (3:10)

Eastbound	Section D Riverhead to Taupaki	Section C Taupaki to CRH	Section B CRH Intersection	Section A CRH to Brigham	TOTAL (mm:ss)
Evening Peak	95	15	25	100	240 (4:00)
Forecast Year 2026 Predicted Travel Time					
Morning Peak	70	5	25	90	190 (3:10)
Evening Peak	215	15	25	135	390 (6:30)

Travel time savings are predicted for Option 1. Section A travel times improve by some 50 seconds for both the eastbound and westbound directions in 2015, with this increasing to some 3 minutes in the evening westbound direction.

Introducing a roundabout at the Coatesville Riverhead Highway intersection introduces delays of some 25-35 seconds, with up to 65 seconds predicted during the 2026 busy morning eastbound movement.

7.3 Option 2

In addition to the upgrades introduced in Option 1, Option 2 includes the additional road capacity upgrade:

- Two eastbound lanes between Coatesville Riverhead Highway and Brigham Creek roundabout (Section A)

In order to compare the performance of Option 2, the same outputs presented for the Base Case have been summarised. That is, the intersection analysis has focussed on the performance of the SH16/Taupaki Road and SH16/Coatesville Riverhead Highway intersections, with predicted travel times through the SH16 corridor for each of the study sections also being presented.

Table 6 summarises the predicted intersection performance, with Table 7 summarising the predicted SH16 corridor travel times for Option 2.

Table 6: Option 2 Intersection Performance (Delay (seconds) / Level of Service)

Intersection Approach	2015 Morning Peak (6-7am)	2015 Evening Peak (5-6pm)	2026 Morning Peak (6-7am)	2026 Evening Peak (5-6pm)
SH16 / Coatesville Riverhead Highway Intersection				
SH16 (East)	6 sec / LOS A	17 sec / LOS B	7 sec / LOS A	15 sec / LOS B
Coatesville Riverhead Hway	29 sec / LOS C	15 sec / LOS B	41 sec / LOS D	18 sec / LOS B
SH16 (West)	23 sec / LOS C	15 sec / LOS B	33 sec / LOS C	15 sec / LOS B
TOTAL Intersection	**19 sec / LOS B**	**16 sec / LOS B**	**26 sec / LOS C**	**15 sec / LOS B**

Intersection Approach	2015 Morning Peak (6-7am)	2015 Evening Peak (5-6pm)	2026 Morning Peak (6-7am)	2026 Evening Peak (5-6pm)
SH16 / Taupaki Road / Old North Road Intersection – same as Option 1				
Taupaki Road	8 sec / LOS A	15 sec / LOS B	9 sec / LOS A	29 sec / LOS C
SH16 (East)	8 sec / LOS A	17 sec / LOS B	9 sec / LOS A	51 sec / LOS E
Old North Road	105 sec / LOS F	16 sec / LOS B	231 sec / LOS F	36 sec / LOS D
SH16 (West)	121 sec / LOS F	30 sec / LOS C	158 sec / LOS F	78 sec / LOS F
Total Intersection	**80 sec / LOS F**	**20 sec / LOS C**	**122 sec / LOS F**	**54 sec / LOS E**

An improved level of performance is predicted at the SH16/Coatesville Riverhead Highway intersection for Option2 when compared with Option 1 as a result of the downstream bottleneck on SH16 (east of the Coatesville Riverhead Highway intersection) being removed through widening to two eastbound lanes. The performance of the western approach improves from LOS D (in Option 1) to LOS C in Option 2.

The performance of the SH16/Taupaki Road intersection is as per Option 1, as the upgrade for Option2 is consistent with Option 1 through this intersection.

Table 7: Option 2 Predicted Corridor Travel Times (seconds)

Eastbound	Section D Riverhead to Taupaki	Section C Taupaki to CRH	Section B CRH Intersection	Section A CRH to Brigham	TOTAL (mm:ss)
Base Year 2015 Predicted Travel Time					
Morning Peak	205	25	25	70	325 (5:25)
Evening Peak	110	25	15	70	225 (3:45)
Forecast Year 2026 Predicted Travel Time					
Morning Peak	245	25	35	70	375 (6:15)
Evening Peak	160	25	15	75	280 (4:40)
Westbound	**Section A CRH to Brigham**	**Section B CRH Intersection**	**Section C Taupaki to CRH**	**Section D Riverhead to Taupaki**	**TOTAL (mm:ss)**
Base Year 2015 Predicted Travel Time					
Morning Peak	70	5	25	90	190 (3:10)
Evening Peak	95	15	25	100	240 (4:00)
Forecast Year 2026 Predicted Travel Time					
Morning Peak	70	5	25	90	190 (3:10)
Evening Peak	215	15	25	135	390 (6:30)

Improvements in eastbound travel times are predicted when compared against the Base Case and Option 1. Widening SH16 eastbound between Coatesville Riverhead Highway and Brigham Creek Road removes the bottleneck, and as such improves travel times by 1 minute in the morning peak.

7.4 Option 3

In addition to the upgrades introduced in Option 1 and Option 2, Option 3 includes additional road capacity, being:

- Two westbound lanes between Coatesville Riverhead Highway and Brigham Creek roundabout (Section A)

In order to compare the performance of Option 3, the same outputs presented for the Base Case have been summarised. That is, the intersection analysis has focussed on the performance of the SH16/Taupaki Road and SH16/Coatesville Riverhead Highway intersections, with predicted travel times through the SH16 corridor for each of the study sections also being presented.

Table 8 summarises the predicted intersection performance, with Table 9 summarising the predicted SH16 corridor travel times for Option 3.

Table 8: Option 3 Intersection Performance (Delay (seconds) / Level of Service)

Intersection Approach	2015 Morning Peak (6-7am)	2015 Evening Peak (5-6pm)	2026 Morning Peak (6-7am)	2026 Evening Peak (5-6pm)
SH16 / Coatesville Riverhead Highway Intersection				
SH16 (East)	6 sec / LOS A	17 sec / LOS B	7 sec / LOS A	16 sec / LOS B
Coatesville Riverhead Hway	29 sec / LOS C	15 sec / LOS B	42 sec / LOS D	18 sec / LOS B
SH16 (West)	23sec / LOS C	15 sec / LOS B	33sec / LOS C	15 sec / LOS B
TOTAL Intersection	**19 sec / LOS B**	**16 sec / LOS B**	**26 sec / LOS C**	**15 sec / LOS B**
SH16 / Taupaki Road / Old North Road Intersection – Same as Option 1 and Option 2				
Taupaki Road	8 sec / LOS A	15 sec / LOS B	9 sec / LOS A	29 sec / LOS C
SH16 (East)	8 sec / LOS A	17 sec / LOS B	9 sec / LOS A	51 sec / LOS E
Old North Road	105 sec / LOS F	16 sec / LOS B	231 sec / LOS F	36 sec / LOS D
SH16 (West)	121 sec / LOS F	30 sec / LOS C	158 sec / LOS F	78 sec / LOS F
Total Intersection	**80 sec / LOS F**	**20 sec / LOS C**	**122 sec / LOS F**	**54 sec / LOS E**

The performance of both intersections remain the same as in Option 2.

Table 9: Option 3 Predicted Corridor Travel Times (seconds)

Eastbound	Section D Riverhead to Taupaki	Section C Taupaki to CRH	Section B CRH Intersection	Section A CRH to Brigham	TOTAL
Base Year 2015 Predicted Travel Time					

Morning Peak	205	25	25	70	325 (5:25)
Evening Peak	110	25	15	70	225 (3:45)
Forecast Year 2026 Predicted Travel Time					
Morning Peak	245	25	35	70	375 (6:15)
Evening Peak	160	25	15	70	270 (4:30)
Westbound	**Section A CRH to Brigham**	**Section B CRH Intersection**	**Section C Taupaki to CRH**	**Section D Riverhead to Taupaki**	**TOTAL**
Base Year 2015 Predicted Travel Time					
Morning Peak	70	5	25	90	190 (3:10)
Evening Peak	70	15	25	100	215 (3:35)
Forecast Year 2026 Predicted Travel Time					
Morning Peak	70	5	25	90	190 (3:10)
Evening Peak	70	15	25	135	245 (4:05)

Widening the westbound carriageway between Brigham Creek Road to the Riverhead Coatesville Highway has improved westbound travel times. While westbound travel times are improved, it is noted that the capacity of the state highway as you enter into Kumeu, remains. As such, queues extending back from the SH16/Access Road intersection may extend back and impact on the performance of Section D to some extent.

7.5 Option 5

In addition to the upgrades introduced in Option 1 and Option 2 and Option 3, Option 5 includes additional road capacity, being:

- Two eastbound lanes between Riverhead Road and Taupaki Road (Section D)

As the capacity downstream from the SH16/Taupaki Road and SH16/Coatesville Riverhead Highway intersections, the predicted performance of these intersections remains the same as reported I Option 3. As such, Option 3 intersection performance should be referred to, as presented in Table 8.

Predicted travel times along SH16 are summarised in Table 10 for Option 5.

Table 10: Option 5 Predicted Corridor Travel Times (seconds)

Eastbound	**Section D Riverhead to Taupaki**	**Section C Taupaki to CRH**	**Section B CRH Intersection**	**Section A CRH to Brigham**	**TOTAL**
Base Year 2015 Predicted Travel Time					
Morning Peak	205	25	25	70	325 (5:25)
Evening Peak	110	25	15	70	225 (3:45)

Eastbound	Section D Riverhead to Taupaki	Section C Taupaki to CRH	Section B CRH Intersection	Section A CRH to Brigham	TOTAL
Forecast Year 2026 Predicted Travel Time					
Morning Peak	240	25	35	70	370 (6:10)
Evening Peak	160	25	15	70	270 (4:30)
Westbound	**Section A CRH to Brigham**	**Section B CRH Intersection**	**Section C Taupaki to CRH**	**Section D Riverhead to Taupaki**	**TOTAL**
Base Year 2015 Predicted Travel Time					
Morning Peak	70	5	25	90	190 (3:10)
Evening Peak	70	15	25	100	215 (3:35)
Forecast Year 2026 Predicted Travel Time					
Morning Peak	70	5	25	90	190 (3:10)
Evening Peak	70	15	25	135	245 (4:05)

Widening the eastbound carriageway between Riverhead Road and Taupaki Road only provides a small benefit to travel times, with a 5 second improvement predicted when compared to Option 3.

8 ECONOMIC ANALYSIS

8.1 Economics Methodology

The methodology being used to determine the project benefits relies on outputs from the SH16 model. Traffic demands have been sourced from the TFUG SATURN traffic model, which represents Scenario I10 land use and a Do Minimum infrastructure investment scenario.

The economic analysis of the project is guided by the NZ Transport Agency Economic Evaluation Manual (EEM), Section A11.12.

The assessment completed returns predicted benefits only and excludes crash cost calculations. Project costs (investigation, design, property, construction and maintenance) have been provided by the Safe Roads Alliance. The benefits presented below will be included within the Safe Roads economic assessment of the project, where it is expected that the excluded components above will be added.

8.2 Evaluation Period and Discount Rate

The economic assessment has been undertaken in accordance with the NZ Transport Agency EEM, using a 40 year evaluation period and a 6% discount rate. The evaluation period has been assumed to start at the time when a significant portion of project costs are incurred.

Each option has been evaluated with an assumed construction period of three years, starting in 2017 and finishing in 2020. Noting that the Safe Roads project is addressing immediate safety issues, while

also improving efficiency, we are mindful that traffic demands have not been sourced beyond 2026. This is on the basis that a much wider infrastructure response is needed. When implemented, the wider response will likely draw a significant number of trips away from the current SH16 corridor, therefore reducing benefits. With this in mind, project user costs have been interpolated to 2031 (based on 2016 and 2026 outputs), with the user costs post 2031 being assessed through several sensitivities.

The primary evaluation includes the following assumptions:

- Peak Spreading of AM Peak operation in 2026. The current corridor during the AM peak is generally saturated during the busy hour period. The length of time that the corridor is expected to be congested in the future is expected to increase as a result of growth. As such, the analysis considers congestion at the intersections occurring between 6:00am and 9:00am, rather than 6:00am to 8:00am as observed today.
- Capping of delays. Forecast delays predicted in the SIDRA modelling at the Coatesville Riverhead Highway intersections in 2026 has been capped to that included in the 2015 SIDRA models. The reason for this is that the queue length reflected in the 2015 model and intersection delay is generally at a limit where motorists behaviour make alternative arrangements. This provides a conservative assessment.
- Road users costs post 2031 being halved, ie 50% of those calculated for 2031, on the basis that a wider transport solution would be in place about this time to cater for anticipated growth.

With the above assumptions in mind, being AM Peak spreading and 50% of the benefits reducing post 2031, several sensitivity tests have been completed which include:

a. Road users costs post 2031 being stopped, ie zero on the basis that the wider infrastructure improvement removes all benefits from the SH16 corridor (Lower)

b. Road users costs post 2031 are capped to those calculated for 2031 (upper)

2. No Peak Spreading of AM Peak operation. That is leaving the default SIDRA outputs during the 8:00 am to 9:00am as per the default model outputs (Lower)

3. AM and PM peak Spreading, noting that with an increase in growth during the AM peak period, the opposite peak spreading may also occur during the evening peak period, where the poor performance of one period extends well into the following period (Upper)

Sensitivity tests ‘a’ and ‘b’ have been performed for sensitivity tests ‘2’ and ‘3’ also. A time zero of 1 July 2017 has been applied to the analysis.

8.3 Annualisation of Benefits

The assessments of road user benefits have been undertaken using predicted travel times, travel distance and speed outputs from the SH16 model. User costs have been calculated from each of the three modelled periods, being morning peak, inter peak and evening peak periods.

Weekend peak costs have also been calculated, with these costs being based on a factor of the inter peak model outputs.

The hours used to derive annual road user costs are as follows:

- Morning peak – 245 days @ 3 hours per day (each hour is assessed individually)
- Inter peak – 245 days @ 8 hours per day
- Evening peak – 245 days @ 2 hours per day
- Weekend/Holiday daytime – 120 days @ 9 hours per day (based on 126% of the inter peak hour model outputs).

The data and methodology used to calculate the above annualisation factors is based on automated traffic counts for SH16. The weekday and weekend traffic profiles are shown below in Table 5 and Table 6 respectively.

Figure 5: 2015 Weekday Traffic Profile

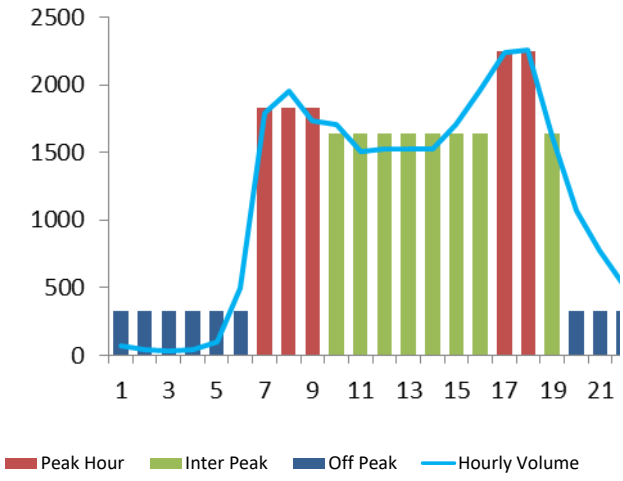
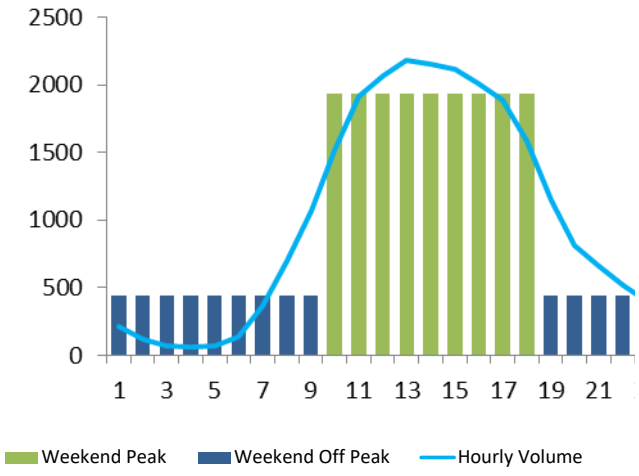


Figure 6: 2015 Weekend Traffic Profile



8.4 Travel Time and Vehicle Operating Costs

Travel time benefits have been calculated using the SH16 model outputs and the values of time taken from Section A4.3 of the EEM, for an Urban Arterial assessment. These are:

- $21.94 for morning peak period travel ($15.13 x 1.45 travel time update factor1)
- $26.03 for inter peak period travel ($17.95 x 1.45 travel time update factor)
- $21.69 for evening peak period travel ($14.96 x 1.45 travel time update factor), and
- $20.43 for weekend travel ($14.09 x 1.45 travel time update factor).

Similarly, congestion relief value and vehicle operating cost savings have been calculated directly, again using the model outputs and standard EEM values. Vehicle operating costs used are those provided in EEM Table A5.7 – Urban Arterial.

As noted in Section 7.1 above, With regards to the predicted operation of the Coatesville Riverhead Highway intersection for the 2026 AM forecast, the economic evaluation uses the 2015 AM SIDRA results for the 6:00 am to 7:00 am period. This assumption reflects that the 2015 performance is somewhat

[1] Update factors to adjust to July 2016

capped, in that motorists will use an alternative route when the queue extends some 700 m along Coatesville Riverhead Highway, and that the predicted delay in 2026 is considered to be unreasonably high.

8.5 Trip Reliability and Vehicle Emission Costs

The trip reliability costs are assumed to be 5% of the total travel time costs and congestion relief costs, while the vehicle emission costs are assumed to be 5% of vehicle operating costs.

8.6 Crash Costs

The Crash Reduction Costs associated with each option have not been included in this evaluation. The Safe Roads Alliance are responsible for calculating crash costs, and therefore crash cost savings.

8.7 Road User Cost Benefits

Project benefits for all road users have been assessed against the Do Minimum (Base Case), which includes the same traffic demands applied to the option models, with the exception of the 2026 6:00am to 7:00am Do Minimum models which have delays capped at 2015 levels. Discounted project benefits when compared to the Do Minimum are shown in Table 11.

Table 11: Discounted Benefits ($) Thousands

Benefit Stream	Option 1	Option 2	Option 3	Option 5
Travel Time Savings	36,010	42,288	52,748	53,291
Vehicle Operating Costs	1,534	1,494	1,352	1,250
Vehicle Emissions	61	60	54	50
Driver Frustration (Congestion)	3,546	4,023	4,024	4,020
Trip Reliability	1,978	2,316	2,839	2,866
Total	**43,129**	**50,180**	**61,017**	**61,477**

The option benefits are predicted to be $43.1 million, $50.2 million, $61.0 million and $61.5 million for Option 1, Option 2, Option 3 and Option 5 respectively. As highlighted above these benefits do not include crash cost benefits.

Travel time benefits (basic travel times, congestion and reliability) are predicted to contribute some 80% to 85% of the total benefits, and the Vehicle Operating Cost and Emission Costs are predicted to provide minor benefits, due to an increase in the total distance travelled predicted in the option models.

Several sensitivity tests have also been undertaken, these include:

- Sensitivity Test 1a: Based on a 40 year evaluation period, where road user costs beyond 2031 have been kept at the predicted 2031 level.
- Sensitivity Test 1b: Road user costs beyond 2031 have been omitted. The reasoning for omitting costs beyond 2031 is to assume a fundamental change in the number of vehicles using SH16. Should a new connection be formed consistent with the preferred TFUG network, this may remove

a significant number of vehicles from the corridor, meaning that current intersection capacity for the Do Minimum and Option scenarios will be such that benefits would be relatively small. Crash cost benefits may still occur, which are assessed separately on the basis that vehicle conflicts would be removed or reduced.

The resulting road user benefits are provided in Table 12 and Table 13 below, with the economic spreadsheets shown in Appendix B.

Table 12: Discounted Benefits ($) Thousands – Sensitivity Test 1a – Capped at 2031

Benefit Stream	Option 1	Option 2	Option 3	Option 5
Travel Time Savings	50,173	58,704	73,180	73,866
Vehicle Operating Costs	2,147	2,093	1,910	1,775
Vehicle Emissions	86	84	76	71
Driver Frustration (Congestion)	4,870	5,518	5,518	5,510
Trip Reliability	2,752	3,211	3,935	3,969
Total Benefit	**60,029**	**69,609**	**84,619**	**85,191**

Table 13: Discounted Benefits ($) Thousands – Sensitivity Test 1b – Omitted Post 2031

Benefit Stream	Option 1	Option 2	Option 3	Option 5
Travel Time Savings	21,847	25,872	32,317	32,716
Vehicle Operating Costs	920	894	794	725
Vehicle Emissions	37	36	32	29
Driver Frustration (Congestion)	2,222	2,529	2,529	2,531
Trip Reliability	1,203	1,420	1,742	1,762
Total Benefit	**26,229**	**30,751**	**37,414**	**37,764**

With regards to sensitivity tests 2a, 2b, 3a and 3c, the total benefits are summarised below.

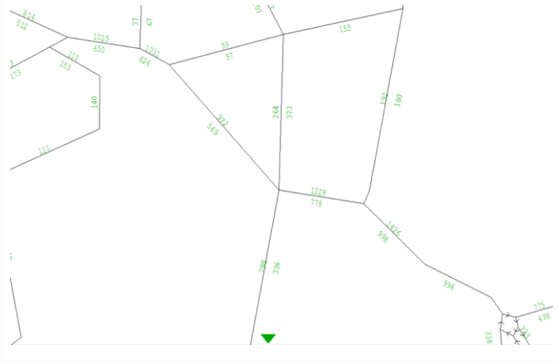
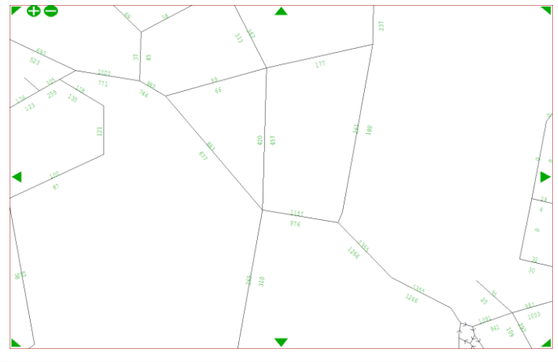
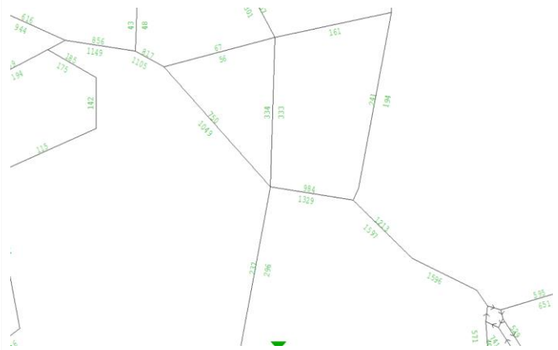
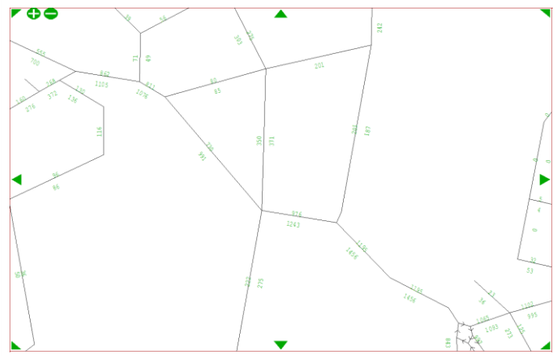
Table 14: Total Discounted Benefits ($) Thousands – Sensitivity Test Summary for Sensitivity Tests 2 and 3

Sensitivity Test	Option 1	Option 2	Option 3	Option 5
No Peak Spreading (Lower) Benefits Halved	21,944	28,995	39,831	40,292
No Peak Spreading (Lower) Benefits Stopped Post 2031 (Lower)	13,432	17,954	24,617	24,967
No Peak Spreading (Lower) Benefits Capped Post 2031 (Upper)	30,456	40,036	55,046	55,618
AM + PM Peak Spreading (Upper) Benefits Halved	52,278	59,329	70,166	70,627
AM + PM Peak Spreading (Upper) Benefits Stopped Post 2031 (Lower)	31,756	36,278	42,941	43,291

Sensitivity Test	Option 1	Option 2	Option 3	Option 5
AM + PM Peak Spreading (Upper) Benefits Capped Post 2031 (Upper)	72,801	82,381	97,391	97,963

APPENDIX A Auckland Regional and TFUG SATURN Model Predictions

Regional Traffic Model and TFUG SATURN Project Traffic Model Predictions

ART Model – 2013 Base AM Peak	ART Model – 2026 AM Peak Do Minimum – Scenario I10	SATURN Project Model – 2015 Base AM Peak	SATURN Project Model – 2026 AM Peak Do Minimum – Scenario I10
			
ART Model – 2013 Base PM Peak	ART Model – 2026 PM Peak Do Minimum – Scenario I10	SATURN Project Model – 2015 Base PM Peak	SATURN Project Model – 2026 AM Peak Do Minimum – Scenario I10
			

APPENDIX B Economic Spreadsheets

Worksheet 3 - Project Benefit Summary

Complete Project (All Sections) - Benefits Halved at 2031

Primary - CRH AM 2026 Intersection Performance as per AM 2016 - AM Peak Spreading

	Project Name					
	Benefits		**PV of User Costs as calculated**			
			Option 1	Option 2	Option 3	Option 5
1	TTC	$	36,009,818	42,287,698	52,748,353	53,291,188
2	VOC	$	1,533,753	1,493,540	1,351,812	1,250,291
3	Accident costs	$	-	-	-	-
4	Vehicle emission costs	$	61,350	59,742	54,072	50,012
5	Driver frustration	$	3,546,017	4,023,378	4,023,721	4,020,175
5a	Trip Reliability	$	1,977,792	2,315,554	2,838,604	2,865,568
6	Monetised external impacts (list)					
	Northern Busway Extension to Albany	$				
	Cycle Project					
7	**PV total net Benefits**		**43,128,730**	**50,179,911**	**61,016,562**	**61,477,233**
	Costs					
8	Investigation					
9	Design					
10	Property					
11	Construction/implementation					
12	Maintenance					
13	Renewal					
14	Operating					
15	External impact mitigation					
16	Activity contingency costs					
17	Risk Management					
18	**PV total net costs**		**50,312,608**	**52,449,437**	**60,608,238**	**61,773,781**
19	**BCR = (7)/(18)**		**0.9**	**1.0**	**1.0**	**1.0**

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Note: Worksheet 3 above excludes crash cost savings

Worksheet 3 - Project Benefit Summary

Complete Project (All Sections) - Benefits Capped at 2031

Primary - CRH AM 2026 Intersection Performance as per AM 2016 - AM Peak Spreading

	Project Name					
	Benefits		**PV of User Costs as calculated**			
			Option 1	Option 2	Option 3	Option 5
1	TTC	$	50,173,060	58,703,537	73,179,684	73,866,159
2	VOC	$	2,147,411	2,093,105	1,909,974	1,775,102
3	Accident costs	$	-	-	-	-
4	Vehicle emission costs	$	85,896	83,724	76,399	71,004
5	Driver frustration	$	4,870,205	5,517,573	5,518,050	5,509,640
5a	Trip Reliability	$	2,752,163	3,211,055	3,934,887	3,968,790
6	Monetised external impacts (list)					
	Northern Busway Extension to Albany	$				
	Cycle Project					
7	**PV total net Benefits**		60,028,736	69,608,995	84,618,995	85,190,694
	Costs					
8	Investigation					
9	Design					
10	Property					
11	Construction/implementation					
12	Maintenance					
13	Renewal					
14	Operating					
15	External impact mitigation					
16	Activity contingency costs					
17	Risk Management					
18	**PV total net costs**		50,312,608	52,449,437	60,608,238	61,773,781
19	**BCR = (7)/(18)**		1.2	1.3	1.4	1.4

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Note: Worksheet 3 above excludes crash cost savings

Worksheet 3 - Project Benefit Summary

Complete Project (All Sections) - Benefits Stopped at 2031

Primary - CRH AM 2026 Intersection Performance as per AM 2016 - AM Peak Spreading

			Option 1	Option 2	Option 3	Option 5
	Project Name					
	Benefits		**PV of User Costs as calculated**			
1	TTC	$	21,846,577	25,871,859	32,317,022	32,716,216
2	VOC	$	920,094	893,975	793,650	725,480
3	Accident costs	$	-	-	-	-
4	Vehicle emission costs	$	36,804	35,759	31,746	29,019
5	Driver frustration	$	2,221,829	2,529,182	2,529,391	2,530,710
5a	Trip Reliability	$	1,203,420	1,420,052	1,742,321	1,762,346
6	Monetised external impacts (list)					
	Northern Busway Extension to Albany	$				
	Cycle Project					
7	**PV total net Benefits**		26,228,724	30,750,828	37,414,130	37,763,772
	Costs					
8	Investigation					
9	Design					
10	Property					
11	Construction/implementation					
12	Maintenance					
13	Renewal					
14	Operating					
15	External impact mitigation					
16	Activity contingency costs					
17	Risk Management					
18	**PV total net costs**		50,312,608	52,449,437	60,608,238	61,773,781
19	**BCR = (7)/(18)**		0.5	0.6	0.6	0.6

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Note: Worksheet 3 above excludes crash cost savings

Memorandum

By:	Jay Kumar	**Date:**	15 March 2021
Subject:	Coatesville Riverhead Highway Roundabout Traffic Volume Update and Safety Check at Crossings	**Our Ref:**	3235084/200/CT

1 Purpose

The purpose of this memorandum is to review the recent Supporting Growth Alliance (SGA) 2038 traffic volumes, compare these to the traffic assessment done in November 2020 and provide recommendations on the design of the roundabout including a safety review of pedestrian and cyclist crossings. Waka Kotahi needs to understand if a satisfactory operational performance is achieved with the updated 2038 volumes and if any further modifications are required for the proposed roundabout at the intersection of Coatesville Riverhead Highway (CRH) and State Highway 16 (SH16). Waka Kotahi is also interested in confirming the optimal pedestrian and cyclist crossing arrangement in terms of safety.

The purpose of this file note is to:

- Compare projected traffic volumes that were used for the CRH and SH16 during Safe Roads - SH16 Brigham Creek to Waimauku - Single Stage Business Case with the current 2038 volumes to understand the volume differences
- Outline the performance of the roundabout noted in the business case
- Outline the performance of the roundabout using the 2020 volumes provided by Waka Kotahi on Friday, October 16, 2020
- Outline the performance of the roundabout using the new predicted 2038 figures
- Identify any changes required to the roundabout layout to improve the LOS with the 2038 data set
- Provide recommendations on the pedestrian and cyclist crossings and a narrative behind the rationale for the recommendation

2 Traffic Volume Comparison

The appended tables (Appendix A) provide a comparison of the traffic volumes from 3 scenarios:

I. the projected traffic volumes for 2021 used to model the roundabout within the Safe Roads Business Case (prepared in 2015),

II. the 2020 surveyed volumes provided by Waka Kotahi for the existing priority-controlled intersection (survey date - Friday October 16), and

III. the 2038 SATURN traffic volumes for a roundabout acquired from Te Tupu Ngātahi (SGA - the Supporting Growth Alliance)

Assumptions and Considerations:

- The modelling inputs received from SGA are preliminary and yet to be fully verified
- This represents a scenario without the Alternative State Highway (ASH) or a new Rapid Transit Corridor to Kumeū
- Due to the wider network included in the SATURN model, when extracting turning movements at some locations, the SIDRA model returns ‘0’ flow on some movements. To some extent, such as right turns

out of CRH, this may be a result of the substantial delays predicted (resulting in re-routing). Our assessment has assumed 10 vehicles

In 2038, without the ASH, high delays are predicted along SH16, particularly at the SH16/Taupaki roundabout. A substantial amount of traffic to/from Kumeū/Huapai (including SH16 through traffic) is predicted to use other rural road routes, such as Foster Road, Puke Road, and Waitakere Road, to 'bypass' the SH16 corridor (and the Taupaki Road and Coatesville Riverhead Highway roundabouts).

The changes in traffic demand between current conditions and 2038 on SH16 will not fully reflect the growth in traffic between Kumeū/Huapai, as well as areas further north/west, and Brigham Creek. If more capacity is provided on SH16 (including at intersections) in advance of the ASH, the modelling predicts there will be latent demand that will just lead to the same customer experience and the period over which delays occur will get longer (i.e. a longer peak period).

Comparison of Traffic Volumes

The comparison of volumes is presented in **Table 1** below.

Table 1: Comparison of Traffic Volumes

Approach LEG	MOVEMENT	2020 surveyed volumes (priority control)		Predicted 2021 volumes from previous Business Case (roundabout)		2038 SGA forecast Volumes (roundabout)	
		AM	PM	AM	PM	AM	PM
SH16 East	TH	1020	1391	887	1286	1275	1664
	RT	319	405	271	250	230	559
CRH	LT	565	353	202	227	191	258
	RT	7	15	4	9	10	10
SH16 West	LT	23	133	2	4	10	10
	TH	1225	1094	1193	976	1508	1418

As expected, the forecast volumes for 2038 are higher than those earlier forecasted for 2021 and used in the business case modelling. This expected growth in traffic demand also comes because of land use changes in growth areas. However, there are some noticeable reductions in volumes with some movements, and the following conclusions can be drawn:

- Traffic volumes turning right from SH16 onto Coatesville-Riverhead Highway are predicted to increase significantly in the PM peak, which is likely to be due to the growth demand in the wider North West area
- The left turn volumes from CRH onto SH16 are predicted to be less in 2038 than indicated in the 2021 PM. This is likely to be due to the rerouting occurring on the wider network as it is more difficult for vehicles to exit CRH.
- The demand flows for the right turn out of CRH and the left turn in to CRH remain low. As set out above, a volume of 10 veh/hr has been adopted for the Sidra Analysis.

3 Roundabout Layout and operations

To provide a comparison between the scenarios above, the designed roundabout layout was modelled in SIDRA to be consistent with the earlier recommendations (memo prepared on 18th November 2020) to include a single left turn lane and a short-shared right and left turn lane (shown in **Figure 1**).

The model has also been adjusted to incorporate speed tables on all approaches.

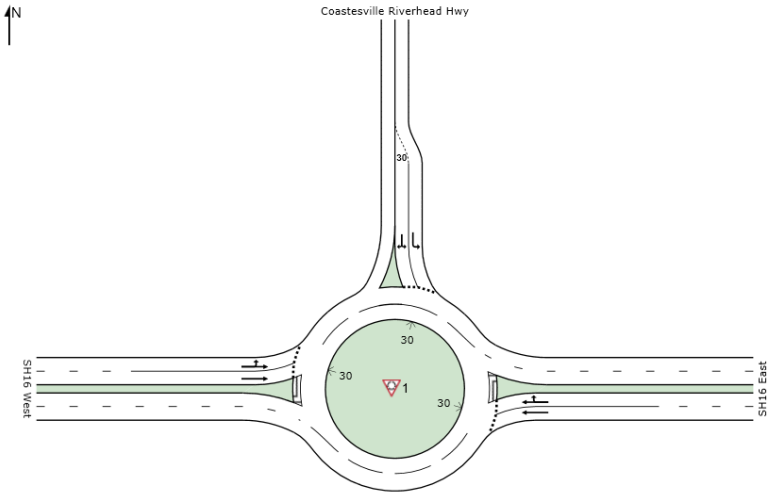


Figure 1 - 2020 Revised SIDRA Model

Original 2015 Business Case – 2021 Forecast Volumes

Using the earlier forecast volumes from the Business Case, the roundabout performs at an overall LOS A for both AM and PM peak as shown in **Table 2** and **Table 3** below **in Appendix A**.

- The 2021 revised roundabout for the AM scenario performs at maximum 50% capacity with the longest queue length on SH16 west leg at 30m
- The 2021 revised roundabout for the PM scenario performs at maximum 47% capacity with the longest queue length on SH16 East leg at 40m

2020 Surveyed Volumes

The 2021 revised roundabout performs at an overall LOS A for both AM and PM peak as shown in **Table 4** and **Table 5** below in **Appendix A**.

- The 2020 revised roundabout for the AM scenario performs at maximum 57% capacity with the longest queue length on SH16 west leg at 35m
- The 2020 revised roundabout for the PM scenario performs at maximum 60% capacity with the longest queue length on SH16 East leg at 51m

Forecast 2038 Volumes from SGA

The 2038 revised roundabout performs at an overall LOS A for both AM and PM peak as shown in **Table 6**Error! Reference source not found. and **Table 7** below in **Appendix A**.

- The 2038 revised roundabout for the AM scenario performs at maximum 61% capacity with the longest queue length on SH16 west leg at 42m
- The 2038 revised roundabout for the PM scenario performs at maximum 78% capacity with the longest queue length on SH16 West leg at 100m

4 Sensitivity Analysis

As a sensitivity test, the assumed traffic volumes on Coatesville-Riverhead Highway were increased by 40%, with a 10% increase in SH16 also assumed.

The 2038 revised roundabout with 40% increased volumes, performs at an overall LOS A for AM peak and LOS B for PM peak as shown in **Table 8** and **Table 9** below **in Appendix A**.

- The 2038 revised roundabout with 40% increased volumes for the AM scenario performs at maximum 69% capacity with the longest queue length on SH16 west leg at 60m
- The 2038 revised roundabout with 40% increased volumes for the PM scenario performs at maximum 93% capacity with the longest queue length on SH16 west leg at 200m

The modelling indicates that the increased 2038 volumes would result in the roundabout reaching maximum capacity, and the queue length for the PM peak being the longest.

5 Pedestrian and Cyclist Crossing Considerations

Several discussions have taken place in relation to the design of pedestrian and cyclist crossings for the Riverhead Highway roundabout. The purpose of these discussions has been the development of a design that offers a safe, intuitive, and efficient use of crossings that are required as a result of the introduction of a shared path at the Southern edge of the highway. These discussions culminated in a meeting on 22 February 2021 (meeting notes in **Appendix C**) where strategy and suggestions were captured by Waka Kotahi traffic specialists, Beca engineers and further discussed with the Waka Kotahi safety team. This memo takes onboard these suggestions as guidance and presents an assessment on the crossings and a corresponding general arrangement plan for the R/A and the proposed crossings.

Design Considerations

5.1 Area Characteristics

The area characteristics suggest the area is more akin to peri-rural (number of private property entry/exits) rather than rural with the potential of developing into urban in future due to expected land development in the area.

5.2 Speed Management

The current corridor (and proposed design) is posted at 80km/h and is deemed to be suitable for a rural area. The option to lower the posted speed limit at the proposed roundabout was considered, however, the speed at the roundabout is likely to be dictated by the geometry through the roundabout rather than the posted speed limit. Following a discussion with Mark Newsome (Waka Kotahi) it was therefore agreed to keep the posted speed at a constant 80km/h along the corridor.

Traverse line marking could also be provided to further reinforce the need to reduce speed.

5.3 Grade separation

A grade separated footbridge would be the preferred solution for pedestrians to cross SH16. However, it is understood that due to project budget constraints this option cannot be progressed further and has been discounted.

5.4 State Highway 16 Approaches

The use of unsignalised pedestrian crossings (i.e. zebra or uncontrolled crossings) on SH16 has been discounted because it requires pedestrians to cross two traffic lanes in two movements (four lanes in total divided by a splitter island/median). This is deemed unsafe within a high-speed rural environment and is not recommended.

A signalized pedestrian crossing with raised table (30:1 ramp) has been proposed on the eastern leg of the roundabout along SH16 to provide a crossing location at the bus stops. The crossing has been placed approximately 12m away from the roundabout to provide adequate separation to the roundabout exit in accordance with Austroads Part 3 as shown below in **Appendix B**. This signalized crossing is expected to result in some delay to SH traffic, and is likely to result in eastbound queues extending through the roundabout. The overall effect of this will be heavily dependent on the pedestrian crossing demand, which may increase through time as the area becomes more urbanized. A quantitative analysis of the potential impact can be carried out during the detailed design phase with an appropriate simulation model (e.g. AIMSUN) to understand the duration of effect, and also to understand the risk associated with an increasing pedestrian demand over time.

There is no pedestrian crossing proposed on the western leg of the roundabout along SH16 as no existing or proposed infrastructure will be in place to provide a connection.

The pedestrian crossing signals could be combined with metering, which may potentially improve the roundabout efficiency. This was mentioned during discussions as a potential addition for the traffic from Kumeu and can be implemented from the onset or retrofitted at a later stage.

5.5 Coatesville/ Riverhead Highway Approach

A 6m wide uncontrolled pedestrian crossing with raised table (30:1 ramp) has been proposed on the northern leg of the roundabout along Coatesville-Riverhead Hwy. This crossing has not been signalised as it is anticipated that the number of users will be relatively low as the majority of users will be on the shared path to the south.

6 Summary and Recommendations

The primary conclusions from this comparison with respect to the project objectives set out by Waka Kotahi, are as follows:

6.1 Traffic Volume Comparison

- The 2020 revised SIDRA Model performs at LOS A for the three periods 2020, 2021 and 2038
- The 2038 revised SIDRA Model operates with an acceptable Level of Service (LOS A).
- The sensitivity test with a 40% increase in volumes on Coatesville Riverhead Highway and a 10% increase on State Highway 16 results in the intersection operating at capacity, with a queue length on SH16 west leg of 200m.
- No Further modification is recommended to the design.

6.2 Pedestrian and Cyclist Crossings

- The recommended pedestrian and cyclist crossing configuration is presented in **Appendix B** based on guidance notes (refer to **Appendix C**) and the design considerations in Section 5 of this memo
- The effect of signalised pedestrian crossings on the approaches to the roundabout has not been modelled as the pedestrian crossing demand is likely to be low. The decision on whether to provide signalised crossings on multilane approaches is more likely to be a safety consideration rather than an operation consideration. Given the future growth planned for the area, pedestrian demand in the future may increase, resulting in the need to review the layout/ form of intersection.

Appendix A

Table 2 - 2021 Roundabout SIDRA AM Output

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: SH16 East											
5	T1	887	5.0	0.350	0.2	LOS A	3.3	24.2	0.06	0.11	41.3
6	R2	271	5.0	0.350	5.2	LOS A	3.2	23.6	0.07	0.30	41.3
Approach		1158	5.0	0.350	1.4	LOS A	3.3	24.2	0.07	0.16	41.3
North: Coatesville Riverhead Hwy											
7	L2	202	5.0	0.196	5.9	LOS A	1.0	7.1	0.76	0.81	38.2
9	R2	4	5.0	0.196	10.7	LOS B	0.9	6.7	0.76	0.81	39.7
Approach		206	5.0	0.196	6.0	LOS A	1.0	7.1	0.76	0.81	38.2
West: SH16 West											
10	L2	2	5.0	0.502	3.1	LOS A	4.1	29.8	0.61	0.32	38.9
11	T1	1193	5.0	0.502	2.4	LOS A	4.1	29.8	0.63	0.35	40.0
Approach		1195	5.0	0.502	2.4	LOS A	4.1	29.8	0.63	0.35	40.0
All Vehicles		2559	5.0	0.502	2.2	LOS A	4.1	29.8	0.38	0.30	40.4

Table 3 - 2021 Roundabout SIDRA PM Output

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: SH16											
5	T1	1286	5.0	0.470	0.3	LOS A	5.1	37.3	0.12	0.10	41.2
6	R2	250	5.0	0.470	5.3	LOS A	5.0	36.8	0.13	0.23	41.5
Approach		1536	5.0	0.470	1.1	LOS A	5.1	37.3	0.12	0.12	41.2
North: Coatesville Riverhead Hwy											
7	L2	227	5.0	0.189	5.1	LOS A	0.9	6.7	0.71	0.76	38.5
9	R2	9	5.0	0.189	9.6	LOS A	0.9	6.4	0.71	0.77	40.1
Approach		236	5.0	0.189	5.2	LOS A	0.9	6.7	0.71	0.76	38.5
West: SH16											
10	L2	4	5.0	0.407	2.7	LOS A	3.1	22.3	0.55	0.27	39.1
11	T1	976	5.0	0.407	2.0	LOS A	3.1	22.3	0.56	0.30	40.1
Approach		980	5.0	0.407	2.0	LOS A	3.1	22.3	0.56	0.30	40.1
All Vehicles		2752	5.0	0.470	1.8	LOS A	5.1	37.3	0.33	0.24	40.6

Table 4 - 2020 Roundabout SIDRA AM Output

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: SH16 East											
5	T1	1020	5.0	0.408	0.2	LOS A	4.3	31.2	0.10	0.11	41.2
6	R2	319	5.0	0.408	5.3	LOS A	4.2	30.5	0.11	0.30	41.2
Approach		1339	5.0	0.408	1.4	LOS A	4.3	31.2	0.10	0.16	41.2
North: Coatesville Riverhead Hwy											
7	L2	565	5.0	0.574	9.8	LOS A	3.8	28.0	0.87	1.02	36.7
9	R2	7	5.0	0.574	15.0	LOS B	3.6	26.1	0.87	1.02	38.0
Approach		572	5.0	0.574	9.9	LOS A	3.8	28.0	0.87	1.02	36.7
West: SH16 West											
10	L2	23	5.0	0.549	3.6	LOS A	4.6	33.9	0.69	0.40	38.7
11	T1	1225	5.0	0.549	3.0	LOS A	4.6	33.9	0.70	0.46	39.8
Approach		1248	5.0	0.549	3.0	LOS A	4.6	33.9	0.70	0.46	39.7
All Vehicles		3159	5.0	0.574	3.6	LOS A	4.6	33.9	0.48	0.43	39.8

Table 5 - 2020 Roundabout SIDRA PM Output

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: SH16											
5	T1	1391	5.0	0.556	0.3	LOS A	7.1	52.0	0.19	0.12	40.9
6	R2	405	5.0	0.556	5.4	LOS A	7.1	51.6	0.20	0.29	41.1
Approach		1796	5.0	0.556	1.5	LOS A	7.1	52.0	0.19	0.16	41.0
North: Coatesville Riverhead Hwy											
7	L2	353	5.0	0.387	7.2	LOS A	2.2	16.1	0.84	0.91	37.6
9	R2	15	5.0	0.387	12.2	LOS B	2.1	15.1	0.83	0.91	39.0
Approach		368	5.0	0.387	7.4	LOS A	2.2	16.1	0.84	0.91	37.7
West: SH16											
10	L2	23	5.0	0.600	5.2	LOS A	6.0	44.1	0.79	0.70	38.4
11	T1	1225	5.0	0.600	4.9	LOS A	6.0	44.1	0.80	0.74	39.5
Approach		1248	5.0	0.600	4.9	LOS A	6.0	44.1	0.80	0.74	39.4
All Vehicles		3412	5.0	0.600	3.4	LOS A	7.1	52.0	0.48	0.45	40.0

Table 6 - 2038 Roundabout SIDRA AM Output

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: SH16 East											
5	T1	1275	5.0	0.462	0.3	LOS A	5.1	37.3	0.13	0.10	45.0
6	R2	230	5.0	0.462	5.3	LOS A	5.0	36.7	0.14	0.22	41.5
Approach		1505	5.0	0.462	1.0	LOS A	5.1	37.3	0.13	0.12	44.4
North: Coatesville Riverhead Hwy											
7	L2	191	5.0	0.243	7.4	LOS A	1.3	9.1	0.83	0.86	37.5
9	R2	10	5.0	0.243	12.6	LOS B	1.2	8.4	0.82	0.86	38.8
Approach		201	5.0	0.243	7.7	LOS A	1.3	9.1	0.82	0.86	37.6
West: SH16 West											
10	L2	10	5.0	0.613	3.1	LOS A	5.8	42.6	0.66	0.32	38.8
11	T1	1508	5.0	0.613	2.4	LOS A	5.8	42.6	0.68	0.35	43.4
Approach		1518	5.0	0.613	2.4	LOS A	5.8	42.6	0.68	0.35	43.4
All Vehicles		3224	5.0	0.613	2.1	LOS A	5.8	42.6	0.43	0.28	43.5

Table 7 - 2038 Roundabout SIDRA PM Output

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: SH16											
5	T1	1664	5.0	0.679	0.3	LOS A	11.7	85.3	0.19	0.11	40.9
6	R2	559	5.0	0.679	5.3	LOS A	11.5	84.2	0.21	0.30	40.9
Approach		2223	5.0	0.679	1.6	LOS A	11.7	85.3	0.20	0.16	40.9
North: Coatesville Riverhead Hwy											
7	L2	258	5.0	0.374	9.1	LOS A	2.2	15.9	0.89	0.94	36.9
9	R2	10	5.0	0.374	14.3	LOS B	2.0	14.6	0.88	0.94	38.2
Approach		268	5.0	0.374	9.3	LOS A	2.2	15.9	0.89	0.94	37.0
West: SH16											
10	L2	10	5.0	0.787	13.1	LOS B	13.4	97.7	1.00	1.25	35.9
11	T1	1418	5.0	0.787	13.5	LOS B	13.4	97.7	1.00	1.29	36.4
Approach		1428	5.0	0.787	13.5	LOS B	13.4	97.7	1.00	1.29	36.4
All Vehicles		3919	5.0	0.787	6.4	LOS A	13.4	97.7	0.54	0.63	38.9

Table 8 - 2038 Roundabout SIDRA AM Output 40%

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: SH16 East											
5	T1	1403	5.0	0.512	0.3	LOS A	6.2	45.1	0.17	0.10	44.9
6	R2	253	5.0	0.512	5.3	LOS A	6.1	44.5	0.18	0.22	41.4
Approach		1656	5.0	0.512	1.1	LOS A	6.2	45.1	0.18	0.12	44.3
North: Coatesville Riverhead Hwy											
7	L2	267	5.0	0.402	10.3	LOS B	2.3	16.9	0.88	0.96	36.5
9	R2	14	5.0	0.402	16.1	LOS B	2.1	15.3	0.87	0.96	37.4
Approach		281	5.0	0.402	10.6	LOS B	2.3	16.9	0.88	0.96	36.5
West: SH16 West											
10	L2	11	5.0	0.691	4.1	LOS A	8.0	58.3	0.75	0.50	38.5
11	T1	1659	5.0	0.691	3.7	LOS A	8.3	60.3	0.77	0.58	43.1
Approach		1670	5.0	0.691	3.7	LOS A	8.3	60.3	0.77	0.58	43.1
All Vehicles		3607	5.0	0.691	3.0	LOS A	8.3	60.3	0.51	0.40	43.0

Table 9 - 2038 Roundabout SIDRA PM Output 40%

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: SH16											
5	T1	1830	5.0	0.753	0.4	LOS A	16.5	120.8	0.28	0.12	40.7
6	R2	615	5.0	0.753	5.5	LOS A	15.8	115.1	0.32	0.30	40.7
Approach		2445	5.0	0.753	1.7	LOS A	16.5	120.8	0.29	0.17	40.7
North: Coatesville Riverhead Hwy											
7	L2	361	5.0	0.596	15.0	LOS B	4.0	29.0	0.94	1.07	34.9
9	R2	14	5.0	0.596	20.9	LOS C	3.6	26.0	0.92	1.06	35.7
Approach		375	5.0	0.596	15.2	LOS B	4.0	29.0	0.94	1.07	34.9
West: SH16											
10	L2	11	5.0	0.930	30.5	LOS C	28.5	207.8	1.00	1.94	30.8
11	T1	1560	5.0	0.930	31.9	LOS C	28.5	207.8	1.00	1.97	30.9
Approach		1571	5.0	0.930	31.9	LOS C	28.5	207.8	1.00	1.97	30.9
All Vehicles		4391	5.0	0.930	13.6	LOS B	28.5	207.8	0.60	0.89	36.1

Appendix B

Revised roundabout design as shown in **Figure 2** have the following modification:

- Speed Table removed on the west leg
- Signalised brought 12m to the roundabout

Figure 2 – Proposed Roundabout Layout

Memorandum

Appendix C

Coatesville Roundabout Pedestrian/ Cyclist Crossing Strategy

Monday, 22 February 2021
5:08 PM

Attendance:	Andria D'Souza (ADS)
	Tim Elliott (TE)
	Nick Lagaros (NL)
	Richard Landon-Lane (TLL)
	Malcolm McAulay (MM)
	Kevan Fleckney (KF)
	Jay Kumar (JK)
	Rob Mason (RM)

Item		Action
Purpose	The purpose of the meeting is to address pedestrian/ cyclists crossing methodology at the proposed Coatesville Riverhead roundabout	
Operating Speed	Key item to consider is the operating speed of the proposed roundabout. The current corridor (and proposed design) is considered to be suitable for a rural area with 80km/h speed limit, however the following points suggest that a lower speed limit (60km/h?) may be more appropriate: • The presence of raised platforms on the approach • The area characteristics suggest it is more akin to peri-rural (number of private property entry/exits) rather than rural with the potential of developing urban in future due to expected land development in the area • The requirement for pedestrian/cyclists' crossings due to the introduction of a shared path A discussion with Mark Newsome to be arranged to consider the speed reduction proposition (refer to Post Meeting Notes (PMN) below	ADS/NL

Pedestrian Crossing Options	• Grade separation: ideal but an option that cannot be progressed further as part of this project based on budget constraints
	• Zebra Crossings: not recommended over two approach lanes and two exit lanes
	• Independent signalised crossings:
	  • Staggered configuration recommended - would require median widening with dog leg
	  • Can be a combined signal control solution with metering that will potentially improve the R/A efficiency
	  • With raised tables - 30:1 proposed that may prove to be OK combined with some recognisable speed reduction	

	elements (noting that the raised table intersection on Gordonton Rd uses 1:25) • To be located away from the R/A and at an appropriate location w.r.t. bus stops • Oteha Valley R/A is a good example of this application • Can be paired with visible means of recognising a speed reduction such as concrete ramps and/or line marking thickness • Buff calcined bauxite high friction surfacing increases safety and is conspicuous on approaches to signalised pedestrian crossings (for entry and exit crossings - also used at Oteha Valley Rd)	
Recommendation/ Way Forward	• Meet with Mark Newsome on speed reduction • Obtain WK safety team endorsement • Complete R/A Memo with section on pedestrian crossing recommendation • Sign-off: no formal sign off is envisaged provided WK Traffic & Safety teams are onboard • Update the design to include endorsed pedestrian/cyclists crossing	ADS/NLADS RM/JK
PMN:	**Kevan feedback:** Further to meeting feedback: • We discussed metering signals yesterday and the potential risk that using a ped crossing to double-up as a metering signal poses • The metering signals would help traffic egress Riverhead Road when the SH16 from Kumeu becomes dominant • If the western arm was not needed to have a signalised pedestrian crossing facility (but eastern and northern arms do), then we could install metering signals on the approach from Kumeu, activated by a queue detector on Riverhead Road. The signals would be gated on the left and on the median • The exit towards Kumeu would have no signals • It would be a project/Safety Engineer decision whether passive crossings were to be retained on top of the speed table • If no passive crossings were to be retained, the SUP on the approach from Kumeu could be replaced with a single=direction cycle track (assuming no demand for local pedestrian movements to nearby properties) **Mark Newsome feedback:** • Against having staggered Xings away from R/A - is there anything stopping us placing them combined with proposed elevated platforms? • Max speed irrelevant as R/A will dictate operational seed (Keep 80kmh for consistency across corridor) • Per Kevan' note - could have Xings at the East and not the West with shared path/ elevated platforms at the West removed but potentially add a metering signal at the West (approach from Kumeu)	

Attachment 3 – Flow Transportation Specialist SH16 Brigham Creek to Waimauku SSBC Economic Update dated 28 April 2020

flow
TRANSPORTATION SPECIALISTS

28 April 2020

David Mitchell
Waka Kotahi NZ Transport Agency
Private Bag 106602
AUCKLAND 1143

Dear David

SH16 BRIGHAM CREEK TO WAIMAUKU SSBC ECONOMIC UPDATE

Waka Kotahi has engaged Flow Transportation Specialists Ltd (Flow) to update the economic assessment for the SH16 Brigham Creek to Waimauku Single Stage Business Case (SSBC) project. The benefit cost ratio for the project was assessed in 2017 to sit between 1.0 and 1.35, as reported in the SSBC. The updated economic assessment calculates the BCR to sit at the higher end of this range, with a BCR of 1.3.

