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SH16 Brigham Creek to Waimauku Project: Stage 2 - Assessment of Alternatives

Prepared for: Waka Kotahi NZ Transport Agency – Auckland
Prepared by: Beca Limited (Beca)

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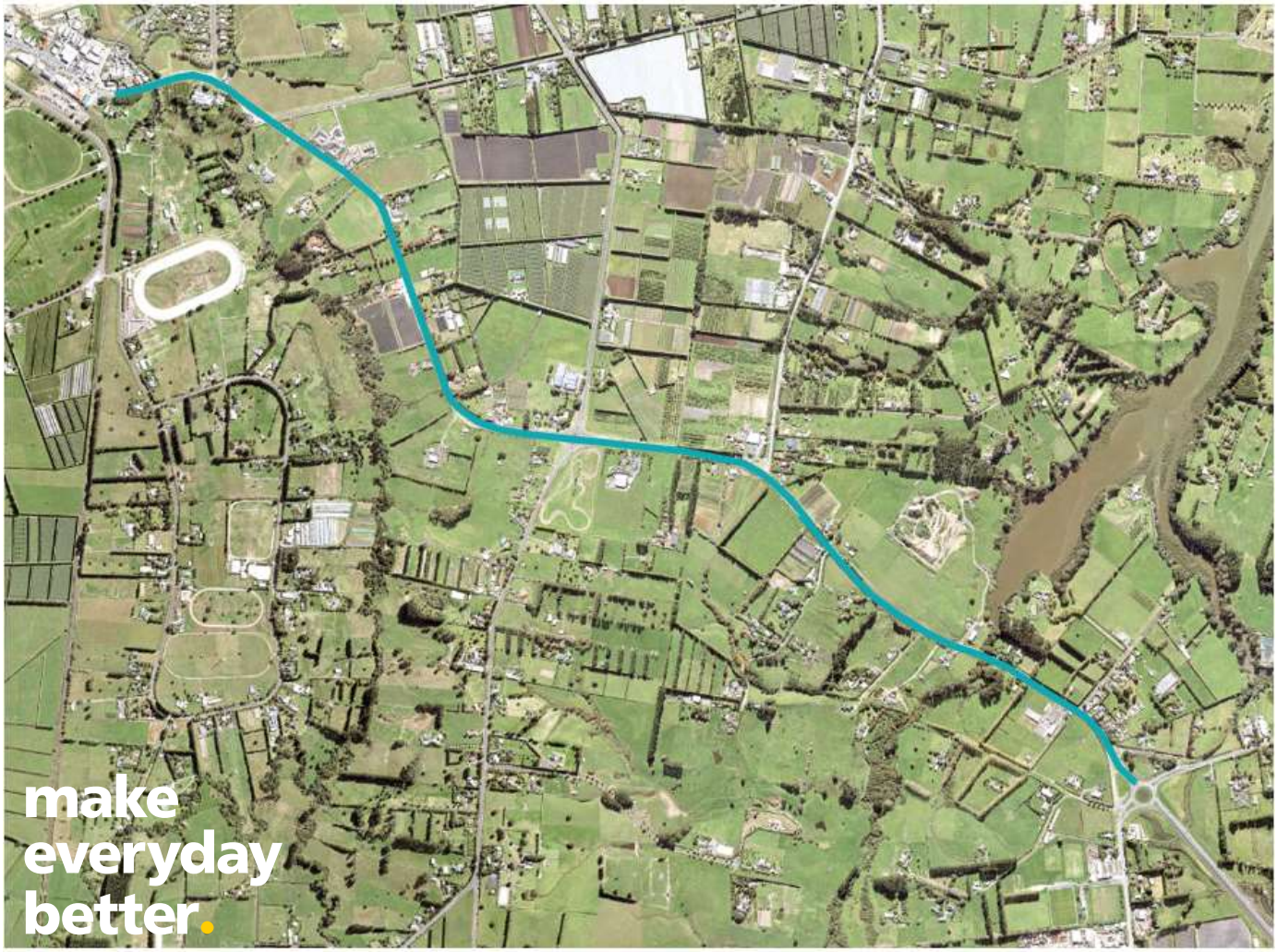

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Sensitivity: General

Revision History

Revision Nº	Prepared By	Description	Date
1	Sian Stirling Sarah McCormick	First draft for client review	17.06.22
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Document Acceptance

Action	Name	Signed	Date
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on behalf of	Beca Limited		

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Appendices

1 Introduction

The SH16 Brigham Creek to Waimauku Project: Stage 2 – Brigham Creek to Kumeū (the Project) will improve the safety, efficiency and active mode facilities along 4.3km of the State Highway 16 (SH16) corridor. The Project will be located between the existing Brigham Creek intersection and the Kumeū Town Centre (see Figure 1 below). The Project is being undertaken by Waka Kotahi NZ Transport Agency (Waka Kotahi). The Project includes safety mechanisms specifically designed to reduce the incidents of deaths and serious injuries (DSIs). The Project components include:

- Additional traffic lanes between Brigham Creek roundabout and Coatesville-Riverhead Highway
- A new two-lane roundabout at the intersection of Coatesville-Riverhead Highway
- Additional traffic lanes between Coatesville-Riverhead Highway and Taupaki Road
- Widened road shoulders
- Flexible median safety barrier between Brigham Creek roundabout and Taupaki Road
- A flush median between Taupaki Road and Kumeū
- A new 3 metre wide shared-use path between Brigham Creek and Kumeū
- Stormwater network improvements to service SH16.

Figure 1 - Stage 2 of the SH16 Brigham Creek to Waimauku Project corridor and the proposed upgrades

1.1 Purpose of this report

Waka Kotahi is a crown entity responsible for the construction, operation, and maintenance of New Zealand's state highway network. In this capacity, Waka Kotahi has served a Notice of Requirement (NoR) to alter existing SH16 designations and applications for associated resource consents, to designate land and deliver the Project improvements.

This 'Assessment of Alternatives' report has been prepared by Beca Ltd on behalf of Waka Kotahi, as the requiring authority for SH16.

The purpose of this report is to address the requirements of section 171(1)(b) of the Resource Management Act 1991 (RMA). The provisions require a territorial authority to consider:

> *"whether adequate consideration has been given to alternative sites, routes, or methods of undertaking the work if –*
>
> *(i) the requiring authority does not have an interest in the land sufficient for undertaking the work; or*
>
> *(ii) it is likely that the work will have a significant adverse effect on the environment."*

The Assessment of Effects on the Environment (Beca, 2022) indicates that the Project will not result in significant adverse effects. However, Waka Kotahi does not currently have an interest in all the land required for the construction, operation, and maintenance of the Project. Accordingly, a full evaluation of alternative sites, routes, and methods has been undertaken. This report summarises the methods used to identify and assess alternatives for the safety, efficiency and active mode components; identifies the range of alternatives considered; and details the reasons that the preferred sites, routes, and methods were chosen over other options.

This report supports the NoR to alter designations 6766 and 6740 within the Auckland Unitary Plan – Operative in Part 2016 (AUP) and has been prepared in accordance with:

a) RMA Section 171(1)(b); and

b) Waka Kotahi's Business Case Approach guidance to document option development, assessment, and selection process.

There are several principles and key considerations for a requiring authority to apply and adhere to when undertaking an assessment of alternatives and identifying a preferred option. Of note are the following:

a) The process should be adequately transparent and robust, and clearly recorded so that it can be understood by others;
b) An appropriate range of alternatives should be considered; and
c) The extent of options considered, and the assessment of these options, should be proportional to the potential effects of the options being considered.

1.2 Report Structure

The report will discuss the:

- Project drivers, background and genesis (Section 1 and Section 2)
- Assessment of Alternatives methodology, including the Multi-Criteria Analysis (MCA) Framework (Section 3)
- Option assessment process and rationale for the selection of the preferred option for each section of the corridor (Section 4) and localised areas (Section 5). The full breakdown of the alternatives assessment (scores and comments) is provided in various appendices to this report.

1.3 Project background

The genesis of this Project dates back 7 years, as set out below.

1.3.1 Transport for Future Urban Growth Project

The Transport for Future Urban Growth (TFUG) Project was commissioned following confirmation of the Auckland Council Future Urban Land Supply Strategy in November 2015 which identified the proposed sequencing of growth in greenfield areas.