Flow assisted Beca in 2017 in assessing the economic benefits for the SH16 Brigham Creek to Waimauku Single Stage Business Case Project. Since 2017, further development of the option has taken place, where a cycle facility has been added. MRCagney assessed the benefit of the cycle facility in 2020, with update factors being applied to the road user benefits calculated in 2017. The documents referred to above include

- Single Stage Business Case, State Highway 16: Brigham Creek to Waimauku. September 2017 Appendices. Beca Infrastructure.
    - Appendix D Traffic Demand Modelling. SH16 Safe Roads Alliance, SH16 Corridor Option Evaluation. August 2017. Flow Transportation Specialists
    - Appendix T Endorsed Option Economics prepared by Beca.
- NZ3061: SH16 cycle path economics, Economic update technical note, dated 9 April 2020. MRCagney.

This economic update considers the update of the economic benefits in greater detail. Table 1 summarises the previous assessment assumption, as well as the updated assessment assumption.

Table 1: SH16 Brigham Creek to Waimauku SSBC Economic Update

Economic Element	Assumption	Previous Assessment	Updated Assessment
Update factors	Travel Time	1.45	1.54
	CRV and Driver frustration	1.45	1.54
	Vehicle Operating Cost	0.98	1.10
	Crash Cost	1.03	1.09

Table 1: SH16 Brigham Creek to Waimauku SSBC Economic Update

Economic Element	Assumption	Previous Assessment	Updated Assessment
Evaluation Timestream Assumptions	Time Zero	01/07/2017	01/10/2021
	Construction Start	01/07/2018	31/09/2024
	Construction Period	2 – 3 Years	3 Years
	Benefit Period	37 Years	37 Years
	Benefit Start	01/01/2021	01/10/2024
Consistency with Kumeu Huapai Improvements Project	Kumeu Bypass Implementation	2031	2038
	Off peak Factors	OP / WP / WO 0.20 / 1.26 / 0.22	OP / WP / WO 0.22 / 1.18 / 0.24
Coatesville Riverhead Highway Intersection	Predicted Delay	Cap AM delay at 2016 levels for all 3 AM Peak periods (6-9am)	Cap AM delay at 2016 levels for 6-7 AM Peak only
Crash Analysis Update	Accident by Accident assessment for Sections D and E	Based on 2011-2015 crash data	Based on 2015-2019 crash data
P50 Cost	Pre-implementation Costs Property Construction	$4,463,100 $7,695,000 $72,476,640	$4,980,895 $11,137,310 $116,972,655

While most of the updates above relate to input factors, the more significant updates relate to

- Kumeu Bypass implementation assumption
- Safety Assessment update, to 2015-2019 crash data
- Costs

Each have been briefly summarised below.

Kumeu Bypass Implementation

The recent Kumeu to Huapai Transporting Improvements project being assessed by Auckland Transport proposes upgrades at the SH16 (Main Road) / Access Road intersection and SH16 (Main Road) / Station Road intersection. A key input to this analysis was the assumption around what time the Kumeu Bypass is constructed, which then removes traffic from SH16. It was assumed that the bypass would be constructed in 2038.

As such, this assumption was carried over to this SH16 project, with the assumption in the 2017 SSBC assuming 2031.

Safety Assessment

The SH16 SSBC breaks the SSBC study area into five sections, as set out below. The methodology used to assess crash costs has also been summarised.

- Section A – Brigham to Coatesville Riverhead Highway (Rate Analysis)
- Section B – Coatesville Riverhead Highway Intersection (Rate Analysis)
- Section C – Coatesville Riverhead Highway to Taupaki Roundabout (Rate Analysis)
- Section D – Taupaki Roundabout to Old Railway Road (Accident by Accident)
- Section E – Huapai to Waimauku (Accident by Accident)

Sections A to C is based on the crash prediction models included in the Crash Estimation Compendium. Because of this, any update in crash history will not impact on the crash rate analysis outputs. For Section D and E however updated crash information will amend the crash costs. We have therefore updated the crash history for Section D and E, with the following table summarising the previous and recent crash information.

Table 2: Crash Analysis Update

	2011-2015 Crash History		2015-2019 Crash History	
	Section D	**Section E**	**Section D**	**Section E**
Fatal	1	1	0	0
Serious	1	7	4	6
Minor	8	6	8	8
Crash Cost	**$1,606,700**	**$11,987,900**	**$10,368,990**	**$13,091,580**

While both sections have had a reduction in fatal crashes, there has been an increase in serious crashes in Section D, with crashes in Section E remaining consistent. When updating the crash assessment an anomaly in the previous crash evaluation was highlighted which has also resulted in some greater benefits being predicted.

Cost

Costs have been provided to Flow by Waka Kotahi NZ Transport Agency. The costs have been applied as per the MRCagney assessment. The cost and timeframes are summarised in Table 3.

Table 3: Cost Update Assumption

Cost Element	Value	Portion and Time Incurred	Discounted Cost
Pre-implementation Costs	$4,940,895	100% in 2021	$4,661,222
Property	$11,137,309	50% in 2022	$4,956,083
		50% in 2023	$4,675,550
Construction (including Management, Surveillance and Quality Assurance)	$116,972,655	36% in 2022	$37,477,889
		48% in 2023	$47,141,998
		16% in 2024	$14,824,528
Routine and Periodic Maintenance	$11,551,699	Varies	$3,335,537
TOTAL			**$117,072,806**

Benefits

The predicted benefits for the SH16 Brigham Creek to Waimauku SSBC are summarised in Table 4.

Table 4: Benefit Update

Benefit Element	Component	Discounted Cost
Travel Time		$93,477,421
Vehicle Operating		$3,160,868
Crash		$30,384,160
Vehicle Emission		$126,435
Driver Frustration		$7,217,829
Trip Reliability		$5,034,762
Cycle Path	Travel time benefit	$74,000
	Health and environmental benefits	$2,727,000
	Safety benefits	$121,000
TOTAL		**$142,323,476**
Benefit Cost Ratio		**1.2**

Sensitivity Test

The cycling assessment completed by MRCagney assumed forecast cycle users in 2038 to be in the order of 250 cyclists per day. This seems reasonable. However, we have referred to the Auckland Cycle Model (ACM) to see what daily users the ACM predicts. While acknowledging that the facility is located on the periphery of the network, the ACM predicts some 350 to 400 cyclists per day, should a protected and safe facility be installed.

With the ACM predicting some 100 to 150 more daily cyclists, a sensitivity test which assumes an increase of some 40% in cycle benefits has been assessed. This increases cycle benefits by some $1.2 Million, with the BCR remaining at 1.3.

Should you need to clarify any of the above, please contact me on (09) 970 3876.

Yours sincerely

Terry Church
SENIOR ASSOCIATE

Reference: P:\NZTA\000-SH16 Safe Roads\L1A200428_SH16 Economic Update.docx - Terry Church

Attachment 4 – Flow Transportation Specialist SH16 Brigham Creek Road to Waimauku Update to Economic Analysis dated December 2021

SH16 Brigham Creek Road to Waimauku

Update to Economic Analysis

December 2021

flow
TRANSPORTATION SPECIALISTS

flow
TRANSPORTATION SPECIALISTS

Project:	**SH16 Brigham Creek Road to Waimauku**
Title:	**Update to Economic Analysis**
Document Reference:	**P:\NZTA\206 SH16 Economics Update- Contract 5496\4.0 Reporting\R1B211202_Economic Update2.docx**
Prepared by:	**Qing Li**
Project Manager	**Terry Church**
Reviewed by:	**Ian Clark**

Revisions:

Date	Status	Reference	Approved by	Initials
30 November 2021	Draft	R1A211130	Terry Church	TC
2 December 2021	Issued	R1B211202	Terry Church	

EXECUTIVE SUMMARY

This report provides an update to the economic analysis for the SH16 Brigham Creek Road to Waimauku project. Analysis was previously provided by Flow Transportation Specialists (Flow) in 2017 for the Single Stage Business Case (SSBC), which predicted a benefit cost ratio (BCR) between 1.0 and 1.35. In 2020, an update of the SSBC economic evaluation was undertaken and a BCR of 1.1 was predicted at the time.

Waka Kotahi has now requested Flow to provide another update of the economics analysis, so that the latest traffic volume predictions along SH16 can be based on the latest Supporting Growth Alliance (SGA) North West SATURN models (March 2021). In addition, the economic evaluation procedure has also been updated to incorporate Waka Kotahi's Monetised Benefits and Costs Manual (MBCM), published in August 2021.

We have used the same spreadsheet model and SIDRA models developed previously, and updated the inputs using data from the SGA SATURN model. The latest Vehicle Emission Prediction Model (VEPM, version 6.2) has also been used to inform the predicted emission costs associated with both Do Minimum and Option scenarios.

The project includes two stages, with Stage 1 being the Huapai to Waimauku section and Stage 2 covering the Brigham Creek Road to Kumeu section. We have tested three scenarios which consider the order of construction, being

- Scenario 1: full programme (Stage 1 and 2) to be constructed during a 30 month period (assuming the same construction period for Stage 2, which is longer). Construction is assumed to start in 2022
- Scenario 2: Stage 1 being constructed first (estimated to take 24 months, starting in 2022), with Stage 2 being constructed in the next NLTP period (construction is assumed to start in 2025)
- Scenario 3: Stage 2 being constructed first (estimated to take 30 months, starting in 2022), with Stage 1 being constructed in the next NLTP period (construction is assumed to start in 2025)

The following table provides the predicted benefits and costs for each scenario, with costs being updated to reflect 2021 values.

Table ES1: Benefit Update (Net Present Values,$)

Benefit Element	Scenario 1	Scenario 2	Scenario 3
Total Benefits	$121,119,000	$115,481,000	$121,119,000
Total Costs	$139,259,000	$129,106,000	$135,069,000
Benefit Cost Ratio	0.87	0.89	0.90

The above table indicates that the results are predicted to be very similar for the three scenarios, with the BCRs for all three scenario being marginally under 1.

CONTENTS

1 INTRODUCTION

This report provides a summary of the update to the economic evaluation for the proposed SH16 Brigham Creek Road to Waimauku project. Previously, an economic evaluation was prepared by Flow Transportation Specialists (Flow) in 2017 based on the SATURN models developed for Transport for the Future Urban Growth (TFUG) project. This SATURN model has since been updated by the Supporting Growth Alliance (SGA), so an update to the economic evaluation of the project has been undertaken.

Similar to the previous evaluation, the following models have been used to inform the economic evaluation

- The SGA Northwest SATURN model has been used to inform the predicted traffic volumes at the intersections along SH16 in 2028, and it has been used to understand the potential impacts of the proposed Alternative State Highway (ASH) on the traffic volumes along existing SH16 sections (once constructed)
- A spreadsheet model has been used, which considers travel times on SH16 between Riverhead Road and Brigham Creek Road. The model not only calculates vehicle travel speeds/distances on SH16 based on traffic volumes but also considers the bottleneck effects predicted at key intersections (Taupaki roundabout, Coatesville-Riverhead Highway T-intersection and Brigham Creek Road roundabout)
- SIDRA models have been developed to capture the travel times/bottleneck delays predicted at the above key intersections.

2 MODEL UPDATE

As discussed above, the SGA SATURN model has been used to inform the predicted traffic volumes on SH16 and its side roads. The model was originally developed for the TFUG project, and it has been updated in 2021 by SGA to incorporate a land use scenario termed Scenario I11.5 (August 2020).

2.1 Model Scenarios and Forecast Years

In this update, the base models which represent the traffic conditions in 2015 have been retained, on the basis that they were calibrated to reflect existing traffic conditions. The future 2026 scenarios have been updated to reflect a 2028 forecast, so they are consistent with the SGA SATURN model.

In addition, we note that a more recent land use scenario (Scenario I11.6) has been developed by the Auckland Forecasting Centre (AFC) earlier this year, and the SGA SATURN model has not yet been updated to reflect these new land use forecasts. We have looked into the land use predictions in the project area (Kumeu/Huapai and Riverhead) between the two land use scenarios, and these are compared in Table 1.

Table 1: Forecast Land Use Predictions -2028 (rounded to nearest 50)[1]

	Scenario I11.5		Scenario I11.6	
	Households	**Employment**	**Households**	**Employment**
Kumeu/Huapai	2,450	2,400	3,000 (+550)	2,100 (-300)
Riverhead	550	550	950 (+400)	600 (+50)

Table 1 indicates that additional growth is predicted in both Kumeu/Huapai and the Riverhead area in Scenario I11.6, indicating that the SGA SATURN model may slightly under-represent the anticipated growth in the area.

Similar to the previous assessment, it has been noted that traffic volumes through the Kumeu area will be affected by the capacity constraints entering/exiting Kumeu, and the SATURN models predict that some traffic will reassign away from the SH16 corridor, leading to very minor growth along the project corridor between Taupaki and Brigham Creek Road.

As such, we have kept the assumption to increase corridor traffic volumes by 5% in 2028 from the previous assessment, on the basis that with the proposed SH16 improvements (widening and converting priority intersections to roundabouts), additional traffic will most likely be attracted to the corridor.

3 ECONOMICS UPDATE

In addition to the updates to the SATURN model outputs, the following aspects have also been considered in this update

- The same annualisation factors used in the previous analysis have been retained, on the basis that they were derived from existing traffic data. The previous assumptions with regard to peak spreading have also been carried over
- It is assumed that the proposed Alternative Stage Highway (ASH) will be delivered in 2038, which is consistent with the previous assessment. The predicted project benefits post 2038 have been reduced by 50% as the ASH is expected to reduce traffic volumes along the existing SH16 corridor
- The project includes two stages, with Stage 1 being the Huapai to Waimauku sections and Stage 2 covering the Brigham Creek Road to Kumeu sections. We have tested three economic scenarios which consider the order of the construction, being
    - Scenario 1: full programme (Stage 1 and 2) to be constructed during a 30 month period (assuming the same construction period for Stage 2, which is longer). Construction is assumed to start in 2022
    - Scenario 2: Stage 1 being constructed first (estimated to take 24 months, starting in 2022), with Stage 2 being constructed in the next NLTP period (construction is assumed to start in 2025)

[1] Base on Macro Strategic Model (MSM) 3.2 zone boundaries. Kumeu/Huapai: MSM Zone 142 to 145, 151 and 152. Riverhead: MSM Zone 147

- Scenario 3: Stage 2 being constructed first (estimated to take 30 months, starting in 2022), with Stage 1 being constructed in the next NLTP period (construction is assumed to start in 2025)

- The evaluation has also been updated to align with Waka Kotahi's Monetised Benefits and Costs Manual (MBCM). The manual was published in August 2021 and it supersedes the Economic Evaluation Manual used previously. While the vast majority of the evaluation process remains similar, the evaluation has been updated with new update factors and a new methodology to estimate emission/greenhouse gas benefits
- The previous crash cost analysis which captured the 2015-2019 crash statistics has been retained, on the basis that the traffic volumes have been affected by the Covid lockdowns between 2020 and 2021. As such, updating the crash statistics for 2020 and 2021 may result in unreliable statistics. We have however looked at the crash trends reported on both Stage 1 and Stage 2 sections and these are discussed in Section 3.1 below
- The estimated benefits associated with the proposed cycle path have been assumed to be unchanged from the previous evaluation (based on an assessment by MRCagney)

3.1 Crash Trends Comparison

We have interrogated the Crash Analysis System (CAS) and extracted the reported crashes along the Stage 1 and Stage 2 sections. Table 2 provides a comparison of the total number of crashes that occurred between 2015 -2019 and 2020 – 2021 (till October).

Table 2: Crash Count Comparison

	Stage 1, Huapai to Waimauku		**Stage 2, Brigham Creek Road to Kumeu**	
	2015 – 2019	**2015 – 2019**	**2015 – 2019**	**2020 - 2021**
Fatal	0	0	1	0
Serious	5	0	3	1
Minor	11	0	23	9
Total Crashes Reported/per year	42 / 8.4	1 / 0.6[2]	102 / 20.4	34 / 18.9

It can be seen that both Stage 1 and Stage 2 sections are reported as having reduced crashes per year, and the crash severity has also reduced on both sections. We also note that a significant reduction has occurred on the section between Huapai (Matua Road west) and Waimauku, possibly due to the reduced level of traffic from SH16 west. The comparison indicates that the crash record along SH16 during 2020 and 2021 has been affected by the Covid lockdowns, therefore analysis that includes these years is unsuitable for crash cost analysis. On this basis, we have retained the 2015-2019 crash statistics and evaluation.

[2] The total crashes reported between 2021 and 2022 have been divided by a factor of 1.8, as 2021 has not yet finished

3.2 Greenhouse Gas Emission Costs

As discussed, the project benefits associated with greenhouse gas (predominately CO_2) costs have been estimated using the procedure provided in Monetised Benefits and Cost Manual (MBCM). Previously, the CO_2 emission cost was assumed to be 4% of the Vehicle Operating Costs.

The update this time includes the following procedure:

- The average travel speeds and the total distances travelled have been obtained from the latest spreadsheet/SIDRA models
- The Vehicle Emission Prediction Model (VEPM, version 6.2) published by Waka Kotahi has been used to estimate the CO_2 productions associated with each option/peak period
- The predicted CO_2 emissions in each modelled year (2015 and 2028) have been calculated based on the annualisation factors and they have been interpolated to calculate the yearly costs in other future years
- The recommended shadow price of carbon provided in Table 11 of MBCM has been applied to the CO_2 emissions above to calculate the yearly CO_2 costs associated with each option. For this assessment, the recommended 'High' price has been used.

The predicted CO_2 emission costs are set out in Table 3.

Table 3: Predicted CO_2 Emission Costs

	Do Minimum		Option	
	2015	**2028**	**2015**	**2028**
Shadow Price of Carbon (NZ$2020)	$104	$143	$104	$143
Annual CO2 Emissions (Tonnes)	14,742	14,043	14,743	14,017
Annual CO2 Costs (NZ$2020)	$1,533,160	$2,008,200	$1,533,290	$2,004,470

3.3 Project Costs

The expected construction costs (P50) provided by Waka Kotahi have been updated to reflect the new costs evaluated in 2021[3], with costs for each stage being provided separately. For maintenance costs, the same annual and periodic costs estimated in the SSBC have been used and they have been split pro-rata to the length of each individual stage. The estimated costs for each stage of the project are summarised in Table 4.

[3] Project Estimate – Form E, SH16 Brigham Creek to Waimauku Stage 1 (October 2021) and Project Estimate – Form E, SH16 Brigham Creek to Waimauku Stage 2 (April 2021)

Table 4: Cost Update Assumption – Not discounted

Coast Element	Stage 1 and 2	Stage 1 Only	Stage 2 Only
Pre-Implementation Costs	$5,306,122	$85,835	$5,220,287
Property	$23,650,000	$650,000	$23,000,000
Construction	$118,048,204	$43,910,000	$74,138,204
Routine and Periodic Maintenance	$11,551,699	$3,713,046	$7,838,653

3.4 Project Benefits

The predicted benefits for the project are summarised in Table 5.

Table 5: Benefit Update (Net Present Values, $thousands)

Benefit Element	Scenario 1: Stage 1 and Stage 2 constructed together	Scenario 2: Stage 1 first, Stage 2 starts in 2025	Scenario 3: Stage 2 first, Stage 1 starts in 2025
Travel Time	$82,915	$78,353	$82,915
Vehicle Operating	$5,754	$5,595	$5,754
Safety	$14,300	$14,300	$14,300
Vehicle Emission	$418	$418	$418
Driver Frustration	$6,850	$6,355	$6,850
Trip Reliability	$4,488	$4,235	$4,488
Shared Path Benefits	$2,922	$2,922	$2,922
Public Transport Travel Time	$2,466	$2,347	$2,466
Public Transport Reliability	$1,005	$955	$1,005
Total Benefits	$121,119	$115,481	$121,119
Total Costs	$139,259	$129,106	$135,069
Benefit Cost Ratio	0.87	0.89	0.90

The above table indicates that the timing of the stage 1 and Stage 2 construction will have very modest impacts on the project BCRs.

4 SENSITIVITY TESTS

As requested by Waka Kotahi, we have included a sensitivity test which investigates the project BCR if raised pedestrian tables and signalised pedestrian crossings are provided on SH16 at the Taupaki Road and Coatesville-Riverhead Highway roundabouts. Due to the limitation of SIDRA not being able to model signalised pedestrian crossing/zebra crossings at roundabouts, we have made the assumption that the

proposed pedestrian crossings will result in a reduction in the approach speeds at the roundabouts, from the existing 80 kph to 50 kph.

Table 6 sets out the road user benefits predicted from this sensitivity test.

Table 6: Benefit Summary – Sensitivity Test (Net Present Values, $thousands)

Benefit Element	Scenario 1, without pedestrian crossings	Scenario 1, with pedestrian crossings	Difference
Travel Time	$82,921	$9,500	-89%
Vehicle Operating	$5,791	$364	-94%
Driver Frustration	$6,823	$6,882	+1%
Trip Reliability	$4,487	$819	-82%

The above table indicates that the proposed pedestrian crossings will result in a reduction in travel time, vehicle operating and trip reliability benefits of the project. We however note that SIDRA predicts very modest changes to delays at the roundabouts as the slower approaching speeds are predicted to result in greater gaps to the side road traffic, therefore improving congestion/driver frustration experienced on the side roads.

We also note that the proposed pedestrian crossing facilities may bring additional pedestrian safety benefits to the corridor, particularly with the proposed shared path. We however note that very modest safety benefits are predicted for the shared path which may be associated with the low pedestrian/cyclist volumes observed and expected along the corridor.

A BCR value of 0.3 is therefore predicted for the sensitivity test (assuming the project costs and timeframe stay the same as the core test).

In addition to the above, we have included a further sensitivity test for all scenarios, where the estimated P95 costs have been used to calculate project BCRs. These are summarised below.

Table 7: Benefit Update (Net Present Values, $thousands) – Sensitivity Test with P95 Costs

Benefit Element	Scenario 1	Scenario 2	Scenario 3
Total Benefits	$121,119	$115,481	$121,119
Total Costs	$150,680	$139,751	$146,074
Benefit Cost Ratio	0.80	0.83	0.83

5 CONCLUSIONS

Waka Kotahi has requested Flow to update the economic analysis of the SH16 Brigham Creek Road to Waimauku Single Stage Business Case. The main purpose of this update is to capture the effects of the updated SATURN models developed by Supporting Growth Alliance (SGA) North West. In addition, the economic evaluation procedure has also been updated to incorporate Waka Kotahi's Monetised Benefits and Costs Manual (MBCM), published in August 2021.

We have used the same spreadsheet model and SIDRA models developed previously and updated the inputs using data extracted from the SGA SATURN model.

The project includes two stages, with Stage 1 being the Huapai to Waimauku section and Stage 2 covering the Brigham Creek Road to Kumeu section. We have tested three scenarios which consider the order of construction, being

- Scenario 1: full programme (Stage 1 and 2) to be constructed during a 30 month period (assuming the same construction period for Stage 2, which is longer). Construction is assumed to start in 2022
- Scenario 2: Stage 1 being constructed first (estimated to take 24 months, starting in 2022), with Stage 2 being constructed in the next NLTP period (construction is assumed to start in 2025)
- Scenario 3: Stage 2 being constructed first (estimated to take 30 months, starting in 2022), with Stage 1 being constructed in the next NLTP period (construction is assumed to start in 2025)

The following table provides the predicted benefits and costs for each scenario, with costs being updated to reflect 2021 values.

Table 8: Benefit Update (Net Present Values, $)

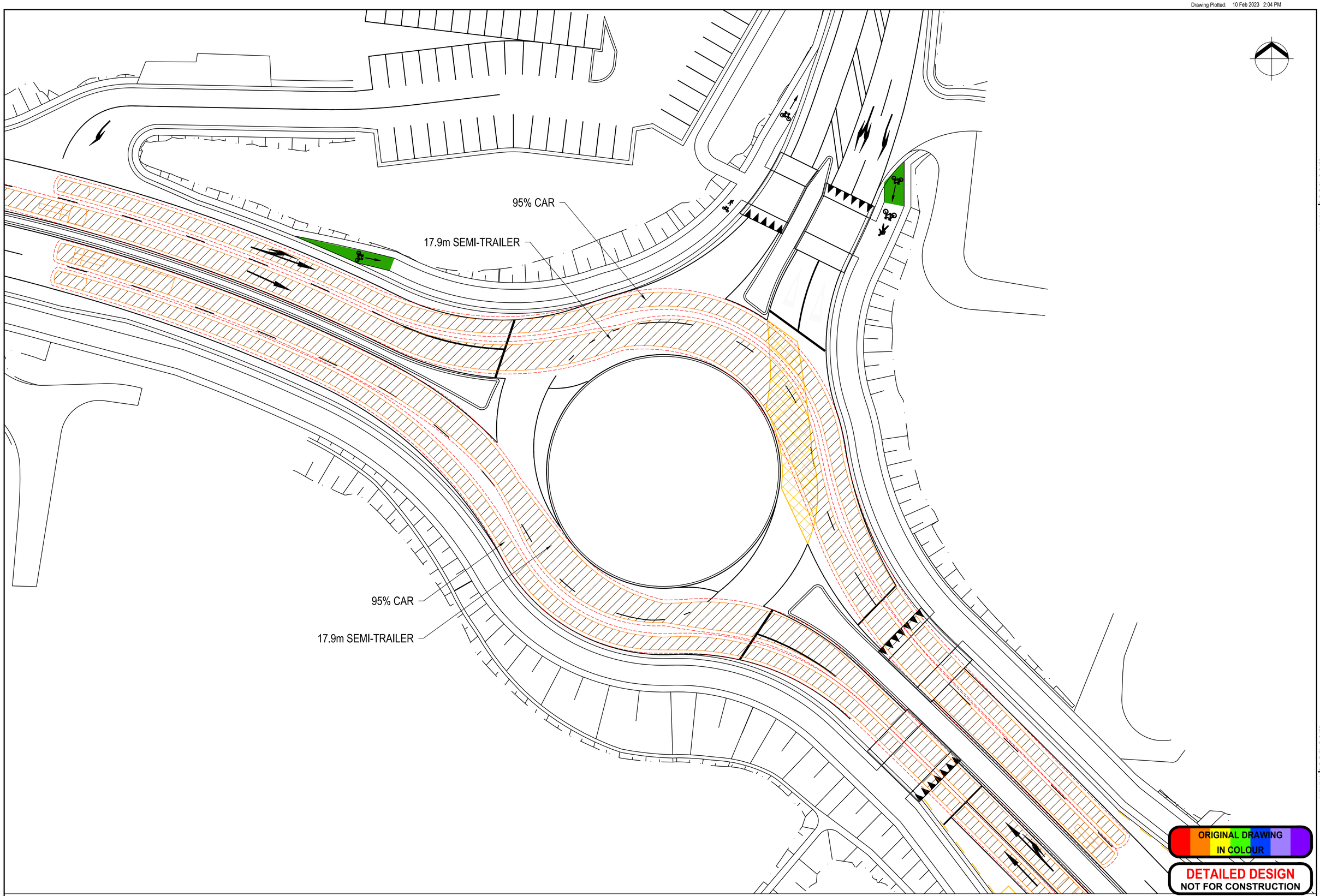
Benefit Element	Scenario 1	Scenario 2	Scenario 3
Total Benefits	$121,119,000	$115,481,000	$121,119,000
Total Costs	$139,259,000	$129,106,000	$135,069,000
Benefit Cost Ratio	0.87	0.89	0.90

The above table indicates that the results are predicted to be very similar for the three scenarios, with the BCRs for all three scenarios being marginally under 1.

Attachment 5 – Waka Kotahi Crash Analysis System (CAS) data - CAS output file SH16 Stage 2 CAS Output Data.xlsx dated 09/02/2023

Attachment 6 - Drawings – Vehicle tracking SH16/Coatesville Roundabout dated July 2022

Drawing Plotted: 10 Feb 2023 2:04 PM



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ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
A	FOR INFORMATION	AH			JULY '22

Drawing Originator: Beca

Original Scale (A1) 1:250
Reduced Scale (A3) 1:500

Design	A. HOLT	JULY '22	Approved For Construction*
Drawn	A. HOLT	JULY '22	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: VEHICLE TRACKING SH16/COATESVILLE ROUNDABOUT SHEET 1

Discipline: CIVIL

Drawing No.: 3235084-TR-0001

Rev.: A

DO NOT SCALE

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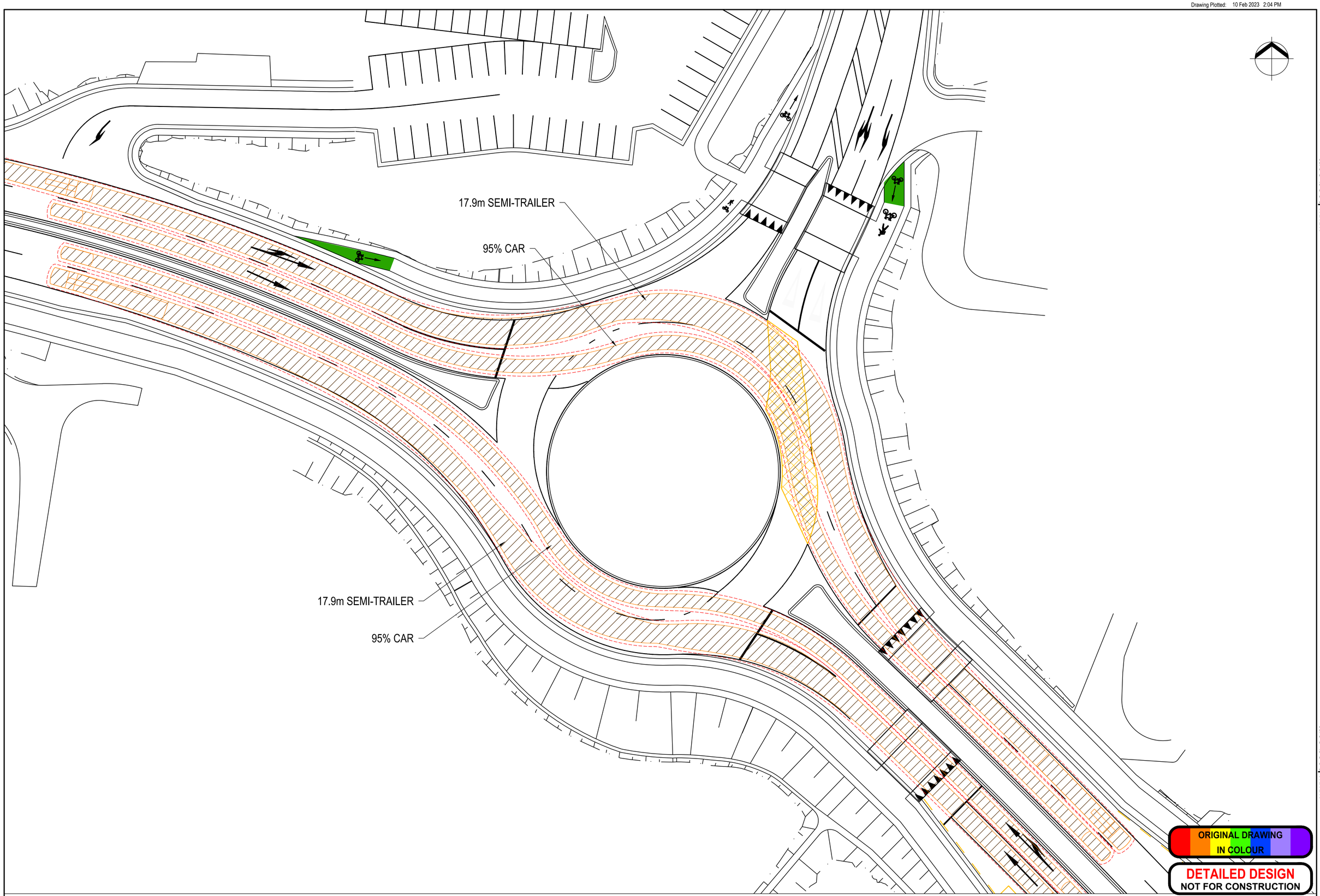
Document No. 3235084-TR-0001.DWG

Drawing Plotted: 10 Feb 2023 2:04 PM



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Design	A. HOLT	JULY '22	Approved For Construction*
Drawn	A. HOLT	JULY '22	
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Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: VEHICLE TRACKING SH16/COATESVILLE ROUNDABOUT SHEET 2

Discipline: CIVIL

Drawing No. 3235084-TR-0002

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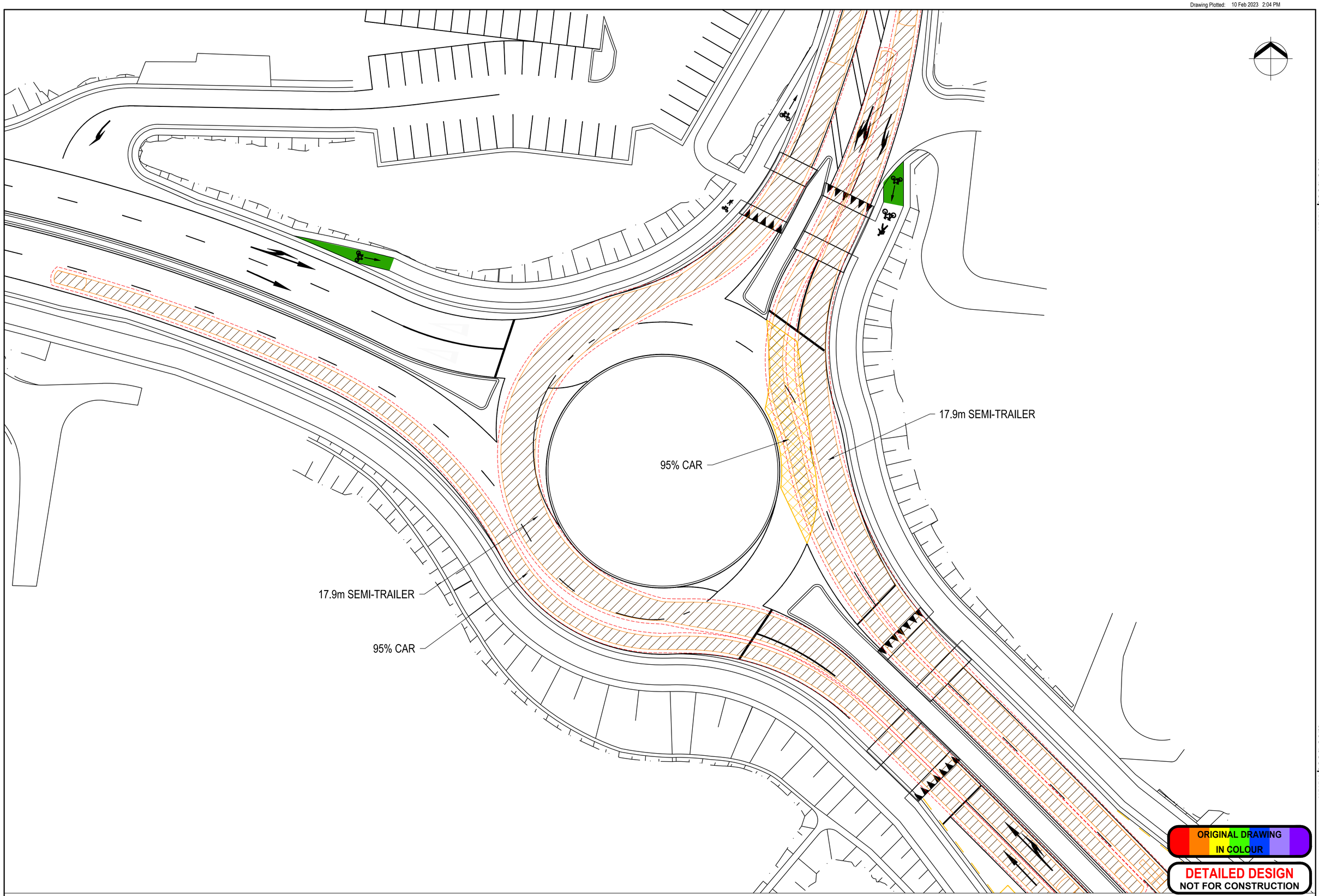

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No.	Revision	By	Chk	Appd	Date
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Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: VEHICLE TRACKING SH16/COATESVILLE ROUNDABOUT SHEET 3

Discipline: CIVIL

Drawing No.: 3235084-TR-0003

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Document No. 3235084-TR-0003.DWG

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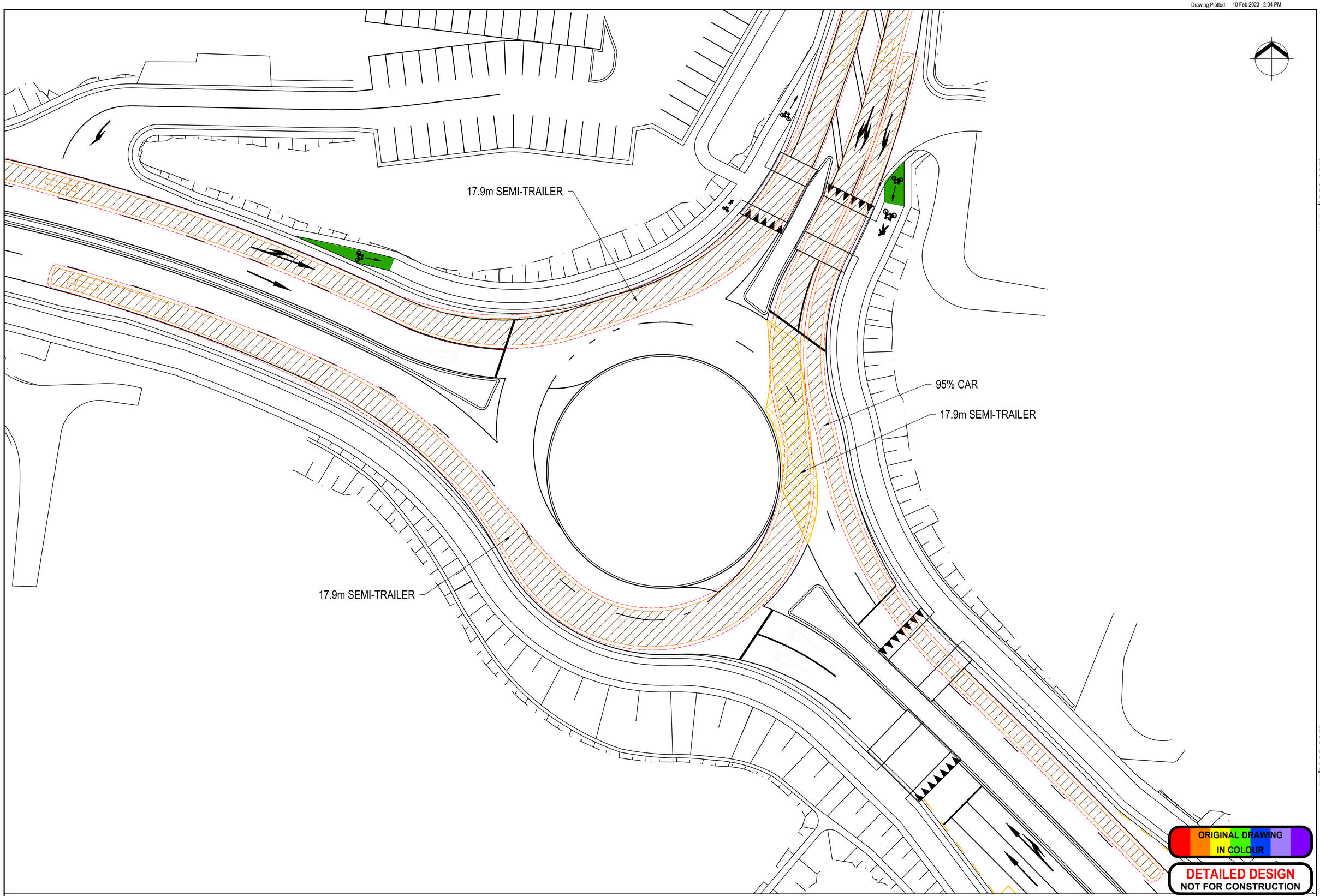

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Original Scale (A1) 1:250
Reduced Scale (A3) 1:500

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Drawn	A. HOLT	JULY '22	
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Dwg Check			Date

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Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: VEHICLE TRACKING SH16/COATESVILLE ROUNDABOUT SHEET 4

Discipline: CIVIL

Drawing No.: 3235084-TR-0004

Rev.: A

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Document No. 3235084-TR-0004.DWG

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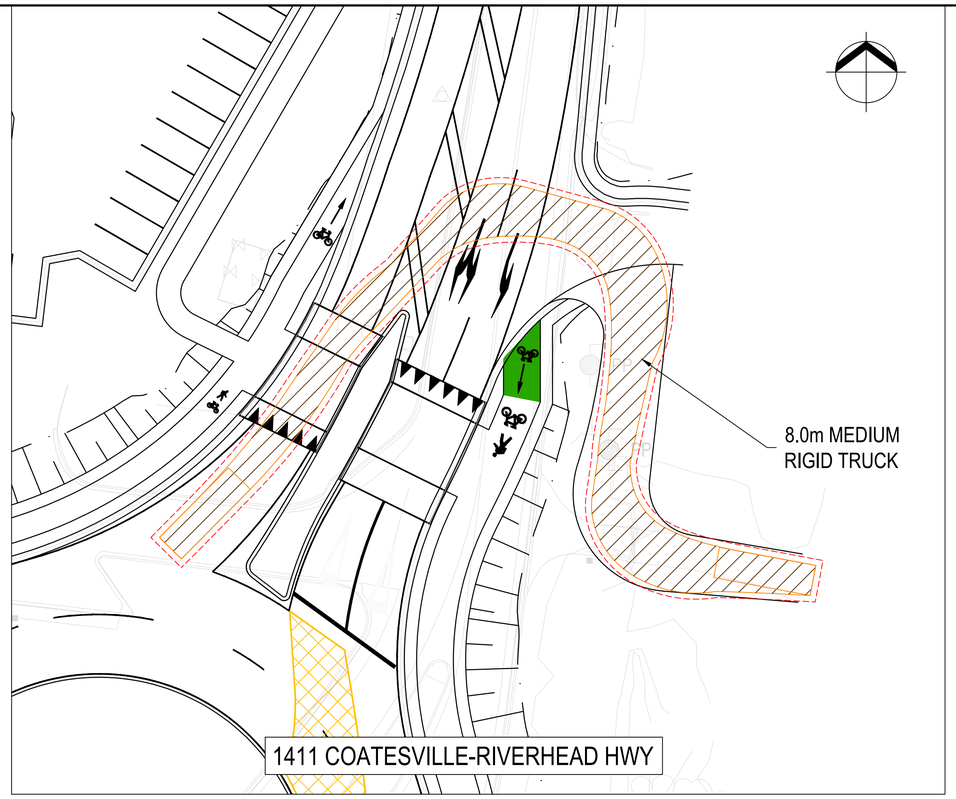