The TFUG Programme Business Case (PBC) was undertaken in a partnership between Auckland Transport, Auckland Council and Waka Kotahi to identify a preferred transport programme that responds to the scale and pace of growth in the Future Urban Growth Areas in Auckland. The PBC sought to enhance the liveability of Auckland and it undertook specific area-based studies. One of these studies identified key issues in the North West of Auckland. It highlighted how SH16 is currently the only access point into Kumeū. It is a critical connection route for servicing the growth areas in the short to medium term and prior to the development and urbanisation of greenfield sites (Future Urban zoned land). The development of these greenfield sites is scheduled for 2028-2032 under the *Auckland Future Urban Land Supply Strategy* (Auckland Council, 2017). Among other matters, the final PBC (dated September 2016) recommended a programme that would address state highway safety improvements.

1.3.2 Safe Roads and Roadsides Programme – SH16 Business Case

The Safe Roads Alliance was established by the New Zealand government in 2015 to accelerate the planning, design, and delivery of road safety and reduce the number of DSIs on high-risk rural state highways. Bringing together Waka Kotahi and other parties, the Alliance remit was to deliver the *Safe Roads and Roadsides Programme* to enable safety improvements to be made to over 90 high-risk rural state highways across New Zealand over six years. The improvements were aimed to make roads more forgiving of human error, helping to reduce the occurrence of crashes, and limiting their severity when they do happen. The improvements included roadside safety barriers, wide centrelines, improved road signs and markings, rumble strips, wider road shoulders, intersection upgrades, better signage and safe and appropriate speed limits. The programme aimed to reduce DSIs on New Zealand roads by 900 over 10 years by making over 400 kilometres of rural roads safer.

The SH16 Brigham Creek to Waimauku Project corridor was one of the sections of rural state highway identified for the *Safe Roads and Roadsides Programme*. This Project was formed to improve the safety of the corridor as well as respond to issues relating to efficiency, resilience, access, and travel choice within the surrounding area. The focus of the Project was areas of the highway with a speed limit of around 80km/hr. Therefore, the project was divided into two distinct ‘rural’ road areas separated by the Huapai and Kumeū townships. Stage 1 comprises the Huapai to Waimauku section of SH16 and Stage 2 comprises the Brigham Creek to Kumeū section of SH16.

A Single Stage Business Case (SSBC) for the Project commenced May 2016. The concept design for the corridor improvement was completed in August 2017 and the SSBC was completed and approved by Waka Kotahi in December 2017.

In 2018, the Safe Roads Alliance developed a Walking and Cycling addendum to the SSBC which resulted in a decision to add a shared use path into the project concept design. This was added in response to the *Government Policy Statement on Land Transport 2018/19–2027/28* (GPS 2018) which included ‘A land transport system that enables transport choice and access’ as an objective. A shared used path would provide the opportunity for modal shift in line with this strategic direction. The Safe Roads Alliance was dis-established shortly after this and Waka Kotahi took sole ownership of the Project.

1.3.3 SH16 Brigham Creek to Waimauku Detailed Design and Consenting

Waka Kotahi commenced the Project pre-implementation phase (i.e. detailed design and consenting activities) in August 2020. This involved a comprehensive review of previous work to inform next steps.

Section 2 below provides an overview of the previous options assessment undertaken during the business case phase as well as the further options assessment undertaken in the lead up to the detailed design and consenting of the Project.

2 Options Assessment Overview

Throughout the life of the Project, there have been several options assessment processes. Early stages of options assessment in 2016-2018 supported the case for investment in the Project (this resulted in a SSBC). Recent options assessments were undertaken during the design and consenting phase to revisit and refine the design and support the RMA consenting process.

This section summarises the focus of the various options assessment processes.

A timeline of the options assessment is shown in

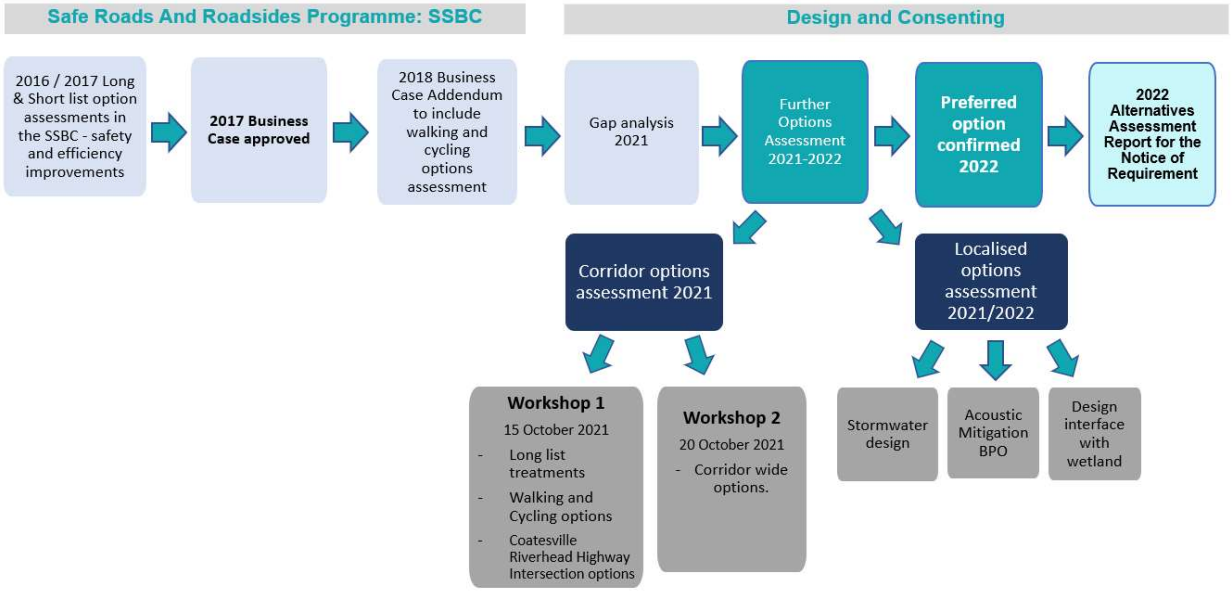

Figure 2 below.

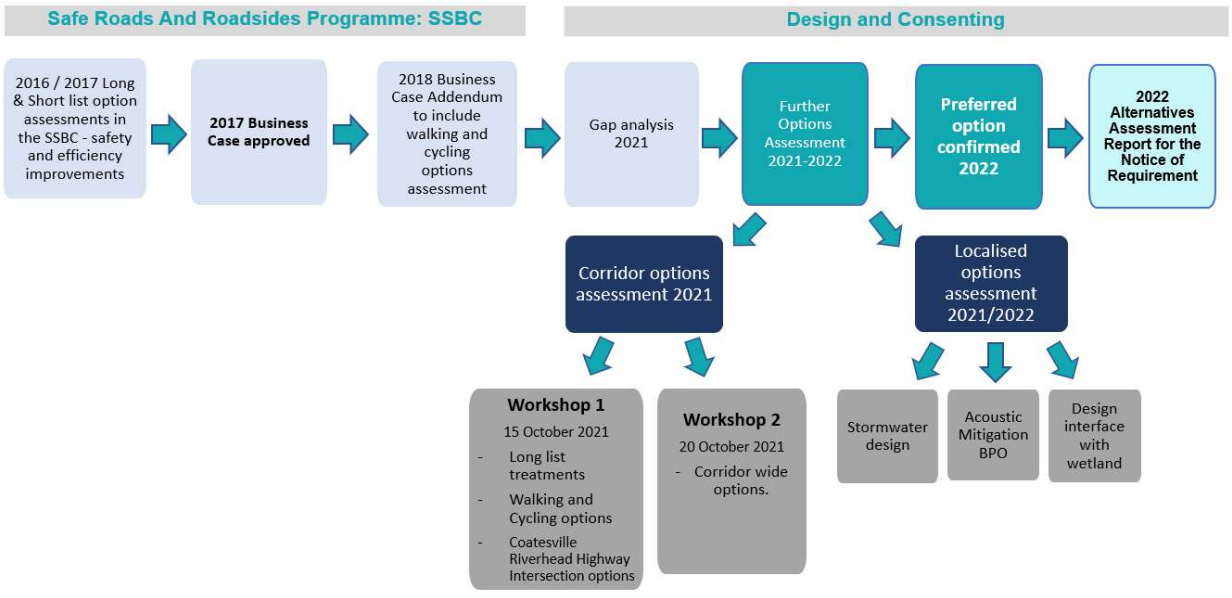

Figure 2 - A timeline of the alternative options development and assessment

2.1 Single Stage Business Case Phase

2.1.1 Corridor Sections

The SSBC split the SH16 corridor up into four sections for Stage 2 (refer to Figure 3 below):