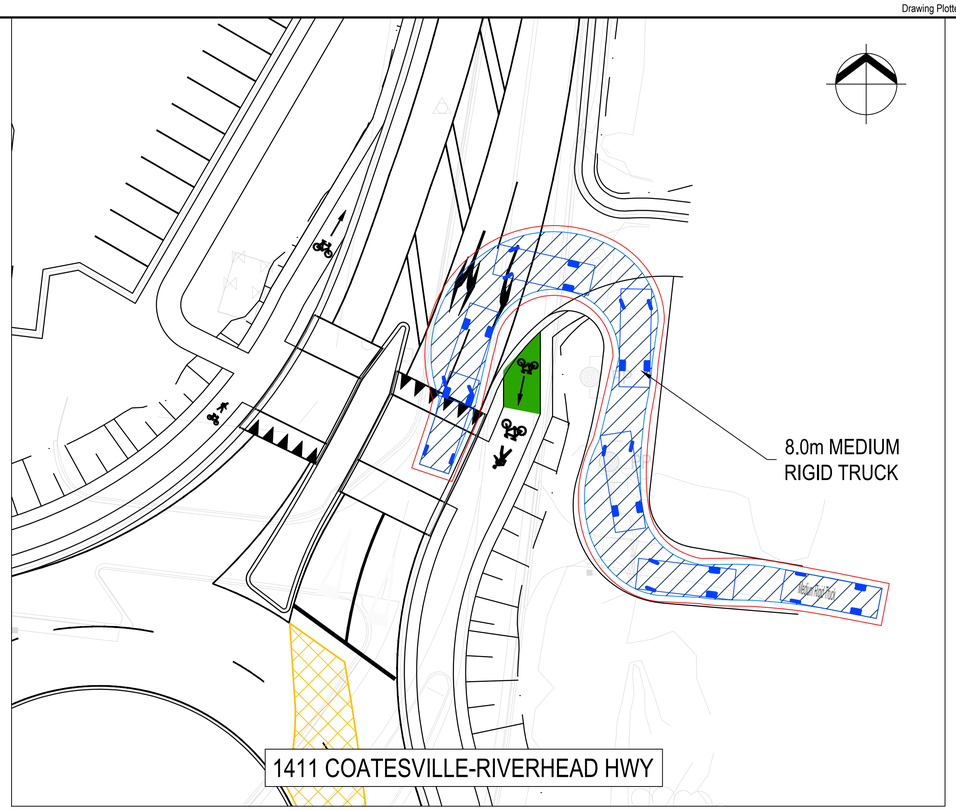

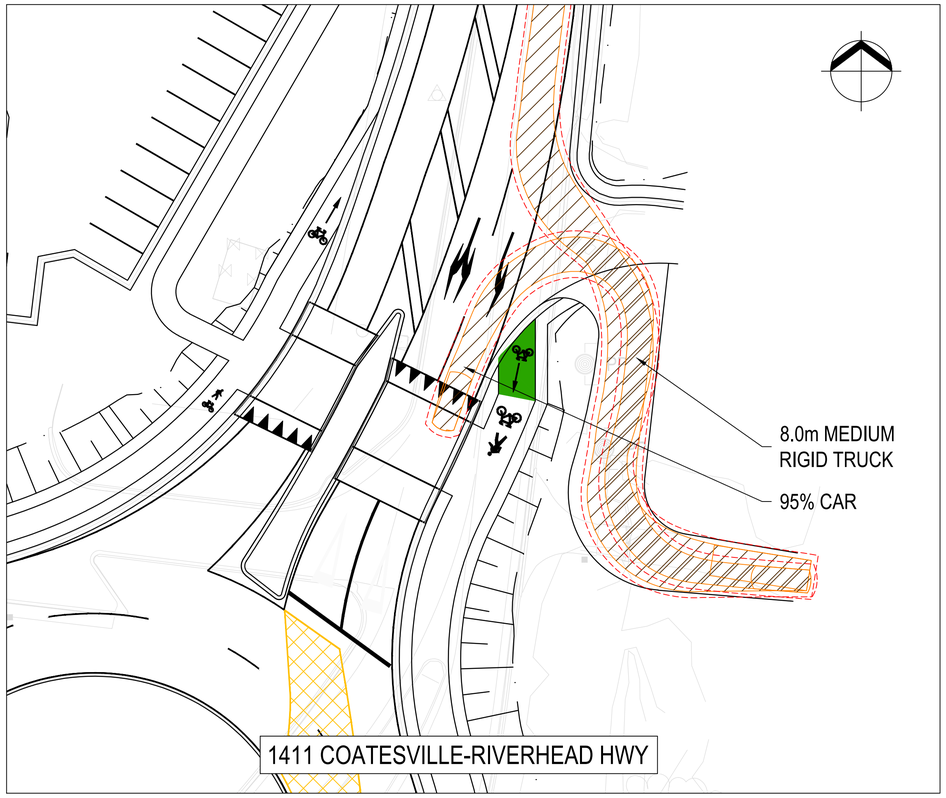

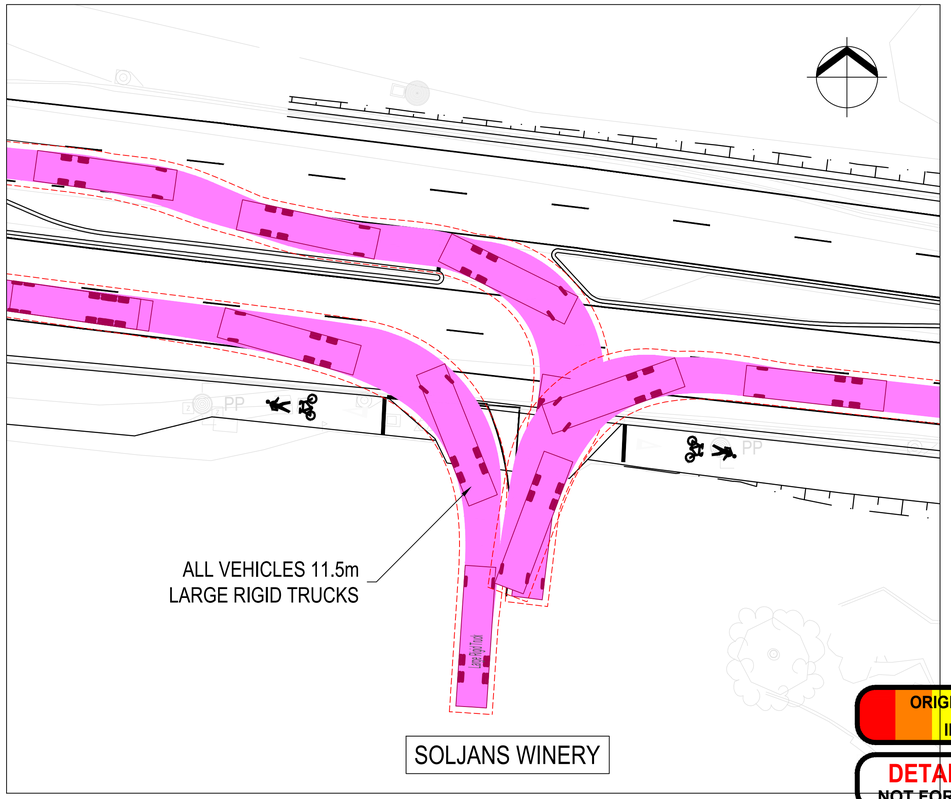

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No.	Revision	By	Chk	Appd	Date
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Drawing Originator: Beca

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	Drawn	A. HOLT	JULY '22
Reduced Scale (A3) 1:500	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date

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Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: VEHICLE TRACKING 1411 COATESVILLE AND SOLJANS SHEET 5

Discipline: CIVIL

Drawing No.: 3235084-TR-0005

Rev.: A

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Attachment 7 – Preliminary Design Road Safety Audit SH16 - Safety Improvements Stage 2 Brigham Creek to Kumeu dated 29 April 2021

Sensitivity: General

PRELIMINARY DESIGN ROAD SAFETY AUDIT
SH16 - SAFETY IMPROVEMENTS
STAGE 2 BRIGHAM CREEK TO KUMEU

PREPARED FOR WAKA KOTAHI NZ TRANSPORT AGENCY

29 April 2021

Stantec

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QUALITY STATEMENT

PROJECT MANAGER	ROAD SAFETY AUDIT TEAM LEADER
Ali Siddiqui	Keith Weale

PREPARED BY		
Keith Weale		29 April 2021
CHECKED BY		
Nick Gluyas		29 April 2021
REVIEWED BY		
Nick Gluyas		29 April 2021
APPROVED FOR ISSUE BY		
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Waka Kotahi NZ Transport Agency

Stage 2 Brigham Creek to Kumeu

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1 Introduction

1.1 Safety Audit Definition and Purpose

A road safety audit is a term used internationally to describe an independent review of a future road project to identify any safety concerns that may affect the safety performance. The audit team considers the safety of all road users and qualitatively reports on road safety issues or opportunities for safety improvement.

A road safety audit is therefore a formal examination of a road project, or any type of project which affects road users (including cyclists, pedestrians, mobility impaired etc.), carried out by an independent competent team who identify and document road safety concerns.

A road safety audit is intended to help deliver a safe road system and is not a review of compliance with standards.

The primary objective of a road safety audit is to deliver a project that achieves an outcome consistent with Safer Journeys and the Safe System approach, which is a safe road system free of death and serious injury. The road safety audit is a safety review used to identify all areas of a project that are inconsistent with a Safe System and bring those concerns to the attention of the client so that the client can make a value judgement as to appropriate action(s) based on the risk guidance provided by the safety audit team.

The key objective of a road safety audit is summarised as:

'to deliver completed projects that contribute towards a safe road system that is free of death and serious injury by identifying and ranking potential safety concerns for all road users and others affected by a road project.'

A road safety audit should desirably be undertaken at project milestones such as:

- concept stage (part of business case);
- scheme or preliminary design stage (part of pre-implementation);
- detail design stage (pre-implementation or implementation); or
- pre-opening or post-construction stage (implementation or post-implementation).

A road safety audit is not intended to be a technical or financial audit and does not substitute for a design check of standards or guidelines. Any recommended treatment of an identified safety concern is intended to be indicative only, and to focus the designer on the type of improvements that might be appropriate. It is not intended to be prescriptive and other ways of improving the road safety or operational problems identified should also be considered.

In accordance with the procedures set down in the NZTA Road Safety Audit Procedures for Projects Guidelines - Interim release May 2013 the audit report should be submitted to the client who will instruct the designer to respond. The designer should consider the report and comment to the client on each of any concerns identified, including their cost implications where appropriate, and make a recommendation to either accept or reject the audit report recommendation.

For each audit team recommendation that is accepted, the client will make the final decision and brief the designer to make the necessary changes and/or additions. As a result of this instruction the designer shall action the approved amendments. The client may involve a safety engineer to provide commentary to aid with the decision.

Decision tracking is an important part of the road safety audit process. A decision tracking table is embedded into the report format at the end of each set of recommendations. It is to be completed by the designer, safety engineer, and client for each issue, and should record the designer's response, client's decision (and asset manager's comments in the case where the client and asset manager are not one and the same) and action taken.

A copy of the report including the designer's response to the client and the client's decision on each recommendation shall be given to the road safety audit team leader as part of the important feedback loop. The road safety audit team leader will disseminate this to team members.

1.2 The Project

The safety and capacity of SH16 are proposed to be improved by:

- widening the highway to four lanes, including median barriers, between Brigham Creek Road/Fred Taylor Drive and Taupaki Road/Old North Road,
- constructing a two-lane roundabout at the intersection of Coatesville-Riverhead Road,
- providing a 2.5 m wide flush median between Taupaki Road/Old North Road and Old Railway Road, and
- constructing a shared path along the entire length of the project.

1.3 The Road Safety Audit Team

This road safety audit has been carried out in accordance with the NZTA Road Safety Audit Procedure for Projects Guidelines – Interim release May 2013.

Table 1-1: Road Safety Audit Team Members

Name	Position	Organisation	Element
Keith Weale	Technical Director Roads & Highways	Stantec	Team leader
Noel Tunnicliffe	Roading Engineer	RoadLab	Team member
Grant Gordon	Senior Network Safety Engineer	Auckland System Management Waka Kotahi	Team member

1.4 Previous Road Safety Audits

The following road safety audits have been carried out on the project previously.

- SH16 Brigham Creek to Waimauku preliminary design road safety audit in August 2017. (Opus, 2017)
- SH16 Kumeu to Waimauku preliminary design road safety audit in October 2018.
- S16 Brigham Creek to Kumeu Stage 2 preliminary road safety review comments on the shared path only in December 2018. (WSP Opus, 2018)

1.5 Scope of this Road Safety Audit

This is a preliminary design road safety audit of the proposed SH16 widening to four lanes and safety improvements between Brigham Creek Road and Weza Lane in Kumeu, excluding the two existing roundabouts at Brigham Creek Road/Fred Taylor Drive and at Taupaki Road/Old North Road.

1.6 Briefing, Site Visit and Audit

Andria D'Souza of Waka Kotahi and the designers, Nicholas Lagaros, and Adam Holt of Beca, briefed the road safety audit team on 6 April 2021.

The road safety audit team visited the site and carried out the audit on Tuesday 13 April 2021.

1.7 Report Format

The potential road safety problems identified have been ranked as follows.

The expected crash frequency is qualitatively assessed based on expected exposure (how many road users will be exposed to a safety issue) and the likelihood of a crash resulting from the presence of the issue. The severity of a crash outcome is qualitatively assessed based on factors such as expected speeds, type of collision, and type of vehicle involved.

Reference to historic crash rates or other research for similar elements of projects have been drawn on where appropriate to assist in understanding the likely crash types, frequency and likely severity that may result from a particular concern.

The frequency and severity ratings are used together to develop a combined qualitative risk ranking for each safety issue using the concern assessment rating matrix in Table 1-3. The qualitative assessment requires professional judgement and a wide range of experience in projects of all sizes and locations.

In ranking specific concerns, the auditors have considered the objectives of the Safe System approach, i.e., to minimise fatal or serious injury crashes.

In undertaking this assessment, the safety audit team has utilised the following descriptor tables to enable a fair and reasonable rating of the risks.

Table 1-2: Crash Frequency Descriptor

Crash Frequency	Indicative Description
Frequent	Multiple crashes (more than 1 per year)
Common	1 every 1-5 years
Occasional	1 every 5-10 years
Infrequent	Less than 1 every 10 years

Crash severity is determined on the likelihood of a crash resulting in death or serious injury. The reader is advised that the severity of an injury is determined in part by the ability of a person to tolerate the crash forces. An able-bodied adult will have a greater ability to recover from higher trauma injuries, whereas an elderly person may have poor ability to recover from high trauma injuries. The auditors consider the likely user composition, and hence the likely severity of injury to that user.

Table 1-3: Concern Assessment Rating Matrix

Severity (likelihood of death or serious injury)	**Frequency** (probability of a crash)			
	Frequent	Common	Occasional	Infrequent
Very likely	Serious	Serious	Significant	Moderate
Likely	Serious	Significant	Moderate	Moderate
Unlikely	Significant	Moderate	Minor	Minor
Very unlikely	Moderate	Minor	Minor	Minor

While all safety concerns should be considered for action, the client or nominated project manager will make the decision on the course of action will be adopted based on the guidance given in this ranking process with consideration to factors other than safety alone. As a guide, a suggested action for each concern category is given in Table 1-4.

Table 1-4: Concern Categories

Concern	Suggested action
Serious	Major safety concern that must be addressed and requires changes to avoid serious safety consequences.
Significant	Significant safety concern that should be addressed and requires changes to avoid serious safety consequences.
Moderate	Moderate safety concern that should be addressed to improve safety.
Minor	Minor safety concern that should be addressed where practical to improve safety.

In addition to the ranked safety issues, it may be appropriate for the safety audit team to provide additional comments with respect to items that may have a safety implication but lie outside the scope of the safety audit. A comment may include items where the safety implications are not yet clear due to insufficient detail for the stage of project, items outside the scope of the audit such as existing issues not impacted by the project or an opportunity for improved safety but not necessarily linked to the project itself. While typically comments do not require a specific recommendation, the auditors may give suggestions in some instances.

1.8 Documents Provided

The road safety audit team was provided with the following documents for this audit.

DRAWING NO.				DRAWING TITLE
GENERAL				
3235084		CA	1000	COVER PAGE
3235084		CA	1001	DRAWING LIST
3235084		CA	1102	DRAWING LIST
3235084		CA	1103	DRAWING LIST
3235084		CA	1104	DRAWING LIST
GENERAL ARRANGEMENT				
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3235084		CA	1201	GENERAL ARRANGEMENT
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3235084		CG	1252	LONGITUDINAL SECTIONS
3235084		CG	1253	LONGITUDINAL SECTIONS
TYPICAL CROSS SECTIONS				
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3235084		CG	1303	TYPICAL CROSS SECTIONS - ROUNDABOUT ICD
3235084		CG	1304	TYPICAL CROSS SECTIONS - COATESVILLE-RIVERHEAD HWY
3235084		CG	1305	TYPICAL CROSS SECTIONS - COATESVILLE-RIVERHEAD HWY TO TAUPAKI ROAD
3235084		CG	1306	TYPICAL CROSS SECTIONS - COATESVILLE-RIVERHEAD HWY TO TAUPAKI ROAD
3235084		CG	1307	TYPICAL CROSS SECTIONS - TAUPAKI ROAD TO OLD RAILWAY ROAD
3235084		CG	1308	TYPICAL CROSS SECTIONS - TAUPAKI ROAD TO OLD RAILWAY ROAD
3235084		CG	1309	TYPICAL CROSS SECTIONS - OLD RAILWAY ROAD TO KUMEU
DETAILED CROSS SECTIONS - BRIGHAM CREEK TO COATESVILLE-RIVERHEAD HWY				
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3235084		CG	1406	DETAILED CROSS SECTIONS - BRIGHAM CREEK TO COATESVILLE-RIVERHEAD HWY
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3235084		CG	1422	DETAILED CROSS SECTIONS - BRIGHAM CREEK TO COATESVILLE-RIVERHEAD HWY
3235084		CG	1423	DETAILED CROSS SECTIONS - BRIGHAM CREEK TO COATESVILLE-RIVERHEAD HWY
3235084		CG	1424	DETAILED CROSS SECTIONS - BRIGHAM CREEK TO COATESVILLE-RIVERHEAD HWY
3235084		CG	1425	DETAILED CROSS SECTIONS - BRIGHAM CREEK TO COATESVILLE-RIVERHEAD HWY
3235084		CG	1426	DETAILED CROSS SECTIONS - BRIGHAM CREEK TO COATESVILLE-RIVERHEAD HWY
DETAILED CROSS SECTIONS - NEW ROUNDABOUT AND COATESVILLE-RIVERHEAD HWY				
3235084		CG	1431	DETAILED CROSS SECTIONS - ROUNDABOUT ICD
3235084		CG	1432	DETAILED CROSS SECTIONS - ROUNDABOUT ICD
3235084		CG	1433	DETAILED CROSS SECTIONS - ROUNDABOUT ICD
3235084		CG	1434	DETAILED CROSS SECTIONS - COATESVILLE-RIVERHEAD HWY
3235084		CG	1435	DETAILED CROSS SECTIONS - COATESVILLE-RIVERHEAD HWY
DETAILED CROSS SECTIONS - COATESVILLE-RIVERHEAD HWY TO TAUPAKI ROAD				
3235084		CG	1441	DETAILED CROSS SECTIONS - COATESVILLE-RIVERHEAD HWY TO TAUPAKI ROAD
3235084		CG	1442	DETAILED CROSS SECTIONS - COATESVILLE-RIVERHEAD HWY TO TAUPAKI ROAD
3235084		CG	1443	DETAILED CROSS SECTIONS - COATESVILLE-RIVERHEAD HWY TO TAUPAKI ROAD
3235084		CG	1444	DETAILED CROSS SECTIONS - COATESVILLE-RIVERHEAD HWY TO TAUPAKI ROAD
3235084		CG	1445	DETAILED CROSS SECTIONS - COATESVILLE-RIVERHEAD HWY TO TAUPAKI ROAD
3235084		CG	1446	DETAILED CROSS SECTIONS - COATESVILLE-RIVERHEAD HWY TO TAUPAKI ROAD
3235084		CG	1447	DETAILED CROSS SECTIONS - COATESVILLE-RIVERHEAD HWY TO TAUPAKI ROAD
DETAILED CROSS SECTIONS - TAUPAKI ROAD TO OLD RAILWAY ROAD				
3235084		CG	1451	DETAILED CROSS SECTIONS - TAUPAKI ROAD TO OLD RAILWAY ROAD
3235084		CG	1452	DETAILED CROSS SECTIONS - TAUPAKI ROAD TO OLD RAILWAY ROAD
3235084		CG	1453	DETAILED CROSS SECTIONS - TAUPAKI ROAD TO OLD RAILWAY ROAD
3235084		CG	1454	DETAILED CROSS SECTIONS - TAUPAKI ROAD TO OLD RAILWAY ROAD
3235084		CG	1455	DETAILED CROSS SECTIONS - TAUPAKI ROAD TO OLD RAILWAY ROAD
3235084		CG	1456	DETAILED CROSS SECTIONS - TAUPAKI ROAD TO OLD RAILWAY ROAD
3235084		CG	1457	DETAILED CROSS SECTIONS - TAUPAKI ROAD TO OLD RAILWAY ROAD
3235084		CG	1458	DETAILED CROSS SECTIONS - TAUPAKI ROAD TO OLD RAILWAY ROAD
3235084		CG	1459	DETAILED CROSS SECTIONS - TAUPAKI ROAD TO OLD RAILWAY ROAD
3235084		CG	1460	DETAILED CROSS SECTIONS - TAUPAKI ROAD TO OLD RAILWAY ROAD
3235084		CG	1461	DETAILED CROSS SECTIONS - TAUPAKI ROAD TO OLD RAILWAY ROAD
3235084		CG	1462	DETAILED CROSS SECTIONS - TAUPAKI ROAD TO OLD RAILWAY ROAD
3235084		CG	1463	DETAILED CROSS SECTIONS - TAUPAKI ROAD TO OLD RAILWAY ROAD
3235084		CG	1464	DETAILED CROSS SECTIONS - TAUPAKI ROAD TO OLD RAILWAY ROAD
DETAILED CROSS SECTIONS - OLD RAILWAY ROAD TO KUMEU				
3235084		CG	1471	DETAILED CROSS SECTIONS - OLD RAILWAY ROAD TO KUMEU
3235084		CG	1472	DETAILED CROSS SECTIONS - OLD RAILWAY ROAD TO KUMEU
3235084		CG	1473	DETAILED CROSS SECTIONS - OLD RAILWAY ROAD TO KUMEU
3235084		CG	1474	DETAILED CROSS SECTIONS - OLD RAILWAY ROAD TO KUMEU
3235084		CG	1475	DETAILED CROSS SECTIONS - OLD RAILWAY ROAD TO KUMEU
3235084		CG	1476	DETAILED CROSS SECTIONS - OLD RAILWAY ROAD TO KUMEU

DRAWING NO.				DRAWING TITLE
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3235084		CG	1478	DETAILED CROSS SECTIONS - OLD RAILWAY ROAD TO KUMEU
EXISTING SERVICES				
3235084		CU	2000	EXISTING SERVICES LEGEND AND NOTES
3235084		CU	2001	EXISTING SERVICES PLAN
3235084		CU	2002	EXISTING SERVICES PLAN
3235084		CU	2003	EXISTING SERVICES PLAN
3235084		CU	2004	EXISTING SERVICES PLAN
3235084		CU	2005	EXISTING SERVICES PLAN
3235084		CU	2006	EXISTING SERVICES PLAN
3235084		CU	2007	EXISTING SERVICES PLAN
3235084		CU	2008	EXISTING SERVICES PLAN
3235084		CU	2009	EXISTING SERVICES PLAN
3235084		CU	2010	EXISTING SERVICES PLAN
3235084		CU	2011	EXISTING SERVICES PLAN
3235084		CU	2012	EXISTING SERVICES PLAN
3235084		CU	2013	EXISTING SERVICES PLAN
COMBINED SERVICES RELOCATION				
3235084		CU	2050	COMBINED SERVICE RELOCATIONS LEGEND AND NOTES
3235084		CU	2051	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2052	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2053	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2054	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2055	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2056	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2057	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2058	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2059	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2060	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2061	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2062	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2063	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2064	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2065	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2066	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2067	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2068	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2069	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2070	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2071	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2072	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2073	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2074	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2075	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2076	COMBINED SERVICE RELOCATIONS PLAN
3235084		CU	2077	COMBINED SERVICE RELOCATIONS PLAN
COMBINED SERVICES TRENCH CROSS SECTIONS				
3235084		CU	2081	COMBINED SERVICE TYPICAL TRENCH CROSS SECTIONS
3235084		CU	2082	COMBINED SERVICE TYPICAL TRENCH CROSS SECTIONS
3235084		CU	2083	COMBINED SERVICE TYPICAL TRENCH CROSS SECTIONS
3235084		CU	2084	COMBINED SERVICE TYPICAL TRENCH CROSS SECTIONS

DRAWING NO.				DRAWING TITLE
3235084		CU	2085	COMBINED SERVICE TYPICAL TRENCH CROSS SECTIONS
3235084		CU	2086	COMBINED SERVICE TYPICAL TRENCH CROSS SECTIONS
STORMWATER PLANS				
3235084		CD	2100	STORMWATER LEGEND AND NOTES
3235084		CD	2101	STORMWATER PLAN
3235084		CD	2102	STORMWATER PLAN
3235084		CD	2103	STORMWATER PLAN
3235084		CD	2104	STORMWATER PLAN
3235084		CD	2105	STORMWATER PLAN
3235084		CD	2106	STORMWATER PLAN
3235084		CD	2107	STORMWATER PLAN
3235084		CD	2108	STORMWATER PLAN
3235084		CD	2109	STORMWATER PLAN
3235084		CD	2110	STORMWATER PLAN
3235084		CD	2111	STORMWATER PLAN
3235084		CD	2112	STORMWATER PLAN
3235084		CD	2113	STORMWATER PLAN
3235084		CD	2114	STORMWATER PLAN
3235084		CD	2115	STORMWATER PLAN
3235084		CD	2116	STORMWATER PLAN
3235084		CD	2117	STORMWATER PLAN
3235084		CD	2118	STORMWATER PLAN
3235084		CD	2119	STORMWATER PLAN
3235084		CD	2120	STORMWATER PLAN
3235084		CD	2121	STORMWATER PLAN
3235084		CD	2122	STORMWATER PLAN
3235084		CD	2123	STORMWATER PLAN
3235084		CD	2124	STORMWATER PLAN
3235084		CD	2125	STORMWATER PLAN
3235084		CD	2126	STORMWATER PLAN
3235084		CD	2127	STORMWATER PLAN
STORMWATER LONGITUDINAL SECTIONS				
3235084		CD	2201	STORMWATER LONG SECTIONS
3235084		CD	2202	STORMWATER LONG SECTIONS
3235084		CD	2203	STORMWATER LONG SECTIONS
3235084		CD	2204	STORMWATER LONG SECTIONS
3235084		CD	2205	STORMWATER LONG SECTIONS
3235084		CD	2206	STORMWATER LONG SECTIONS
3235084		CD	2207	STORMWATER LONG SECTIONS
3235084		CD	2208	STORMWATER LONG SECTIONS
3235084		CD	2209	STORMWATER LONG SECTIONS
3235084		CD	2210	STORMWATER LONG SECTIONS
3235084		CD	2211	STORMWATER LONG SECTIONS
3235084		CD	2212	STORMWATER LONG SECTIONS
3235084		CD	2213	STORMWATER LONG SECTIONS
3235084		CD	2214	STORMWATER LONG SECTIONS
3235084		CD	2215	STORMWATER LONG SECTIONS

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3235084		CD	2218	STORMWATER LONG SECTIONS
3235084		CD	2219	STORMWATER LONG SECTIONS
3235084		CD	2220	STORMWATER LONG SECTIONS
3235084		CD	2221	STORMWATER LONG SECTIONS
3235084		CD	2222	STORMWATER LONG SECTIONS
3235084		CD	2223	STORMWATER LONG SECTIONS
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3235084		CD	2227	STORMWATER LONG SECTIONS
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3235084		CD	2229	STORMWATER LONG SECTIONS
3235084		CD	2230	STORMWATER LONG SECTIONS
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3235084		CD	2232	STORMWATER LONG SECTIONS
3235084		CD	2233	STORMWATER LONG SECTIONS
3235084		CD	2234	STORMWATER LONG SECTIONS
3235084		CD	2235	STORMWATER LONG SECTIONS
3235084		CD	2236	STORMWATER LONG SECTIONS
3235084		CD	2237	STORMWATER LONG SECTIONS
3235084		CD	2238	STORMWATER LONG SECTIONS
3235084		CD	2239	STORMWATER LONG SECTIONS
STORMWATER TYPICAL DETAILS				
3235084		CD	2301	STORMWATER TYPICAL DETAILS
3235084		CD	2302	STORMWATER TYPICAL DETAILS
3235084		CD	2303	STORMWATER TYPICAL DETAILS
3235084		CD	2304	STORMWATER TYPICAL DETAILS
3235084		CD	2305	STORMWATER TYPICAL DETAILS
3235084		CD	2306	STORMWATER TYPICAL DETAILS
3235084		CD	2307	STORMWATER TYPICAL DETAILS
3235084		CD	2308	STORMWATER TYPICAL DETAILS
3235084		CD	2309	STORMWATER TYPICAL DETAILS
3235084		CD	2310	STORMWATER TYPICAL DETAILS
STREET LIGHTING				
3235084		BE	2600	LIGHTING NOTES AND LEGEND
3235084		BE	2601	LIGHTING PLAN
3235084		BE	2602	LIGHTING PLAN
3235084		BE	2603	LIGHTING PLAN
3235084		BE	2604	LIGHTING PLAN
3235084		BE	2605	LIGHTING PLAN
3235084		BE	2606	LIGHTING PLAN
3235084		BE	2607	LIGHTING PLAN
3235084		BE	2608	LIGHTING PLAN
3235084		BE	2609	LIGHTING PLAN
3235084		BE	2610	LIGHTING PLAN
3235084		BE	2611	LIGHTING PLAN
3235084		BE	2612	LIGHTING PLAN
3235084		BE	2613	LIGHTING PLAN

DRAWING NO.				DRAWING TITLE
ROAD MARKING AND SIGNAGE				
3235084		CT	2800	ROAD MARKINGS AND SIGNAGE LEGEND AND NOTES
3235084		CT	2801	ROAD MARKINGS AND SIGNAGE PLAN
3235084		CT	2802	ROAD MARKINGS AND SIGNAGE PLAN
3235084		CT	2803	ROAD MARKINGS AND SIGNAGE PLAN
3235084		CT	2804	ROAD MARKINGS AND SIGNAGE PLAN
3235084		CT	2805	ROAD MARKINGS AND SIGNAGE PLAN
3235084		CT	2806	ROAD MARKINGS AND SIGNAGE PLAN
3235084		CT	2807	ROAD MARKINGS AND SIGNAGE PLAN
3235084		CT	2808	ROAD MARKINGS AND SIGNAGE PLAN
3235084		CT	2809	ROAD MARKINGS AND SIGNAGE PLAN
3235084		CT	2810	ROAD MARKINGS AND SIGNAGE PLAN
3235084		CT	2811	ROAD MARKINGS AND SIGNAGE PLAN
3235084		CT	2812	ROAD MARKINGS AND SIGNAGE PLAN
3235084		CT	2813	ROAD MARKINGS AND SIGNAGE PLAN
BARRIERS				
3235084		CB	2900	BARRIERS LEGEND AND NOTES
3235084		CB	2901	BARRIERS PLAN
3235084		CB	2902	BARRIERS PLAN
3235084		CB	2903	BARRIERS PLAN
3235084		CB	2904	BARRIERS PLAN
3235084		CB	2905	BARRIERS PLAN
3235084		CB	2906	BARRIERS PLAN
3235084		CB	2907	BARRIERS PLAN
3235084		CB	2908	BARRIERS PLAN
3235084		CB	2909	BARRIERS PLAN
3235084		CB	2910	BARRIERS PLAN
3235084		CB	2911	BARRIERS PLAN
3235084		CB	2912	BARRIERS PLAN
3235084		CB	2913	BARRIERS PLAN
PAVEMENT AND SURFACING				
3235084		CP	3100	PAVEMENT AND SURFACING LEGEND AND NOTES
3235084		CP	3101	PAVEMENT AND SURFACING PLAN
3235084		CP	3102	PAVEMENT AND SURFACING PLAN
3235084		CP	3103	PAVEMENT AND SURFACING PLAN
3235084		CP	3104	PAVEMENT AND SURFACING PLAN
3235084		CP	3105	PAVEMENT AND SURFACING PLAN
3235084		CP	3106	PAVEMENT AND SURFACING PLAN
3235084		CP	3107	PAVEMENT AND SURFACING PLAN
3235084		CP	3108	PAVEMENT AND SURFACING PLAN
3235084		CP	3109	PAVEMENT AND SURFACING PLAN
3235084		CP	3110	PAVEMENT AND SURFACING PLAN
3235084		CP	3111	PAVEMENT AND SURFACING PLAN
3235084		CP	3112	PAVEMENT AND SURFACING PLAN
3235084		CP	3113	PAVEMENT AND SURFACING PLAN
3235084		CP	3114	PAVEMENT AND SURFACING PLAN

DRAWING NO.				DRAWING TITLE
PAVEMENT AND SURFACING DETAILS				
3235084		CP	3201	PAVEMENT AND SURFACING DETAILS
3235084		CP	3202	PAVEMENT AND SURFACING DETAILS
STRUCTURES - KUMEU SHARED USE BRIDGE				
3235084		SE	4000	COVER SHEET AND DRAWING INDEX
3235084		SE	4005	GENERAL ARRANGEMENT - PLAN
3235084		SE	4006	GENERAL ARRANGEMENT - ELEVATION
3235084		SE	4007	GENERAL ARRANGEMENT - TYPICAL SECTIONS
STRUCTURES - BRIGHAM SHARED USE BRIDGE & ROAD WIDENING				
3235084		SE	4100	COVER SHEET AND DRAWING INDEX
3235084		SE	4105	GENERAL ARRANGEMENT - PLAN
3235084		SE	4106	GENERAL ARRANGEMENT - LONG SECTIONS
3235084		SE	4107	GENERAL ARRANGEMENT - CROSS SECTIONS
3235084		SE	4108	GENERAL ARRANGEMENT - DETAIL CROSS SECTIONS
RETAINING WALL				
3235084		GE	5000	RETAINING WALLS DRAWING LIST AND LOCALITY PLAN
3235084		GE	5001	RETAINING WALLS GENERAL NOTES
3235084		GE	5002	RETAINING WALL TYPICAL DETAIL - STEEL FILL RETAINING WALL
3235084		GE	5003	RETAINING WALL TYPICAL DETAIL - STEEL FILL RETAINING WALL
3235084		GE	5004	TYPICAL DETAIL - TIMBER FILL RETAINING WALL SUPPORTING SHARED USE PATH
3235084		GE	5005	TYPICAL DETAIL - TIMBER CUT RETAINING WALL WITH SHARED USE PATH
LANDSCAPE				
3235084		AL	6000	LANDSCAPE NOTES AND LEGEND
3235084		AL	6001	LANDSCAPE PLAN
3235084		AL	6002	LANDSCAPE PLAN
3235084		AL	6003	LANDSCAPE PLAN
3235084		AL	6004	LANDSCAPE PLAN
3235084		AL	6005	LANDSCAPE PLAN
3235084		AL	6006	LANDSCAPE PLAN
3235084		AL	6007	LANDSCAPE PLAN
3235084		AL	6008	LANDSCAPE PLAN
3235084		AL	6009	LANDSCAPE PLAN
3235084		AL	6010	LANDSCAPE PLAN
3235084		AL	6011	LANDSCAPE PLAN
3235084		AL	6012	LANDSCAPE PLAN
3235084		AL	6013	LANDSCAPE PLAN
3235085		AL	6200	PLANT SCHEDULE
3235085		AL	6300	LANDSCAPE DETAILS

All drawings were labelled preliminary, revision A.

1.9 Disclaimer

The findings and recommendations in this report are based on an examination of available relevant plans, the specified road and its environs, and the opinions of the road safety audit team. However, it must be recognised that eliminating safety concerns cannot be guaranteed since no road can be regarded as safe and no warranty is implied that all safety issues have been identified in this report. Safety audits do not constitute a design review nor are they an assessment of standards with respect to engineering or planning documents.

Readers are urged to seek specific technical advice on matters raised and not rely solely on the report.

While every effort has been made to ensure the accuracy of the report, it is made available on the basis that anyone relying on it does so at their own risk without any liability to the safety audit team or their organisations.

2 Safety Concerns

2.1 Footpaths and Shared Paths

2.1.1 Brigham Creek roundabout crossing **Significant**

A previous road safety audit recommended shifting the existing pedestrian crossing refuge eastwards to the customary position two vehicle lengths from the roundabout where the traffic speeds would be slower, which the designers have done. However, while on site the current road safety audit team realised that there was so much fast traffic in both directions that pedestrians and cyclists would have great difficulty in finding a gap to cross safely. For the speeds observed, there would be insufficient safe crossing sight distance to the east due to the geometry of the existing roundabout. The concern is that pedestrians and cyclists would become impatient and cross with less than safe gaps in traffic.

There is also the safety concern that the layout shown does not align with any desire lines, and that pedestrians and cyclists will try to cross at the current position, which would be even more unsafe due to even higher speeds and the unexpectedness of a crossing. It should be noted that the current crossing requires pedestrians and cyclists to cross only one lane at a time. It should also be noted that the fences in the current median refuge have been hit by a vehicle.

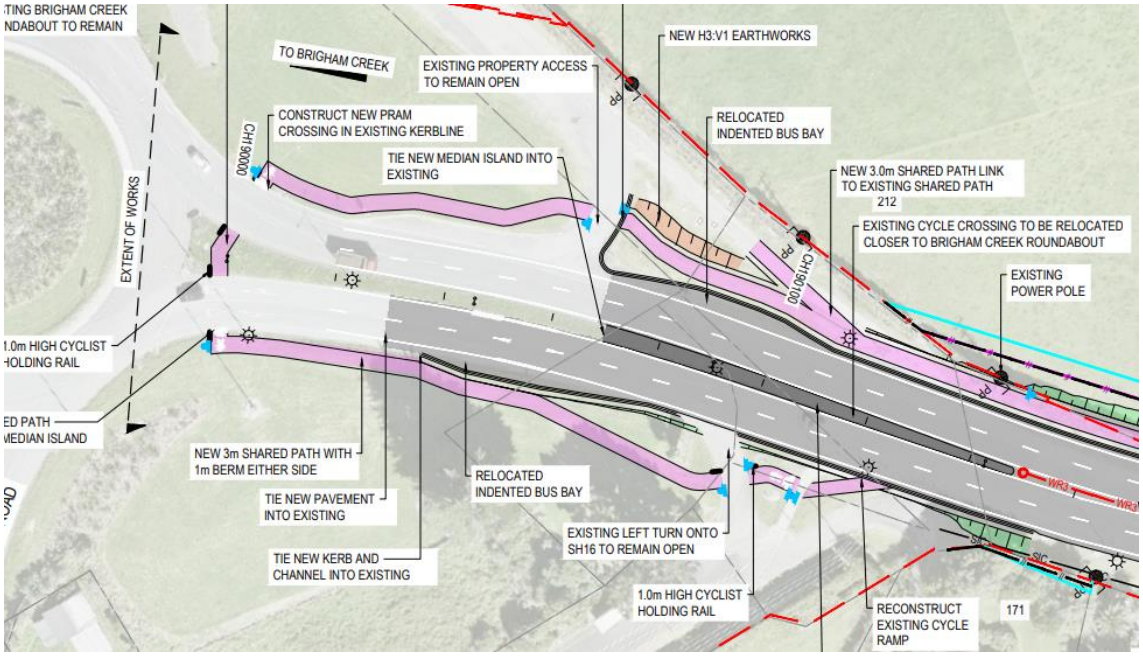

Figure 1: Proposed pedestrian crossing west of Brigham creek Road roundabout

The proposed crossing shown in Figure 1 contrasts with the philosophy of raised and signalised pedestrian and cyclist crossing facilities applied at the proposed Coatesville-Riverhead Road roundabout, which should be considered for the Brigham Creek Road roundabout as well.

Ideally, grade separation at the existing crossing location, which is aligned with the desire line, would be the safest. A ramp along the old alignment of Fred Taylor could provide the level difference required on the southern side for a subway. On the northern side the ground falls away naturally. However, the nature of this project within the Safer Network Programme of works, probably tends the first stage solution towards a more affordable raised table signalised crossing at the existing crossing location.

If a signalised crossing is adopted, it may need to be a two-phase crossing and therefore the median must be designed to be wide enough to cycle around the stagger and have enough storage capacity for a family outing or a small group of riding companions. This applies to the proposed signalised crossing of SH16 at the Coatesville-Riverhead Road roundabout as well, which, although shown direct according to the crosswalk lines, shows a stagger in the footpath.

Comment

It may be difficult for drivers turning left from Brigham Creek Road towards the city to find safe gaps in the heavy eastbound traffic. A signalised pedestrian crossing could be combined with metering the heavy westbound flow to provide safer left turn opportunities from Brigham Creek Road onto the motorway.

Recommendation(s)

1. Ideally and in the long term, provide a grade-separated crossing at the desire line crossing.
2. In the short term, provide a signalised pedestrian crossing on a raised table aligned with the desire line.
3. Ensure that the median is designed with sufficient storage capacity and width for riding a bicycle around the stagger safely.

Frequency Crashes are likely to be occasional	Severity Death or serious injury is very likely	Rating The safety concern is significant
Designer response	Signalised pedestrian crossing with raised table to be provided at desire line.	
Safety Engineer comment	2. Concur with SAT and Designer's response. A consistent treatment to address vulnerable users crossing at the roundabouts on SH16 across the project extents, ie., Brigham Creek, Taupaki, and Riverhead Coatesville, is going to achieve a good safety outcome that aligns well with the GPS. 3. Agree with SAT.	
Client decision	Agree with Safety Engineer.	
Action taken	Recommendation to be taken onboard during detailed design.	

2.1.2 Cyclist priority at local accesses

Moderate

In general, the local accesses are shown with a kerb extending across the entrance, indicating that cyclists and pedestrians have right of way.

However, there are some high traffic generators where it might not be obvious that cyclists have right of way, due to the size of the access tending towards an intersection. Examples would be at Soljans Estate Winery, at Phil Greig Strawberry Gardens, at the BP service station, and at the Kumeu River Winery.

Where it may be decided that vehicular traffic has or needs right of way, the path should be designed to alert cyclists to look out for and to give way to turning traffic. This is usually accomplished by the presence of ramps and tactile surface indicators but can be reinforced by cranking the path towards the boundary slightly.

Recommendation(s)

1. At the more highly trafficked accesses, especially those used regularly by the public, reinforce the cyclist and pedestrian priority by painting a green section of path across the entrance. This should also alert drivers to look behind them when turning left.
2. Where turning traffic has priority, ensure that cyclists and pedestrians are made aware of the need to look for and give way to turning traffic, and that the path alignment approaching the crossing facilitates pedestrians looking for approaching traffic.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	1. Green paint to be provided across all accesses where pedestrians/cyclists are to have priority. 2. Signs and markings to be provided for pedestrians/cyclists to highlight priority. Shared path alignment to be reviewed and where possible realigned to provide improved line of sight.	
Safety Engineer comment	Concur with SAT and Designer's response.	

Client decision	Agree with SAT, Designer and Safety Engineer.
Action taken	Recommendation to be taken onboard during detailed design.

2.1.3 Sight line to shared path at accesses

Moderate

In some cases, the slight lines along the shared path are obscured by vegetation, fences, or gate pillars for exiting drivers. An example is shown in Figure 2.

Figure 2: Gate pillars at Soljans Estate winery

Recommendation(s)

1. Include a speed control device such as a speed bump so that drivers exiting the access do so slowly enough that an approaching pedestrian or cyclist can see the front of the vehicle before the driver sees the pedestrian or cyclist and so that the pedestrian or cyclists can take action to avoid hitting the vehicle if necessary. Placement of the speed control device in relation to the edge of path, wheels, and front of a vehicle is very important for such a measure to be effective.
2. Particular care should be taken to provide inter-visibility on steep grades where shared path users could reach higher speeds.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	1. Speed control devices to be installed on a case-by-case basis. 2. Sight lines along shared path to be reviewed and any obstructions cleared where possible to provide required visibility.	
Safety Engineer comment	Agree with Designer's response.	
Client decision	Agree with Designer and Safety Engineer	
Action taken	Recommendations to be adopted on a case by case basis	

2.1.4 Buffer between roundabout and shared path

Moderate

The proposed shared paths follow the perimeter of the roundabout very closely, thus placing vulnerable road users needlessly close to turning traffic.

There is no footpath connection from the crossing to the Boric Supermarket. Some workers may travel by bus and need to walk to and from the bus stops on the eastern side of the roundabout as indicated by the gold arrow in Figure 3.

The shared path connection in front of Boric Supermarket is not considered to be a pedestrian desire line, this section of path is seen to be only used by city-bound cyclist wanting to avoid the roundabout and therefore the width and signage should be appropriate for its use.

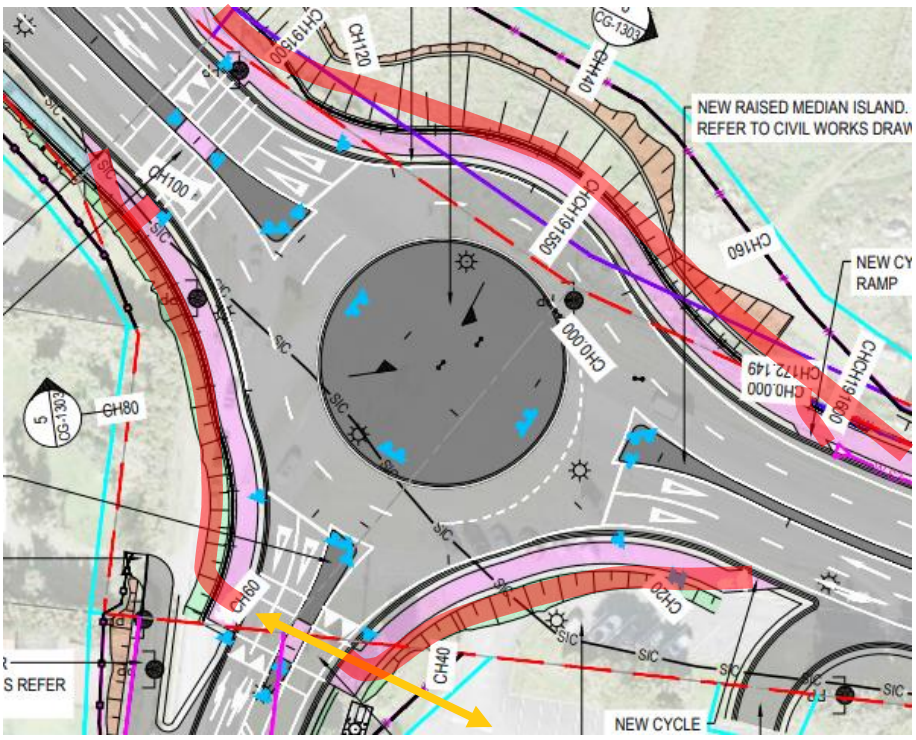

Figure 3: Suggested improvements to shared path at Coatesville-Riverhead Road

Recommendation(s)

1. Increase the width of the buffer strip between the roundabout outer perimeter and the shared paths. In most cases the path can be aligned more directly along the desire lines as illustrated in red in Figure 3.
2. Provide a footpath connection between the crossing and the Boric Supermarket.
3. Ensure that the path and signage in front of Boric Supermarket is designed for its intended use.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	1. Shared path to be realigned to increase separation at roundabout as per Fig 3., subject to endorsement of any cost impact 2. Footpath connection into Boric to be provided. Further consultation with Boric required to determine best location for pedestrian access. 3. The path outside Boric is for on-road cyclists who want to exit the carriageway prior to the roundabout. This cycle path will be reduced to 2.0m width with appropriate signage.	
Safety Engineer comment	1. Agree with SAT, a straight alignment for SUP is preferred. 2. Concur with SAT and Designer's response. 3. Concur with SAT and Designer's response.	
Client decision	Agree with SAT, designer and safety engineer. Regarding point 1 designer to retain existing alignment with barriers, unless deemed unsafe.	
Action taken	Recommendations to be further developed during detailed design.	