- Section A: From Brigham Creek roundabout through to Coatesville-Riverhead Highway intersection
- Section B: The SH16 / Coatesville-Riverhead Highway intersection
- Section C: From Coatesville-Riverhead Highway intersection through to Taupaki Road / Old North Road roundabout
- Section D: From Taupaki Road / Old North Road roundabout through to Old Railway Road, east of Kumeū.

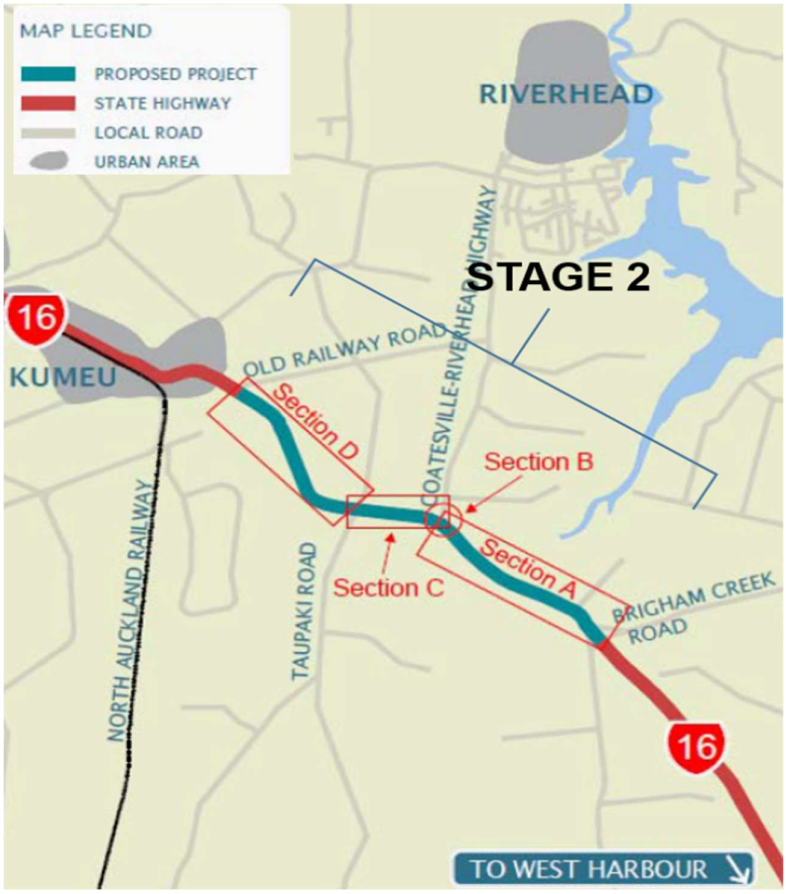

Figure 3: Section A-B in Stage 2 of the Project

2.1.2 Corridor Options Assessment

The SSBC formulated a long list of available safety and efficiency treatments, rather than options. The long list covered treatments for all sections then treatments for specific sections. Each treatment was considered at a conceptual level and assessed on an adopt/reject basis with commentary focusing on reasons around contribution to investment objectives (safety and efficiency benefits).

The adopted treatments were packaged into various shortlisted options for each section of the corridor. The shortlisted options included various safety and efficiency upgrades such as double yellow lines, wide centre line, median barriers, four laning, roundabouts, signalised intersections. There were also corridor-wide treatments that would apply to all options e.g. shoulder widening and side barriers.

The shortlisted options assessment was undertaken utilising a Multi-Criteria Analysis (MCA) Framework to determine the preferred option for each section of the SH16 Stage 2 corridor.

2.1.3 Business Case Addendum: Active Mode Facility

In 2018, a Business Case Addendum was developed due to the GPS 2018 coming into effect. The addendum considered the impact and intent of GPS 2018, specifically the opportunities for the provision of active mode (walking and cycling) facilities as a specific response to the problems and benefits of investment identified in the SSBC.

The long-list option assessment resulted in a shared use path being identified as the preferred form of a new active mode facility along the Project corridor.

The short-listed options assessment was undertaken utilising an MCA Framework to determine the preferred option in terms of the location (i.e. general route) of the new shared use path.

2.2 Detailed Design and Consenting Phase

In accordance with Section 171(1)(b) of the RMA, an Assessment of Alternatives was undertaken for the upgrade of the Project corridor (Stages 1 and 2). A number of alternative safety, efficiency and active mode improvement options were considered during the SSBC development.

Since the SSBC was approved by Waka Kotahi in 2017, there have been government policy changes and a range of new information has emerged that is of relevance to the Project and consideration of alternatives.

During the Pre-Implementation Phase, the Project Objectives were refined, further options assessment was undertaken, and the preferred option underwent detailed design to confirm the land requirement for construction and operation of the proposed improvements. Further information is provided below.

An Alternatives Assessment Gap Analysis was undertaken in August 2021. The purpose of this analysis was to revisit, review and update the alternatives assessment undertaken during the SSBC against the revised project objectives and ascertain whether any of the underlying assumptions about land use and resource management that were relied upon in identifying the preferred option had changed since the SSBC phase and what influence this would have on a revised assessment and the preferred options.

2.2.1 Refined Project Objectives

The Project Investment Objectives were reviewed October 2020 to February 2021, in light of the recent Government Policy Statement on Land Transport 2021/22 – 2030/31 (GPS 2021).

The refined and final Project Objectives are:

- Objective 1 –To improve safety on SH16 between Brigham Creek Road and Kumeū
- Objective 2 – To improve efficiency on SH16 between Brigham Creek Road and Kumeū
- Objective 3 – To provide transport infrastructure which supports modal shift.

Figure 4 - Objectives 'Line of Sight'

2.2.2 New information relevant to the Project

The Alternatives Assessment Gap Analysis identified a range of new information that had emerged since 2017 and is relevant to the Project. These include:

- New Government policy was introduced mid-late 2020, relating to resource management:

    - The National Policy Statement on Urban Development (NPS:UD) came into effect in 2020. It recognises the national significance of having well-functioning urban environments that meet the diverse needs of changing communities. It ensures there is sufficient development capacity to meet the different needs of people and communities.
    - The National Policy Statement for Freshwater Management (NPS:FM) came into effect in September 2020. It provides local authorities with updated direction on how they should manage freshwater. The NPS:FM informs the Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (NES:F), which regulate activities that pose risks to the health of freshwater and freshwater ecosystems.
- The GPS 2021 was released which identified four strategic priorities for land transport investment: safety, better travel options, improving freight connections, and climate change.
- Guidance from Waka Kotahi on Multi Criteria Analysis (MCA) was updated in August 2020.New information was available on the receiving environment for the Project works given site visits / investigations in 2021, including the final Water Classification Assessment Report (Beca, August 2021).

The Gap Analysis concluded that the previous alternatives assessment needed to be revisited in order to be retested and updated. Further consideration was also given to additional options that may have arisen since the SSBC work.

2.2.3 Further Options Assessment

During the Pre-Implementation phase, two key options assessment activities were undertaken:

- A corridor options assessment process
- Localised options assessment processes to progress detailed design, understand potential environmental effects and test mitigation options.

Corridor Options Assessment

The Project team undertook a corridor options assessment in October 2021. This involved a review of the MCA Framework and two online options assessment workshops to retest and update the options assessment scores and associated commentary.

The MCA framework used for the corridor options assessment is outlined in Section 4.1 of this report. This framework aligns with the Waka Kotahi MCA User Guidance (dated August 2020) and the Project Objectives.