2.1.5 Inside radius of cycle paths

Minor

Following on from the previous concern in Section 2.1.4, the drawings show squared-off footpath intersections. It is not possible for elderly cyclists to cycle around such tight radii, and they have difficulty in lifting their heavy electric bicycles to manoeuvre them around to face the crossing, often falling off or over their bicycles in the process.

The industry standard is a minimum radius of 2.5 m for the inside edge of any shared path. This means that the buffer width referred to in Section 2.1.4 needs to be at least 2.5 m wide at the crossings.

Recommendation(s)

1. Ensure that inside edges of shared paths always have a minimum radius of 2.5 m.

Frequency Crashes are likely to be occasional	Severity Death or serious injury is unlikely	Rating The safety concern is minor
Designer response	Minimum 2.5m radius to be provided on inside of shared path.	
Safety Engineer comment	Concur with SAT and Designer's response.	
Client decision	Agree with SAT, Designer and Safety Engineer.	
Action taken	Recommendation to be taken onboard during detailed design.	

2.1.6 Cycle on-ramps

Moderate

Cycle on-ramps are proposed but would not place cyclists back onto the road from the shared path safely as they lead cyclists directly into the lanes (the shoulders are very narrow). Ramps should place cyclists back onto the shoulder of the road in the lee of a kerbed section with no shoulders.

Motorists can be taken by surprise when a cyclist, whom they thought was continuing along the path, is suddenly sharing a lane with them and can thus fail to avoid colliding with a cyclist or fail to give a cyclist enough clearance.

The road safety audit team recognises that the shoulders are narrow but suggests that the shoulders can be widened by about 0.5 m for a short distance downstream of the on-ramps to allow drivers time to accept that a cyclist is riding next to them and for cyclists then to move into the lane when there is a suitably safe gap if they so desire.

Recommendation(s)

1. Introduce cyclists safely back onto the road in a wide enough shoulder that is in the lee of a kerb build-out. Extend a widened shoulder for cyclists for a suitable distance downstream of the on-ramp.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	Kerb build-out provided and shoulder to be widened to 2.0m for a suitable distance to allow cyclists to enter carriageway safely.	
Safety Engineer comment	Agree with SAT, a shoulder space for the cyclists to merge with on road traffic is a good outcome. Cycle ramps to be marked green, and also shoulder to be marked with green hatching to remind the road users to watch out for onroad cyclists.	
Client decision	Agree with SAT, Designer and Safety Engineer.	
Action taken	Recommendation to be taken onboard during detailed design.	

2.1.7 Safety barriers between road and shared path

Moderate

Semi-rigid barriers are proposed between the road and the shared path from Ch 192 500 to Ch 193 000 as shown in Figure 4. The reason for placing them in such a position is not clear as most if not all existing power poles are shown to be removed and the services relocated underground. All lighting columns appear to be frangible and ground planted, which would not require barriers, and are shown 0.4 m clear of the back edge of the path.

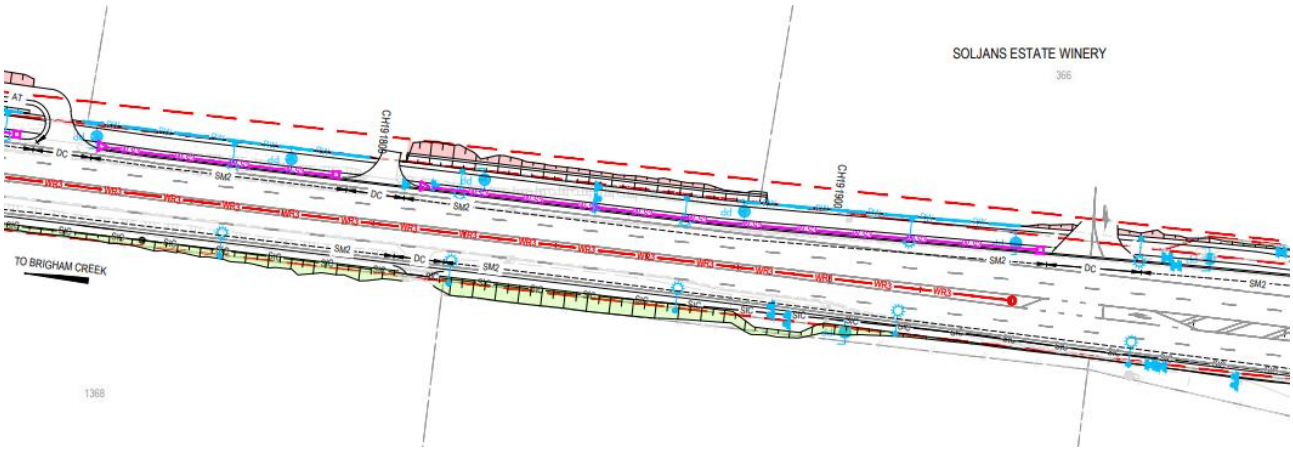

Figure 4: Example of safety barriers between kerb and shared path

Barriers are also shown on the typical cross-section 6 in Figure 6 between the shared path and the circulating lanes of roundabouts, but not on the Coatesville-Riverhead Road roundabout barrier plans (Sheet 5). It would be very unusual to require barriers at modern roundabouts in view of the low entry speeds and the difficulty of providing gaps in the barriers, complete with leading end terminals, at pedestrian and cyclist crossing points.

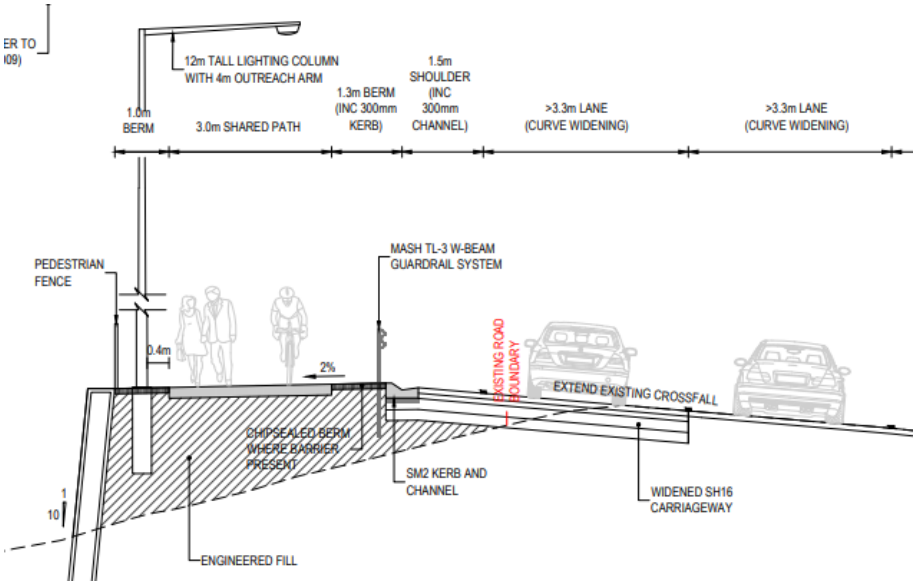

Figure 5: Barriers between kerb and shared path at retaining wall

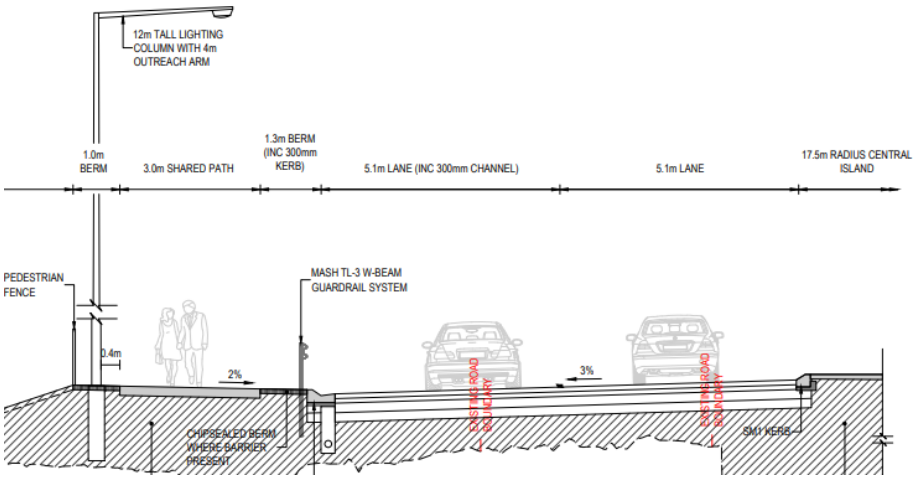

Figure 6: Barriers between kerb and shared path at roundabout

The safety concern is the trip and fall potential for a cyclist colliding with the back of the barrier. A slight misunderstanding between a pedestrian and a cyclist or a scooter rider could launch them over the barrier and into the path of a vehicle. The outcome of the same situation without barriers would probably result in a cyclist stumbling or falling off the bicycle onto the buffer strip or the shoulder of the road where they would be less likely to be hit by a passing vehicle.

The possible mitigation to erect a fence or a rail along the barriers would probably obscure sight lines for drivers entering SH16 from the various accesses further than the proposed barriers would already do. Horizontal rails would be a windscreen penetration hazard if struck by a vehicle.

Recommendation(s)

1. Preferably, shift the barriers to the back of the shared path. If not possible due to the position of isolated immovable power poles, try to increase the buffer clearance to the back of the barriers. The path can wander in and out slightly to achieve this between power poles.
2. Avoid providing safety barriers at roundabouts, unless there is a very real hazard such as a high fill retaining wall, permanent water etc. and in any case provide such barriers along the back of the footpaths.
3. Ensure that any power poles that remain are, like the lighting columns, set back clear of the shared path. This applies to electrical cabinets and their plinths as well.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	1. Barrier locations to be reviewed and positioned at back of shared path. 2. Barriers to be reviewed and removed from roundabout where not required. 3. Any existing power poles that are not being undergrounded as part of the works to be set back clear of shared path.	
Safety Engineer comment	1. It is recommended to keep the current design considering the environment is still rural. Shared use path is used by pedestrians of all ages. There is a risk of a child or dog unleash could run into the traffic. SUP behind a barrier provides more safety benefits in rural area. 2. In an urban environment SAT's suggestion is valid but this is a rural high speed environment, which is going to remain rural for few more years. Although presence of speedtables at the roundabout reduces the speeds, however this is still a safe option to protect the vulnerable shared use path users from an errant vehicle or a pedestrian trying to cross the roundabout. 3. Agree with SAT.	
Client decision	For points 1 and 2 agree with Safety Engineers comments, for point 3 agree with SAT and Designer	
Action taken	Designer to action safety engineers' comments and addressed this in the detailed design stage.	

2.1.8 Bus stops

Moderate

There are bus stops proposed adjacent to the shared path. The typical cross-section of one of the bus stops shows a 4 m wide path behind a 0.3 m Kassel kerb. The safety concern is that the path would not be wide enough for a bus stop, shared path, and bus shelter, and that there would be no clear demarcation of pedestrian or passenger priority over cyclists. There have been recent crashes with death and serious injury outcomes involving passengers alighting from buses at poorly designed or narrow bus stops.

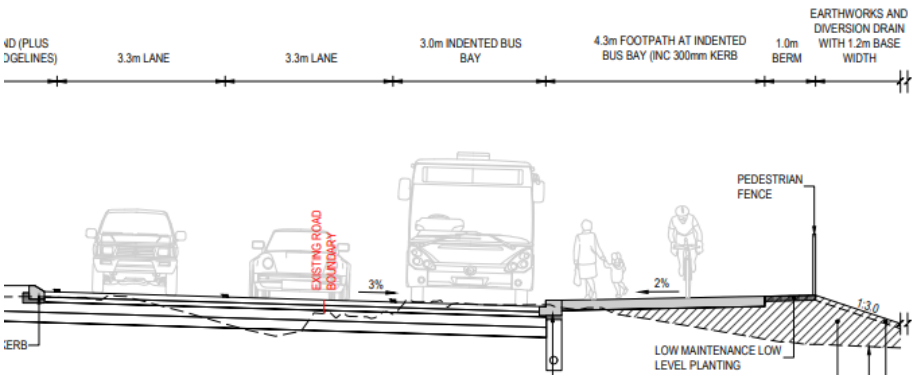

Figure 7: Bus stop cross-sectional detail

Recommendation(s)

1. Ensure that there is proper guidance and safe separation of passenger, pedestrian, and cyclist activities at bus stops, including enough width for the bus shelter.
2. Assign priority to pedestrians and passengers at bus stops.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	Indented bus bay to be designed to provide a 3.5m wide safe island (including 2m wide shelter) for pedestrians with 3.0 wide shared path realigned at the back of the island.	
Safety Engineer comment	1. Acknowledge SAT's concern, however a 4.3m plus 1mtr berm is a manageable space in a rural context. Project to adopt AT's bus stop standards to match other bus stops in the vicinity so that it is consistent across the network. Road marking and signage to be used to address the concern highlighted. 2. Project to adopt AT's bus stop standards that is already existing in the vicinity.	
Client decision	Agree with Safety Engineer	
Action taken	Designer to follow Safety Engineer's comments	

2.1.9 BP Service Station

Moderate

Cross-section 13 at the BP Service Station shows the shared path hard up against the kerb with no buffer strip, yet there is a 1.0 m berm between the back of the footpath and the low retaining wall in which there is only one lighting column.

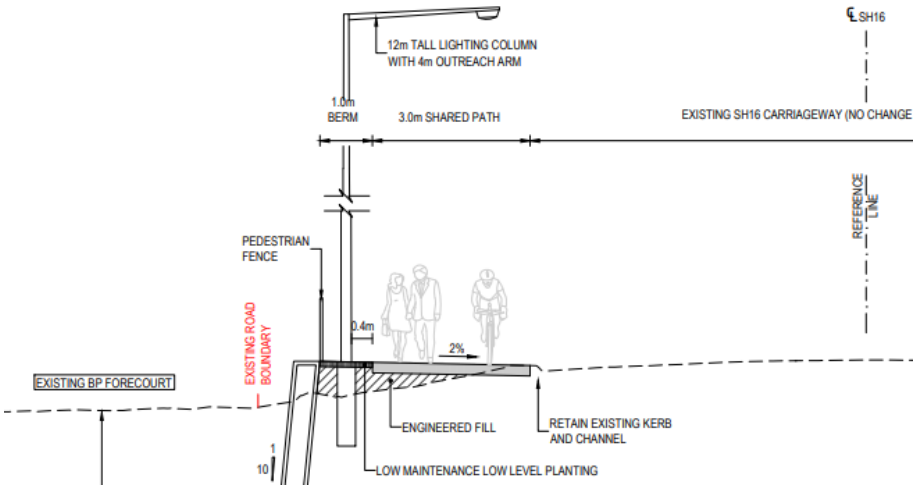

Figure 8: Cross-section at BP Service Station

The single lighting column could be shifted to below or within the retaining wall, thus allowing the buffer to be reinstated. The buffer strip would not necessarily have to be vegetated but should have a different surface texture.

The safety concern is that pedestrians and cyclist will be closer to passing traffic and to vehicles turning into the service station. Pedestrians and cyclists would have to look 180° behind them before crossing. A generous buffer at the entrance would make it easier for pedestrians and cyclists to look behind them before crossing.

On site, it did not appear that the retaining wall would be required if the footpath sloped at 2 % towards the garage forecourt, thus lowering the back of path by 160 mm as has been proposed at the retaining wall shown in Figure 5. This would also match the entry and exit levels closely and avoid the back of path sloping longitudinally up and down at each crossing.

Recommendation(s)

1. Redesign the footpath along the BP Service Station frontage so that the buffer strip can be maintained between the path and the kerbs, and so that the back of footpath more closely matches the levels of the existing entrance and exit levels.
2. Ensure that it is clear whether pedestrians and cyclists, or motorists have right of way when entering or leaving the service station. This is usually achieved by orientating the kerb crossings in favour of one or the other.
3. Refer also to the recommendations in Section 2.1.2.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	1. Shared path to fall away from SH16 to more closely match existing levels and buffer to be carried through adjacent to the carriageway. 2. Motorists to have priority at BP entrance with orientation of shared path to be adjusted and hold rails provided. Cyclists to have priority at BP exit with green paint across shared path and speed bump for motorists.	
Safety Engineer comment	1. Concur with SAT and Designer's response. 2. Designers to ensure that the service station entry and exit operates at a safe and appropriate speed.	
Client decision	Agree with SAT, Designer and Safety Engineer.	
Action taken	Recommendation to be taken onboard during detailed design.	

2.1.10 Separation of incompatible path users

Moderate

Some users such as cycles, scooters and skateboards may reach high speeds on the steeper grades, such as the descent to Brigham Creek bridge, with 8 % grade shown from Ch 190 700 to Ch 191 150. With such high speed differentials possible, separation of modes should be considered.

Recommendation(s)

1. Consider providing better separation of walking from other faster path users, particularly on steeper grades, such as by segregated paths.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	Additional signs and markings to be provided to inform users of steep grades and high speeds.	
Safety Engineer comment	Agree with Designer's response.	
Client decision	Agree with Designer and Safety Engineer.	
Action taken	Additional signs and markings to be provided to inform users of steep grades and high speeds. Segregated paths are outside the project scope.	

2.2 Speed

2.2.1 Safe and appropriate speed

Moderate

The narrow 3.3 m lanes and narrow 0.75 m median and 1.0 m outside shoulders, together with kerbing and lighting will help promote a more urban arterial road driving environment where westbound drivers would expect speeds to be lower than the motorway environment that they have just left. The lower speed environment will be reinforced by the regular interruption in free traffic flow that the three roundabouts in 4 km will create.

The existing speed limit is 80 km/h between Brigham Creek Road and Old Railway Road, where it currently drops to 50 km/h through Kumeu.

The existing 80 km/h speed limit might not be a safe and appropriate speed for the four-lane wire rope barrier median divided section from Brigham Creek Road to Taupaki Road, given the level of roadside development and the inability for left turners off the highway to decelerate clear of through traffic. Nor would it appear to be a safe and appropriate speed for the two-lane section between Taupaki Road and Old Railway Road, where there are also numerous driveways allowing right turns, even though these would be across only one lane of opposing traffic and a flush median would be provided. There are also numerous left turns across the shared path where drivers turning left would have to wait in the single through lane to give way to pedestrians or cyclists thus increasing the risk of rear-end crashes.

During the site inspection, which took place during an off-peak time just after lunch, the running speed did not reach anywhere near 80 km/h along the highway and was mostly around 60 km/h to 65 km/h. This was not due to the geometric alignment of the road but the volume of traffic along the road.

Recommendation(s)

1. Review the safe and appropriate speed limits for each section of the highway.

Frequency Crashes are likely to be common	Severity Death or serious injury is unlikely	Rating The safety concern is moderate
Designer response	Review of safe and appropriate speeds outside of project scope.	

Safety Engineer comment	Designer to check if the geometrical elements allows 85th percentile traffic to operate safely for the proposed design at the posted speed. If the geometry offers higher speed comforts to the drivers, adopt measures to achieve compliance. Once project becomes operational, Safe and Appropriate Speeds (SaAS) could be re-evaluated.
Client decision	Agree with Safety Engineer's comments.
Action taken	Designer to action safety engineers' comments and addressed this in the detailed design stage.

2.3 Cross-section and Geometry

2.3.1 Proposed westbound two-lane carriageway extension Minor

In a previous audit, the safety auditors recommended shifting the merge of the two westbound lanes from its present position about 150 m downstream of the Taupaki Road roundabout to a position about 450 m downstream of the roundabout and past the right-hand curve. The current proposed design incorporates this recommendation as shown in Figure 9.

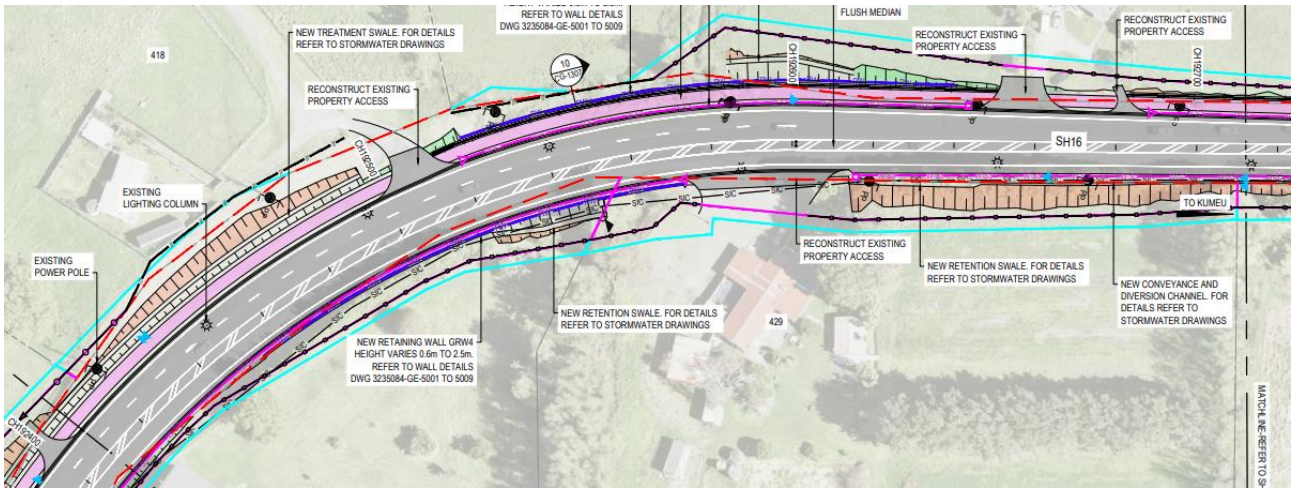

Figure 9: Proposed termination location of two-westbound lanes

However, the previous safety audit carried out in 2017 was possibly not able to foresee the current review of and reductions in speed limits across the country, nor the dramatic increase in traffic along SH16. In view of this, the current road safety audit team questions the advisability of extending the downstream merge to the point that the two-lane section could be regarded as a short passing lane that could promote higher speeds, especially at the merge.

The current end of the two-lane carriageway is more legible being associated with the Taupaki Road roundabout than if it were shifted westwards to a midblock position where it would suggest to unfamiliar driver that the two-lane carriageway continues all the way to Kumeu.

In its current position, just downstream of the Taupaki Road roundabout, the merge is likely to take place at a slightly slower speed and in a more orderly zip-like fashion with less likelihood of flow breakdown and unexpected or sudden braking and rear-end crashes.

Recommendation(s)

1. Leave the westbound merge from two lanes to one in its current position just downstream of the Taupaki Road roundabout.

Frequency Crashes are likely to be occasional	Severity Death or serious injury is unlikely	Rating The safety concern is minor
Designer response	Merge to be retained as per current position.	

Safety Engineer comment	Concur with SAT and Designer's response.
Client decision	Agree with SAT, Designer and Safety Engineer.
Action taken	Recommendation to be taken onboard during detailed design.

2.3.2 Width of indented bus bay

Minor

The width of indented bus bays is shown in Figure 7 as 3.0 m adjacent to a 3.3 m wide lane. For the speed environment, the combined 6.3 m width might not provide enough separation between the bus and passing heavy vehicle traffic, particularly if the bus driver does not pull completely into the bus bay.

Recommendation(s)

1. Consider widening the bus bays slightly to provide more clearance between stopped buses and passing heavy vehicles.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is very unlikely	Rating The safety concern is minor
Designer response	Indented bus bay widths to be increased to 3.5m.	
Safety Engineer comment	Auckland Transport (AT) has a requirement around the indented bus bay and in-line bus stops. Relevant standard to be adopted that suits AT's requirement.	
Client decision	Agree with Safety Engineers comments	
Action taken	Designer to confirm At's requirement during detailed design phase.	

2.3.3 Safety value of 2.5 m wide flush median

Comment

The road safety audit team was asked to comment on the added safety value of the proposed 2.5 m wide flush median between Taupaki Road and Old Railway Road. It is not certain if this was intended to direct the project in favour of providing a median barrier or of omitting the flush median. The road safety audit team assumes the latter but needs to remain objective and allow the project team to make that decision.

The relative safety benefits of median barrier, versus wide flush median, versus wide centreline treatment, versus centreline only are well set out in the Standard Safety Intervention Toolkit of Waka Kotahi. Suffice it to say that, provided safe turnarounds can be provided, a median barrier is the safest. A flush median or wide centreline treatment would not prevent a head-on crash but might give just that much more width within which to recover from wandering across the centreline before colliding with an oncoming vehicle, or for a driver to pass a cyclist. The increased safety that the flush median provides for right turns is clear.

The omission of a median barrier, or of the flush median should be seen against the likely operating speed of the highway. Operating speed is influenced by safe and appropriate speed limit, which should be considered as well.

2.4 Coatesville-Riverhead Road Roundabout

2.4.1 Circulating carriageway geometry

Minor

The Coatesville-Riverhead Road approach has a double left turn towards Brigham Creek and only a single right turn towards Kumeu, but there are two circulating lanes.

This could be interpreted to be a double right turn, which would create a cross-over conflict. There would also be a give way confusion at the westbound entrance if a driver turning right from Coatesville-Riverhead Road changed lanes to the outside lane just as a westbound driver slipped by in the left lane.

The spirally marked right turn from SH16 into Coatesville-Riverhead Road has a dead area as shown in gold in Figure 10 and should either be kerbed or hatched out. This is important for drivers making U-turns who need to be directed into the outside lane, especially if their access is a short distance from the roundabout and there is little opportunity to change lanes downstream of the roundabout. Such drivers could become trapped in the inside lane.

The proposed spiral marking outlined in gold also creates a less acute angle of intersection than desirable, which could increase the severity of injury of a crash. The red outline on the opposite side of the roundabout illustrates how the angle can be improved by developing the spiral later. Note the dead area in red is half the size of the dead area in gold.

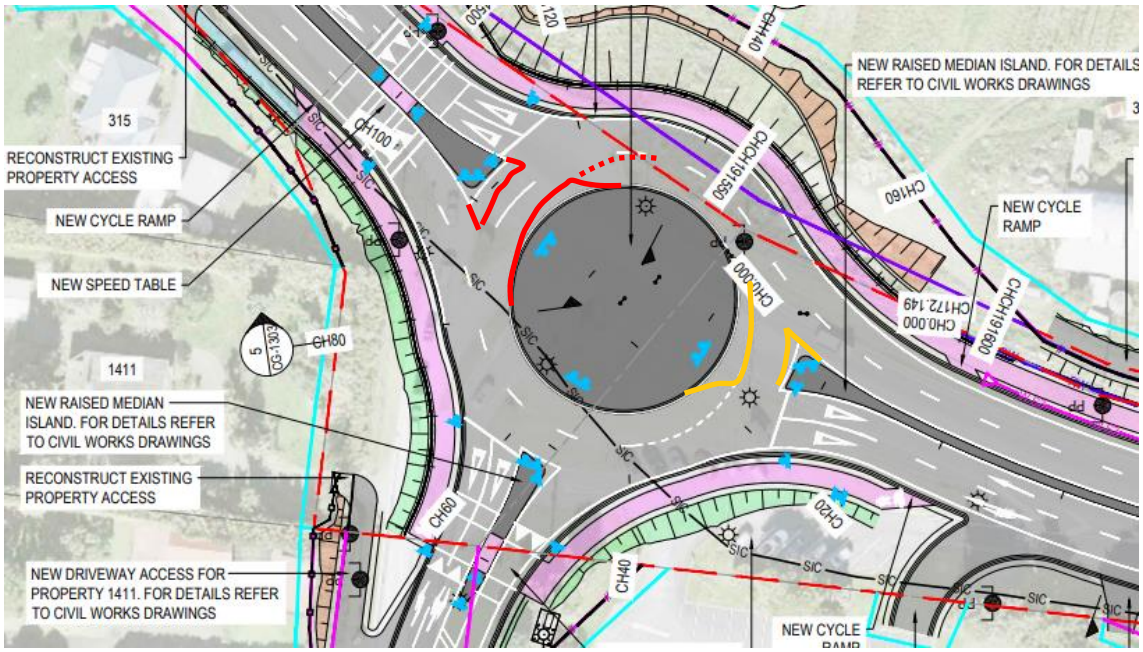

Figure 10: Coatesville-Riverhead Road roundabout circulating lane markings

Recommendation(s)

1. Since there is no need for two lanes for the right turn from Coatesville-Riverhead Road towards Kumeu, the roundabout should be designed with only a single circulating lane in that quadrant.
2. The circulating lane should spiral outwards so that both westbound lanes give way to right-turning traffic.
3. Improve the spiral markings shown in gold so that the dead area is reduced and so that the angle of intersection is more acute to reduce the severity of injury in a crash.

Frequency Crashes are likely to be occasional	Severity Death or serious injury is unlikely	Rating The safety concern is minor
Designer response	1. Circulating carriageway to be reduced to 1 lane in quadrant. 2. Spiral markings to be provided as shown. 3. Spiral markings improved as shown.	
Safety Engineer comment	Concur with SAT and Designer's response.	
Client decision	Agree with SAT, Designer and Safety Engineer.	
Action taken	Recommendation to be taken onboard during detailed design.	

2.4.2 Raised table crossing effectiveness

Moderate

In principle, the raised table crossings proposed on the Coatesville-Riverhead Road leg and across SH16 on the eastern leg are positive safety features. However, the courtesy nature of the Coatesville-Riverhead Road crossing could be confusing if a driver in one lane gives way but the driver in the other does not realise that there is a pedestrian using the crossing. The same argument is often applied to zebra crossings across two lanes of traffic. However, if the ramp is appropriate for the environment (e.g. Austroads GRD7 Section 2.1) and the ramp is placed 1.5 m to 3 m from the crossing itself, the approach speed should be slow enough to avoid hitting a pedestrian in such a case or for the pedestrian to be able to stop in time. Avoid placing the ramp too far away as drivers can speed up very quickly after negotiating the ramp.

Adding zebra markings to the raised table would reinforce the need to look out for pedestrians, however signalising the crossing would be the safest outcome. The road safety audit team notes that in a recent roundabout project Waka Kotahi has instructed the use of 1:35 approach and departure ramps, which in the opinion of the road safety audit team will have little or no speed reduction effect. It is therefore important that the raised tables are designed to be effective.

It is somewhat inconsistent that the western leg of SH16 does not have a raised table on the approach, even though there is no pedestrian crossing or desire line across the western leg.

Taking the above comments into consideration, and to compensate for the inconvenience of severe ramps on the approaches, the designers could consider placing the whole roundabout on a raised platform.

Recommendation(s)

1. Ensure that the approach ramps to the proposed raised table crossings are severe enough to achieve the desired safe negotiating speed.
2. Place the ramps 1.5 m to 3 m in advance of the crossing so that there is more time to avoid a pedestrian or for the pedestrian to avoid a vehicle.
3. Consider signalising the raised table across the Coatesville-Riverhead leg.
4. Consider adding a raised table to the eastbound approach for consistency or place the whole roundabout on a raised platform.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	1. 1:25 approach and 1:40 departure ramps provided. 2. Ramps to be placed 3m in advance of crossing. 3. The number of users crossing at Coatesville-Riverhead Highway will be low so we have not provided a signalised crossing. 4. We have not provided a raised table on the eastern approach as it may encourage pedestrians to use it as a crossing point rather than the signalised crossing on the western approach.	
Safety Engineer comment	Concur with SAT and Designer's response.	
Client decision	Agree with Designer and Safety Engineer.	
Action taken	Recommendation 1 and 2 to be taken onboard during detailed design.	

2.4.3 Road surface levels and shape

Moderate

Figure 11 indicates that the roundabout has been designed with the central island on a 5.6 % tilted plane and with the circulating carriageway falling away at 3 % radially in the customary way, although normally 2 % should apply to roundabouts and the 5.6 % tilted plane slope is excessive in this case. The combination of proposed crossfall and tilt will lead to a dramatic drop of 1.5 m (47.0 m to 45.5 m contours) from the eastbound approach limit line to the Coatesville-Riverhead Road limit line and an adverse camber of 3 % on a 6 % downhill gradient.

The proposed grading of the roundabout will hide the roundabout from view from the eastbound approach. Refer to Figure 11 and to Section 2.4.4. It may also hide westbound car turn indicators from view across the central island plants.

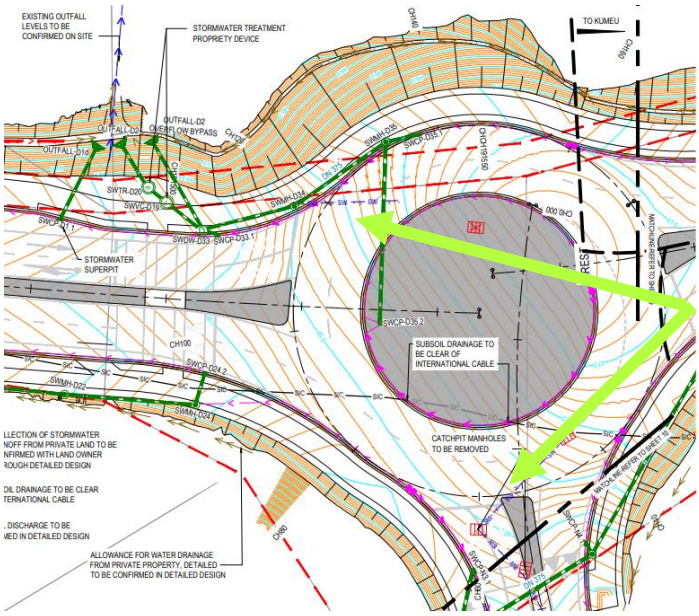

Figure 11: Coatesville-Riverhead Road roundabout contours

Recommendation(s)

1. Review the circulating carriageway levels to reduce the effect of adverse superelevation (currently 3 %) combined with a steep downhill gradient (currently about 6 %) to avoid heavy vehicle instability.
2. Improve the overall visibility of and recognisability as a roundabout from the eastbound approach. Refer also to Section 2.4.4.

Frequency Crashes are likely to be common	Severity Death or serious injury is unlikely	Rating The safety concern is moderate
Designer response	1. Circulating carriageway levels to be reviewed with a tilted plane closer to 2% provided. 2. Visibility reviewed and improved as per 2.4.4.	
Safety Engineer comment	Concur with SAT and Designer's response.	
Client decision	Agree with SAT, Designer and Safety Engineer.	
Action taken	Recommendation to be taken onboard during detailed design.	

2.4.4 Eastbound approach visibility to roundabout site

Moderate

Figure 12 gives an idea of the eastbound approach to the Coatesville-Riverhead Road roundabout circulating carriageway. As currently designed, the roundabout limit line would be about 30 m past the ID signs in Figure 12 but would be visible due to the raising of the roundabout as shown in red on the longitudinal section in Figure 13. However, it is clear from Figure 12 that most of the circulating carriageway and the whole central island would be hidden over the crest and partially around the 250 m radius horizontal curve. Planting of the central could not be relied upon to highlight its presence as anything that grew above the crest would blend in with the background trees.

Figure 12: Eastbound approach to Coatesville-Riverhead Road roundabout site (Argonaut, 2021)

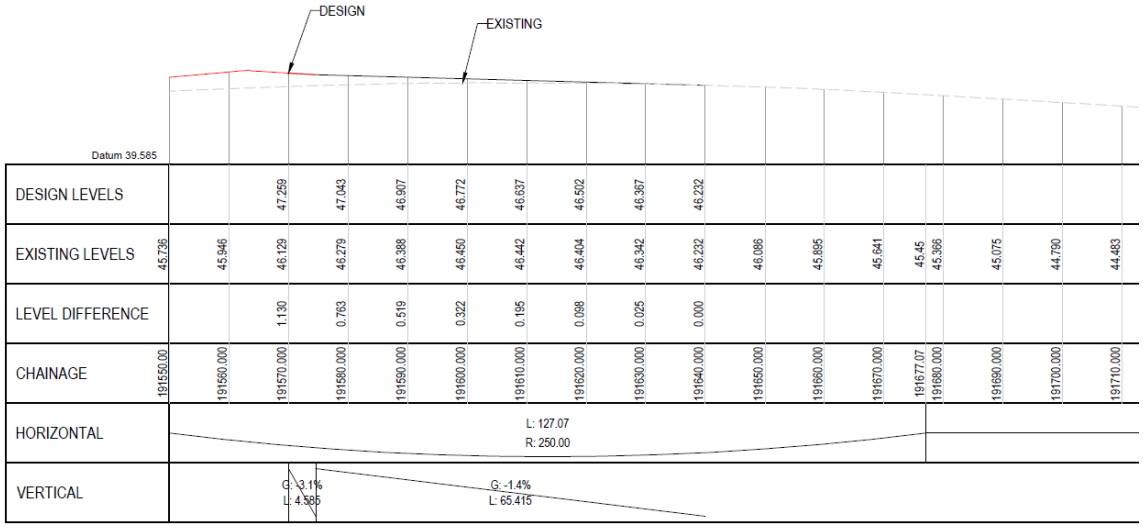

Figure 13: Coatesville-Riverhead Road eastbound approach vertical alignment

The eastbound approach has a 7 % superelevation (Figure 14), which may create an additional crest vertical curve leading to the roundabout, and which may affect the visibility of the roundabout ahead further.

7 % may also cause tracking issues within the lanes leading up to the roundabout as vehicles slow down and gravity tends to track them towards the inside of the curve.

The superelevation creates a 55 m flow path as indicated by the arrows in Figure 14 at the point where drivers may be braking for the end of a queue.

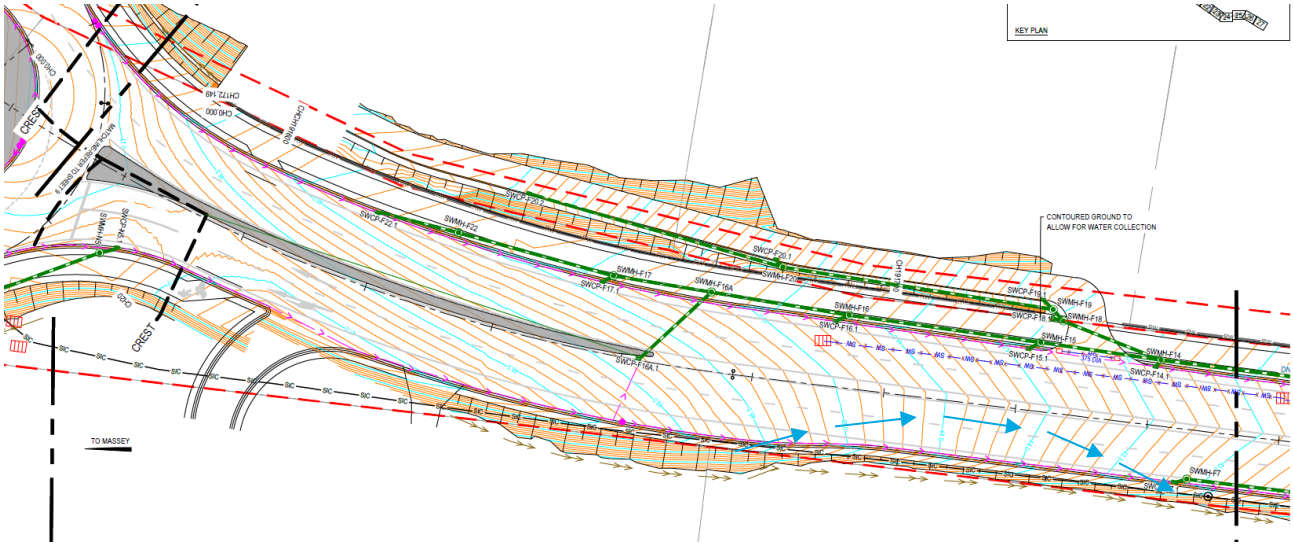

Figure 14: Coatesville-Riverhead Road eastbound approach contours

The designers may find that visibility to the roundabout would be improved by not lifting it above the existing road as proposed and by lowering the eastbound approach with a long crest vertical curve instead and perhaps accepting adverse superelevation to remove the artificial crest curve referred to above. Trying to save existing pavement in this section of the project is not worth the consequences.

It should be noted that only 500 m will separate the Coatesville-Riverhead Road and Taupaki Road roundabouts, and that therefore the design speed approach sight distance and superelevation standards normally applied to isolated rural roundabouts and horizontal curves may not apply in this case. It comes down to a decision whether the proposed good sight distance to the limit line, but with no visibility of the roundabout until drivers are upon it, would be safer than reduced visibility of the limit line but earlier visibility of the roundabout ahead. The latter may give the driver a better understanding of what to expect ahead, especially since the roundabout will also be partially hidden around the 250 m radius curve.

In summary, the road safety audit team feels that the current proposal will hide the roundabout central island and most of the circulating carriageway over a crest that would be positioned exactly at the limit line. Refer to Figure 13. This, coupled with the excessive tilted plane of the roundabout mentioned in Section 2.4.3, will restrict the eastbound visibility of the roundabout severely

Recommendation(s)

1. Review the design levels of the roundabout and its eastbound approach to achieve the best and safest compromise between the proposed visibility of the limit line with almost no visibility of the roundabout central island and much of the circulating carriageway versus somewhat reduced visibility of the limit line but with improved visibility of the roundabout central island and circulating carriageway.
2. Review the necessity for 7 % superelevation on the approach curve, and the westbound departure curve.
3. Refer to the commentary on the choice of safe and appropriate speed limit in Section 2.2.1 in support of a different or reduced eastbound design approach standards from those proposed for the purpose of improving visibility of the roundabout.

Frequency **Crashes are likely to be infrequent**	**Severity** **Death or serious injury is likely**	**Rating** **The safety concern is moderate**
Designer response	1. Roundabout levels to be reviewed for improved visibility. 2. Super elevation to be removed on approach. Lead Advisor Safety Waka Kotahi made general comment at recent Safe System Engineering Workshop that we should not be providing super elevation at roundabouts as this will encourage higher speeds on entry. 3. Review of safe and appropriate speed outside of project scope.	
Safety Engineer comment	1. Concur with SAT and Designer's response. 2. Agree with SAT.	

Client decision	Agree with SAT, Designer and Safety Engineer.
Action taken	Recommendation to be taken onboard during detailed design.

2.5 Local Access

2.5.1 Wrong way movements at left-in left-out intersections

Moderate

Kennedys Road and all other local accesses where there is a median barrier are to be converted to left-in and left -out operation.

To avoid wrong way turns against oncoming traffic, those accesses that are generally used by the public should have a raised triangular median to reinforce the obligatory left-turn. The drawings do show a painted island at Kennedys Road, but it could become invisible on a wet night.

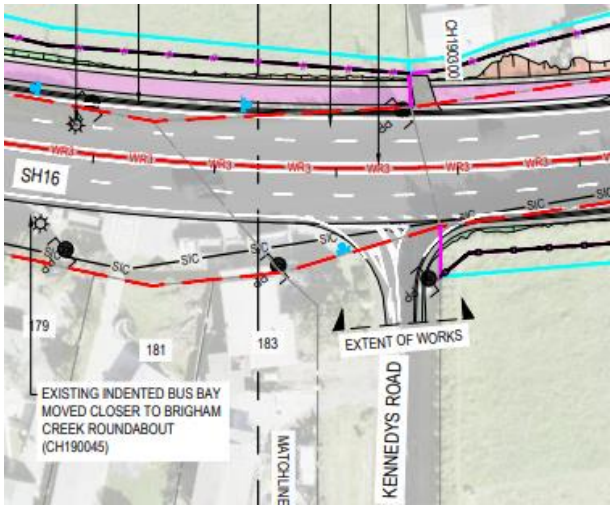

Figure 15: Kennedys Road left-in and left-out island

The untrafficked portion of each intersection or access is likely to collect stone chips, which could become a sliding hazard for motorcyclists.

The kerbs should be fully mountable for safety and would accommodate the occasional large vehicle.

Recommendation(s)

1. Provide a raised median island at all accesses that are generally used by the public to reinforce the obligatory left-turn.
2. Where appropriate, and where there is sufficient space, erect a low give way sign on the island, ensuring that it does not obstruct intersection sight lines.
3. Erect no right turn signs at the intersections.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	1. Raised island to be included where left-turn only to be provided. 2. Low give way signs to be provided where possible. 3. No right turn signs to be provided.	
Safety Engineer comment	Concur with SAT and Designer's response.	
Client decision	Agree with SAT, Designer and Safety Engineer.	
Action taken	Recommendation to be taken onboard during detailed design.	

2.5.2 Wide accesses

Minor

Some of the accesses are shown very wide. Examples are at Ch 191 200, at Ch 192 600, at Phil Greig Strawberry Gardens, and at Ch 193 350. This could lead to high-speed exits endangering others in the car park or on the shared path for instance.

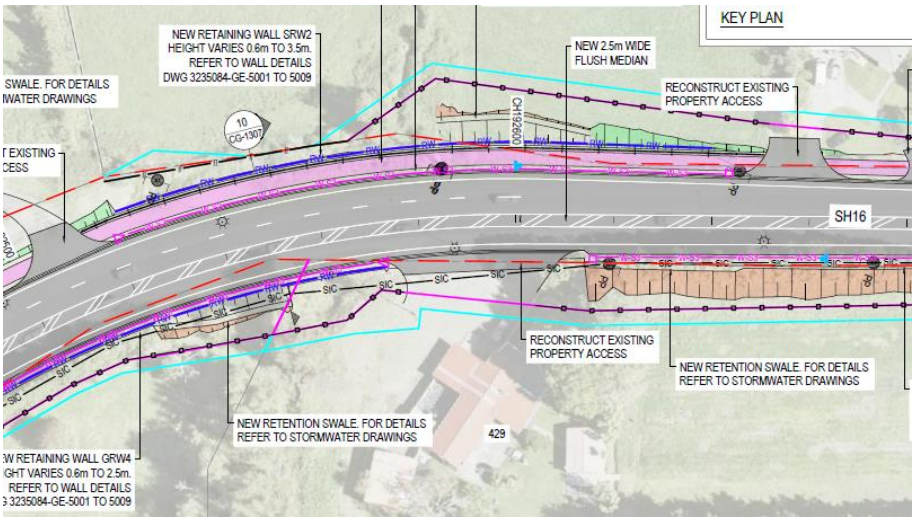

Figure 16: Example of proposed excessively wide access

Recommendation(s)

1. Rationalise the accesses so that they promote safe turning speeds.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is unlikely	Rating The safety concern is minor
Designer response	Following consultation with stakeholders' accesses to be rationalised based on vehicle tracking.	
Safety Engineer comment	Agree with Designer's response.	
Client decision	Agree with Designer and Safety Engineer.	
Action taken	Recommendation to be taken onboard during detailed design.	

2.5.3 Soljans Estate Winery right-turn movements

Moderate

The Soljans Estate winery access arrangement shown in Figure 17 is intended to allow right turns into the winery but not right turns out of the winery and into SH16. It is unlikely that the the proposed layout would prevent such turns physically though.

Since the Coatesville-Riverhead Road roundabout would be only 400 m away for U-turns, the safest would be to allow only left-in and left-out movements. However, the safety audit team does appreciate the difficulties of promoting such an arrangement with businesses that might rely on passing trade.

The road safety audit team refers to the comments on selection of a safe and appropriate speed limit in Section 2.2.1 and suggests that right turns across two lanes of traffic would not be safe at the current speed limit of 80 km/h.

It is noted that the Soljans Estate Winery acknowledges the unsafe nature of its access as is evidenced by the sign on its gatepost shown in Figure 2 recommending to those exiting the winery that they should make a U-turn at the Taupaki Road roundabout if wishing to proceed eastwards.

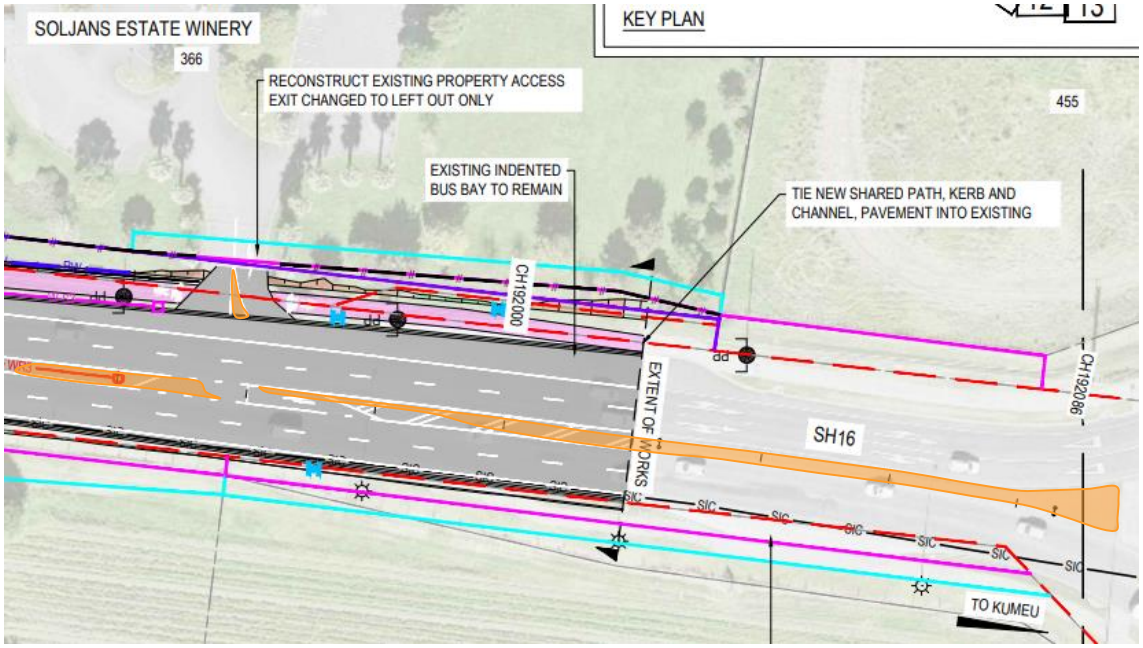

Figure 17: Soljans Estate Winery entrance

Recommendation(s)

1. Preferably, prohibit right turns altogether by extending the median barrier up to the roundabout and by constructing a raised island to direct drivers to turn left when exiting the winery.
2. If the banning of right turns is prohibitive, then extend the existing raised median of the roundabout eastwards past the winery entrance and create a curved portion as suggested in Figure 17 to prevent right turns out of the winery. Consider what the safe and appropriate speed limit should be having allowed right turns into the winery.

Frequency Crashes are likely to be occasional	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	1. Right turn in to be retained. 2. Raised median to be extended to reinforce no right turn out.	
Safety Engineer comment	Agree with Designer's response.	
Client decision	Agree with Designer and Safety Engineer.	
Action taken	Raised median to be extended to reinforce no right turn out during detailed design.	

2.5.4 Kumeu produce market

Moderate

The proposed widening of the highway will shift the edge line about 1 m closer to the Kumeu produce market and thus exacerbate the existing poor visibility to and from the Kumeu produce market, which is and will continue to be obscured by the position of the access around a sharp bend in the road.

The extension of the westbound passing lane is discussed in Section 2.3.1. If the passing lane merge were to remain in its current position, then the offset of the edge line from the Kumeu produce market could perhaps be shifted southwards by say 2.5 m to improve the sight distance around the curve.

This lack of adequate sight distance highlights the need for the selection of a safe and appropriate speed limit. With a lower speed limit, the curve could perhaps be tightened slightly to provide even more sight distance.

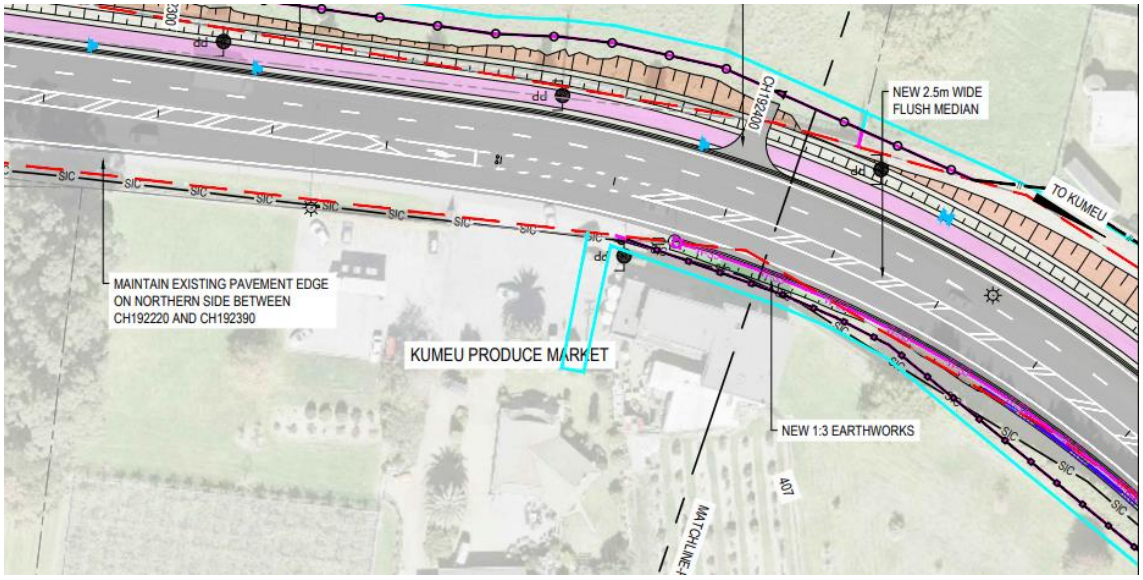

Figure 18: Kumeu Produce market entrance

Recommendation(s)

1. Consider omitting the westward extension of the passing lane and improve the sight distance around the curve to and from the Kumeu produce market.

Frequency Crashes are likely to be occasional	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	Extension of passing lane to be removed and existing arrangement reinstated.	
Safety Engineer comment	Concur with SAT and Designer's response.	
Client decision	Agree with SAT, Designer and Safety Engineer.	
Action taken	Recommendation to be taken onboard during detailed design.	

2.5.5 Boric Supermarket

Moderate

The left-in only proposal for access to the Boric Supermarket off SH16 eastbound carriageway shown at point A in Figure 19 was revised during the safety audit to fulfil a previous design phase undertaking to provide a left-in and left-out access to SH16 at the same point A location. This was further revised during the audit to shift the left-in and left-out access to the west at Point 1 in Figure 19. The road safety audit team understands that direct access to SH16 is an entrenched property right and that the access only from Coatesville-Riverhead Road at point B would not be an acceptable compromise.

For the record, the designed wide entrance only (left-in only) access shown at A in Figure 19 could have been mistaken for a two-way entrance leading to head-on crashes in the entrance and possible wrong way turns onto SH16. This is particularly the case if signs are faded or damaged or go missing. It would also have been on an adverse 7 % crossfall for traffic turning left into the supermarket, which could have been problematic for heavy vehicle stability if taken too fast.

A two-way access at point A in Figure 19 would have been too close to the roundabout. This could have resulted in drivers turning left out of the supermarket into lane 1, due to the heavy traffic, and then trying to U-turn across straight through eastbound traffic passing through the roundabout and crashing at the point indicated.

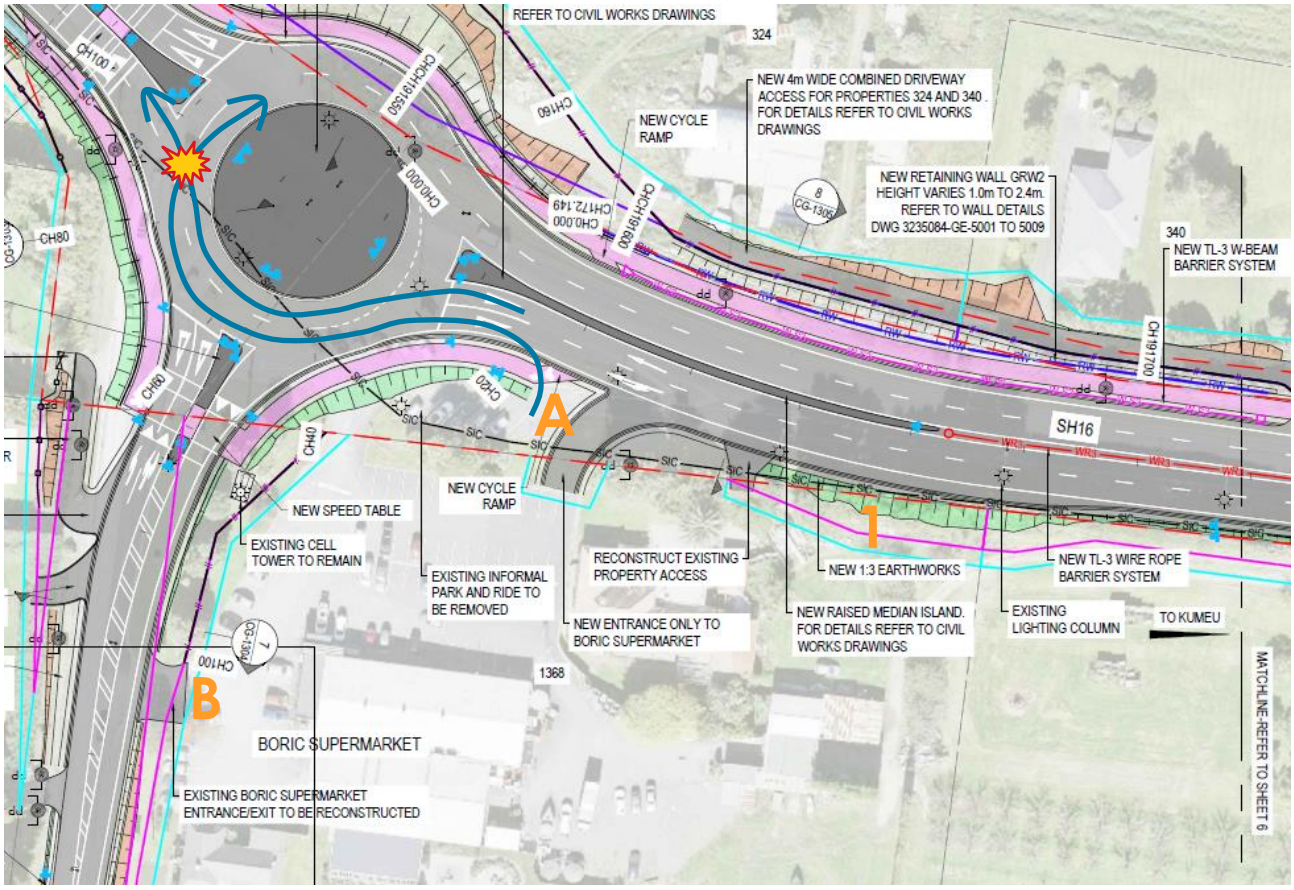

Figure 19: Currently proposed Boric Supermarket access

The following sketch of an alternative access at point 1 in Figure 20 was provided to the road safety audit team for comment.

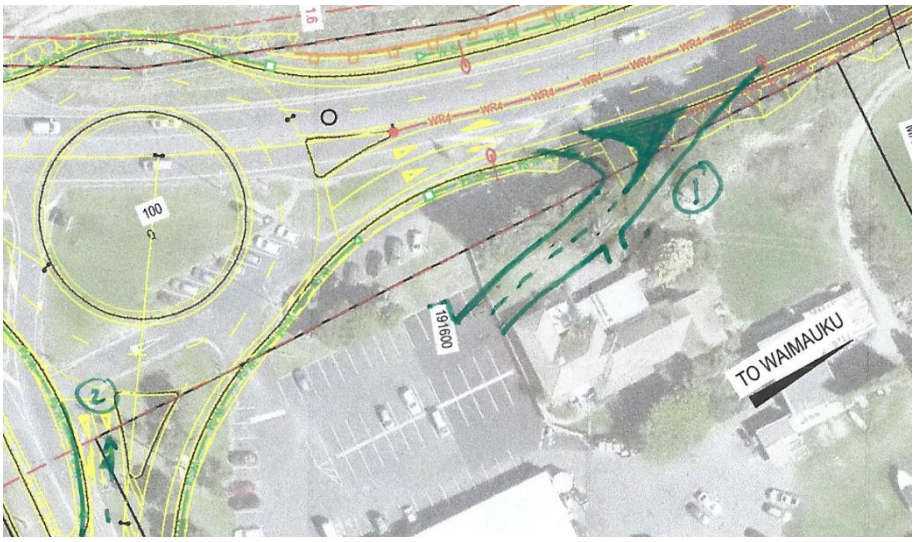

Figure 20: Alternative access to Boric Supermarket provided to audit team

The left-in left-out proposal would mitigate the safety concern that could lead to conflicting lane change crashes in the roundabout for drivers trying to perform a U-turn, as there would be more opportunities to move into lane 2 before entering the roundabout. The access could be improved if moved further west right up to the property boundary.

The safety audit team accepts that the sketch in Figure 20 is conceptual but highlights the safety concern that the left turn into the supermarket car park is too acute and will promote high speed turns. The exit should be at right angles to SH16.

The use of a median island to direct drivers to turn left into SH16 is a positive safety feature. Refer to Section 2.5.1.

Recommendation(s)

1. Although the safest would be to direct all the Boric Supermarket traffic to the Coatesville-Riverhead Road access, a two-way access as a far west of point 1 in Figure 20 would be safer than any access closer to the roundabout.
2. Reduce the proposed 7 % superelevation at the new access to avoid heavy vehicle instability when turning into the access from SH16.

Frequency Crashes are likely to be occasional	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	1. Left-in/left-out to be provided along SH16 with location as far west and close to property boundary as practical. 2. 7% super elevation to be removed.	
Safety Engineer comment	Concur with SAT and Designer's response.	
Client decision	Agree with SAT, Designer and Safety Engineer.	
Action taken	Recommendation to be taken onboard during detailed design.	

2.5.6 Park-and-ride facility

Minor

With the loss of the existing park-and-ride facility at the Boric Supermarket, there is the possibility that drivers will find somewhere else to park, which may not be a safe place e.g., blocking an access sight line or blocking a footpath or requiring the driver to walk in the road (Coatesville-riverhead Road for example) to access the footpath.

Recommendation(s)

1. Consider providing a like-for-like replacement of the existing park-and-ride facility somewhere.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is unlikely	Rating The safety concern is minor
Designer response	Future park and ride facilities to be provided outside of project scope.	
Safety Engineer comment	Agree with Designer's response.	
Client decision	Agree with Designer and Safety Engineer.	
Action taken	No further action to be taken.	

2.5.7 Properties along Coatesville-Riverhead Road

Comment

The proposed accesses to properties along Coatesville-Riverhead Road do not look as if they could accommodate turning vehicles easily, particularly the southernmost property access closest to the roundabout.

More design work probably needs to be carried out.

2.5.8 Left turns into accesses in general

Moderate

The existing accesses generally have available shoulder width and alignment to facilitate turning out of the highway traffic stream. This is not preserved in the proposed design.

Since the shoulders and lanes will be narrow, there is unlikely to be space for a following driver to pass a driver giving way to pedestrians or cyclists without moving into the adjacent lane or flush median. This could lead to a higher incidence of rear-end crashes and reinforces the need for an appropriate speed limit as discussed in Section 2.2.1.

Recommendation(s)

1. Provide safe opportunities for drivers to decelerate and turn off the highway into accesses, consistent with highway operating speed, especially if it is decided that the speed limit is to remain at 80 km/h.
2. Review the safe and appropriate speed limits for each section of the highway. Ensure speeds are appropriate for the level of roadside development with access from the highway.

Frequency Crashes are likely to be common	Severity Death or serious injury is unlikely	Rating The safety concern is moderate
Designer response	1. 1:10 tapers with 2.5m shoulder widths provided on entry and exit to accesses. 2. Safe and appropriate speed review outside of project scope.	
Safety Engineer comment	1. Agree with Designer's response. 2. Refer to the speed comment in the earlier speed section	
Client decision	Agree with Safety Engineer earlier comment on speeds.	
Action taken	Designer to action accordingly	

2.6 Road Signs and Markings

2.6.1 Intersection direction (ID) signs

Minor

The proposed low-mounted ID signs on the medians are stacked up to three high and each have more than one line of text. The sign stack in the Coatesville-Riverhead Road approach median would be about 2.6 m high taking kerb height and mounting height into consideration. This would result in total obstruction of sight lines at the limit lines. High mounting such signs is equally obstructive for heavy vehicle drivers.

Recommendation(s)

1. Low-mounted ID signs installed in the median at roundabouts must have only one destination on one board so that drivers can see over the top of the signs e.g., only Auckland and only Helensville and only Albany or Coatesville. The tourist signs have no place in the roundabout and should be on applicable advance signing only.

Frequency Crashes are likely to be occasional	Severity Death or serious injury is unlikely	Rating The safety concern is minor
Designer response	ID signs on roundabout to be single destination only and positioned appropriately for visibility.	
Safety Engineer comment	Concur with SAT and Designer's response.	
Client decision	Agree with SAT, Designer and Safety Engineer.	
Action taken	Recommendation to be taken onboard during detailed design.	

2.6.2 Edge marker posts

Comment

Edge marker posts are shown. Edge marker posts should not be necessary along a fully lit highway.

2.6.3 Supplementary give way plate

Minor

The supplementary roundabout give way plate unnecessarily raises the height of the low-mounted roundabout give way sign obstructing the view from the limit line. Having served their transitional purpose, the supplementary give way plates are no longer required and fell out of use ten years ago.

Recommendation(s)

1. Omit the supplementary roundabout give way plates.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is unlikely	Rating The safety concern is minor
Designer response	Supplementary roundabout give way plates to be removed.	
Safety Engineer comment	Agree with Designer's response.	
Client decision	Agree with SAT, Designer and Safety Engineer.	
Action taken	Recommendation to be taken onboard during detailed design.	

2.6.4 U-turns at Coatesville-Riverhead Road roundabout

Comment

Since U-turns are allowed/necessary at the Coatesville-Riverhead Road roundabout, the arrows in lane 2 on the eastbound approach, which show straight ahead only, should be amended to include a U-turn arrow.

2.7 Lighting

2.7.1 Lighting columns in median near limit line

Minor

Following on from Section 2.6.1 on ID signs mounted in the median obscuring sight lines, it is noted that there are lighting columns proposed in that location too.

It would be preferable to light the circulating carriageway from the perimeter and avoid placing lighting columns that add to the potential sight line obstructions already caused by ID signs and give way signs.

Refer to Section 2.7.2 on central island lighting.

Recommendation(s)

1. Avoid obstructing sight lines with lighting columns in the median, even momentarily.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is unlikely	Rating The safety concern is minor
Designer response	Existing lighting columns in the median at Brigham Creek roundabout to be retained. Street lighting design to be reviewed with the view to remove columns in the median at Coatesville-Riverhead roundabout as long as a compliant design can be achieved as per AS/NZ1158.	

Safety Engineer comment	Agree with SAT.
Client decision	Agree with designer
Action taken	Recommendation to be taken onboard during detailed design as long as a compliant design can be achieved as per AS/NZ1158.

2.7.2 Roundabout central island lighting

Minor

With reference to Section 2.7.1, it would be preferable to light the circulating carriageway from the perimeter, but also to light the central island. This is an often-neglected area when the lighting designer concentrates on lighting only the carriageway to the required levels of lighting and leaves the central island in darkness. The central island must be visible at night as it is the feature that defines the presence of a roundabout.

Some overseas countries require the central island to be lit to a higher level than the carriageway.

The centre of the central island is the least likely area to be hit by an out-of-control vehicle. Most veer slightly to the left of centre therefore a lighting mast exactly in the centre of the roundabout need not be protected.

Recommendation(s)

1. Light the centre of the central island to the same level as the circulating carriageway.

Frequency Crashes are likely to be occasional	Severity Death or serious injury is unlikely	Rating The safety concern is minor
Designer response	Central island to be lit as per AS/NZS 1158.	
Safety Engineer comment	Agree with SAT.	
Client decision	Agree with SAT, Designer and Safety Engineer.	
Action taken	Recommendation to be taken onboard during detailed design.	

2.8 Landscaping

2.8.1 Combustible wood chips

Minor

Combustible wood chips are being used more commonly as weed control and mulching. When dry the chips are very susceptible to careless disposal of cigarette butts and the resulting smoke from a low-temperature fire can reduce visibility. Fire crews are also exposed to traffic where they attend incidents.

Recommendation(s)

1. Avoid the use of combustible wood chips and use traditional non-combustible mulch instead.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is unlikely	Rating The safety concern is minor
Designer response	Mulch to be in accordance with the NZTA P39 Landscape Specification.	
Safety Engineer comment	Agree with Designer's response.	

Client decision	Agree with Designer and Safety Engineer
Action taken	Type of Mulch to be used to be confirmed during detailed design in accordance with the NZTA P39 Landscape Specification.

3 Audit Statement

We declare that we remain independent of the design team and have not been influenced in any way by any party during this road safety audit.

We certify that we have used the available plans, and have examined the specified roads and their environment, to identify features of the project we have been asked to look at that could be changed, removed, or modified to improve safety.

We have noted the safety concerns that have been evident in this audit and have made recommendations that may be used to assist in improving safety.

Signed  Date 21 April 2021

[Team leader name, qualification, position, company]

Signed  Date 28 April 2021

Grant Gordon, BE (Civil), MEngNZ, Senior Network Safety Engineer, ASM

Signed  Date 21 April 2021

Noel Tunnicliffe, NZCE (Civil), Civil Engineer, RoadLab Ltd

4 Response and Decision Statements

System designers and the people who use the roads must all share responsibility for creating a road system where crash forces do not result in death or serious injury.

4.1 Designer's Responses

I have studied and considered the auditors' safety concerns and recommendations for safety improvements set out in this road safety audit report and I have responded accordingly to each safety concern with the most appropriate and practical solutions and actions, which are to be considered further by the safety engineer (if applicable) and project manager.

Signed  Date 12 May 2021

Adam Holt, Senior Designer, Beca

4.2 Safety Engineer's Comments (if applicable)

I have studied and considered the auditors' safety concerns and recommendations for safety improvements set out in this road safety audit report together with the designer's responses. Where appropriate, I have added comments to be taken into consideration by the project manager when deciding on the action to be taken.

Signed  Date 28 May 2021

[Safety Engineer's name, qualification, position, company]

4.3 Project Manager's Decisions

I have studied and considered the auditors' safety concerns and recommendations for safety improvements set out in this road safety audit report, together with the designer's responses and the comments of the safety engineer (if applicable) and having been guided by the auditor's ranking of concerns have decided the most appropriate and practical action to be taken to address each of the safety concerns.

Signed  Date 20/5/2021

[Project Manager's name, qualification, position, company]

4.4 Designer's Statement

I certify that the project manager's decisions and directions for action to be taken to improve safety for each of the safety concerns have been carried out.

Signed  Date 31/05/21

[Designer's name, qualification, position, company]

4.5 Safety Audit Close Out

The project manager is to distribute the audit report incorporating the decisions to the designer, safety audit team leader, safety engineer, and project file.

Date: 26/5/2021

5 References

Argonaut. (2021, January 6). Roadrunner.

Opus. (2017, August 24). SH16 Brigham Creek to Waimauku Safety Retrofit and Capacity Improvements. *Preliminary Design Road Safety Audit*.

WSP Opus. (2018, December 11). State Highway 16 Brigham Creek to Kumeu Stage 2 Shared Path. *Preliminary Road Safety Review Comments*.

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Attachment 8 – SH16 Safety Improvements Stage 2 Brigham Creek to Kumeu Detail Design Road Safety Audit dated 21 September 2022

SH16 – SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Detail Design Road Safety Audit

21 September 2022

Prepared for:
Waka Kotahi

Prepared by:
Keith Weale

Project Number:
310205002.100.0111

Revision	Description	Author	Date	Quality Check	Date	Independent Review	Date

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Prepared by: 

Signature

Keith Weale

Printed Name

Reviewed by: 

Signature

Nick Gluyas

Printed Name

Approved by: 

Signature

Ali Siddiqui

Printed Name

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1 Introduction

1.1 Safety Audit Definition and Purpose

A road safety audit is a term used internationally to describe an independent review of a future road project to identify any safety concerns that may affect the safety performance. The audit team considers the safety of all road users and qualitatively reports on road safety issues or opportunities for safety improvement.

A road safety audit is therefore a formal examination of a road project, or any type of project which affects road users (including cyclists, pedestrians, mobility impaired etc.), carried out by an independent competent team who identify and document road safety concerns.

A road safety audit is intended to help deliver a safe road system and is not a review of compliance with standards.

The primary objective of a road safety audit is to deliver a project that achieves an outcome consistent with Road to Zero and the Safe System approach, which is a safe road system free of death and serious injury. The road safety audit is a safety review used to identify all areas of a project that are inconsistent with a Safe System and bring those concerns to the attention of the client so that the client can make a value judgement as to appropriate action(s) based on the risk guidance provided by the safety audit team.

The key objective of a road safety audit is summarised as:

'to deliver completed projects that contribute towards a safe road system that is free of death and serious injury by identifying and ranking potential safety concerns for all road users and others affected by a road project.'

A road safety audit should desirably be undertaken at project milestones such as:

- concept stage (part of business case);
- scheme or preliminary design stage (part of pre-implementation);
- detail design stage (pre-implementation or implementation); or
- pre-opening or post-construction stage (implementation or post-implementation).

A road safety audit is not intended to be a technical or financial audit and does not substitute for a design check of standards or guidelines. Any recommended treatment of an identified safety concern is intended to be indicative only, and to focus the designer on the type of improvements that might be appropriate. It is not intended to be prescriptive and other ways of improving the road safety or operational problems identified should also be considered.

In accordance with the procedures set down in the NZTA Road Safety Audit Procedures for Projects Guidelines - Interim release May 2013 the audit report should be submitted to the client who will instruct the designer to respond. The designer should consider the report and comment to the client on each of any concerns identified, including their cost implications where appropriate, and make a recommendation to either accept or reject the audit report recommendation.

For each audit team recommendation that is accepted, the client will make the final decision and brief the designer to make the necessary changes and/or additions. As a result of this instruction the designer shall action the approved amendments. The client may involve a safety engineer to provide commentary to aid with the decision.

Decision tracking is an important part of the road safety audit process. A decision tracking table is embedded into the report format at the end of each set of recommendations. It is to be completed by the designer, safety engineer, and client for each issue, and should record the designer's response, client's decision (and asset manager's comments in the case where the client and asset manager are not one and the same) and action taken. Decision tracking of safety concerns ranked as a comment is optional.

A copy of the report including the designer's response to the client and the client's decision on each recommendation shall be given to the road safety audit team leader as part of the important feedback loop. The road safety audit team leader will disseminate this to team members.

1.2 The Project

The safety and capacity of SH16 are proposed to be improved by:

- widening the highway to four lanes, including median barriers, between Brigham Creek Road/Fred Taylor Drive and Taupaki Road/Old North Road,
- constructing a two-lane roundabout at the intersection of Coatesville-Riverhead Road,
- providing a 2.5 m wide flush median between Taupaki Road/Old North Road and Old Railway Road, and
- constructing a shared path along the entire length of the project.

1.3 The Road Safety Audit Team

This road safety audit has been carried out in accordance with the NZTA Road Safety Audit Procedure for Projects Guidelines - Interim release May 2013, by the following team.

• Keith Weale	Stantec	Team leader
• Noel Tunnicliffe	RoadLab	Team member
• Grant Gordon	WSP Auckland System Management Waka Kotahi	Team member

1.4 Briefing, Audit, and Exit Meetings

Andria Dsouza and Heather Liew of Waka Kotahi and the designer, Gareth Clayton of Beca, briefed the road safety audit team on 13 September 2022, after which the road safety audit team conducted its desk top safety audit.

The road safety audit team was asked to comment on the following:

- safety implications of a potential fourth leg private property access off the Riverhead-Coatesville Highway roundabout,
- the proximity of the staggered signalised pedestrian crossings across SH16 to the roundabout give way signs,
- plywood versus steel pole and concrete noise walls, and
- pedestrian and cyclist fencing in the median at staggered signalised crossings.

The designers explained that the stone wall entrance to Soljans Estate Winery would very likely be demolished and reconstructed a few meters back from its current position due to the sight line obstruction safety concern raised in the preliminary design road safety audit. The road safety audit team have therefore assumed that this would be the case.

The road safety audit team had visited the site on Tuesday 13 April 2021 for the preliminary design road safety audit and did not consider that it was necessary to visit the site again.

An exit meeting was held with Andria Dsouza, Heather Liew and Gareth Clayton on 13 September 2022.

1.5 Previous Road Safety Audits

The following road safety audits have been carried out on the project previously.

- SH16 Brigham Creek to Waimauku preliminary design road safety audit in August 2017. (Opus, 2017)
- SH16 Kumeu to Waimauku preliminary design road safety audit in October 2018.
- SH16 Brigham Creek to Kumeu Stage 2 preliminary road safety review comments on the shared path only in December 2018. (WSP Opus, 2018)
- SH16 Brigham Creek to Kumeu Stage 2 preliminary design road safety audit in April 2021. (Stantec, 2021)

1.6 Scope of this Road Safety Audit

This is a detail design road safety audit of the proposed SH16 widening to four lanes and safety improvements between Brigham Creek Road and Weza Lane in Kumeu, excluding the two existing roundabouts at Brigham Creek Road/Fred Taylor Drive and at Taupaki Road/Old North Road.

1.7 Report Format

The potential road safety problems identified have been ranked as follows.

The expected crash frequency is qualitatively assessed on the basis of expected exposure (how many road users will be exposed to a safety issue) and the likelihood of a crash resulting from the presence of the issue. The severity of a crash outcome is qualitatively assessed on the basis of factors such as expected speeds, type of collision, and type of vehicle involved.

Reference to historic crash rates or other research for similar elements of projects, or projects as a whole, have been drawn on where appropriate to assist in understanding the likely crash types, frequency and likely severity that may result from a particular concern.

The frequency and severity ratings are used together to develop a combined qualitative risk ranking for each safety issue using the concern assessment rating matrix in Table 1. The qualitative assessment requires professional judgement and a wide range of experience in projects of all sizes and locations.

In ranking specific concerns, the auditors have considered the objectives of the Safe System approach, i.e., to minimise fatal or serious injury crashes.

In undertaking this assessment, the safety audit team has utilised the following descriptor tables to enable a fair and reasonable rating of the risks.

Table 1: Crash Frequency Description

Crash Frequency	Indicative Description
Frequent	Multiple crashes (more than one per year)
Common	1 every 1 to 5 years
Occasional	1 every 5 to 10 years
Infrequent	Less than 1 every 10 years

Crash severity is determined on the likelihood of a crash resulting in death or serious injury. The reader is advised that the severity of an injury is determined in part by the ability of a person to tolerate the crash forces. An able-bodied adult will have a greater ability to recover from higher trauma injuries, whereas an elderly person may have poor ability to recover from high trauma injuries. The auditors consider the likely user composition, and hence the likely severity of injury to that user.

Table 2: Concern Assessment Rating Matrix

Severity (likelihood of death or serious injury)	**Frequency** (probability of a crash)			
	Frequent	**Common**	**Occasional**	**Infrequent**
Very likely	Serious	Serious	Significant	Moderate
Likely	Serious	Significant	Moderate	Moderate
Unlikely	Significant	Moderate	Minor	Minor
Very unlikely	Moderate	Minor	Minor	Minor

While all safety concerns should be considered for action, the client or nominated project manager will make the decision as to what course of action will be adopted based on the guidance given in this ranking process with consideration to factors other than safety alone. As a guide a suggested action for each concern category is given in Table 3.

Table 3: Concern Categories

Concern	**Suggested Action**
Serious	Major safety concern that must be addressed and requires changes to avoid serious safety consequences.
Significant	Significant safety concern that should be addressed and requires changes to avoid serious safety consequences.
Moderate	Moderate safety concern that should be addressed to improve safety.
Minor	Minor safety concern that should be addressed where practical to improve safety.

In addition to the ranked safety issues, it may be appropriate for the safety audit team to provide additional comments with respect to items that may have a safety implication but lie outside the scope of the safety audit. A comment may include items where the safety implications are not yet clear due to insufficient detail for the stage of project, items outside the scope of the audit such as existing issues not impacted by the project or an opportunity for improved safety but not necessarily linked to the project itself. While typically comments do not require a specific recommendation, the auditors may give suggestions in some instances.

Decision tracking of safety concerns ranked as a comment is optional.

1.8 Documents Provided

The following drawings were provided for the road safety audit.

- 3235084-CA-1201 to 1213 General arrangement plans Rev E
- 3235084-CG-1301 to 1309 Typical cross-sections Rev D
- 3235084-CG-1401 to 1426 Detailed cross-sections Rev D
- 3235084-CG-1431 to 1432 Detailed cross-sections Rev D
- 3235084-CG-1441 to 1448 Detailed cross-sections Rev D
- 3235084-CG-1451 to 1474 Detailed cross-sections Rev D
- 3235084-CG-1481 to 1484 Detailed cross-sections Rev D
- 3235084-CB-2900 to 2913 Barriers and kerbing Rev D
- 3235084-CU-2001 to 2013 Utilities Rev B
- 3235084-CU-2050 to 2077 Utilities Rev B
- 3235084-CU-2081 to 2089 Utilities Rev B
- 3235084-CD-2100 to 2127 Stormwater Rev B
- 3235084-CG-1251 to 1258 Longitudinal sections Rev D
- 3235084-AL-6000 to 6300 Landscaping Rev C
- 3235084-SE-4005 to 4007 Structures Rev D
- 3235084-SE-4105 to 4108 Structures Rev D
- 3235084-SE-4205 to 4208 Structures Rev C
- 3235084-CT-28 & 281 Variable message signs Rev A
- 3235084-CT-2800 to 2801 Road signs and markings Rev A
- 3235084-CT-2811 to 2823 Road signs and markings Rev A
- 3235084-CT-2851 to 2856 Traffic signals Rev B
- 3235084-CT-2881 Sign face details Rev A
- 3235084-CP-3201 to 3207 Pavement Rev B

1.9 Disclaimer

The findings and recommendations in this report are based on an examination of available relevant plans, the specified road and its environs, and the opinions of the road safety audit team. However, it must be recognised that eliminating safety concerns cannot be guaranteed since no road can be regarded as absolutely safe and no warranty is implied that all safety issues have been identified in this report. Safety audits do not constitute a design review nor are they an assessment of standards with respect to engineering or planning documents.

Readers are urged to seek specific technical advice on matters raised and not rely solely on the report.

While every effort has been made to ensure the accuracy of the report, it is made available on the basis that anyone relying on it does so at their own risk without any liability to the safety audit team or their organisations.

2 Safety Concerns

2.1 Property Accesses

2.1.1 RIGHT OF WAY AMBIGUITY MODERATE

The drawings show a mixture of six different property access and intersection arrangements for path user or motorized vehicle right of way assignment.

1 One type of access, as in Figure 1, is treated as a private driveway access across the path where path users have right of way, as would be expected by both drivers and path users. No warning markings are shown or indeed required.

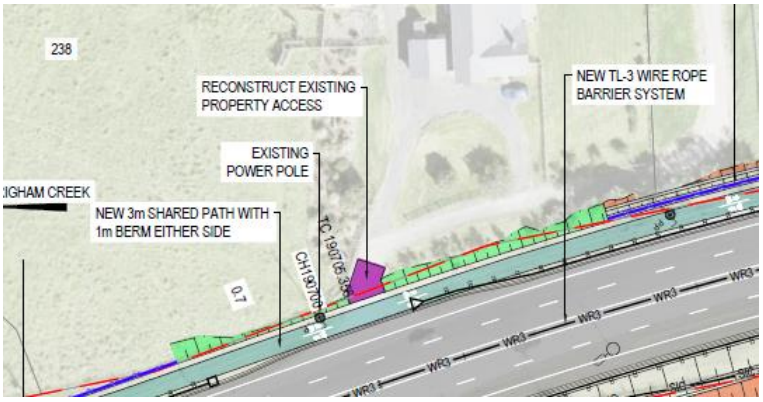


Figure 1: Normal driveway access across path

2 Another type of access as in Figure 2 and Figure 3 is treated as a commercial access across the path where path users have right of way, as would be expected by both drivers and path users, but a series of cyclist warning symbols have been proposed.

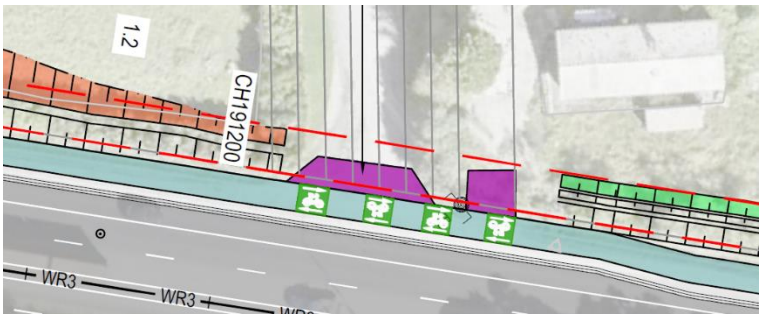


Figure 2: Normal driveway across path but with cyclist symbols

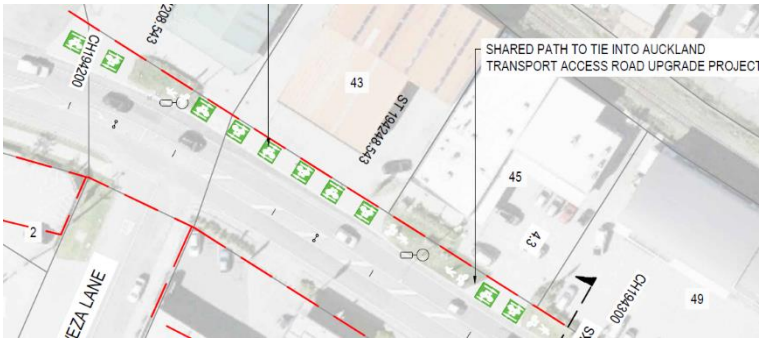


Figure 3: Retail access in Kumeu

The proposed cycle symbols, as used along Hutt Road in Wellington in Figure 4, appear to be fussy and difficult to maintain in good condition with the scuffing of vehicle tyres. Note that in Figure 4 and in Figure 11 they are already worn. They also indicate that the path should be for the exclusive use of cyclists when in fact the Brigham Creek to Kumeu path is a shared use path. Note the footpath alongside the cycleway in Figure 4.

Figure 4: Hutt Road cycleway (Google, 2020)

3 The Soljans Estate Winery entrance in Figure 5 has been treated with a solid green marking assigning priority to path users. However, the right turn bay and road markings in the entrance would suggest to drivers that it is a formal intersection, which indeed it is. Drivers would not be expecting to stop across two lanes of traffic if a cyclist suddenly appeared, nor would they be expecting to look for a gap in two lanes of traffic as well as a coinciding gap in the path users before turning right. Refer to further comments on the Soljans Estate Winery access in Section 2.1.4.

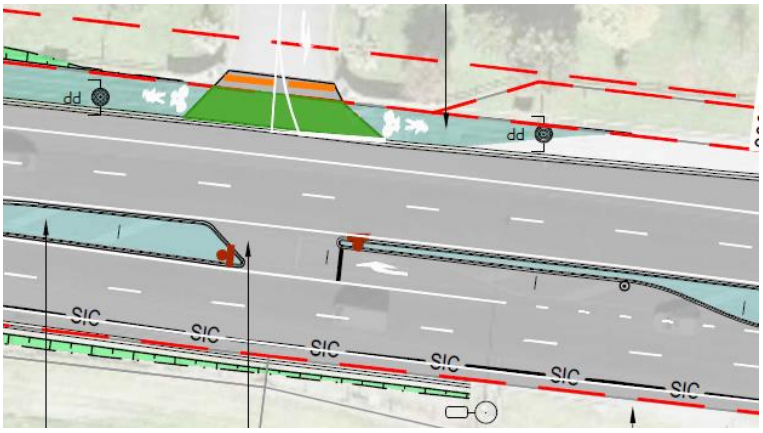


Figure 5: Soljans Estate Winery access

4 Another type as shown in Figure 6 is where the access is treated as a side road where it would be expected that motorized vehicles would have right of way, but where the designers have shown by markings that the path users have right of way. This would be very confusing for drivers turning into the access and relies on the continued long-term superior visibility of the green markings in all weather and lighting conditions to assign the priority to path users.

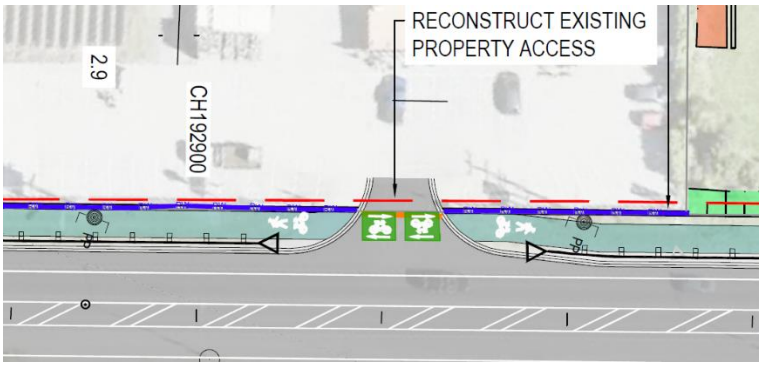


Figure 6: Phil Greig Strawberry Gardens access

5 Figure 7 shows a hybrid where the kerbing looks as though drivers should have right of way but is marked to assign right of way to path users. The presence of a channel across the entrance and exit further reinforces that it is a driveway crossing, but the kerbs suggest otherwise.

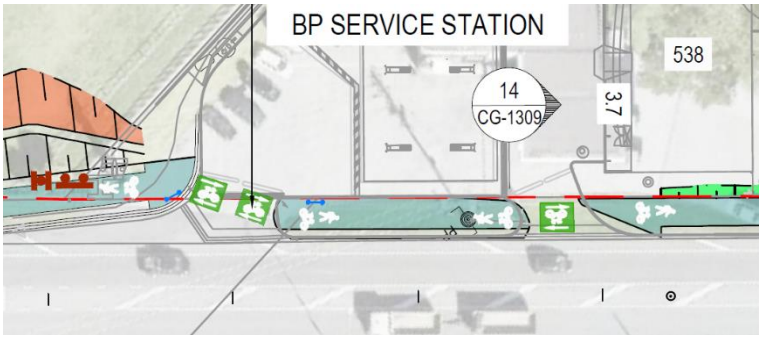


Figure 7: BP service station forecourt access

6 Figure 8 shows a normal side road intersection with no markings, but where it would be obvious that drivers have right of way. Refer to Section 2.2.2 for other safety issues relating to this intersection.

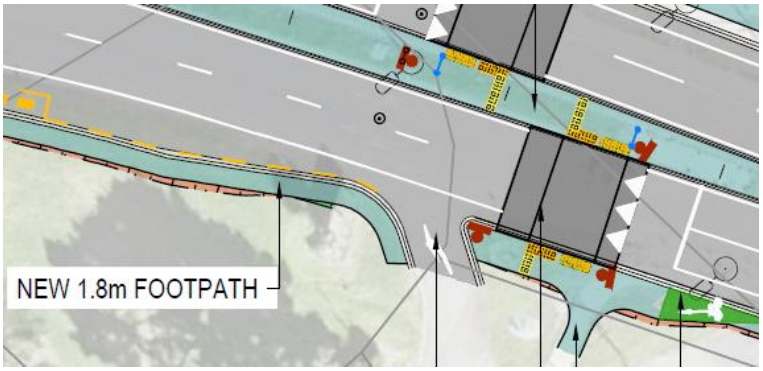


Figure 8: Normal motorized vehicle priority intersection

To avoid ambiguity, it is suggested that all the property accesses, including the access to the BP service station forecourt, be treated in the same way by carrying the dropped kerb and channel parallel to the highway and path across the access. By default, and without relying on any applied markings, the priority is automatically assigned to the path user.

A solid green panel is the easiest and most recognisable warning that could be applied in cases where it is deemed necessary to highlight to drivers that the path may be used by fast moving cyclists and scooters.

Figure 9: A typical service station entrance

The only exception would apply to the Soljans Estate Winery, as the access looks like an intersection and is technically an intersection. Here, motorized vehicle drivers should have right of way to reduce the risk of drivers stopping across oncoming traffic or failing to see or stop for a path user, as described above. In this case the path should end at pram crossings with tactile warning indicators and advance warning bars as per normal.

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

The ranking of this safety concern is based on the ambiguity of right of way that would occur at Soljans Estate Winery, Phil Greig Strawberry Gardens access, and the BP service station, and also the risk that the right of way markings might not be maintained in a perfectly visible condition at all times for the life of the highway.

Frequency rating	Crashes resulting from this safety concern could be infrequent.
Severity rating	Death or serious injury resulting from this safety concern could be likely.
Risk ranking	The safety concern is therefore deemed to be moderate.

Recommendation(s)

1 Assign the right of way to path users at all accesses, including the BP service station, by default in the normal and easily recognisable way of carrying the kerb and channel across the access to avoid any ambiguity; and do not rely on markings to assign priority.

2 Where warning is required, use simple green panel markings, that extend slightly beyond the width of the access and are squared off at right angles to the path, instead of complex and difficult to maintain markings.

Decision Tracking

Designer response	The right of way has been assigned to path users at accesses by default by providing continuity of the kerb and channel, grade, crossfall, colour and texture of the shared use path across the access to avoid ambiguity. Where additional warning/delineation is required, such as accesses identified with potential higher use or expected HCVs, additional green cycle/ped markings in line with current shared path marking standards will be provided. Noted vehicle access exceptions to the above are Soljans Estate Winery, Phil Greig's Strawberry Farm and BP Kumeu. In these locations the vehicle access has priority and will be treated as a side road intersection in terms of treatment.
Client safety engineer comment	Additional delineation should be provided at accesses identified with potential high use or HCVs, unless it is decided that vehicle access has priority. Where vehicles have priority, the access/ shared use path shall be delineated to show that vehicles have priority.
Client decision	Agree with designer and safety engineer.
Action taken	

2.1.2 INTER-VISIBILITY AT PROPERTY ACCESSES MODERATE

The designers pointed out that roughly 2 m high solid panel noise walls would probably be required along many of the property boundaries and that the walls would extend up to the accesses to maximise the noise reduction.

The designers have identified that visibility between drivers exiting the properties and paths users (traveling at typically 30 km/h on bicycles and scooters) will be problematic at many such properties, hence the proposals to add warning markings on the paths as described in Section 2.1.1.

In such situations, it is seldom possible to provide the required sight line from the driver's eye position to a path user without the vehicle first extending into the path before the driver can see. However, it is possible for the path user to see the nose of the vehicle before the driver sees the path user. Therefore, as long as the path user can take evasive action or stop in time before the vehicle extends substantially across the path, a collision can be avoided.

The warning markings alone are unlikely to prevent a collision unless the driver slows down to a stop before allowing the front of the vehicle to extend into the path. Therefore, it is suggested that in cases where adequate safe inter-visibility between driver and path user cannot be provided, a raised speed bump be positioned such that the driver will have to stop the vehicle in such a position that the path user can see the nose of the vehicle poking beyond the fence or noise wall, but not extending into the path.

Figure 10 illustrates the concept; only the bump has been installed a little too far back for a pedestrian to be able to see the vehicle before the driver starts to speed up again after negotiating the bump.

Figure 10: A speed bump at a concealed driveway, but set a little too far back (Google, 2022)

Figure 11: A speed bump at a concealed driveway, but set a little too far forward (Google, 2020)

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

Frequency rating	Crashes resulting from this safety concern could be infrequent.
Severity rating	Death or serious injury resulting from this safety concern could be likely.
Risk ranking	The safety concern is therefore deemed to be moderate.

Recommendation(s)

1 As described in the commentary above, provide speeds bumps at those accesses where adequate safe inter-visibility between driver and path user cannot be provided, such that the path user can see and avoid a vehicle before it starts to protrude into the path.

Decision Tracking

Designer response	Vehicle access have been reviewed for adequate safe inter-visibility. Fencing, landscaping and associated accommodations works are designed to maximise inter-visibility between drivers and path users as far as practicable within the site constraints. Vehicle access where adequate safe inter-visibility between driver and path user cannot be provided will include additional safety measures including the provision of speed bumps and signage. This is intended to encourage safer speeds as vehicles and users approach improving users' ability to see and react to a vehicle or user.
Client safety engineer comment	Concur with SAT's recommendation and designer's response.
Client decision	Agree with SAT, Designer and Safety Engineer.
Action taken	

2.1.3 BORIC SUPERMARKET SH16 ACCESS MODERATE

A left-in and left-out access is to be provided on SH16 for the Boric Supermarket.

There is a risk that unfamiliar motorists will turn right out of the access into the face of oncoming traffic in the eastbound carriageway, especially since it will be two lanes wide. The no right turn sign on the median may not be noticed as it will come into view late.

There is also a risk that the access will look like a replication of the existing left-turn slip lane, and that drivers will enter it at speed not realising that it ends in a car park, and that it is two-way.

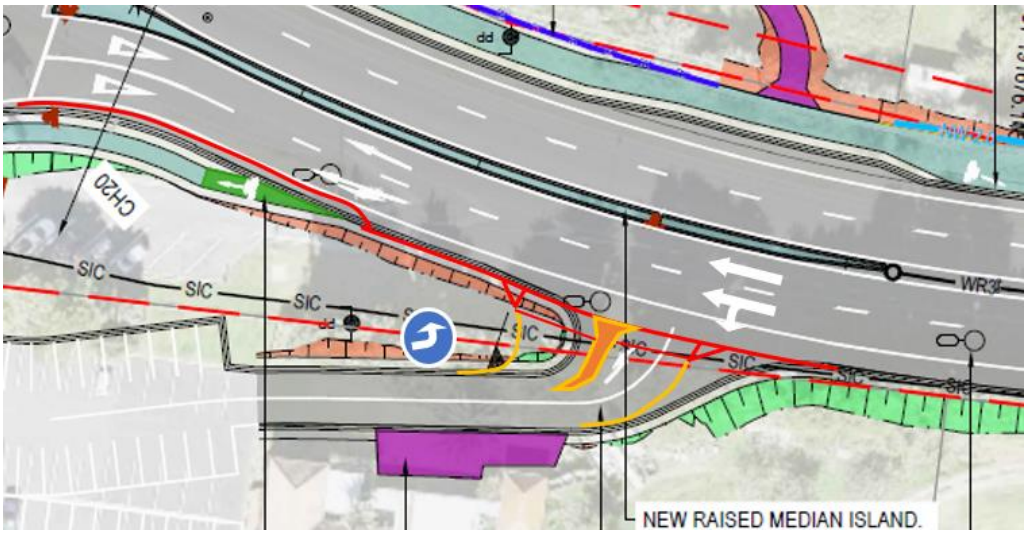


Figure 12: Suggested improvements to Boric Supermarket access

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

Frequency rating	Crashes resulting from this safety concern could be infrequent.
Severity rating	Death or serious injury resulting from this safety concern could be likely.
Risk ranking	The safety concern is therefore deemed to be moderate.