The options assessment involved input from several Subject Matter Experts (SME) including the following disciplines:

- Road Safety
- Transport Planning / Efficiency
- Civil Engineering
- Transport Engineering
- Environmental Planning
- Social Impact
- Ecology
- Environmental
- Property
- Operations and Maintenance
- Stakeholder Management

- Project Management.

Workshop 1 was held on the 15th October 2021. This workshop assessed the long list of treatments (safety; efficiency), long list of walking and cycling facility options (by form and location) and covered the shortlisted options assessment for the SH16 / Coatesville Riverhead Highway Intersection (Section B).

Workshop 2 was held on 20th October 2021. This workshop covered the shortlisted options assessment for the remaining corridor wide options (Sections A-C and Section D).

A summary of the long list options assessment methodology and outcome is provided in Section 3.

Section 4 contains a summary of the corridor-wide options assessment methodology and outcome, broken down by:

- Walking and cycling options;
- SH16 / Coatesville Riverhead Highway Intersection options (Section B); and
- Corridor wide options (Sections A-C and Section D)

Localised Options Assessment

The 'localised' options assessments relate to specific areas along the project corridor that face more localised challenges. The assessments sought to understand issues, impacts, and identify a design that can mitigate the environmental challenges at these localised areas. These localised options assessments included:

- Stormwater design for the catchment flowing to Discharge Point 7
- NZ6806 noise mitigation options for various locations across the alignment
- Project design (safety, efficiency, and shared use path improvements) interface with the natural inland wetland located at 522 SH16.

Each of the above localised options assessment processes utilised a bespoke options assessment framework. Section 5 contains a summary of the localised options assessment methodology and assessment outcomes.

3 Assessment of Alternatives – Long List Corridor Treatments

The purpose of the Project is to upgrade an existing State Highway with safety, efficiency, walking and cycling improvements. The alternatives were developed in the context of treatments and options that could be applied to an existing linear 'site', being a specific section of the SH16 corridor between the Brigham Creek roundabout and Kumeū township.

The workshop process involved a systematic review and discussion of the assessment of long list treatments (safety, efficiency).

This section summarises the outcomes of the long list 'Corridor' Treatments Assessment.

3.1 Long List Assessment

3.1.1 Safety and Efficiency Improvements

A long list of corridor treatments (safety; efficiency) were generated and assessed on an 'Adopt' or 'Reject' basis against the Project Objectives. The long list of corridor safety treatments included various median treatments, roadside treatments (i.e. shoulder widening, barriers), and other treatments (curve realignment, intersection improvements, signage improvements, walking and cycling facilities). The long list of efficiency treatments (such as the provision of additional lanes, a flush median, intersection changes) were bespoke to each section of the corridor.

The long list treatment assessment, including the rationale for the suite of safety and efficiency treatments 'adopted' for further consideration, is provided in Appendix A – Long List Corridor Treatment Assessment.

The adopted treatments were packaged up into different combinations to develop a short list of corridor options. Some treatments were corridor-wide treatments meaning they would apply to all options e.g. shoulder widening and side barriers.

3.1.2 Walking and Cycling Improvements

Several potential options were identified for the 'form' of a new walking and cycling facility along SH16. These options included a shared use path, separated pedestrian facility, separated cycle facility and an on-road cycle lane. An off-road, shared use path, that provides for both walking and cycling was adopted as the preferred form and taken forward to the short list options assessment as it caters for pedestrians and targets less experienced / new cyclists who may try an off-road facility which provides a safer environment than on-road cycling. The provision of a shared use path does not preclude cyclists from cycling on the road whilst catering for both active mode users.

4 Assessment of Alternatives – Short List Corridor Options

This section summarises the assessment methodology and outcomes of the short list 'Corridor' Options Assessment.

The workshop process involved a systematic review and discussion of the assessment of:

- Shortlisted Walking and Cycling options (by form and location)
- Short listed SH16 / Coatesville Riverhead Highway Intersection options (Section B)
- Shortlisted Corridor options (Sections A - C)
- Shortlisted Corridor options (Section D).

4.1 Assessment of Short List Alternatives Methodology

An overview of the assessment of alternatives methodology used to assess the different shortlisted corridor-wide options is provided below.