Recommendation(s)

1 Convert the access to a dropped kerb commercial crossing as recommended for all accesses in Section 2.1.1.

2 In addition to recommendation 1 above, provide a raised triangular island in the bell mouth of the access to direct drivers to turn left out to SH16, and to slow down when turning left from SH16 into the car park.

3 Add a set of lane arrows immediately to the west of the Boric Supermarket access, replicating the set already shown on the drawings.

4 Add a turn left only sign on the straight section of the car park access road so that it is visible before reaching SH16.

5 Consider shifting the access slightly to the east to ease the left turn out and to tighten the left turn in.

Decision Tracking

Designer response	Boric accessway geometry to be reviewed with respect to recommendations 1 to 5 and implemented where required vehicle tracking can be provided for.
Client safety engineer comment	Concur with SAT's recommendation and designer's response.
Client decision	Agree with SAT, Designer and Safety Engineer. Accessway geometry to be reviewed with respect to recommendations 1 to 5.
Action taken	

2.1.4 SOLJANS ESTATE WINERY MODERATE

This section serves to summarise the general safety concerns and recommendation of Sections 2.1.1 and 2.1.2 as they apply to the Soljans Estate Winery entrance.

As mentioned in Section 2.1.1, the Soljans Estate Winery entrance in Figure 5 has been treated with a solid green marking assigning priority to path users. However, the right turn bay and road markings in the entrance would suggest to drivers that it is a formal intersection, which indeed it is. Drivers would not be expecting to stop suddenly across two lanes of traffic if a cyclist suddenly appeared, nor would they be expecting to look for a gap in two lanes of traffic as well as a gap in the path users before turning right.

It is therefore suggested that the Soljans Estate Winery entrance be the exception to the recommendation to assign priority the path users at all property accesses. Instead, the entrance should be marked as a priority-controlled intersection, completed with all regulatory signs and markings.

As mentioned in Section 2.1.2, and also in the previous road safety audit, the existing stone wall would restrict visibility to path users severely. (Stantec, 2021, p. 13 Section 2.1.3) The drawings do indicate two orange bars, which the safety audit team assumes are proposed speed humps, but this could not be confirmed in the briefing meeting.

The designers said that it was likely that the stone walls would be demolished and rebuilt further back. This would provide the opportunity to improve inter-visibility between path users and exiting drivers by not necessarily reconstructing the walls with a curved section either side of the gate pillars, but rather with straight walls in line with the new property boundary. If desired, the existing curved feature could be retained as a low planter box, provided that the plants do not obscure the sight lines.

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

Frequency rating	Crashes resulting from this safety concern could be infrequent.
Severity rating	Death or serious injury resulting from this safety concern could be likely.
Risk ranking	The safety concern is therefore deemed to be moderate.

Recommendation(s)

1 Refer to the recommendations set out above and the relevant recommendations in Sections 2.1.1 and 2.1.2 as they apply to the Soljans Estate Winery entrance.

Decision Tracking

Designer response	Soljans Estate Winery access has priority over the shared path and will be treated as a side road intersection in terms of marking and signage treatment. Kerbing and the shared path will not be continuous across the access and pram crossings will be provided either side of the access along with signage. This access has been reviewed for adequate safe inter-visibility. Fencing, landscaping and associated accommodations works have been removed/relocated to maximise inter-visibility between drivers and path users as far as practicable within the site constraints.
Client safety engineer comment	Ensure that the access and shared path is designed and delineated to show that vehicle has priority over pedestrians and cyclists.
Client decision	Agree with Designer and Safety Engineer. No further action required.
Action taken	

2.1.5 ACCESS AT CH 19 1720 MODERATE

The proposed access at Ch 19 1720 is impractical as even a passenger car at full steering lock would not be able to make the 180-degree left turn into the property from the widened shoulder provided.

Drivers exiting the property would have to look 180 degrees behind them for a cyclist using the shared path, which is impractical and would be unsafe.

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

Frequency rating	Crashes resulting from this safety concern could be infrequent.
Severity rating	Death or serious injury resulting from this safety concern could be likely.
Risk ranking	The safety concern is therefore deemed to be moderate.

Recommendation(s)

1 Amend the access so that vehicles enter and leave at more or less 90 degrees to SH16 and the shared path. Consider a jug handle alignment of the driveway if appropriate.

Decision Tracking

Designer response	The vehicle assess has been modified for the design vehicle tracking as recommended
Client safety engineer comment	Concur with SAT's recommendation and designer's response.
Client decision	Agree with SAT, Designer and Safety Engineer.
Action taken	

2.1.6 GATES COMMENT

Some of the properties have gates.

Recommendation(s)

1 Provide sufficient space for the driver to park the vehicle clear of the swing of the gates to open or close them without the vehicle extending into the road or across the shared path.

Since this safety concern is ranked as a comment, decision tracking in the table below is optional.

Optional Decision Tracking

Designer response	As part of the project's accommodation works where gates are to be provided, provision for safe parking and gate operation outside of the extents of the road and shared path will be provided for.
Client safety engineer comment	Agree with SAT's comments.
Client decision	Agree with SAT, Designer and Safety Engineer.
Action taken	

2.1.7 EXCESSIVELY WIDE INFORMAL ACCESSES COMMENT

Excessively wide informal accesses were highlighted in the previous audit. (Stantec, 2021, p. 29 Section 2.5.2) The agreed action was that these would be rationalised based on vehicle tracking. This does not appear to have been actioned.

Since this safety concern is ranked as a comment, decision tracking in the table below is optional.

Optional Decision Tracking

Designer response	Following consultation with stakeholders' accesses have been rationalised based on State Highway vehicle access geometry requirements and vehicle tracking. Vehicle access outside the extents of the road shoulders are generally provided on a like for like basis with the existing access arrangements and only limited improvements to accesses are being implemented where required. CH191200 – Existing access services a number of properties including HCV's. Existing access widths are being maintained. CH192600 – Existing access has been rationalised to separate in and out accesses. Phil Greig Strawberry Gardens – Existing access has been rationalised. CH193350 – Existing wide access serves multiple property accesses including a café and the retirement village. Following stakeholder consultation access is proposed to be retained as per the existing arrangement.
Client safety engineer comment	Noted.
Client decision	Agree with designer response. No further action required.
Action taken	

2.1.8 DIRECT ACCESS OFF ROUNDABOUT COMMENT

The road safety audit team was asked to comment on the safety implications of a potential fourth leg private property access off the Riverhead-Coatesville Highway roundabout.

Two options for the form of private access directly off a roundabout are possible.

First, the access could be a dropped kerb driveway crossing with the channel following the perimeter of the circulating lane. The safety concern with such an arrangement is that following drivers would not expect driver to turn left off a roundabout circulating lane at a dropped crossing that has had no advance destination signage (refer to further comments on advance signage below) and would be almost invisible to a following driver. The negotiating speed of a dropped crossing would be slow, and this would exacerbate the unexpectedness of the manoeuvre. This creates a risk of rear-end crashes or sideswipe crashes in two-lane circulating carriageways as a driver swerved to avoid the vehicle in front.

Second, the access could be designed to be a fully-fledged fourth exit and entrance that matched the geometric layout of the other three legs, complete with priority control signage etc.

The safety concern with such an access is that it would have to be signed on the advance direction signs as a private driveway, but the destination would be meaningless or absent. This could cause confusion regarding which exit to take. It is not certain if navigation software would be able to accept such a layout,

which could cause further confusion. Generally, such software instructs drivers to take the first or second or third exit. Would drivers, in turn, count the private access as an exit or not? Such indecision could cause sudden unpredictable manoeuvres leading to crashes.[1]

The major safety concern for the second option relates to drivers that have taken the incorrect exit believing it to be a relatively high-speed exit, only to find themselves confronted by a closed gate, or speed humps, or children playing in the road that has suddenly become someone's driveway, or parked cars. The results could be death or very serious injury.

Recommendation(s)

1 Do not create a direct property access off the roundabout.

2.2 Cyclist and Pedestrian Paths and Crossings

2.2.1 SOLJANS ESTATE WINERY BUS STOP MODERATE

There is a bus stop outside Soljans Estate Winery as shown in Figure 13. The width of the existing path, although signed as a shared path, would not allow a cyclist to pass a passenger alighting from a bus without the risk of conflict.

The drawings indicate that no widening of the existing path is proposed at the bus stop.

Figure 13: Soljans Estate Winery bus stop

[1] Such installation has proven problematic at the SH1/SH5 roundabout just south of Tirau.

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

Frequency rating	Crashes resulting from this safety concern could be infrequent.
Severity rating	Death or serious injury resulting from this safety concern could be likely.
Risk ranking	The safety concern is therefore deemed to be moderate.

Recommendation(s)

1 Widen the existing path so that bus passengers can alight without being in danger of being struck by a passing cyclist.

Decision Tracking

Designer response	Shared path to be widened in this location to accommodate shared path users and alighting bus passengers.
Client safety engineer comment	Concur with SAT's recommendation and designer's response.
Client decision	Agree with SAT, Designer and Safety Engineer. Shared path to be widened at this point.
Action taken	

2.2.2 BRIGHAM CREEK SIGNALISED PEDESTRIAN CROSSING MINOR

There are a number of safety concerns with the signalised pedestrian crossing at Brigham Creek roundabout, particularly on the northern side of SH16.

1 There is only 2.8 m between the kerb and the back of the footpath for pedestrians and cyclists to stand and wait for the signalised crossing phase on the northern side of the Brigham Creek signalised pedestrian crossing.

2 There is little space for cyclists to be able to turn to face the crossing and there is no space for a hold rail.

3 The cycle call buttons are on the same side of the crossing, such that it places cyclists in directly opposing paths. This applies also to the westbound carriageway crossing.

4 There are gaps between the pedestrian and cyclist tactile pavers.

5 There is a cycle ramp to the west of the crossing that takes up the entire width of the footpath, placing pedestrians and cyclists at risk of colliding. It would also require the footpath levels to drop to the road level at the ramp.

6 There are no pram crossings across the uncontrolled high entry angle left turn slip lane just to the east of the signalised pedestrian crossing.

7 Cyclists and pedestrians and the clutter of signal poles and shared path and raised safety platform warning signs are likely to obstruct safe intersection sight distance to the west for drivers entering SH16.

This northern side of the signalised pedestrian crossing needs a redesign taking the above into account.

Suggested safety improvements are shown in Figure 14.

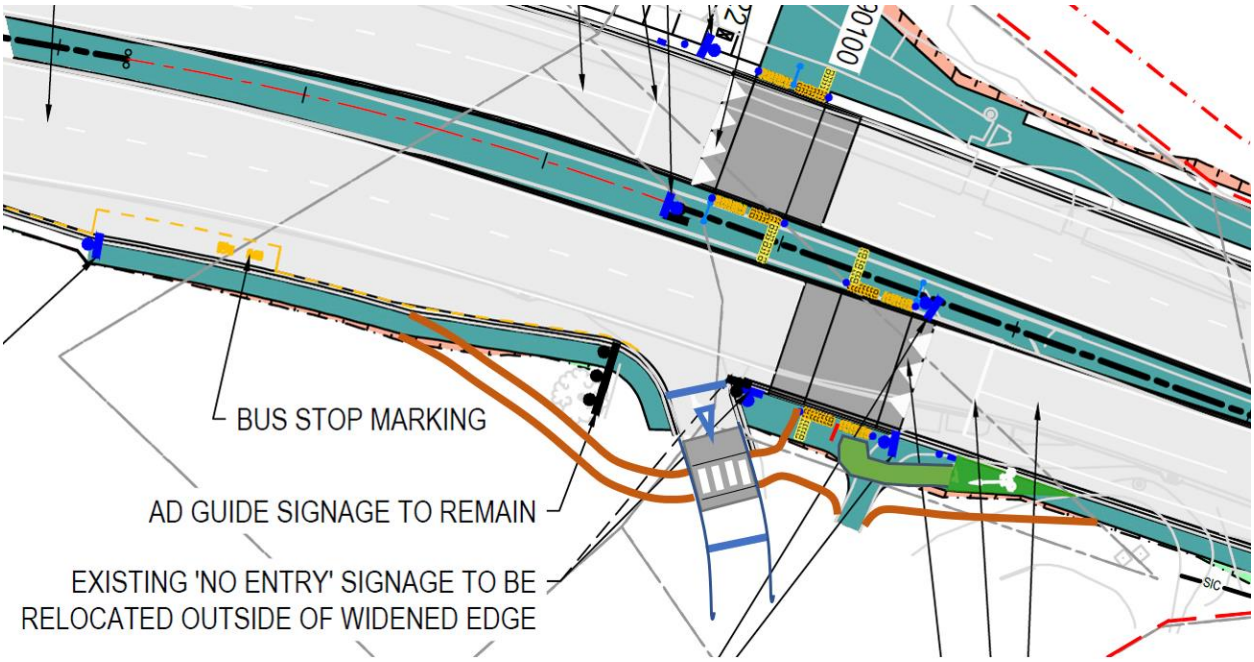


Figure 14: Suggested safety improvements at crossing

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

Frequency rating	Crashes resulting from this safety concern could be occasional.
Severity rating	Death or serious injury resulting from this safety concern could be unlikely.
Risk ranking	The safety concern is therefore deemed to be minor.

Recommendation(s)

1 Increase the space on the northern side of the crossing to avoid conflicts between cyclists and pedestrians.

2 Provide enough space for cyclists to manoeuvre around to face the signalised crossing and to install a hold rail that does not impede pedestrian access.

3 Provide stub pole call buttons on the left-hand side of the cyclist crossing between the pedestrian and cyclist tactile pavers. In such cases, the gap referred to in note 4 above would be acceptable as it would be filled with the pole and hold rail.

4 Maintain the footpath width past the cycle ramp instead of sharing the ramp with the footpath.

5 Provide a raised safety platform zebra crossing across the left-turn slip lane and convert the intersection to a give way priority-controlled intersection.

6 Place as many signs and poles out of the driver sight line from the left turn slip lane to the west as possible.

Decision Tracking

Designer response	Design to be reviewed with respect to implementing recommendations 1 to 4 and 6. Note as per Waka Kotahi instruction the Raised safety platform is to be removed from the design at the Brigham Creek crossing of SH16. A signalised Pedestrian and Cyclist crossing is to be maintained Due to very low vehicle volumes on the one-way side road access it is proposed not to adopt a raised safety platform zebra crossing in this location. Standard intersection pram crossings are proposed.
Client safety engineer comment	Concur with SAT's recommendation and designer's response. The need for a raised safety platform should be considered.
Client decision	Agree with Designers response. Review crossing with respect to implementing recommendation 1 to 4 and 6. Due to the low volumes of traffic and visibility raised safety platform zebra crossing not required in the location.
Action taken	

2.2.3 FOOTPATH AT KENNEDYS ROAD CORNER MODERATE

Presumably, the existing bus stop at The Grind café serves the residents of Kennedys Road. Since the bus stop will shift eastwards to Brigham Creek roundabout, the footpath has been designed along the northern side of SH16. However, the path is shown starting at the existing bus stop sign about 50 m east of Kennedys Road. Therefore, it is assumed that pedestrians should continue to walk in the existing informal car parking area in front of The Grind café from Kennedys Road to the start of the new footpath.

Since the drawings also show that the existing car parking area is to be kerbed, it would be safer if the car park were converted to parallel parking to prevent diagonal parking that would cause drivers to reverse into the highway and to utilise the space gained to provide a kerbed footpath past the front of the café as far as Kennedys Road.

A suggested footpath is shown in orange in Figure 15.

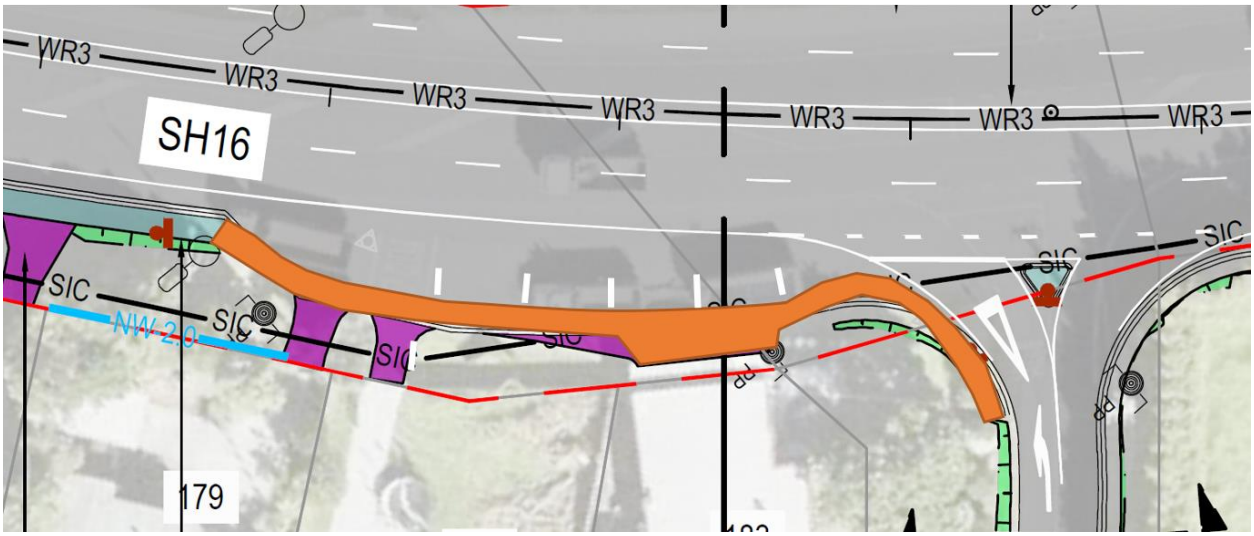


Figure 15: Suggested footpath extension at The Grind café at Kennedys Road

There are a few residential properties to the west of Kennedys Road, but there is no footpath provision for them to walk to the bus stop or to the café. There is a risk that they might walk in the shoulder of the road.

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

The ranking of this concern is based on vehicles reversing into the road and of pedestrians walking in the road where there is no footpath to the west of Kennedys Road.

Frequency rating	Crashes resulting from this safety concern could be occasional.
Severity rating	Death or serious injury resulting from this safety concern could be likely.
Risk ranking	The safety concern is therefore deemed to be moderate.

Recommendation(s)

1 Provide a footpath past The Grind café from Kennedys Road to the start of the proposed footpath along the northern side of SH16.

2 As a minimum, provide an all-weather verge e.g., compacted gravel, along the northern side of SH16 to serve the residential properties west of Kennedys Road.

Decision Tracking

Designer response	A flush footpath to provide access is proposed. It is intended that this will be delineated within the existing informal car parking area in front of the Grind café from Kennedys Road to the start of the new proposed footpath with line marking and vehicle stop kerbs. A flush footpath is proposed as the existing finished floor level of the Grind Café is effectively level with the existing parking area levels. Construction of a standard raised concrete footpath would affect drainage and access to the cafe as well as adjacent vehicle crossings. West of Kennedys Road a all-weather verge (granular material) will be provided where this will not impact other design elements including increasing land requirements.
Client safety engineer comment	Agree with SAT's recommendations. Footpath will separate pedestrians from moving vehicles and is safer for pedestrians.
Client decision	Agree with SAT, Safety Engineer and Designer response, level footpath to be provided and delineated with vehicle stop kerbs and line marking.
Action taken	

2.2.4 SAFETY FENCING AT CROSSINGS SIGNIFICANT

As requested, the road safety audit team comments on median fencing at the staggered signalised pedestrian crossings.

Corralling pedestrians and cyclists like cattle to cross in two stages at staggered signalised intersection in low-speed urban environments is frowned upon as it suggests that pedestrians and cyclists do not belong in city environments and have to be herded across a car-centric facility. Fencing, unless very extensive, is not effective against jaywalking around the end of the fencing anyway.

However, in the high-speed environment of SH16, the fences can be regarded not as herding devices, but as safety devices to prevent a pedestrian from stumbling or a cyclist from wobbling and falling into the path of a passing vehicle. Therefore, the road safety audit team recommends that fences be installed.

However, be aware of the sight line restrictions caused by fencing that can obscure little people, so omit the fencing that is at right angles to the approaching traffic or end it back about 1 m from the kerb.

Also ensure that the fencing is set back sufficiently so that it is not struck by passing vehicles.

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

Frequency rating	Crashes resulting from this safety concern could be occasional.
Severity rating	Death or serious injury resulting from this safety concern could be very likely.
Risk ranking	The safety concern is therefore deemed to be significant.

Recommendation(s)

1 Provide pedestrian and cyclist safety fencing at staggered signalised crossings. However, be aware of the sight line restrictions that can obscure little people and omit the fencing that is at right angles to the approaching traffic.

2 Ensure that the fencing is set back sufficiently so that it is not struck by passing vehicles.

Decision Tracking

Designer response	Pedestrian and cyclist safety fencing at staggered crossings to be implemented as recommended.
Client safety engineer comment	Concur with SAT's recommendation and designer's response.
Client decision	Agree with SAT, Designer and Safety Engineer. Implement pedestrian and cyclist safety fence parallel to carriageway in line with recommendations 1 and 2.
Action taken	

2.2.5 COATESVILLE-RIVERHEAD ROUNDABOUT BUS STOP MINOR

The eastbound cycle bypass is shown passing through the bus stop with no demarcated or positive conflict separation between bus passengers and cyclists, although the typical cross-section on Drawing CG-1302 does show the cycle path passing behind the bus shelter.

The cycle bypass operates in only one direction and therefore needs to be only 1.5 m wide, not 2.5 m wide beyond the bus stop.

A suggested improvement in conflict separation is shown in Figure 16.

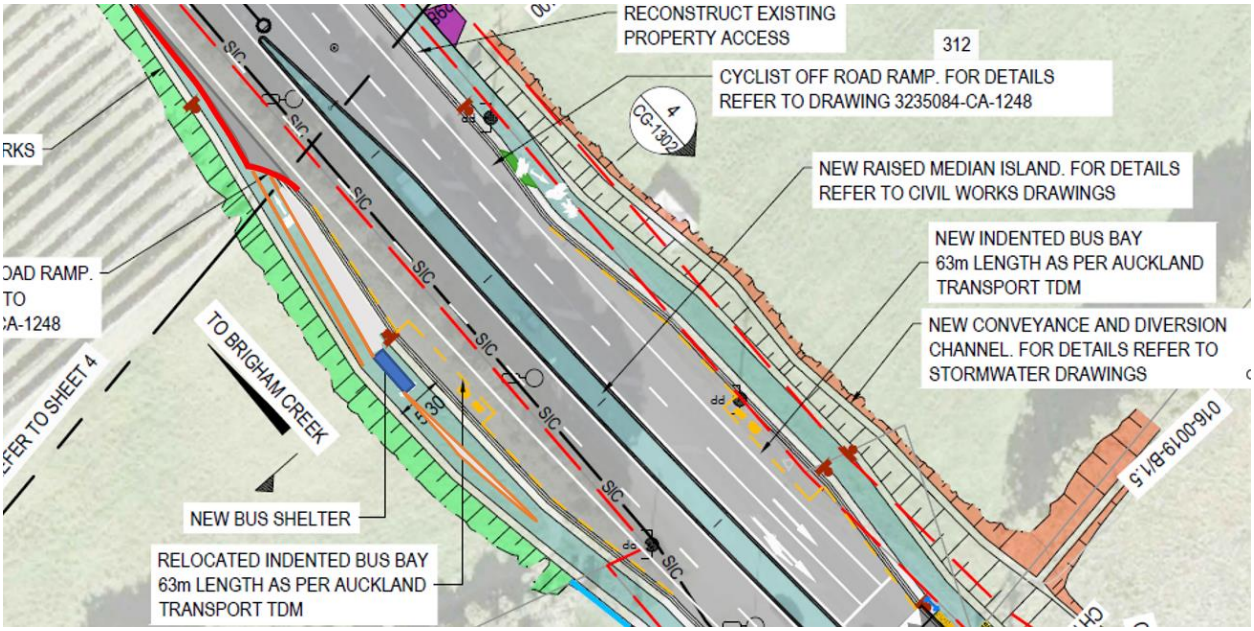


Figure 16: Suggested cyclist and bus passenger conflict separation at bus stop

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

Frequency rating	Crashes resulting from this safety concern could be infrequent.
Severity rating	Death or serious injury resulting from this safety concern could be unlikely.
Risk ranking	The safety concern is therefore deemed to be minor.

Recommendation(s)

1 Adopt the suggested layout in Figure 16, to reduce the conflict between cyclists and bus passengers alighting the bus.

Decision Tracking

Designer response	Layout to be adopted generally as recommended and in line with AT Bus stop/shared path design requirements.
Client safety engineer comment	Agree with SAT's recommendation.
Client decision	Agree with SAT, designer and Safety Engineer Response. Adopt layout in line with AT bus stop/shared path design requirements.
Action taken	

2.2.6 UNASSIGNED PRIORITY CROSSINGS SIGNIFICANT

Raised safety platform crossings with unassigned priority are shown across the Coatesville-Riverhead Highway and Taupaki Road approaches to the two roundabouts. These crossings will be used regularly by cyclists wishing to bypass the roundabouts, the shared path users, and bus passengers walking to and from the downstream bus stops.

In the past, the reasons for not marking zebra crossings across two-lane carriageways has been well explained and promoted. However, all the arguments against marking zebra crossings across two or more lanes in the same direction of travel were based on flush-marked zebra crossings, and never contemplated the effect of marking, or not marking, zebra crossings on raised safety platforms.

We now have a situation of ambiguity where:

- pedestrians are not sure if all approaching drivers will give way to them if they step onto the courtesy raised safety platform, which looks like and is intended to be a safe place to cross,
- and where drivers are not sure if they should or should not give way out of courtesy, and
- where following drivers might be expecting the driver in front of them to give way in light traffic but would probably not expect them to give way in peak traffic.

An unmarked raised safety platform crossing may therefore be unsafe for the same reasons given in the past that approaching drivers cannot see past a high-sided vehicle to a pedestrian crossing the adjacent lane. However, provided that the raised safety crossing is effective in reducing speed to say 20 km/h to 25 km/h adequately far enough away from the crossing, even if a pedestrian were to suddenly appear from behind a high-sided vehicle, the driver in the adjacent lane should still be able to stop in time quite easily. Unfortunately, the proposed 1:25 slope will not achieve this (indeed the warning sign suggests 45 km/h) and therefore the raised safety platform courtesy crossing as currently designed is likely to be as unsafe as no facility or a flush-marked zebra crossing across two lanes.

The road safety audit team acknowledges that it would be a difficult call for a designer to mark a zebra crossing across two lanes now, even on a raised safety platform, given the entrenched mindset of most practitioners that providing no crossing facility is safer than providing a zebra crossing across two lanes.

It would be retrogressive if the designers decided to remove the proposed raised safety platform in response to this safety concern. Therefore, the road safety audit team suggests that, as a minimum, the proposed unmarked raised safety platforms be constructed with an approach slope that effectively reduces the vehicle speeds to 20 km/h to 25 km/h on the Coatesville-Riverhead Highway and Taupaki Road approaches to the roundabouts only. This would not apply to the signalised crossings across SH16.

In addition, it is recommended that a 3 m buffer zone between the approach slope and the crossing be created, which would increase the conflict separation and reaction time between a pedestrian or cyclist and driver and within which a driver should be able to avoid a collision.

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

The ranking of this safety concern is based on the proposed approach slope of the raised safety platform not reducing speeds to 20 km/h to 25 km/h and the slope being too close to where pedestrians would be crossing to be effective in avoiding a collision.

Frequency rating	Crashes resulting from this safety concern could be occasional.
Severity rating	Death or serious injury resulting from this safety concern could be very likely.
Risk ranking	The safety concern is therefore deemed to be significant.

Recommendation(s)

1 Ensure that the raised safety platform will reduce vehicle speeds at the crossing to 20 km/h to 25 km/h.

2 Provide a buffer zone between the approach ramp and the section of the raised safety platform where pedestrians and cyclists would be directed to cross.

3 Consider applying a full treatment zebra crossing on the raised safety platform comprising limit line, belisha beacons, high friction surfacing etc.

Decision Tracking

Designer response	Uncontrolled Pedestrian and Cyclist crossings with a raised safety platform is proposed as designed at the Coatesville-Riverhead Highway and Taupaki Road roundabout approaches. Raised safety platform geometry proposed is an approach ramp 1:20, departure ramp 1:40 and a 75mm platform height. Tactile pavers will be positioned to direct pedestrians and cyclists to cross as far from the approach vehicles as possible to provide a buffer zone. Zebra treatment was considered however it would push the location of the raised crossing further from the crossing desire-line and impact vehicle accesses at Coatesville-Riverhead Highway in addition to safety concerns noted within the discussion above.
Client safety engineer comment	Agree with the approach ramp of 1:20, departure ramp of 1:40 and a 75mm height platform proposed by the designer. Agree with the designer's response regarding zebra crossing treatment. Monitor for the time being. For two-lane crossing locations (roundabout approaches and departures), zebra crossing a have a safety disbenefit (vehicle 1 stops and hides the pedestrians from vehicle 2), so making these a courtesy crossing encourages the pedestrian to be cautious and check that both lanes are clear or at least aware of their presence.
Client decision	Agree with Designer and Safety Engineer.
Action taken	

2.2.7 HIGH FRICTION SURFACING AT PEDESTRIAN CROSSINGS MODERATE

Given the relatively high-speed environment on the approach to the signalised pedestrian crossings across SH16, the possibility of sun strike on this mainly east-west alignment, and the possibly infrequent and unexpected red display at certain times of the day, it is recommended that high friction surfacing be applied ahead of the signalised pedestrian crossings as per normal practice.

Ensure that the colour of the high friction surfacing does not detract from the limit line and maintains a colour contrast.

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

Frequency rating	Crashes resulting from this safety concern could be infrequent.
Severity rating	Death or serious injury resulting from this safety concern could be very likely.
Risk ranking	The safety concern is therefore deemed to be moderate.

Recommendation(s)

1 Apply high friction surfacing ahead for all pedestrian and cyclist crossings.

Decision Tracking

Designer response	Apply high friction surfacing ahead of pedestrian and cyclist crossings where not approaching from an adjacent roundabout. Traffic speed is expected to be reduced due to negotiating the roundabouts. Where the pedestrian and cyclist crossings are in proximity to the roundabout exit, we do not consider high friction surfacing necessary however the operation can be monitored and implemented later if required.
Client safety engineer comment	Agree with designer's response.
Client decision	Agree with designer and safety engineer.
Action taken	

2.2.8 COATESVILLE-RIVERHEAD RAISED SAFETY PLATFORM MINOR

A number of the foregoing general safety concerns apply to the proposed layout of the cycle and pedestrian paths leading to and from the raised safety platform across Coatesville-Riverhead Highway, and to the access arrangements for the nursery at property No 1409 and access to No 1411.

In summary:

- there are pedestrian and cyclist conflict points on both sides of the crossing,
- the turn radius for cyclists is too sharp, refer to the previous road safety audit report, (Stantec, 2021, p. 16 Section 2.1.5)
- cyclists are not reintroduced onto the road in the lee of protective kerbs,
- there are confusing access arrangements regarding pedestrian right of way, and
- the one-way cycle bypass on the western side of the roundabout is shown as a shared path, with no indication that it is one-way or that pedestrians should not be walking that way as there is no crossing facility on the western side of the roundabout.

One-way cycle bypass paths need be only 1.5 m wide, which will provide some extra space for the suggested safety improvements shown in Figure 17 to be implemented. The shoulder around the perimeter of the roundabout must be omitted and must not be marked with a white line. The red lines in Figure 17 indicate the suggested kerb line coinciding with the white edge lines shown on the drawings. The yellow lines indicate the realigned cycle bypass to provide larger radius manoeuvring turns for cyclists.

Directional indicator tiles are not required on the western side of the crossing as pedestrians approach the crossing directly. There should be no pedestrians on the cycle bypass.

Most cyclists will be heading east along SH16, so will turn right across the raised safety platform. However, those heading north along Coatesville-Riverhead Highway must give way to pedestrians, hence a zebra crossing shown across the one-way cycle bypass.

As recommended in Section 2.1.1, the accesses to Boric supermarket, the nursery, and No 1411 are shown as commercial kerb crossings. This has the advantage of providing a larger combined shared access for the nursery and No 1411, which should ease turning movements.

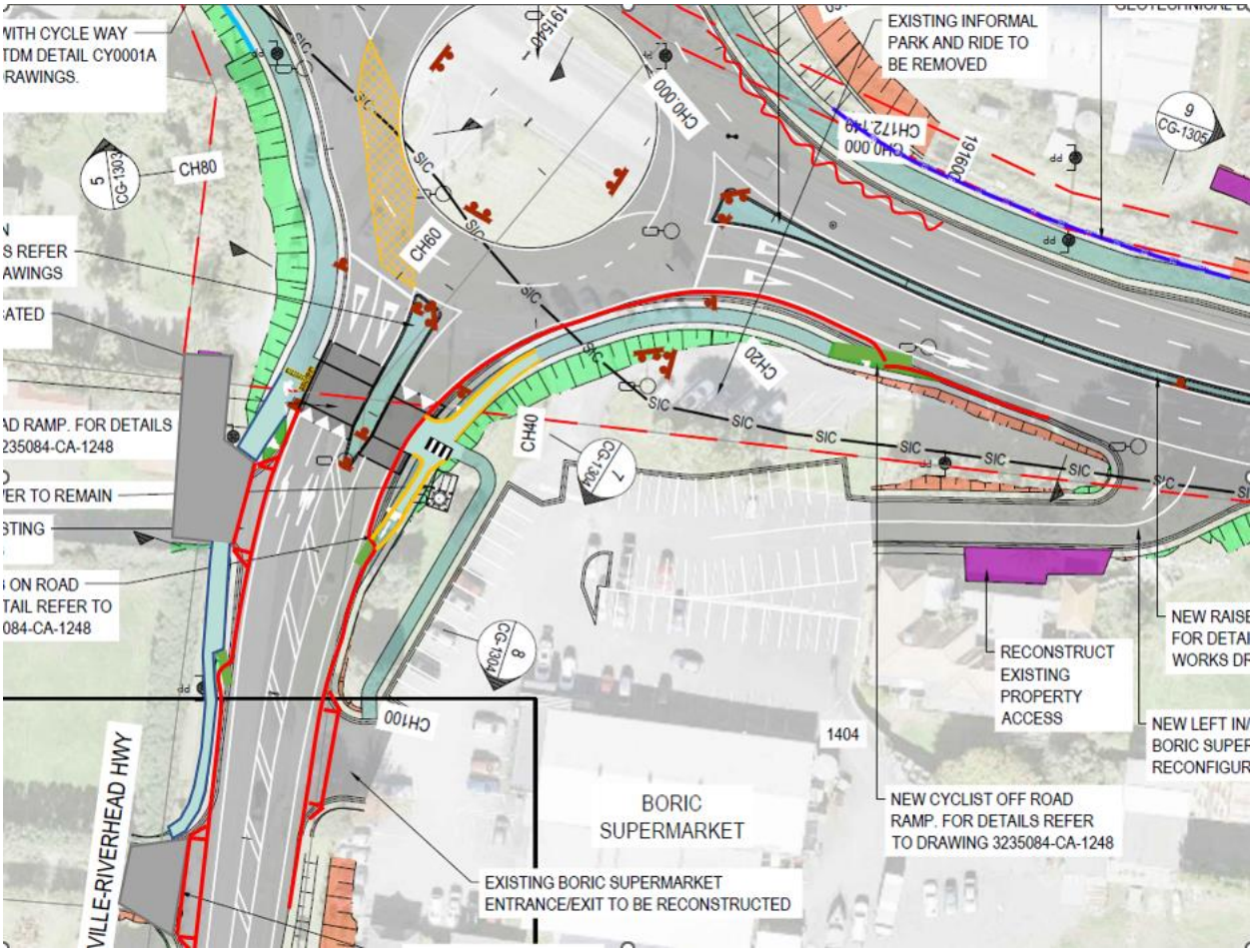


Figure 17: Suggested safety improvements to Coatesville-Riverhead crossing and accesses

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

Frequency rating	Crashes resulting from this safety concern could be occasional.
Severity rating	Death or serious injury resulting from this safety concern could be unlikely.
Risk ranking	The safety concern is therefore deemed to be minor.

Recommendation(s)

1 Amend the layout as suggested in Figure 17.

2 Add a ‘no pedestrians’ sign at the northern end of the one-way cycle bypass on the western side of the raised safety platform.

Decision Tracking

Designer response	Design to be reviewed in line with provided recommendations and adopt layout.
Client safety engineer comment	Concur with SAT's recommendation and designer's response.
Client decision	Agree with SAT, Designer and Safety Engineer
Action taken	

2.3 Roundabouts

2.3.1 CYCLIST SAFETY ON APPROACH TO ROUNDABOUT SERIOUS

The approaches to the roundabout have been designed with the shoulders tapering to zero at the limit line. This suggests to cyclist that they will have a relatively safe continuous shoulder to cycle on through the roundabout, only for it to end at the most dangerous position for cyclists to find themselves in, next to a heavy vehicle where the trailer tracking coincides with the cyclist position.

The TCD manual recommends ending the shoulder edge line about 30 m back from the limit line to suggest to cyclists that they should share the lane with general traffic from that point on. This recommendation is now considered to be too subtle and largely ineffective in preventing cyclists from entering or waiting in the danger zone where they may be hit by a trailer.

The Waka Kotahi Cycling Network Guidance Group has endorsed the following improvement to the markings where a cycle bypass has been provided. The philosophy is to indicate the safest route for cyclist by means of a green panel leading from an abruptly terminating shoulder onto the path. Thereafter, no shoulder or edge lines are to be marked for left-turning traffic and the lane width reduces to a constant 3.5 m wide up to the limit line to indicate to those cyclists who wish to remain on the road that they should take ownership of the lane and not try to cycle next to a heavy or indeed any vehicle. The area required for trailer tracking in the vicinity of the limit line is marked with a flush textured treatment. It is on the same crossfall plane as the approach to the roundabout so that surface water flows to the kerb and channel. The surface should be one that is not comfortable but still safely traversable for cyclists. This is to encourage cyclists to continue to hold onto their ownership of the lane and not move to the kerb and into the danger area described above. Figure 18 illustrates the philosophy.

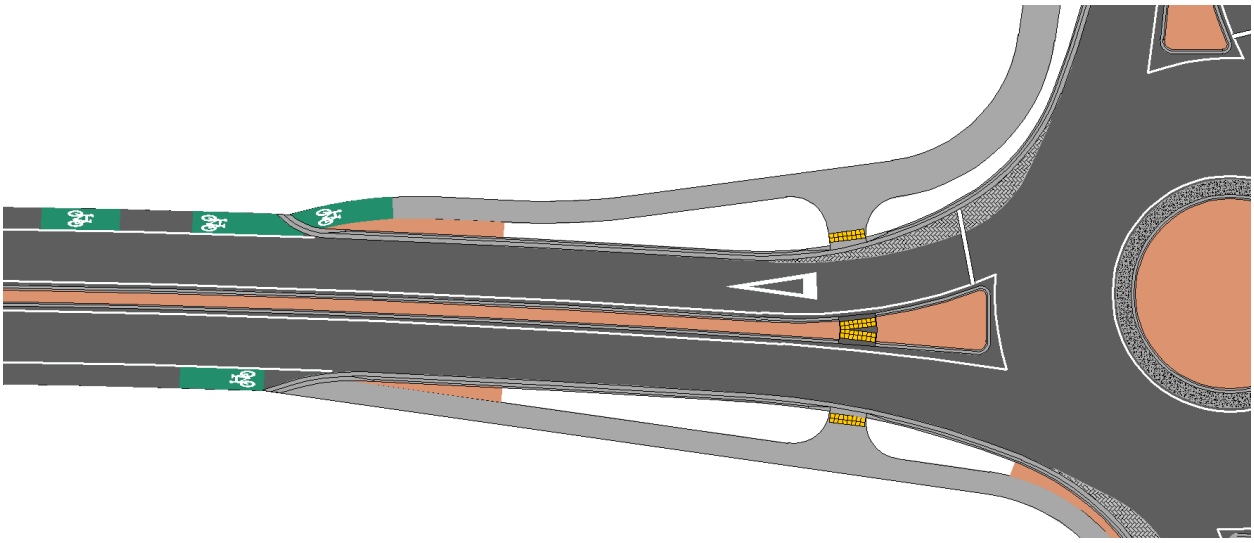


Figure 18: Cycle bypass and danger area demarcation philosophy

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

Frequency rating	Crashes resulting from this safety concern could be common.
Severity rating	Death or serious injury resulting from this safety concern could be very likely.
Risk ranking	The safety concern is therefore deemed to be serious.

Recommendation(s)

1 Do not carry the shoulder marking edge line through to the limit line.

2 End the shoulder abruptly at the ramp leading to the cycle bypass path.

3 Consider adopting the latest arrangement that demarcates the danger area for cyclists as described above and shown in Figure 18 with the approval of Waka Kotahi.

Decision Tracking

Designer response	Design to be reviewed in line with provided recommendations and adopt layout.
Client safety engineer comment	Agree with SAT's recommendation and designer's response.
Client decision	Agree with SAT, Designer and Safety Engineers response. Review design in line with provided recommendations.
Action taken	

2.3.2 CYCLIST SAFETY ON DEPARTURE FROM ROUNDABOUT MODERATE

The cyclist bypass paths are shown reintroducing cyclists potentially into the path of an unsuspecting passing motorist. The bypass paths should always join the shoulder in the lee of a protective kerb as shown in Figure 18 in Section 2.3.1. This was raised in the previous audit report but has not been implemented throughout the proposed design. (Stantec, 2021, p. 15 Section 2.1.6)

The departure and re-entry angles are too flat. This risks a bicycle wheel slipping out from under cyclists as they ride over the channel. Applying the principles shown in Figure 18 in Section 2.3.1 would eliminate this safety concern by making the crossing angle closer to 90 degrees. Also, the channel must not have a lip, but must form a smooth transition—the same as would apply to a pram crossing. An example of an unsafe cycle ramp is shown in Figure 19.

Figure 19: Example of an unsafe cycle ramp

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

Frequency rating	Crashes resulting from this safety concern could be occasional.
Severity rating	Death or serious injury resulting from this safety concern could be likely.
Risk ranking	The safety concern is therefore deemed to be moderate.

Recommendation(s)

1 Reintroduce cyclists onto the shoulder of the road in the lee of a protective kerb and channel.

2 Design the departure and re-entry angles across the kerb and channel as close to 90 degrees as practicable.

Decision Tracking

Designer response	Proposed to review design in line with provided recommendations and adopt layout.
Client safety engineer comment	Concur with SAT's recommendation and designer's response.
Client decision	Agree with SAT, Designer and Safety Engineer.
Action taken	

2.3.3 EXISTING TAUPAKI ROAD ROUNDABOUT COMMENT

The drawings indicate that no work is to be carried out at the existing Taupaki Road roundabout.

The roundabout was constructed in about 2012 with shoulders for cyclists around the entire roundabout. Under the current philosophy for cyclist safety at roundabouts, such shoulders would not have been provided. Refer to Section 2.3.1.

The concern is raised as a comment as the roundabout is outside the scope of works. Nevertheless, Waka Kotahi should consider improving the safety of cyclists at this roundabout as well.

2.4 Bus Stops

2.4.1 BUS ACCESS TO FRED TAYLOR DRIVE MINOR

Shifting the existing bus stop from Kennedys Road to the Brigham Creek Road roundabout makes sense as it will be closer to the new signalised pedestrian crossing across SH16, which connects the desire line to the shared path along the southern side of SH16.

The bus route, which is along Fred Taylor Drive, will require eastbound bus drivers to cross into the right-hand lane immediately after leaving the bus stop to turn right at the roundabout. Fortunately, the raised safety platform at the signalised crossing will slow speeds down, but it will still be difficult for the bus driver to find a coincident gap in both lanes of traffic in peak times when there is a queue of vehicles at the roundabout.

A detection loop could be installed at the head of the bus stop so that as the bus leaves the bus stop it triggers the pedestrian crossing phase for enough time to create a gap in the queue of traffic and for that gap to be maintained until it reaches the bus.

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

Frequency rating	Crashes resulting from this safety concern could be infrequent.
Severity rating	Death or serious injury resulting from this safety concern could be unlikely.
Risk ranking	The safety concern is therefore deemed to be minor.

Recommendation(s)

1 Consider installing a detection loop at the head of the bus stop so that as the bus leaves the bus stop it triggers the pedestrian crossing phase for enough time to create a gap in the queue of traffic and for that gap to be maintained until it reaches the bus.

Decision Tracking

Designer response	Traffic is expected to be slowed due to the presence of the signalised crossing and approach to the roundabout which is expected to improve access back into the lanes for Busses. As such we do not consider this is necessary but should be monitored.
Client safety engineer comment	Agree with Designer's comments to monitor this.
Client decision	Agree with Designer and Safety Engineer.
Action taken	

2.5 Safety Barriers, Rails, and Fences

2.5.1 POSITION OF SAFETY BARRIERS NEXT TO PATHS MODERATE

The drawings show semi-rigid barriers in the 1 m wide verge between the kerb and the edge of the shared path.

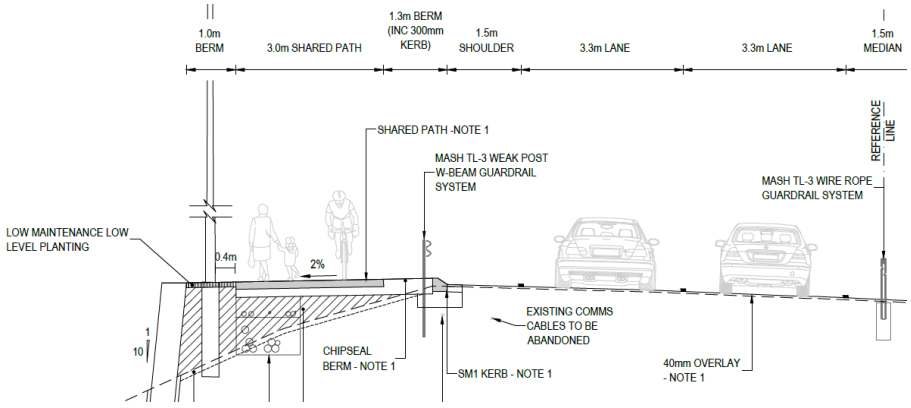


Figure 20: Safety barriers between kerbs and edge of shared path

Safety barriers are designed to prevent vehicles from leaving the road and are not designed to protect pedestrians. In some cases, barriers erected between the path and the road can create a greater hazard than the risk they are intended to mitigate by cyclists snagging pedals on the posts if they have to swerve to miss another path user. This could cause the rider to fall over the barrier and into the road. Not having a barrier, would give the cyclist an opportunity to ride down the mountable kerbs with less likelihood of falling into the traffic.

However, in the situation shown in Figure 20, a roughly 0.5 m wide verge to the footpath would be maintained and the risk described above would be reduced significantly.

It is noted that the retaining wall does not show a fall from height protection, which would be required for both path users and maintenance personnel. It is also noted that a stormwater pipe is shown directly under the driven posts of the safety barrier.

In the plan view in Figure 21, the alignment of the barrier kinks in and out at each driveway crossing, bringing the barrier and the roughly 300 mm wide sharp angular end terminals into the path and causing hazards to pedestrians and cyclists.

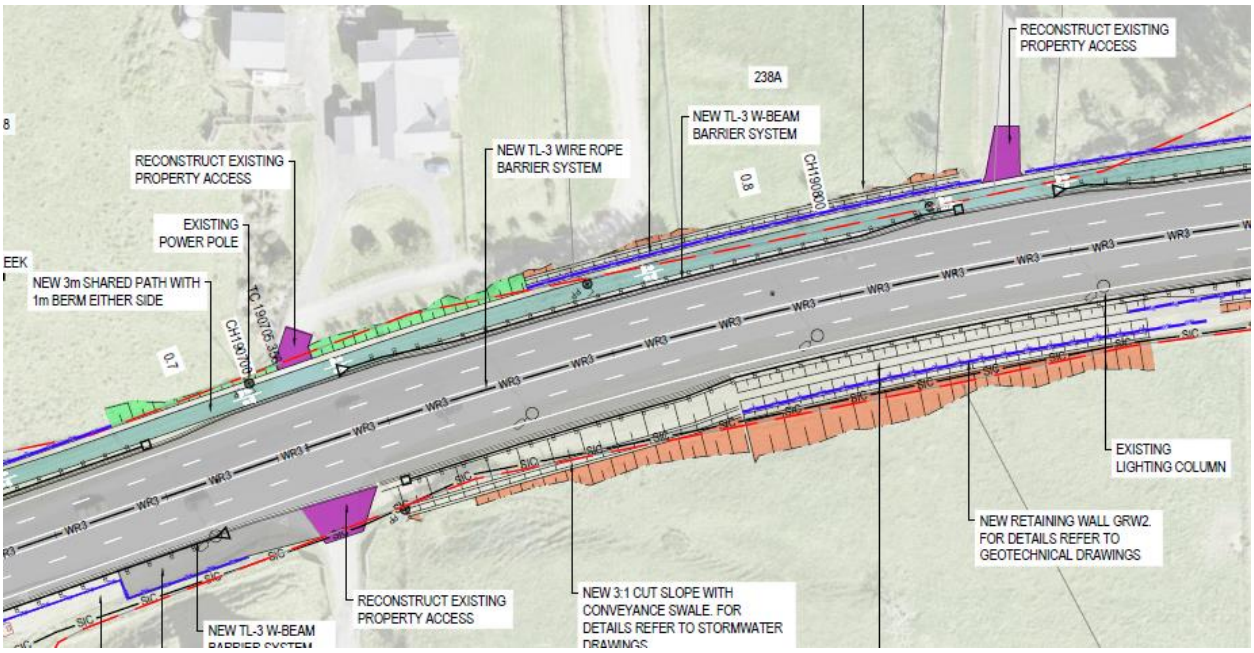


Figure 21: Safety barrier breaks at driveway crossings

At the briefing meeting, the designers said that they were considering shortening the barrier at each driveway to avoid the above safety concern. However, this would reduce the effective length and may affect the protection length required for the retaining walls. If the barriers were placed at the back of the path, the gaps in the barriers at driveways could be minimised.

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

The ranking of this concern is based on the gaps in the barriers not covering the retaining adequately walls.

Frequency rating	Crashes resulting from this safety concern could be infrequent.
Severity rating	Death or serious injury resulting from this safety concern could be likely.
Risk ranking	The safety concern is therefore deemed to be moderate.

Recommendation(s)

1 Keep the safety barrier posts and terminal hardware outside the 0.5 m safety buffer zones of the shared path.

2 Consider placing the barriers on the outside of the shared paths if possible. It is acknowledged that this would not be possible on the approaches to bridges.

Decision Tracking

Designer response	Safety Barrier alignment to be reviewed to maintain 0.5m buffer zone to the shared path at accesses.
Client safety engineer comment	Concur with SAT's recommendation and designer's response.
Client decision	Agree with SAT, Designer and Safety Engineer. Review design to maintain 0.5m buffer zone to the shared path at accesses. No additional investigation on point 2 required.
Action taken	

2.5.2 NOISE WALLS COMMENT

The designers asked the road safety audit team to comment on the safety merits of steel H-profile posts with concrete panels versus timber posts and plywood panels for the noise walls, considering that the walls would be on the boundary of the road in most cases and might be a safety hazard next to the road.

Where the noise walls can be protected by a barrier, there would be no preference for type of noise wall. However, the timber noise walls would be more frangible in a collision where they are unprotected by barriers. Long horizontal timber rails should be avoided, but short nogs are acceptable.

2.5.3 FALL FROM HEIGHT PROTECTION COMMENT

Fall from height protection rails or fences for maintenance personnel and pedestrians and cyclists passing by on footpaths are shown on some retaining wall drawings but not all drawings.

Since building consent would not be issued without such protection, this safety concern is raised as a comment only to remind the designers to check that all required safety rails and fences are included in the design.

Even where building consent does not require fall protection, for example where heights are less than 1 m, the designers should still consider the risk to pedestrians and cyclists.

Recommendation(s)

1 Check that all required safety rails and fences to protect from falls from height are included in the design, including at situations where building consent may not necessarily apply but where the risk remains.

Since this safety concern is ranked as a comment, decision tracking in the table below is optional.

Optional Decision Tracking

Designer response	Safety fencing to protect from falls from height are included in the design.
Client safety engineer comment	Concur with SAT's recommendation and designer's response.
Client decision	Agree with SAT, Designer and Safety Engineer.
Action taken	

2.5.4 EXTEND MEDIAN BARRIER ONTO MEDIAN ISLAND COMMENT

To maximise the benefits of a median barrier, it is a recent Waka Kotahi accepted principle to carry the median barrier onto the median islands to as close to the roundabout or crossing as is practicable. The kerbs should be semi-mountable or mountable and a maximum height of 125 mm or preferably 100 mm. The barrier should follow as close to the back of the approach kerbs as possible as approaches, not departures, are where most loss-of-control crashes occur.

Recommendation(s)

1 Carry the median barriers onto the median islands to as close to the roundabout or crossing as is practicable.

Since this safety concern is ranked as a comment, decision tracking in the table below is optional.

Optional Decision Tracking

Designer response	Median barriers to be extended onto the median islands.
Client safety engineer comment	Concur with SAT's recommendation and designer's response.
Client decision	Agree with SAT, Designer and Safety Engineer.
Action taken	

2.6 Road Signs and Markings

2.6.1 UNCONTROLLED LEFT SLIP LANE MINOR

The design shows an uncontrolled high entry angle left turn slip lane just east of the Brigham Creek signalised pedestrian crossing.

Uncontrolled intersections are a rarity nowadays. There is no reason that this intersection should not be priority-controlled to provide a safer intersection, especially since there is a pathway that crosses it to the bus stop.

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

Frequency rating	Crashes resulting from this safety concern could be infrequent.
Severity rating	Death or serious injury resulting from this safety concern could be unlikely.
Risk ranking	The safety concern is therefore deemed to be minor.

Recommendation(s)

1 Mark and sign the high entry angle left turn slip lane just east of the signalised pedestrian crossing as a standard give-way priority-controlled intersection. Refer also to Section 2.2.2.

Decision Tracking

Designer response	Give-way priority-controlled intersection to be implemented.
Client safety engineer comment	Concur with SAT's recommendation and designer's response.
Client decision	Agree with SAT, Designers and Safety Engineer.
Action taken	

2.6.2 BRIGHAM CREEK ROUNDABOUT AD SIGN MINOR

The existing advance direction sign on the eastbound approach to the Brigham Creek roundabout is to be retained in its existing position. However, that position is directly in the way of the path from the signalised pedestrian crossing to the bus stop. The signal faces and numerous signs at the signalised crossing may also obscure the sign partially.

The no entry sign into the left turn slip lane is unlikely to be seen in its proposed position anyway, as it would be obscured by the A pillar and roof of the vehicle.

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

Frequency rating	Crashes resulting from this safety concern could be infrequent.
Severity rating	Death or serious injury resulting from this safety concern could be very unlikely.
Risk ranking	The safety concern is therefore deemed to be minor.

Recommendation(s)

1 Shift the existing advance direction sign on the eastbound approach to the Brigham Creek roundabout to a position where it is not obscured by the signal faces and does not obstruct the footpath.

2 Alternatively, if the signal faces do not obstruct the visibility of the sign, shift the path to the northern side of the sign. The path would be on a better desire line after cross the left slip lane at right angles and would provide a safe buffer between the highway and the edge of the path. Refer to Section 2.2.2 in this regard too.

3 Shift the no entry sign a little way down the slip road and on the eastern side of the slip road where is can be seen.

Decision Tracking

Designer response	Agree with recommendations. Signage and path alignment in this area to be reviewed with respect to visibility.
Client safety engineer comment	Concur with SAT's recommendation and designer's response.
Client decision	Agree with SAT, Designer and Safety Engineer.
Action taken	

2.6.3 ADVANCE DIRECTION SIGN LAYOUT MINOR

Drawing CT-2881 shows the advance direction signs replicating the layouts and destinations of the existing advance direction signs at Brigham Creek roundabout and Taupaki Road roundabout as shown in Figure 22. As far as can be ascertained, no such sign exists in MOTSAM or the TCD Manual.

The main safety concern with signs that show a lane layout is that it looks like a bypass lane where straight through traffic in the left-hand lane does not have to give way to traffic on the right.

Signs that show a lane layout are too complicated to be comprehended in the time available and without being able to see the actual roundabout to correlate what is on the sign with what is on the ground. By the time the driver reaches the roundabout the layout and the destinations have been forgotten because there was too much information.

Figure 22: Existing AD-5 sign on approach to Taupaki Road roundabout

It should be borne in mind that the primary message of the advance direction signs is to show destinations and not lane layouts. Direction signs are for drivers who are not familiar with the route and should be as simple as possible to be effective.

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

Frequency rating	Crashes resulting from this safety concern could be infrequent.
Severity rating	Death or serious injury resulting from this safety concern could be unlikely.
Risk ranking	The safety concern is therefore deemed to be minor.

Recommendation(s)

1 Revise the advance direction signs to the layout shown in Figure 7.2.5 in MOTSAM and Table 5-3 of TCD Manual Part 4 (draft for consultation), even though they may not match the existing signs at Brigham Creek roundabout and Taupaki Road roundabout, as those signs were erected many years ago and could be due for replacement. In other words, consider the advisability and desirability of perpetuating the existing signs.

2 Consider replacing all the existing signs with signs that conform to Figure 7.2.5 in MOTSAM, and at the same time drop the Waitakere and Kumeu destinations. Refer to Section 2.6.8. It is noted that at the most recent roundabout to be constructed on SH16 (in Waimauku) Helensville and Auckland are the only destinations.

Decision Tracking

Designer response	Advance direction signs to revised to the layout shown in Figure 7.2.5 in MOTSAM and Table 5-3 of TCD Manual Part 4 (draft for consultation). Waka Kotahi to confirm destination removal from signs.
Client safety engineer comment	Concur with SAT's recommendation and designer's response. Advance direction signs to be revised in accordance with MOTSAM.
Client decision	Agree with SAT, Designer and Safety Engineer. All new signage to be revised to meet MOTSAM and TCD manual. Existing signs not being relocated are outside the scope of works. The only exception is if this is a safety issue or causes confusion.
Action taken	

2.6.4 RAISED SAFETY PLATFORM WARNING MARKINGS SIGNIFICANT

Experience has shown that white painted shark teeth applied to the concrete approach ramps on raised safety platforms provide questionable contrast in wet and poor lighting conditions; and do not last long anyway, especially under high traffic volumes. There is also sun strike to consider on this mainly east-west alignment.

On most crossings there are only one and a half to two shark teeth shown per lane, which reduces the warning effect. More and narrower shark teeth also provide more options for motorcyclists to avoid riding on the white markings.

Since the raised safety platforms would be unexpected on an 80 km/h highway, there is the possibility that they could be hit at speed if not seen in time and cause back or neck injury to susceptible vehicle occupants.

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

In ranking this concern, the safety audit team has considered a neck or back injury as described above, rather than a crash *per se*.

Frequency rating	Crashes resulting from this safety concern could be frequent.
Severity rating	Death or serious injury resulting from this safety concern could be unlikely.
Risk ranking	The safety concern is therefore deemed to be significant.

Recommendation(s)

1 Increase the number of shark teeth to three or four per lane by reducing the base dimension of the triangles but keeping the height elongated for improved visibility.

2 Provide a strong and long-lasting durable colour and texture contrast between the white shark teeth and the approach slope. Consider a black oxide exposed aggregate finish on the concrete with white thermoplastic markings.

Decision Tracking

Designer response	Agreed, recommendations to be implemented. Minimum of 3 shark teeth pre lane and provision of contrasting markings with substrate.
Client safety engineer comment	Concur with SAT's recommendation and designer's response.
Client decision	Agree with SAT, Designers and Safety Engineer.
Action taken	

2.6.5 LIMIT LINE ORIENTATION AT KENNEDYS ROAD COMMENT

The limit line at Kennedys road is marked parallel to the highway, which is about 45 degrees to the left turn out of Kennedys Road. Since only left turns are allowed at Kennedys Road, it would be preferable to reinforce this with a limit line that is at right angles to the intended path of a vehicle turning left.

It is noted that MOTSAM requires the angle of the limit line to be no more than 30 degrees from a right angle to the path of the vehicle. Angled limit lines make it difficult for drivers to judge where exactly to stop or give way.

Recommendation(s)

1 Orientate all limit lines to close to 90 degrees to the paths of vehicles.

Since this safety concern is ranked as a comment, decision tracking in the table below is optional.

Optional Decision Tracking

Designer response	Noted, limit lines to be reviewed.
Client safety engineer comment	Noted. Concur with SAT's recommendation and designer's response.
Client decision	Agree with SAT, Designer and Safety Engineer. Limit line orientation to be reviewed.
Action taken	

2.6.6 KENNEDYS ROAD STOP VERSUS GIVE WAY CONTROL COMMENT

The drawings show a give way priority-controlled intersection at Kennedys Road intersection. The existing Kennedys Road is a stop-controlled intersection. This may be due to poor sight distance to the west caused by a row of wind break trees on the adjoining property.

Recommendation(s)

1 Check the sight distance at Kennedys Road and consider whether the proposed give way priority -controlled intersection treatment is appropriate.

Since this safety concern is ranked as a comment, decision tracking in the table below is optional.

Optional Decision Tracking

Designer response	Noted, give way priority controlled intersection treatment to be reviewed.
Client safety engineer comment	Concur with SAT's recommendation and designer's response.
Client decision	Agree with SAT, Designer and Safety Engineer. Give way priority controlled intersection treatment to be reviewed.
Action taken	

2.6.7 SOLID LINE LENGTHS ON APPROACHES TO LIMIT LINES COMMENT

Generally, the solid lines separating the two lanes on the approaches to the roundabout limit lines and pedestrian crossing limit lines are only 15 m to 20 m long. On some approaches to the pedestrian crossing limit lines there are no solid lines separating the lanes.

15 m corresponds with the minimum length shown in MOTSAM. However, the TCD Manual now recommends 30 m as the minimum. There is no need to apply absolute minimum standards. It would be safer to avoid lane changing so close to the roundabout, or to the signalised pedestrian crossings or to the raised safety platforms.

Recommendation(s)

1 Increase the length of the solid white line separating lanes on the approaches to roundabouts, signalised crossings and raised safety platforms from 15 m to at least 30 m or at least as far as is practicable.

Since this safety concern is ranked as a comment, decision tracking in the table below is optional.

Optional Decision Tracking

Designer response	Noted, length on the approaches to roundabouts, signalised crossings and raised safety platforms to be increased to 30m where able.
Client safety engineer comment	Concur with SAT's recommendation and designer's response.
Client decision	Agree with SAT, Designer and Safety Engineer.
Action taken	

2.6.8 SPLITTER ISLAND ID SIGNS AND GIVE WAY PLATES MINOR

The intersection direction signs proposed have two destinations one above the other for SH16 and three destinations for Coatesville-Riverhead Highway.

The vertical dimension of the intersection direction signs can obscure driver sight lines to entering vehicles and to their turn indicators when they are low mounted and also when they are high mounted for passenger car drivers and truck drivers, respectively.

There are no such approved destinations as Waitakere or Kumeu for state highways. Familiar drivers do not need to read any of the signs but introducing too many destinations creates confusion for unfamiliar drivers. Similarly, Coatesville-Riverhead Highway leads only indirectly to Albany. The direct route to Albany is via Brigham Creek Road at the next roundabout.

Supplementary give way plates are shown below the roundabout give way signs. These plates were intended to be transitional for only a few years after 2015 and fell out of use ten years ago.

The supplementary plates raise low-mounted give way signs on roundabout splitter islands so that they obstruct visibility to circulating vehicles and turn indicators. As such, the supplementary plates are considered to be a hazard and should not be used.

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

Frequency rating	Crashes resulting from this safety concern could be occasional.
Severity rating	Death or serious injury resulting from this safety concern could be unlikely.
Risk ranking	The safety concern is therefore deemed to be minor.

Recommendation(s)

1 Use only single destinations Auckland and Helensville all intersection direction signs, including the advance direction signs.

2 Use only Riverhead as the destination on Coatesville-Riverhead Highway, as that is the first destination to be reached.

3 Delete the give way supplementary plates from the drawings.

Decision Tracking

Designer response	Waka Kotahi to confirm revised destinations. Supplementary give way signs to be removed.
Client safety engineer comment	Concur with SAT's recommendation and designer's response. Waka Kotahi will confirm revised destinations.
Client decision	Agree with SAT, Designer and Safety Engineer. Remove supplementary give way signs.
Action taken	

2.6.9 LIMIT LINES TO EXTEND TO KERB LINE COMMENT

The limit lines are shown extending only up to the edge lines. They should extend to the kerb line so that they apply to the shoulder, where cyclists might be riding, as well.

Recommendation(s)

1 Extend the limit lines to the kerbs.

Since this safety concern is ranked as a comment, decision tracking in the table below is optional.

Optional Decision Tracking

Designer response	Noted, limit lines to be extended to kerbs.
Client safety engineer comment	Concur with SAT's recommendation and designer's response.
Client decision	Agree with SAT, Designer and Safety Engineer. Limit lines to be extended.
Action taken	

2.6.10 ROUNDABOUT GIVE WAY SIGNS MINOR

The designers asked the road safety audit team to comment on the proximity of the staggered signalised pedestrian crossings across SH16 to the Coatesville-Riverhead Highway roundabout and Taupaki Road roundabout give way signs. This may also apply to Brigham Creek roundabout.

The visibility of both the traffic signals and the roundabout give way signs could be reduced significantly by sun strike as SH16 is orientated east-west. In such situations drivers concentrating on one thing may miss another vital sign or signal. The raised safety platforms can serve as an effective mitigating measure provided that they do reduce speeds to 45 km/h, and of course that they too can be seen against sunstrike.

TCD Rule 10.4(1)(b)(i) states that roundabouts controlled by roundabout metering signals must also have a '"give-way roundabout" sign that complies with Schedule 1, and that has been mounted on a reflectorised, fluorescent yellow-green backing board that provides a border of at least 150 mm.' It could be argued that the proximity and irregular phase activation of a pedestrian crossing would be similar to roundabout metering, and that therefore the fluorescent yellow-green backing boards may be a mandatory requirement.

It is doubtful if the 150 mm fluorescent yellow-green strip would improve visibility against sun strike that much, and perhaps a much larger rectangular backing board might be required instead for sun strike. However, care must be taken not to create a give-way sign that loses its recognisability due to over-enthusiastic use of a backing board, as for example in Figure 23.

Figure 23: Give-way backing boards at Queenstown Road exit ramp (Google, 2022)

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

Frequency rating	Crashes resulting from this safety concern could be occasional.
Severity rating	Death or serious injury resulting from this safety concern could be unlikely.
Risk ranking	The safety concern is therefore deemed to be minor.

Recommendation(s)

1 Seek advice on the statutory requirements for the give way sign format for those placed beyond traffic signals. The road safety audit team suggests that larger signs may be more visible than a small sign with a large fluorescent yellow-green border. If the fluorescent yellow-green borders are mandatory, then ensure that the border is in proportion to the size of the sign so that the sign itself is not lost within the border.

2 Ensure that the give way triangle markings are of a superior long-life variety from the day of inception and that they stand out from the pavement in all weather conditions.

3 Provide high friction surfacing up to the limit line to assist those drivers who might have missed the signs to stop at the last second.

Decision Tracking

Designer response	We are not aware of any additional statutory requirements for the give way signage in this location and propose that the operation of give way signage as designed is monitored. Noted, all road markings are HPLL type Drivers are already expected to be slowed from the raised safety platforms and signalised pedestrian crossing which allow users more time to notice roundabout / give-way signs as they approach the roundabout. As such high friction surfacing is not expected to be required in these locations.
Client safety engineer comment	SAT's recommendation 1. The give-way sign must be sized to 900 × 1040, in accordance with MOTSAM Part 1 and Traffic Control Devices Rule 2004 Coloured backing board will detract from the regulatory function. TCD Part 1 Section 4.1.8 states that backing boards are typically used: • on temporary traffic signs for level 2 and 3 roads • on urban or rural speed threshold sites, where the backing board also contributes significantly to the 'gating' effect being sought • when other normal treatments have been tried (eg larger signs and upgraded delineation) but a higher-than-expected crash rate is still experienced. Agree with SAT's Recommendation 2. With regards to SAT's Recommendation 3, drivers will slow down at the raised safety platform and are unlikely to speed up between the raised safety platform and roundabout.
Client decision	Agree with Designer and Safety Engineer. No further action required.
Action taken	

2.7 Lighting

2.7.1 CENTRAL ISLAND LIGHTING MODERATE

To improve the overall night-time visibility and awareness of the central island, a centrally mounted lighting arrangement is very likely to become the default Waka Kotahi standard, unless it can be demonstrated that the same level of lighting can be achieved on the central island as on the circulating carriageway without the use of a central lighting column. This would be unlikely for the size of roundabouts at the Coatesville-Riverhead Highway and Taupaki Road roundabouts.

The central island should be lit to the same level as the circulating carriageway.

It is not the intention that a central lighting column should necessarily replace the requirement for perimeter lighting to achieve the required level of lighting of the circulating carriageway. The lighting of the central island should be regarded as an additional requirement over and above the requirements of AS/NZS1158.1.1:2022.

Figure 24: Example of a well-lit central island

This safety concern should apply to the Taupaki Road and Brigham Creek roundabouts, even though the project brief is to exclude them from the current project extent of work.

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

Frequency rating	Crashes resulting from this safety concern could be occasional.
Severity rating	Death or serious injury resulting from this safety concern could be likely.
Risk ranking	The safety concern is therefore deemed to be moderate.

Recommendation(s)

1 Add a lighting column (three- or four-arm outreach) to the centre of both the Riverhead-Coatesville roundabout and the Taupaki Road roundabout.

Decision Tracking

Designer response	We recommend that no additional lighting is required as the current lighting design is complaint with the lighting design standards. It is also noted that additional lighting may impact on future urban design treatments to the central island which may also include some form of lighting.
Client safety engineer comment	Review lighting design to ensure that the roundabout is visible at night. If the roundabout is poorly lit, consider installing a lighting column at the centre of the roundabouts.
Client decision	Agree with designer comments. Current design is compliant with the lighting design standards.
Action taken	

2.8 Drainage

2.8.1 VEHICLE TRAVERSABLE GRATES AND SCRUFFY DOMES COMMENT

The drainage drawings show vehicle traversable grates in some places where a vehicle that has left the road may be impacted. However, in other places non-traversable headwalls are shown where there is no barrier e.g., Ch 19 1800 eastbound.

Scruffy Domes should not be used unless they are beyond reasonable strike distance of a vehicle that has left the road or are behind barriers.

This concern is raised as a comment as it appears that the designers are aware to the safety concern, but just need to check that the principle is applied consistently throughout the project.

Recommendation(s)

1 Check that all culvert headwalls and access hole grates that are within the likely path of a vehicle that has left the road are safely traversable.

2 Ensure that Scruffy Dome and vertical headwalls are not used or are used only behind barriers.

Since this safety concern is ranked as a comment, decision tracking in the table below is optional.

Optional Decision Tracking

Designer response	Noted, drainage elements to be reviewed for suitable protection or are safely traversable.
Client safety engineer comment	Noted. Concur with SAT's recommendations and Designer's response.
Client decision	Agree with SAT, Designer and Safety Engineer. Review drainage elements for suitable protection or are safely traversable.
Action taken	

2.9 Landscaping

2.9.1 PLANTING OBSCURING SIGHT LINES MODERATE

This is a hardy perennial safety concern that always seems to present itself at post-construction road safety audits where shrubs and trees are found to be obscuring sight lines or have been planted so close to the edge of paths that they will severely reduce the useable width of the paths as the plants mature.

There are some conflicts where lighting columns and/or specimen trees are shown just in front of signs, such as the CDS westbound before Kennedy Lane, which has a lighting column and three titoki trees before it. While the effort that is going into improving the streetscape is appreciated, there are some concerns about the detailed applications.

It is always unfortunate to have to advise after a post-construction audit that recent planting must be removed.

Risk Ranking

The road safety audit team has assigned the following risk ranking to this safety concern.

Frequency rating	Crashes resulting from this safety concern could be occasional.
Severity rating	Death or serious injury resulting from this safety concern could be likely.
Risk ranking	The safety concern is therefore deemed to be moderate.

Recommendation(s)

1 Ensure that the landscape designers clearly show an appropriate no-planting zone or strip along paths on the landscape species layout drawings.

2 Ensure that no large shrubs or trees are shown to be planted within the required sight lines at driveways, intersections, on the inside of curved paths, in front of signs, and along the highway.

3 Ensure that the landscape designers understand that low planting means a mature height of no more than 300 mm including flower spikes—effectively ground cover only.

Decision Tracking

Designer response	Noted, landscape design to be reviewed with respect to the RSA recommendations.
Client safety engineer comment	Noted. Concur with SAT's recommendations and Designer's response.
Client decision	Agree with SAT, Designer and Safety Engineer.
Action taken	

3 Audit Statement

We declare that we remain independent of the design team and have not been influenced in any way by any party during this road safety audit.

We certify that we have used the available plans, and have examined the specified roads and their environment, to identify features of the project we have been asked to look at that could be changed, removed, or modified in order to improve safety.

We have noted the safety concerns that have been evident in this audit and have made recommendations that may be used to assist in improving safety.

Signed  Date 16 September 2022

Keith Weale, BSc(Eng), BEng(Hons), MSc(Eng), CMEngNZ, CPEng
Technical Director – Roads and Highways, Stantec

Signed  Date 19 September 2022

Grant Gordon, BE (Civil), MEngNZ, Senior Network Safety Engineer, ASM

Signed  Date 19 September 2022

Noel Tunnicliffe, NZCE (Civil), Civil Engineer, RoadLab Ltd

4 Response and Decision Statements

System designers and the people who use the roads must all share responsibility for creating a road system where crash forces do not result in death or serious injury.

4.1 Designer's Responses

I have studied and considered the auditors' safety concerns and recommendations for safety improvements set out in this road safety audit report and I have responded accordingly to each safety concern with the most appropriate and practical solutions and actions, which are to be considered further by the safety engineer (if applicable) and project manager.

Signed ---------- Date 15/02/2023 ----------

Gareth Clayton, Senior Associate - Civil Engineering, Beca

4.2 Safety Engineer's Comment (if applicable)

I have studied and considered the auditors' safety concerns and recommendations for safety improvements set out in this road safety audit report together with the designer's responses. Where appropriate, I have added comments to be taken into consideration by the project manager when deciding on the action to be taken.

Signed ---------- Date 15/02/2023 ----------

Heather Liew, Senior Safety Engineer , Waka Kotahi

4.3 Project Manager's Decisions

I have studied and considered the auditors' safety concerns and recommendations for safety improvements set out in this road safety audit report, together with the designer's responses and the comments of the safety engineer (if applicable) and having been guided by the auditor's ranking of concerns have decided the most appropriate and practical action to be taken to address each of the safety concerns.

Signed  Date 16/02/2023

Rex Faithfull, Senior Project Manager (complex), Waka Kotahi

4.4 Designer's Statement

I certify that the project manager's decisions and directions for action to be taken to improve safety for each of the safety concerns have been carried out.

Signed ---------- Date ----------

Designer's name, position, company

4.5 Road Safety Audit Close Out

The project manager is to distribute the audit report incorporating the decisions to the designer, safety audit team leader, safety engineer, and project file.

Date ----------

5 References

Google. (2020, October). Street View.
Google. (2022, June). Street View.
Opus. (2017, August 24). SH16 Brigham Creek to Waimauku Safety Retrofit and Capacity Improvements. *Preliminary Design Road Safety Audit*.
Stantec. (2021, April 29). SH16 - Safety Improvements Stage 2 Brigham Creek to Kumeu. *Preliminary Design Road Safety Audit*.
WSP Opus. (2018, December 11). State Highway 16 Brigham Creek to Kumeu Stage 2 Shared Path. *Preliminary Road Safety Review Comments*.

Attachment 9 – Pre-application Meeting Minutes with Heritage New Zealand Pouhere Taonga dated 9 February 2022 and Pre-application Meeting Notes with Heritage New Zealand Pouhere Taonga (email) dated 18 February 2022 and General Arrangement Plans (attachment to email) dated 26 March 2022.

Minutes of Meeting

Pre-Application Heritage New Zealand Meeting on SH16 Stage 2 Project

Held Wednesday 9th of February 2022 at 10.30am

Via Microsoft Teams (online) videoconference

Present: Ashlie Carlyle, Project Consenting Lead, Beca
Sian Stirling, Planner, Beca
Tessa Robins, Planning Lead, Waka Kotahi
Karolyn Buhring, Environmental Principal, Waka Kotahi
Glen Farley, Project Archaeologist, Cough & Associates
John Brown, Project Built Heritage Specialist, Plan.Heritage
Robin Byron, Conservation Architect, Heritage NZ
Tharron Bloomfield, Maori Heritage officer, Heritage NZ
Greg Walter, Archaeologist, Heritage NZ

Apologies: Sarah, Archaeologist, Heritage NZ

Item	Action
1 Introduction • Welcome and introductions made. • Ashlie provided a Project overview – Copy of the Presentation is attached. • The scope of the project is largely around widening the road and improving the safety of the rural state highway. The project includes additional lanes in areas, installing a 3m wide shared use path, upgrading the Coatesville Riverhead Highway to a roundabout and installing safety features like wire rope median barriers and side barriers. • There are a few areas that contain historic heritage and are of archaeological, cultural and built heritage importance within the project corridor that need to be assessed.	
2 Archaeological Assessment Overview Glen provided an overview of his draft Archaeological Assessment: • To assess any potential effects from the projects on archaeological sites, Glen created a 200m buffer around the route to identify any archaeology site. 17 sites of interest were identified as noteworthy. 7 of those sites were archaeology sites (4 are former structures, 1 was a boat structure, 1 was a former railway line and a midden deposit). • After a further assessment 4 of these sites were identified as potentially affected by the project. These included:	

- 239 SH16 - Former Sinton Homestead: there will be no effects on the building but there will be excavations into the boundary of the property near the road.
- 191 SH16 - Former Sinton Store: the exact location of the store is not known, as it is a recorded site and not a physical discovery. The proposed earthworks are expected to be out of the property boundary. However, some stormwater pipes are proposed that could affect potential archaeological features.
- Brigham Creek Bridge/Culvert –the former bridge. There are several holes that use to support the Form Brigham Creek bridge. The proposed works will not affect any of the known features but there could be effects on unknown features.
- Former portage railway line.

3 Built Heritage Assessment Overview

- John gave an overview of his draft Built Heritage Assessment. He listed the following sites of built heritage significance that may be affected by the project:
  - 238 SH16 – Historic Heritage Extent of Place, scheduled under the Auckland Unitary Plan. There will be no effects on the building as the main dwelling is set back from the road. The scheduled heritage extent of place will be reduced in size once the new property boundaries are finalised (due to Project land requirement to expand existing state highway designation).
  - 222A SH16 - the former Alex Sinton House. This is not currently scheduled but it has been evaluated and recommended to be scheduled by Auckland Council. There is a modified shed near the road boundary that will be affected by the project. A site visit is needed to confirm if it is a pre-1900 shed. The project team will look to see if it can be relocated and if it cannot, it will need to be demolished. If it is demolished the shed will be recorded.
  - 191 SH16 - Janet Sinton house. This is not currently scheduled but it has been evaluated and recommended to be scheduled by Auckland Council. There are notable trees on the site too (which are also heritage trees). There may be works within the dripline of these notable trees, any potential effects of this have been considered within the draft Arboricultural Assessment.
- John's main concerns relate to the installation of potential noise barriers. As the road is being widened and road noise is being brought closer to various dwellings, noise barriers are needed to mitigate the noise effects. John has

been considering the visual effects of these noise barriers / fences on the built heritage in this area. • Robin noted that these built heritage features are all interrelated and the proposal will need to consider the landscape and visual effects as a whole and the relationship these features all have instead of independently assessing them (i.e. the three sites are intrinsically connected). • John noted there is potential for visual impacts however there is currently limited view/connection, as some of these features are already significantly hidden behind mature vegetation and can barely be seen from the state highway. There current environment does not allow for a lot of public observation. • Robin noted the proposal should try to open up the visual setting/connection between the three sites. • John noted there could be an opportunity for heritage interpretation along the shared path area to tell the story of the Sinton Family. • Robin said that would be great, to have a tangible link to the heritage sites. She suggested the interpretation could also talk about water heritage. • Ashlie noted Waka Kotahi is also engaging with mana whenua and Auckland Council regarding this opportunity (i.e. cultural, ecological, heritage narrative) • There was a discussion about noise wall concerns in terms of them being "fit for purpose", type of materials, and the need to integrate them with the landscape. Note – no Heritage NZ Planner present at the meeting to comment.	
4 Approached for Archaeology Authority • The project team and Heritage New Zealand agree that a HNZPT General Authority is a sensible approach for the proposed works in this area around Brigham Creek, even if potential risk of archaeological find is low. This manages programme risk by having an authority and management plan in place. • Beca needs to provide an update on the noise mitigation outcomes when we can. Karolyn highlighted the need to ensure the noise mitigation options do minimise effects on heritage where possible. A balance between the two should be found as noise mitigation is needed to ensure these heritage homes are habitable. • ***Post meeting note:*** *the noise mitigation 'best practicable option' assessment has been completed since this meeting, and the Project Team Recommendation for the area relating to potential adverse noise effects at 238 SH16 (Sinton House) is that no noise barrier be provided. The recommendation is still subject to Waka Kotahi design and landowner engagement feedback, after which the BPO will be confirmed mid 2022.* • Consultation: o We have talked to mana whenua (Ngāti Whātua o Kaipara and Te Kawerau o Maki) about their significant relationship with Brigham Creek and they agree that a general authority would be appropriate.	**Ash** to circulate prelim design to HNZPT

○ Consultation feedback from mana whenua for the purposes of the authority application should specifically focus on 'heritage'.	
5 Timeline/Next Steps • Further collaboration proposed during the detailed design phase (Feb to June) • Lodgement with Auckland Council in September 2022 • Apply for a General Authority via HNZPT concurrently with the RMA applications	

Minuted by: Sian Stirling

SH16 Safety Improvements Project Stage 2 Brigham Creek to Kumeū

HNZPT hui
9 February 2022

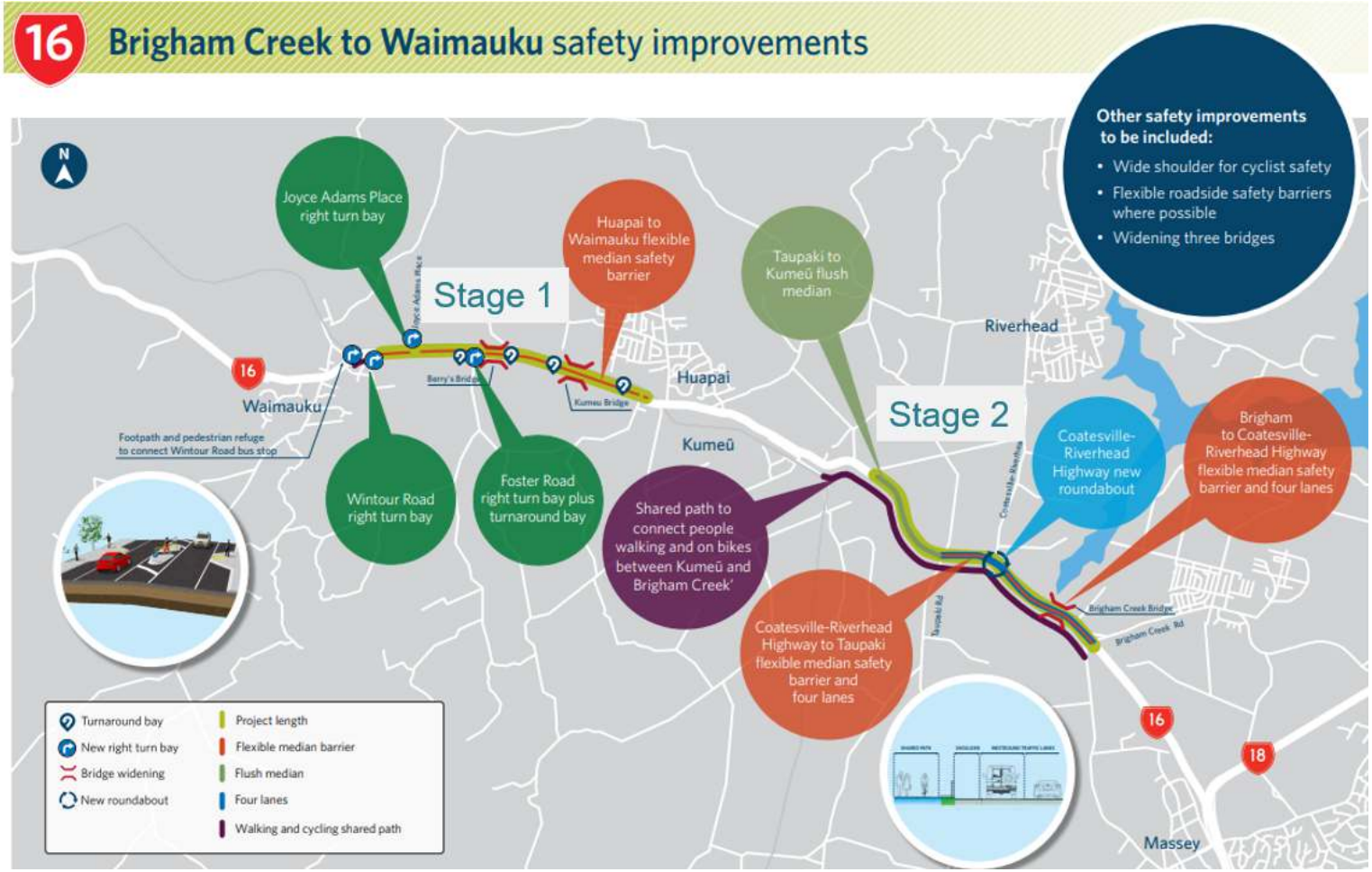
WAKA KOTAHI
NZ TRANSPORT AGENCY

Agenda

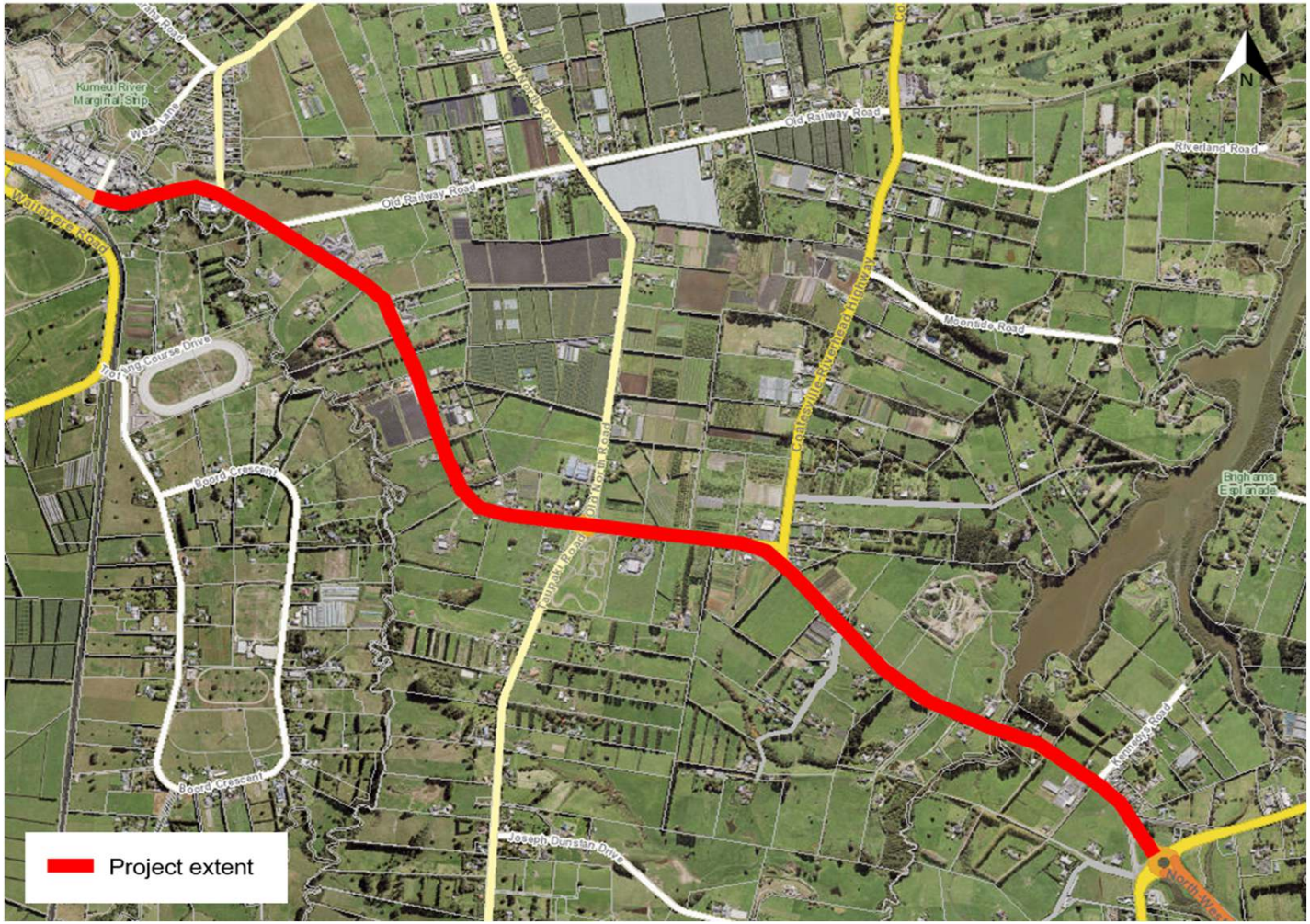
- Introductions
- Project Overview
- Preliminary Design
- Archaeology (Glen Farley) & Built Heritage (John Brown) findings
- HNZPT pathways
- Next steps

Project Overview

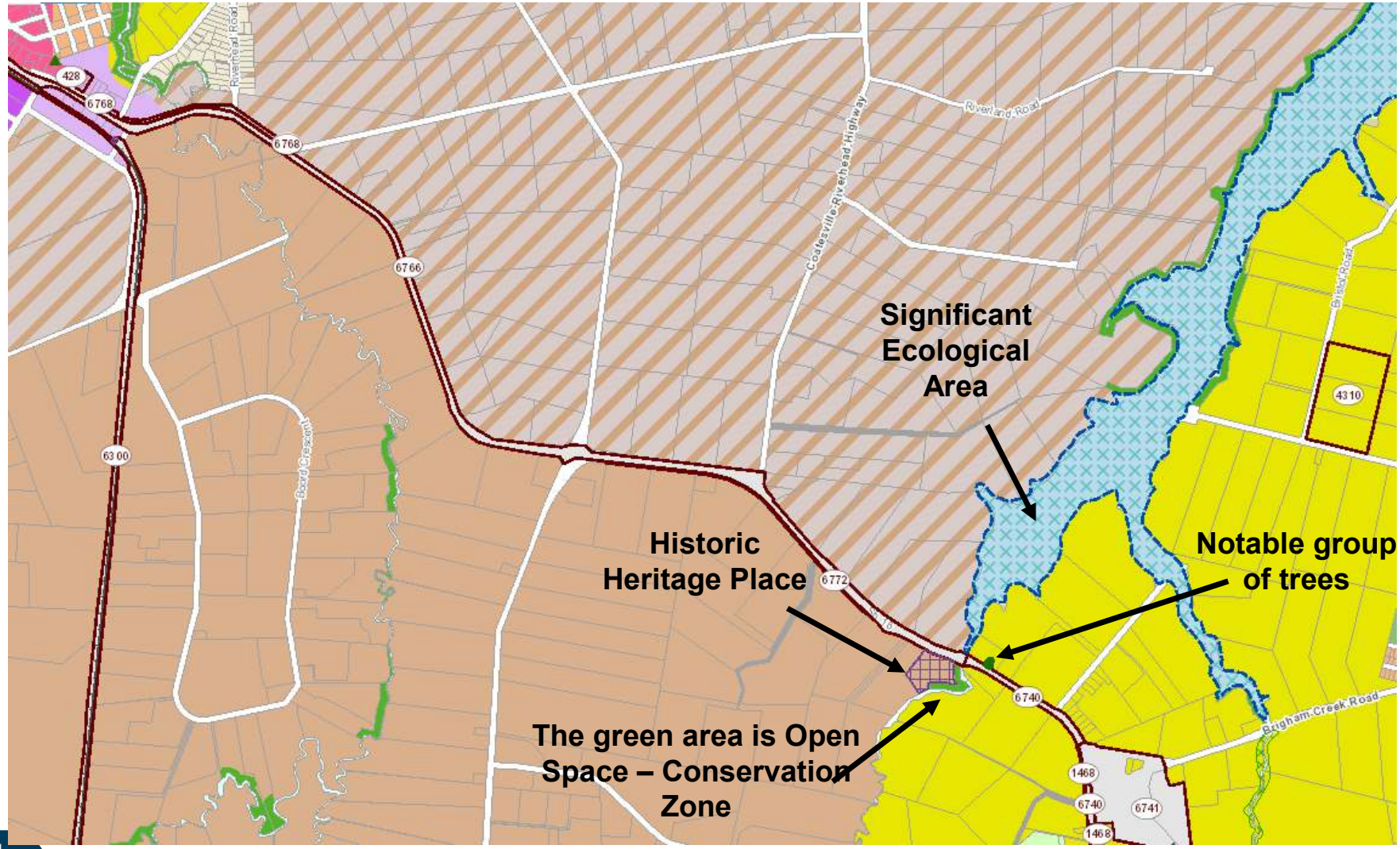
In 2016, Waka Kotahi established the Safe Roads and Roadsides Programme to enable safety improvements to be made to over 90 high-risk rural state highways across NZ. The SH16 Brigham Creek to Waimauku corridor was identified as needing safety improvements. The Project was split into 2 stages.



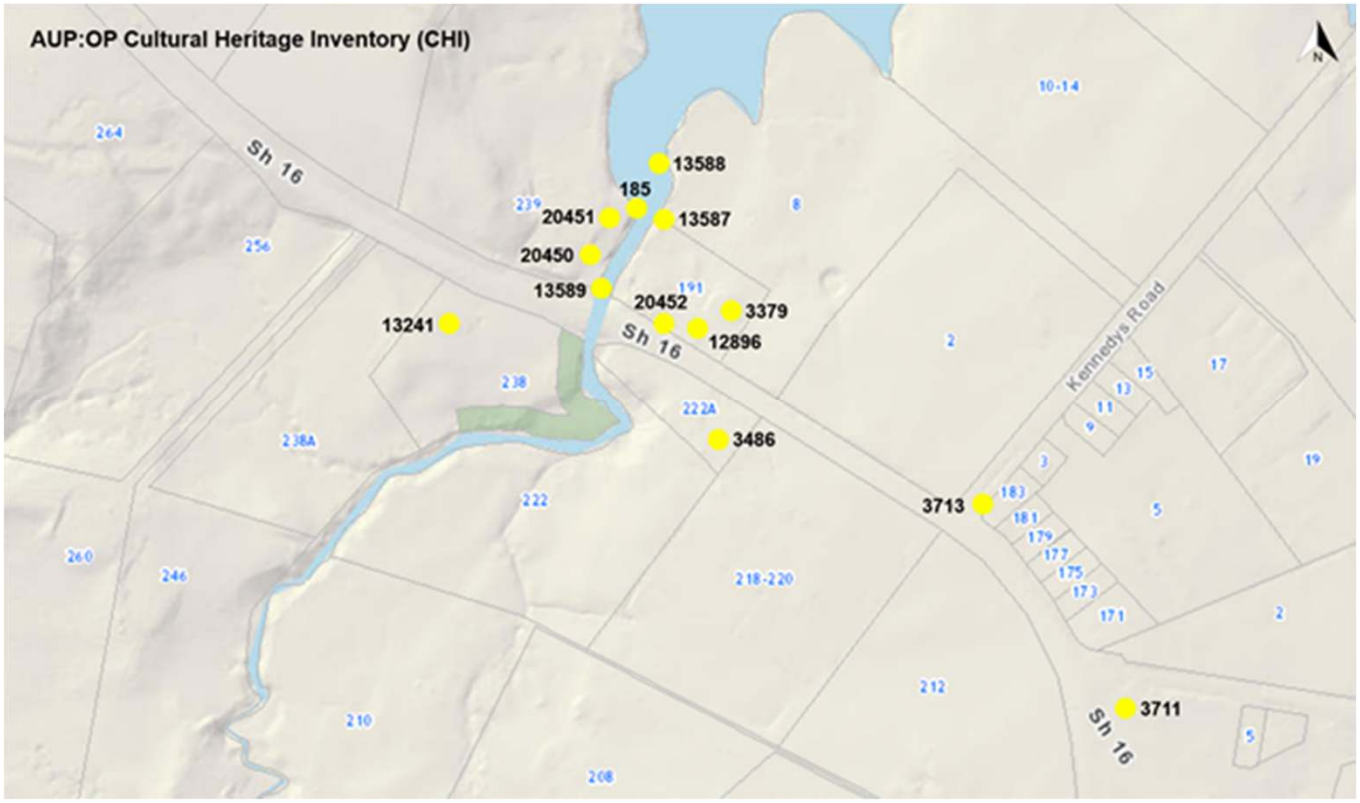
SH16 Stage 2 - Corridor



Existing Environment



Cultural Heritage Inventory



CHI Number	NZAA Site Number	Site Type	Category	Site Name
13241	R11_2828	Building - Dwelling	Historic Structure	Former Sinton House | Sinton House (former)
185	-	Structure (Historic) | Transport | Bridge	Maritime Site	Brigham Creek Bridge | Brigham
3379	-	Building - Dwelling	Historic Structure	Sinton Homestead
12896	-	Tree - Indigenous	Historic Botanical Site	Totara | Kauri | Rimu | Karaka
3486	-	Building- Commercial	Historic Structure	Sinton Homestead
20450	-	House	Archaeological Site	-
20452	-	Built - Commercial	Archaeological Site	Sinton Store and Butchery
20451	-	Slaughterhouse	Archaeological Site	-
3711	-	Former church site	Reported Historic Site	Presbyterian church site
13588	R11_2080	'Turn About'	Archaeological Site	-
13587	R11_2079	Shell Deposit	Archaeological Site	-
13589	R11_2081	Bridge and Weir	Archaeological Site	-
3713	-	Building - Commercial	Historic Structure	Sun Kwong Takeaways

Preliminary Design

All Sections

- Edge barriers at high-risk locations
- 3m shared cycle/pedestrian facility along southern side of SH16

Section A: Brigham Creek Roundabout to Coatesville-Riverhead Highway Intersection

- Two lanes each-way with median safety barrier
- Kennedys Road will be limited to left-in/left-out turning movements.

Section B: Coatesville-Riverhead Highway Intersection

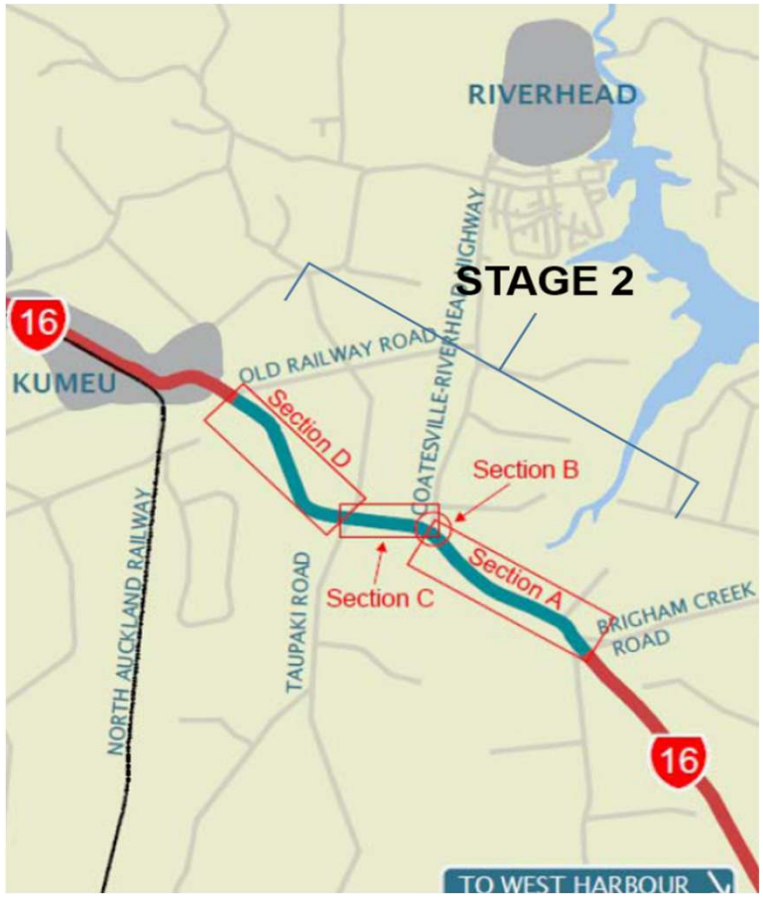
- Two-lane roundabout at intersection

Section C: Coatesville-Riverhead Highway Intersection to Taupaki Road / Old North Rd Intersection

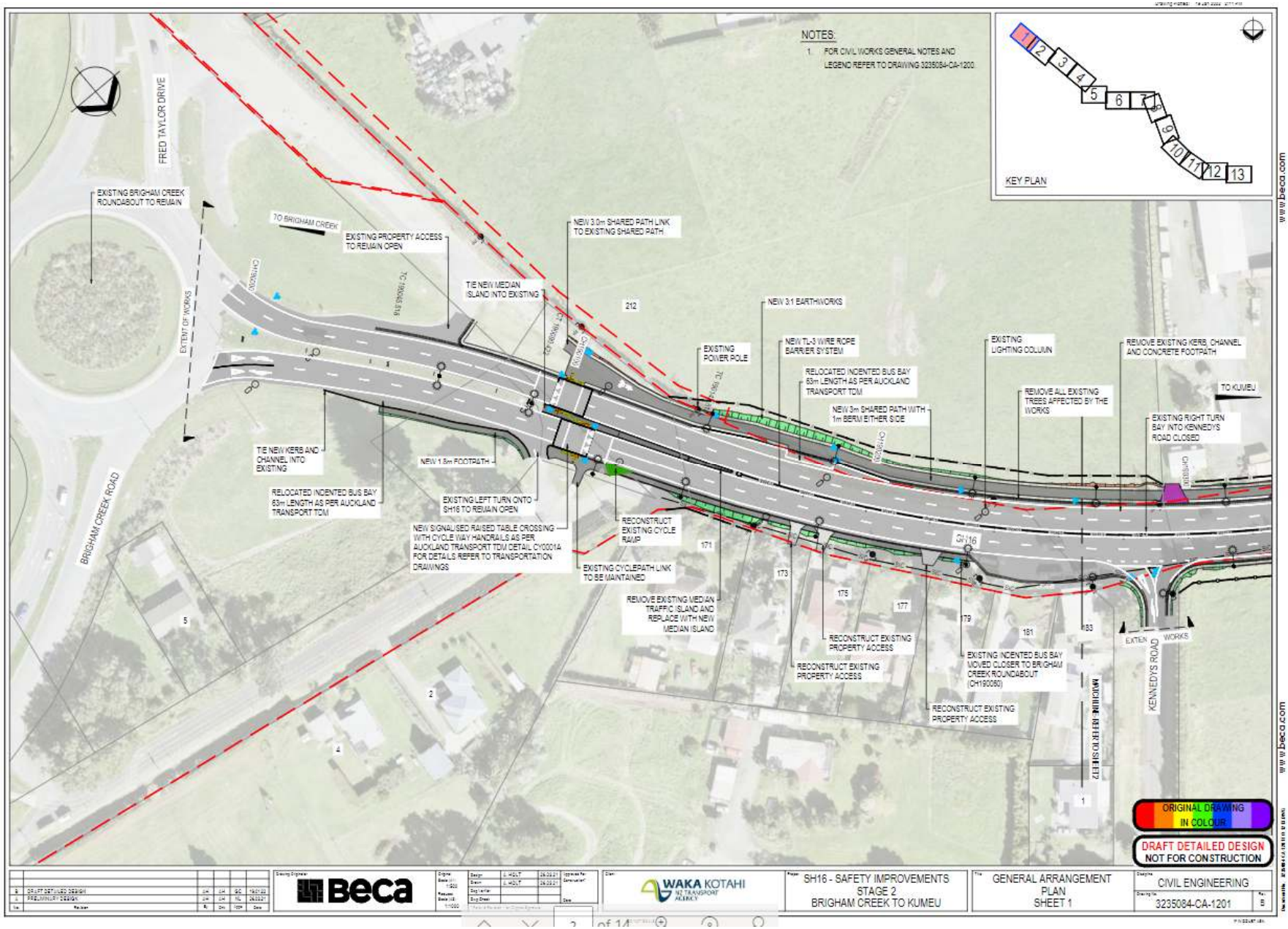
- Two lanes each-way with median safety barrier
- All residential properties will allow left-in/left out turning movements only
- Right turn bay into Soljans Winery. Left turn exit only.

Section D: Old North Road to Old Railway Road Intersection

- One-lane in either direction with painted 2.5m flush median

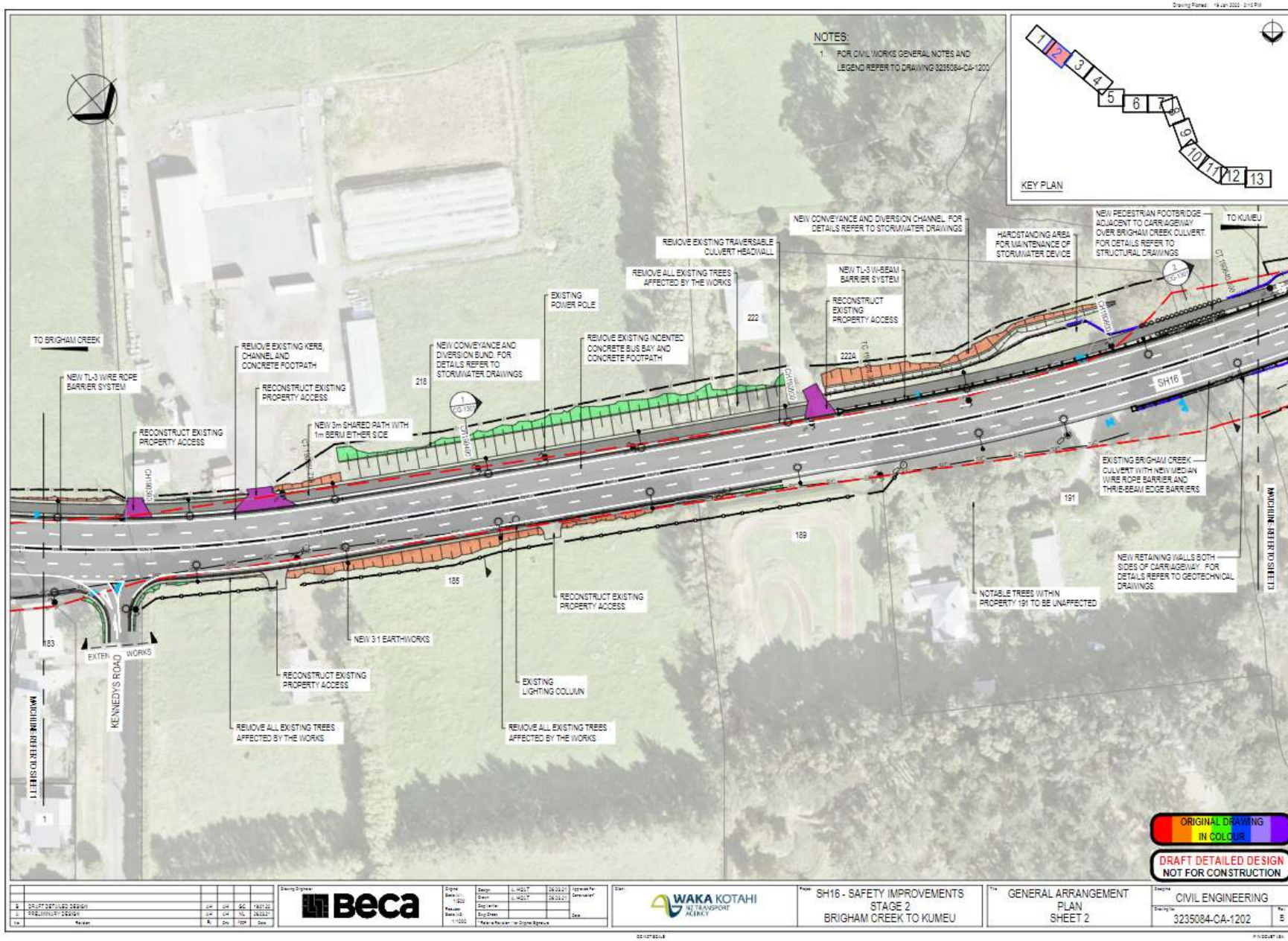


Brigham Creek



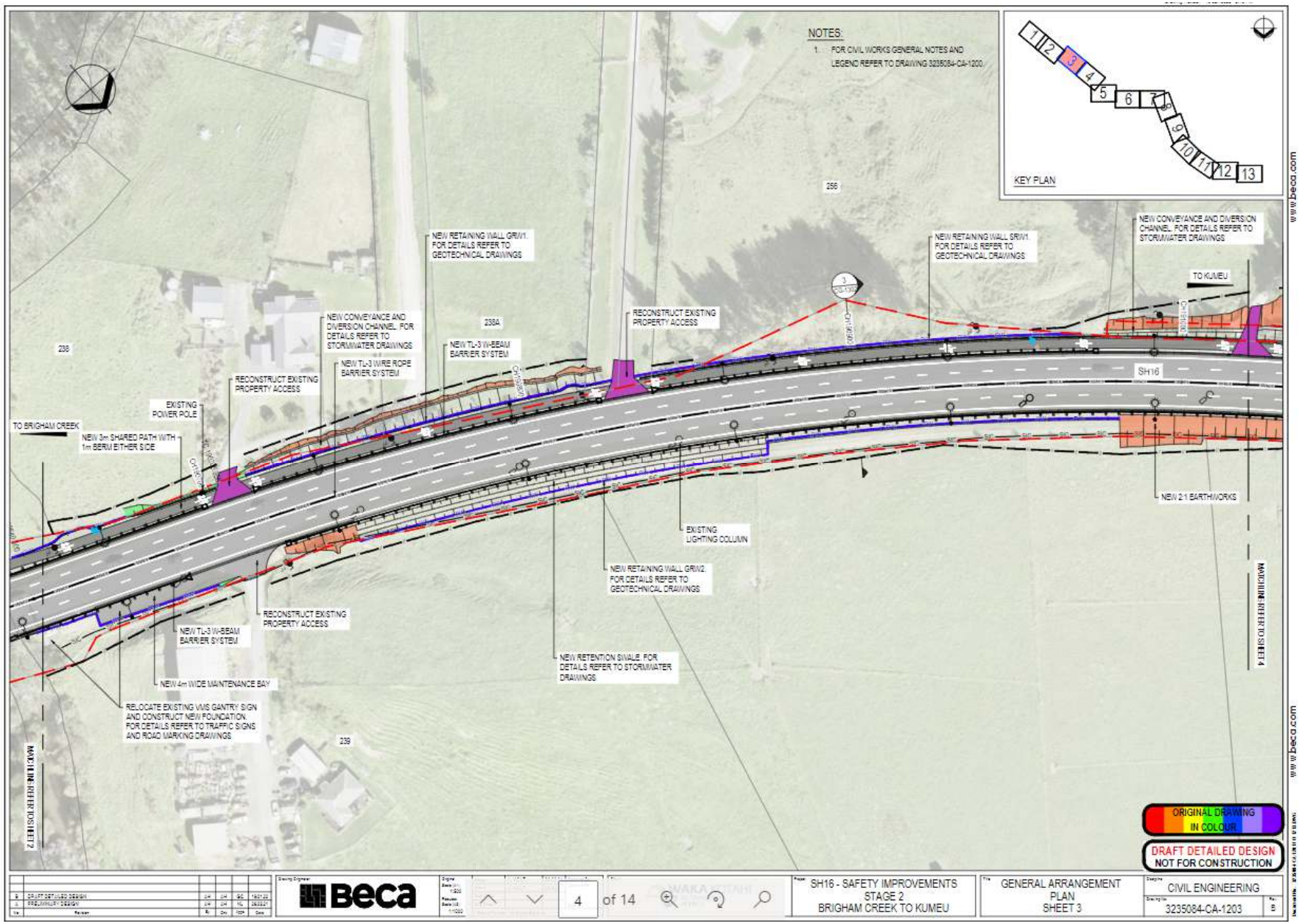
WAKA KOTAHI

Notable Trees (191 SH16)



WAKA KOTAHI

Sinton Family



WAKA KOTAHI

Archaeological Findings

- Recorded archaeological and heritage sites within 200m of the project extent were identified
- A total of 17 sites were identified:
  - Ten historic sites – primarily houses, but including other buildings, the former bridge location, and a group of historic trees
  - Seven archaeological sites – four of which are the locations of former structures, the location of the Portage Railway, a boat ‘turn-around’ area, and a midden deposit
- Potential effects were identified on four of the sites:
  - CHI 20450 (first Sinton homestead at 239 SH16), CHI 20452 (Sinton store at 191 SH16) and R11/2081, CHI 13589 (bridge over Brigham Creek), and R10/1487, CHI 15093 (the Portage Railway)
  - In addition, one scheduled historic heritage place is immediately adjacent to the proposed works at 238 SH16 (AUP OP ID 525, Sinton House)

Built Heritage Findings

191 SH16 (former Janet Sinton homestead and other buildings)

222A SH16 (former Alex Sinton homestead and large shed)

238 SH16 (former Sinton Family homestead)

HNZPT Authority Pathways

1. General Authority - if you wish to undertake an activity that may:

    i. Modify or destroy an archaeological site. This applies to all archaeological sites, including those not yet identified; or

    ii. Have an effect on an archaeological site that's no more than minor and where the site is recorded in the national inventory of archaeological sites.

2. Exploratory Authority - An exploratory investigation could be utilised to establish the presence or absence of an archaeological site, or to carry out limited investigation of a known archaeological site to determine its boundaries or nature.

3. Scientific Authority - For example, an excavation carried out by a University for scientific or research purposes. This type of authority does not apply to land-use activities.

Note: Discussions with mana whenua have indicated a general authority is appropriate for this project.

Next steps

- Further collaboration during the detailed design phase
- Lodgement with Auckland Council
- Apply for a Heritage Authority via HNZPT

Paige Rundle

From: Ashlie Carlyle
Sent: Friday, 18 February 2022 10:00 am
To: Robin Byron; Tharron Bloomfield; Greg Walter
Cc: Karolyn Buhring; Sarah Phear; Sian Stirling; Tessa Robins
Subject: RE: SH16 Stage 2 Project: design near Brigham Creek
Attachments: GA plans for Heritage NZ - sent 18.02.2022..pdf

Sensitivity: General

Hi all,
I had an action to share the draft detailed design for the area around Brigham Creek.
Sheets 1-3 of the design are **attached**.

Kind regards,

Ashlie Carlyle
Senior Associate – Planning & Engagement
Beca
Phone +64 9 300 9000 Fax +64 9 300 9300
DDI +64 9 300 9272 Mobile +64 27 836 7169
ashlie.carlyle@beca.com
www.beca.com

From: Tessa Robins <Tessa.Robins@nzta.govt.nz>
Sent: Thursday, 17 February 2022 4:01 PM
To: Robin Byron <RByron@heritage.org.nz>; Tharron Bloomfield <TBloomfield@heritage.org.nz>; Greg Walter <GWalter@heritage.org.nz>
Cc: Karolyn Buhring <Karolyn.Buhring@nzta.govt.nz>; Sarah Phear <SPhear@heritage.org.nz>; Ashlie Carlyle <ashlie.carlyle@beca.com>; Sian Stirling <Sian.Stirling@beca.com>
Subject: RE: SH16 Stage 2 Project: Potential January meeting

Hi Robin, Tharron and Greg,

Thank you for your time last week. Please find attached minutes from the pre-application meeting for the Waka Kotahi SH16 Stage 2 project.

Feel free to email through any comments on the minutes.

Ngā mihi

Tessa Robins

Planner, Environmental Planning (Auckland/Northland)
Poutiaki Taiao| System Design
Email: Tessa.robins@nzta.govt.nz
Mobile: 021 557 568

Waka Kotahi New Zealand Transport Agency

Auckland, Level 5, AON Centre, 29 Customs Street West
Private Bag 106602, Auckland 1143, New Zealand
Facebook | Twitter | LinkedIn

WAKA KOTAHI NZ TRANSPORT AGENCY www.nzta.govt.nz

From: Robin Byron <RByron@heritage.org.nz>
Sent: Monday, 17 January 2022 10:26 AM
To: Tessa Robins <Tessa.Robins@nzta.govt.nz>
Cc: Karolyn Buhring <Karolyn.Buhring@nzta.govt.nz>; Sarah Phear <SPhear@heritage.org.nz>; Tharron Bloomfield <TBloomfield@heritage.org.nz>
Subject: RE: SH16 Stage 2 Project: Potential January meeting

Mōrena Tessa,

The morning of the 9th of February would work best for all of us.

Ngā mihi | Kind regards,
Robin

From: Tessa Robins <Tessa.Robins@nzta.govt.nz>
Sent: Tuesday, 11 January 2022 7:54 am
To: Robin Byron <RByron@heritage.org.nz>
Cc: Karolyn Buhring <Karolyn.Buhring@nzta.govt.nz>
Subject: RE: SH16 Stage 2 Project: Potential January meeting

Good Morning Robin,

Happy New Year, I hope you had a lovely break.

I just wanted to follow up on my email below to see if you or a member of your team were available for a meeting this month to discuss the heritage and archaeological aspects along the Waka Kotahi SH16 Stage 2 project corridor.

Ngā mihi

Tessa Robins

Planner, Environmental Planning (Auckland/Northland)
Poutiaki Taiao| System Design
Email: Tessa.robins@nzta.govt.nz
Mobile: 021 557 568

Waka Kotahi New Zealand Transport Agency

Auckland, Level 5, AON Centre, 29 Customs Street West
Private Bag 106602, Auckland 1143, New Zealand
Facebook | Twitter | LinkedIn

From: Tessa Robins
Sent: Tuesday, 7 December 2021 2:36 PM
To: RByron@heritage.org.nz
Cc: Karolyn Buhring <Karolyn.Buhring@nzta.govt.nz>
Subject: SH16 Stage 2 Project:

Kia ora Robin,

I hope you are doing well.

Waka Kotahi are progressing on with the safety improvement project referred to as State Highway 16 – Stage 2, discussed in the email trail below with Ann Neil. We would like the opportunity to engage with HNZPT now that we have more detailed information and draft reports for built heritage and archaeology that will inform the final detailed design for the project extent.

We have had a heritage focussed hui with Micah Butt from Ngā Maunga Whakahii o Kaipara and Edward Ashby from Te Kawerau Iwi Tiaki Trust. We sought their input on the heritage maters within the project corridor and their support for Waka Kotahi applying for a general authority under the HNZPT Act.

Please let me know if you would like a meeting with the relevant contacts in your team, myself, our archaeologist (Glen Farley from Clough & Associates) and our built heritage specialist (John Brown from Plan.Heritage) to provide a summary of their assessments alongside our preliminary design which is set to avoid any identified heritage sites/areas where possible. If we could organise a meeting for January in advance that would be great.

Project Extent for Stage 2, east of Stage 1:

Have a lovely afternoon!

Ngā mihi

Tessa Robins

Planner, Environmental Planning (Auckland/Northland)

Poutiaki Taiao| System Design

Email: Tessa.robins@nzta.govt.nz
Mobile: 021 557 568

Waka Kotahi New Zealand Transport Agency

Auckland, Level 5, AON Centre, 29 Customs Street West
Private Bag 106602, Auckland 1143, New Zealand
Facebook | Twitter | LinkedIn

From: Robin Byron <RByron@heritage.org.nz>
Sent: Tuesday, August 24, 2021 5:46:39 PM
To: Ann Neill <Ann.Neill@nzta.govt.nz>; Rebecca Fox <rebecca.fox@aucklandcouncil.govt.nz>
Subject: RE: SH16 Stage 2 Project: Scope of work for Built Heritage Assessment- agreement in principle to engage SME Built heritage assessor

Kia ora Ann,

I confirm that I agree in principle your suggestion for John Brown (Plan.Heritage) to undertake the built heritage assessment.
While not a conservation architect, he does have experience producing built heritage assessments.

Best regards,
Robin

Robin Byron | Senior Conservation Architect BArch MAIBC (Canada) MICOMOS / Tuakana Kaihoahoa Penapena | Heritage New Zealand Pouhere Taonga
Northern Regional Office | SAP Tower, 10th Floor, 151 Queen Street, Auckland City 1010 | PO Box 105 291, Auckland City 1143
Ph: (64 9) 307 9920 | DDI: 307 9928 | E-mail: rbyron@heritage.org.nz

Visit www.heritage.org.nz and learn more about New Zealand's heritage places
Tairangahia a tua whakarere; Tatakihia nga reanga o amuri ake nei – Honouring the past; Inspiring the future

From: Ann Neill <Ann.Neill@nzta.govt.nz>
Sent: Monday, 23 August 2021 11:37 am
To: Rebecca Fox <rebecca.fox@aucklandcouncil.govt.nz>; Robin Byron <RByron@heritage.org.nz>
Subject: FW: SH16 Stage 2 Project: Scope of work for Built Heritage Assessment- agreement in principle to engage SME Built heritage assessor
Importance: High

Morena korua

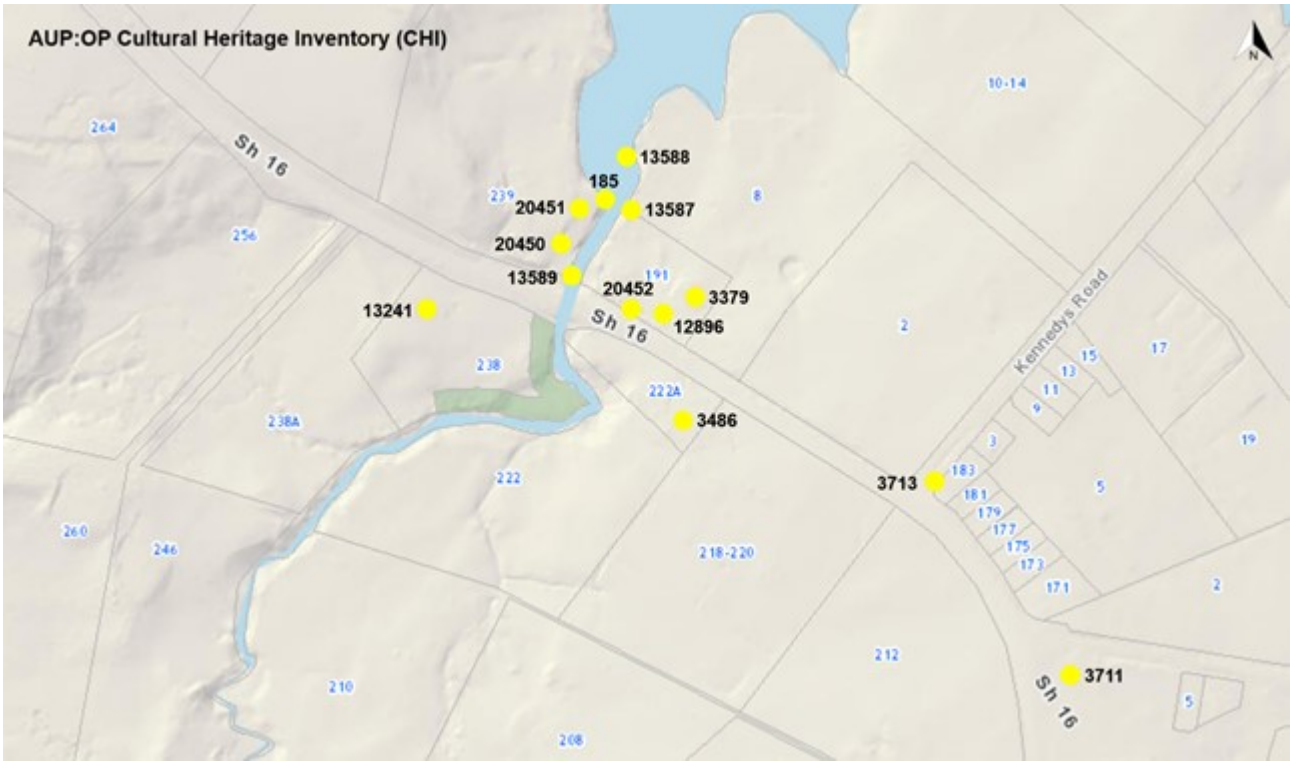
This is rather urgent sorry as the technical leads are meeting on Thursday this week- I told the project team it would be really helpful to have general approval in principle from you both for engaging John Brown to do this relatively small piece of built heritage assessment.

In the forthcoming transport works for Stage 2, SH16 there are potential effects on the roadside setting and curtilage in front of Sinton House (former) included in the Auckland Council CHI and an NZAA recorded site. See Google street view and CHI inventory information below. This is the only listed or scheduled place potentially affected by the proposed works.

This site is protected by the Historic Heritage Overlay in the AUP:OP.
The place is identified as Historic Heritage Overlay Extent of Place [rcp/dp] - 525, recognising the site of the former Sinton House.
See attached AUP zoning – extent of place is over whole property.

CHI Number	NZAA Site Number	Site Type	Category	Site Name

13241	R11_2828	Building - Dwelling	Historic Structure	Former Sinton House | Sinton House (former)



Sinton House
00525 Sinton House (former) 238 State Highway16, Taupaki LOT 1 DP 326070 B
Values protected A,B,D,F,H

An archaeological assessment report was provided for the NOR by Clough & Associates see attached.
As we finalise the consent application for stage 2 Beca on behalf of Waka Kotahi are engaging a built heritage specialist to carry out an assessment on Sinton House. It is proposed to engage heritage consulting firm Plan.Heritage and for John Brown to lead this assessment.

Scope of work for built heritage assessment

Description	Quantity
Attendance at Consenting Kick-off workshop (allow 2 hours) – scheduled for Thursday 26 August 9-11am (also including travel time)	3.00
Site visit to property – note we would first need to seek landowner permission to visit the site; gain necessary approvals	2.00
Discussions with Council regarding project's potential impacts on the heritage site (allow one meeting)	2.00
Review of Prelim Design info and Preparation of a 'Draft' Built Heritage Assessment – by end of September 2021	12.00
Review of 50% detailed design and update to 'final' Built Heritage Assessment – by end of January 2022	4.00
Input to application for General Authority including attendance at pre-application meetings with Heritage NZ	4.00
Allowance for Project team integration (phone calls, emails, two further 1 hr meetings)	4.00

Project status:

The project is aiming to improve safety, efficiency and encourage modal shift through the provision of safety treatments, additional lanes and a new shared use path along the south of the state highway between Brigham Creek and Kumeu.

The project has an approved preliminary design and the team is moving into the detailed design and consenting phase.

I busy finalising the Consenting Strategy and lining up the environmental specialists to undertake assessments that will support the Notice of Requirement to designate land for road, and resource consent applications.

Prelim design:

The proposal (additional lanes, shared use path, stormwater management and retaining wall) encroaches this site, located at 238 State Highway 16 – potentially impacting the trees along the frontage and the driveway arrangement.

Nga mihi
Ann Neill

This message, together with any attachments, may contain information that is classified and/or subject to legal privilege. Any classification markings must be adhered to. If you are not the intended recipient, you must not

GENERAL NOTES:

1. ALL NOTES HEREIN SHALL FORM PART OF THE CONTRACT.
2. ALL NOTES SHALL BE READ IN CONJUNCTION WITH THE CONTRACT SPECIFICATIONS AND ALL DESIGN DRAWINGS APPLICABLE TO THE CONTRACT.
3. ALL WORKS SHALL BE CONSTRUCTED AS DETAILED IN ALL DESIGN DRAWINGS AND IN ACCORDANCE WITH THE REQUIREMENTS OF THE CONTRACT'S SPECIFICATIONS.
4. THE CONTRACTOR MUST CHECK ALL DESIGN DRAWINGS AND IDENTIFY ANY INCONSISTENCIES BETWEEN DESIGN DRAWINGS AND AGAINST THE CONTRACTS SPECIFICATIONS, BASIS OF PAYMENT AND SCHEDULE OF PRICES IN ADVANCE AND PRIOR TO ANY CONSTRUCTION WORKS. THE CONTRACTOR MUST NOTIFY THE ENGINEER IF THERE ARE ANY INCONSISTENCIES.
5. CONTRACTOR MUST INFORM COUNCIL'S ARBORIST FOR ANY WORK UNDER THE DRIPLINE OF THE TREES. NOTIFICATION SHALL BE MADE WELL IN ADVANCE OF ANY CONSTRUCTION WORKS.
6. SEE LANDSCAPE PLANS FOR ALL AREAS OF EXISTING GRASS AND/OR PLANTING AFFECTED DURING CONSTRUCTION.
7. SITE CLEARANCE SHALL BE CONDUCTED PRIOR TO COMMENCEMENT OF ALL CONSTRUCTION WORKS. REFER TO SITE CLEARANCE PLANS.

SETTING OUT NOTES:

1. SET-OUT INFORMATION FOR ROAD CENTRELINES, EDGE LINES AND KERB LINES WILL BE SUPPLIED TO THE CONTRACTOR IN 3D ELECTRONIC FORMAT. FOR KERB TYPES AND LOCATIONS, REFERENCE SHOULD BE MADE TO KERB AND BARRIER DRAWINGS.
2. THE CONTRACTOR MUST CHECK AND VERIFY ALL COORDINATES / LEVELS / DIMENSIONS / SETTING-OUT INFORMATION PRIOR TO COMMENCEMENT OF WORK AND REPORT DISCREPANCIES, IF ANY, IMMEDIATELY TO THE ENGINEER.
3. THE CONTRACTOR MUST TAKE ALL STEPS TO MAKE SURE THAT THE ENGINEER VERIFIES ALL LEVELS AND SETTING-OUTS ON SITE PRIOR TO COMMENCEMENT OF CONSTRUCTION.
4. THE CONTRACTOR MUST UNDERTAKE A SURVEY ON ALL CARRIAGEWAY, FOOTPATH, KERB AND CHANNEL TIE-INS TO PREVENT STORMWATER PONDING. EXTENTS OF WORK MAY EXTEND BEYOND THE LIMITS SHOWN IN THE DESIGN DRAWINGS WITH THE ENGINEER'S APPROVAL.

ROAD KERB AND CHANNEL, FOOTPATH, CENTRAL MEDIAN AND OTHER ROAD ELEMENTS

1. NEW KERB, CHANNEL AND TRAFFIC ISLAND KERBLINE ALONG SH16 SHALL BE SEMI-MOUNTABLE, (SM1 AND SM2 KERB PROFILE). FOR DETAILS AND EXTENTS OF KERB AND CHANNEL REFER TO BARRIER PLANS AND CIVIL WORKS DETAILS DRAWINGS.
2. NEW TRAFFIC ISLAND KERBING TO BE PAINTED REFLECTORISED WHITE IN ACCORDANCE WITH MOTSAM, PART 2, RAISED ISLANDS.
3. NEW TRAFFIC ISLANDS INFILL TO BE 20MPa CONCRETE 100mm DEEP OVER 100mm DEPTH OF COMPACTED BASECOURSE (AP40).
4. NEW FOOTPATHS/SHARED PATHS AND PRAM CROSSINGS TO BE 20MPa CONCRETE 100mm DEEP OVER 100mm DEPTH OF COMPACTED BASECOURSE (AP40).
5. ALL SAWN CONCRETE JOINTS MUST BE SAWCUT NEATLY. SAWCUTTING SHALL GENERALLY BE SQUARE TO THE KERB AND CARRIAGEWAY ALIGNMENT. DRY CUTTING IS NOT PERMITTED.
6. BASECOURSE SHALL BE PLACED AND COMPACTED TO ACHIEVE A MINIMUM CLEGG IMPACT VALUE OF 12 FOR CONCRETE FOOTPATHS.
7. ALL PATH EDGES SHALL BE CONSTRUCTED FLUSH WITH THE ADJACENT GROUND TO AVOID CREATING PEDESTRIAN TRIP HAZARDS.
8. NEW KERBS ADJACENT TO GRASS BERM OR PLANTING BEDS TO BE MORTAR POINTED BEFORE REINSTATEMENT WITH TOPSOIL, MULCH ETC.
9. BATTER SLOPES ARE TO MATCH THE EXISTING GROUND. EITHER 3H:1V OR SLIGHTLY STEEPER DEPENDING ON THE ROADSIDE CONDITION AT THE LOCATION. FOR STEEPENED SLOPES, CONTRACTOR TO UNDERTAKE GROUND TESTING, HAND AUGERS AND / OR SHEAR VANES AT THE DIRECTION OF THE ENGINEER. ENGINEER THEN SHALL ASSESS THE FINDINGS AND INSTRUCT IF FURTHER SLOPE STABILISATION WILL BE REQUIRED.
10. FOR NEW WIRE ROPE MEDIAN BARRIER AND W-SECTION EDGE BARRIER LOCATIONS AND DETAILS, REFER TO BARRIER PLANS .

PROPERTY ACCESS:

1. ALL PROPERTY ACCESS ALONG THE CORRIDOR SHALL BE MAINTAINED AS EXISTING UNLESS NOTED OTHERWISE ON THE GENERAL ARRANGEMENT PLANS. TYPICALLY, DETAILED LAYOUTS SHALL FOLLOW EITHER DIAGRAM D OR AUCKLAND TRANSPORT TDM VEHICLE CROSSING DETAIL VX0103B FOR ALL RESIDENTIAL AND LIGHT COMMERCIAL PROPERTIES OR DIAGRAM E FOR HEAVY COMMERCIAL PROPERTIES ACCORDING TO WAKA KOTAHI PLANNING POLICY MANUAL, APPENDIX 5B ACCESSWAY STANDARDS AND GUIDLINES.
2. REFER TO PAVEMENT AND SURFACING DRAWINGS FOR PROPERTY ACCESS CONSTRUCTION MATERIALS AND DETAILS.

SURVEY:

1. THE SURVEY AND DESIGN IS IN TERMS OF NZTM COORDINATES AND NZVD 2016 VERTICAL DATUM.

SERVICES:

1. CONTRACTOR MUST LIAISE WITH ALL SERVICE AUTHORITIES FOR LOCATION OF SERVICES AND OBTAIN CONSENTS IN ADVANCE AND PRIOR TO ANY CONSTRUCTION WORKS.
2. CONTRACTOR TO CARRY OUT DETAILED DESIGN SERVICES LOCATION PRIOR TO ANY EXCAVATION WORKS.
3. ANY SERVICES DAMAGED BY THE CONTRACTOR SHALL BE REPAIRED, TO THE SATISFACTION OF THE SERVICE PROVIDER, AT THE CONTRACTORS EXPENSE.

LEGEND

- EXISTING ROAD DESIGNATION BOUNDARY
- EXISTING PROPERTY BOUNDARY
- PP — EXISTING POWER POLE (REFER TO UTILITY DRAWINGS FOR POLES TO BE REMOVED)
- EXISTING STREET LIGHTING COLUMN (REFER TO STREET LIGHTING DRAWINGS FOR COLUMNS TO BE REMOVED)
- EXISTING CELL PHONE TOWER ON BORIC LAND TO REMAIN
- SIC — SIC — EXISTING SPARK INTERNATIONAL CABLE
- WR3 — WR3 — NEW MASH TL-3 WIRE ROPE BARRIER
- NEW MASH TL-3 WIRE ROPE BARRIER END TERMINAL
- NEW MASH TL-3 W-BEAM BARRIER
- NEW MASH TL-3 W-BEAM BARRIER LEADING TERMINAL
- NEW MASH TL-3 W-BEAM BARRIER TRAILING TERMINAL
- T-B4 — T-B4 — NEW THRIE BEAM BARRIER
- RW — RW — NEW RETAINING WALL
- NEW 1.8m HIGH FENCE TYPE 1 (TIMBER POST AND PANEL)
- NEW 1.2m HIGH FENCE TYPE 2 (FARM FENCE - STANDARD POST AND WIRE)
- NEW 1.5m HIGH FENCE TYPE 3 (FARM FENCE - TIMBER EQUESTRIAN)
- NEW 1.4m HIGH PEDESTRIAN FENCE (GALVANISED WIRE FENCE) AS PER AUCKLAND TRANSPORT TDM TECHNICAL STANDARDS DRAWING FE0008A
- NEW GATE
- NEW TRAFFIC SIGN
- NEW STREET LIGHTING COLUMN
- NEW WORKS IN CUT
- NEW WORKS IN FILL
- NEW CONCRETE FOOTPATH/SHARED PATH/MEDIAN ISLAND
- NEW TACTILE GROUND SURFACE INDICATORS
- RECONSTRUCTED RESIDENTIAL VEHICLE CROSSING AS PER AUCKLAND TRANSPORT TDM TECHNICAL STANDARDS DRAWING VX0103B
- NEW RAISED TABLE

ORIGINAL DRAWING IN COLOUR

DRAFT DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DRAFT DETAILED DESIGN	AH	AH	GC	19.01.22
A	PRELIMINARY DESIGN	AH	AH	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) NTS
Reduced Scale (A3) NTS

Design	A. HOLT	26.03.21	Approved For Construction*
Drawn	A. HOLT	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: CIVIL WORKS GENERAL NOTES AND LEGEND

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CA-1200

Rev. B

Document No. 3235084-CA-1200.DWG

DO NOT SCALE

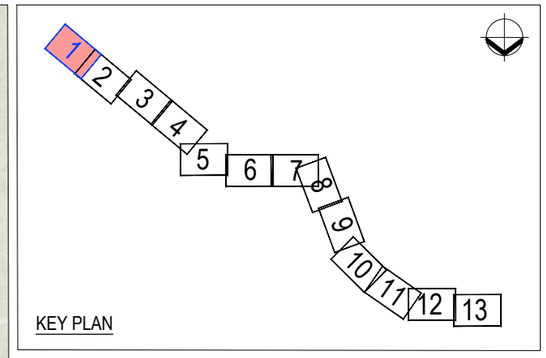
IF IN DOUBT ASK.

www.beca.com

Drawing Plotted: 19 Jan 2022 2:11 PM

NOTES:

1. FOR CIVIL WORKS GENERAL NOTES AND LEGEND REFER TO DRAWING 3235084-CA-1200.



FRED TAYLOR DRIVE

EXISTING BRIGHAM CREEK ROUNDABOUT TO REMAIN

TO BRIGHAM CREEK

EXISTING PROPERTY ACCESS TO REMAIN OPEN

EXTENT OF WORKS

CH190000

TC 190045.518

TIE NEW MEDIAN ISLAND INTO EXISTING

NEW 3.0m SHARED PATH LINK TO EXISTING SHARED PATH

CL 190090.422

CH190100

212

NEW 3:1 EARTHWORKS

EXISTING POWER POLE

NEW TL-3 WIRE ROPE BARRIER SYSTEM

TC 190147.818

RELOCATED INDENTED BUS BAY 63m LENGTH AS PER AUCKLAND TRANSPORT TDM

NEW 3m SHARED PATH WITH 1m BERM EITHER SIDE

CH190200

EXISTING LIGHTING COLUMN

REMOVE EXISTING KERB, CHANNEL AND CONCRETE FOOTPATH

REMOVE ALL EXISTING TREES AFFECTED BY THE WORKS

TO KUMEU

EXISTING RIGHT TURN BAY INTO KENNEDYS ROAD CLOSED

CH190300

TIE NEW KERB AND CHANNEL INTO EXISTING

NEW 1.8m FOOTPATH

RELOCATED INDENTED BUS BAY 63m LENGTH AS PER AUCKLAND TRANSPORT TDM

EXISTING LEFT TURN ONTO SH16 TO REMAIN OPEN

NEW SIGNALISED RAISED TABLE CROSSING WITH CYCLE WAY HANDRAILS AS PER AUCKLAND TRANSPORT TDM DETAIL CY0001A FOR DETAILS REFER TO TRANSPORTATION DRAWINGS

RECONSTRUCT EXISTING CYCLE RAMP

EXISTING CYCLEPATH LINK TO BE MAINTAINED

REMOVE EXISTING MEDIAN TRAFFIC ISLAND AND REPLACE WITH NEW MEDIAN ISLAND

SH16

171

173

175

177

179

181

183

RECONSTRUCT EXISTING PROPERTY ACCESS

RECONSTRUCT EXISTING PROPERTY ACCESS

RECONSTRUCT EXISTING PROPERTY ACCESS

EXISTING INDENTED BUS BAY MOVED CLOSER TO BRIGHAM CREEK ROUNDABOUT (CH190060)

EXTEN WORKS

KENNEDYS ROAD

MATCHLINE-REFER TO SHEET 2

BRIGHAM CREEK ROAD

1
2
4
5

ORIGINAL DRAWING IN COLOUR

DRAFT DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DRAFT DETAILED DESIGN	AH	AH	GC	19.01.22
A	PRELIMINARY DESIGN	AH	AH	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) 1:500
Reduced Scale (A3) 1:1000

Design	A. HOLT	26.03.21	Approved For Construction*
Drawn	A. HOLT	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: GENERAL ARRANGEMENT PLAN SHEET 1

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CA-1201

Rev. B

DO NOT SCALE

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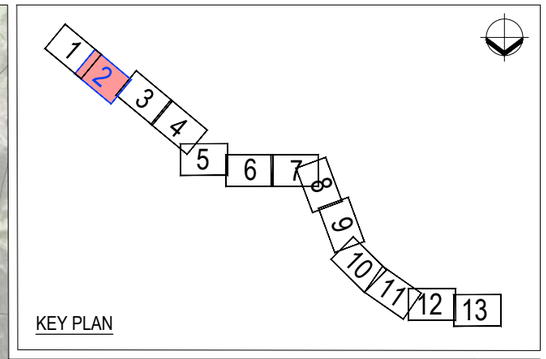
Document No. 3235084-CA-1201 TO 1213.DWG

Drawing Plotted: 19 Jan 2022 2:10 PM

NOTES:

1. FOR CIVIL WORKS GENERAL NOTES AND LEGEND REFER TO DRAWING 3235084-CA-1200.



KEY PLAN

TO BRIGHAM CREEK

TO KUMEU

NEW TL-3 WIRE ROPE BARRIER SYSTEM

REMOVE EXISTING KERB, CHANNEL AND CONCRETE FOOTPATH

RECONSTRUCT EXISTING PROPERTY ACCESS

RECONSTRUCT EXISTING PROPERTY ACCESS

NEW 3m SHARED PATH WITH 1m BERM EITHER SIDE

NEW CONVEYANCE AND DIVERSION BUND. FOR DETAILS REFER TO STORMWATER DRAWINGS

EXISTING POWER POLE

REMOVE EXISTING INDENTED CONCRETE BUS BAY AND CONCRETE FOOTPATH

REMOVE EXISTING TRAVERSABLE CULVERT HEADWALL

REMOVE ALL EXISTING TREES AFFECTED BY THE WORKS

NEW CONVEYANCE AND DIVERSION CHANNEL. FOR DETAILS REFER TO STORMWATER DRAWINGS

HARDSTANDING AREA FOR MAINTENANCE OF STORMWATER DEVICE

NEW TL-3 W-BEAM BARRIER SYSTEM

RECONSTRUCT EXISTING PROPERTY ACCESS

NEW PEDESTRIAN FOOTBRIDGE ADJACENT TO CARRIAGEWAY OVER BRIGHAM CREEK CULVERT. FOR DETAILS REFER TO STRUCTURAL DRAWINGS

EXISTING BRIGHAM CREEK CULVERT WITH NEW MEDIAN WIRE ROPE BARRIER AND THRIE-BEAM EDGE BARRIERS

NEW RETAINING WALLS BOTH SIDES OF CARRIAGEWAY. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS.

NOTABLE TREES WITHIN PROPERTY 191 TO BE UNAFFECTED

RECONSTRUCT EXISTING PROPERTY ACCESS

NEW 3:1 EARTHWORKS

RECONSTRUCT EXISTING PROPERTY ACCESS

EXISTING LIGHTING COLUMN

REMOVE ALL EXISTING TREES AFFECTED BY THE WORKS

REMOVE ALL EXISTING TREES AFFECTED BY THE WORKS

EXTEN WORKS

KENNEDYS ROAD

SH16

CH190300

CH190400

CH190500

CH190600

CT 190640.800

CT 190524.38

CT 190551.718

MATCHLINE-REFER TO SHEET 1

MATCHLINE-REFER TO SHEET 3

183

185

189

191

218

222

222A

1 CG-1301

2 CG-1301

ORIGINAL DRAWING IN COLOUR

DRAFT DETAILED DESIGN
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No.	Revision	By	Chk	Appd	Date
B	DRAFT DETAILED DESIGN	AH	AH	GC	19.01.22
A	PRELIMINARY DESIGN	AH	AH	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) 1:500
Reduced Scale (A3) 1:1000

Design	A. HOLT	26.03.21	Approved For Construction*
Drawn	A. HOLT	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: GENERAL ARRANGEMENT PLAN SHEET 2

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CA-1202

Rev.: B

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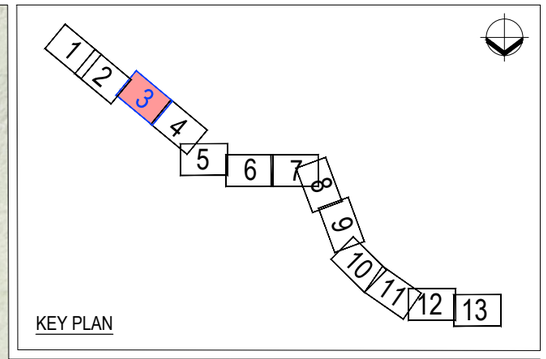
Drawing Plotted: 19 Jan 2022 2:10 PM

NOTES:

1. FOR CIVIL WORKS GENERAL NOTES AND LEGEND REFER TO DRAWING 3235084-CA-1200.



ORIGINAL DRAWING IN COLOUR

DRAFT DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	DRAFT DETAILED DESIGN	AH	AH	GC	19.01.22
A	PRELIMINARY DESIGN	AH	AH	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1)	1:500	Design	A. HOLT 26.03.21
Reduced Scale (A3)	1:1000	Drawn	A. HOLT 26.03.21
		Dsg Verifier	
		Dwg Check	

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: GENERAL ARRANGEMENT PLAN SHEET 3

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CA-1203

Rev.: B

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