MCA Framework:

An MCA Framework is an assessment tool that can provide sufficient understanding of any positive or adverse effects of the various options, and to inform any risks associated with each option. The MCA process enables Waka Kotahi to understand how different options compare against a set of multi-disciplinary and often competing criteria. An MCA Framework was developed for the Project.

The chosen criteria reflected the project objectives and was largely based on the four well-beings: Cultural, Social, Environmental and Economic. These four well-beings address the maters set out under Part 2 of the RMA. SMEs were given an opportunity to review and refine the criteria prior to the assessment.

A 7-point scoring system, supported by assessment comments, was utilised for the assessment of options.

The Cultural Criteria was developed by Mana Whenua[1]. Ngā Maunga Whakahii o Kaipara Development Trust and Te Kawerau o Maki, as the key iwi groups interested in the project and were both involved in the development of the refined cultural criteria (as well as the original MCA process during the SSBC phase). The cultural criteria was split into sub-criteria as outlined in Table 1, yet an overall option assessment was also provided. Accordingly, Mana Whenua representatives expressed their views and provided specialist cultural advice on key issues through the corridor-wide optioneering and assessment of alternatives process.

Te Kawerau o Maki finalised the overall assessment of options against the cultural criteria for the Alternatives retest. Ngā Maunga Whakahii o Kaipara Development Trust supports the response from Te Kawerau o Maki regarding the retest.

Whilst an MCA is an important and effective tool, it is noted that MCA is only one tool of many in the decision-making process.

4.1.1 Criteria

The shortlisted corridor-wide options were assessed against 12 scored criteria and 3 non-scored criteria to identify a preferred solution. The 'scored' assessment criteria and attributes are described in Table 1 below. These were carefully written to align with the Project Objectives and avoid double counting between SME.

[1] Multiple hui were held to explain the process and seek input. Two Mana Whenua groups signalled an interest in being involved in the options assessment processes. Mana Whenua reviewed and confirmed the cultural criteria including a range of sub-criteria which were key considerations to assess the options against.

Table 1: Scored assessment criteria for the Project corridor-wide options assessment

Criterion	Explanation / Measure	Subject Matter Expert
Safety	Consider safety for different types of transport users. Does this option comply with the safe system approach? Gainers/losers in terms of safety. Impacts on personal safety/security. Impact on fatal and serious incidents.	Road Safety/Transport Engineer, Civil Engineer
Efficiency	Effects on travel volumes, journey times or reliability of journey times. Gainers and losers – impacts on users and operators of different transport modes. Effects on journey times for active modes.	Transportation Planners
Systems Integration and Modal Shift	Promotion or enhancement of transport land-use integration. Function of services. Fit with wider government policy including national transport targets and priorities identified in the GPS Land Transport 2021, including provision of infrastructure that supports travel choice and modal shift.	Transportation Planners, Transport Engineer, Environmental Planner
Technical	From a technical standpoint, how straightforward it will be to implement the option (including likely social, environmental and cultural mitigation associated with the option). Also consider innovations for delivery and risks in developing and implementing the option	Civil Engineers
Operational / Maintenance	Factors which might adversely affect the ability to operate or maintain the option over its projected life without major additional costs.	State Highway Network Asset Manager
Safety in design (Zero harm)	Significant hazards that may pose a health and safety risk in the design, build and operation of the option. Consider whether safety can be developed into the design process to control it.	Transport Engineer
Social	Accessibility for transport users and others including access to jobs, communities, shops, services and other facilities. Other transport nodes supported. Impacts on community cohesion. Other community impacts i.e. construction impacts, access, severance, and amenity. Access to community areas – enhanced / reduced.	Social Impact Specialist
Natural Environment	Outstanding/Significant natural features. Effects on CMA, wetlands, lakes, rivers, streams or margins. Effects on conservation estate, areas of known biodiversity, known habitats or threatened species. Potential hazard risks e.g. fault lines, significant erosion, flooding, and sea level rise. More than 0.5ha of vegetation removal.	Environmental Specialist, Ecologist, Environmental Planners
Human Health	Risks to human health related to noise, air quality or contaminated land. Sensitive receivers within 200m. Increase / Reduction of noise and air quality effects through traffic flows or reducing/increasing road gradients. HAIL or SLUR (contaminated) sites within 200m of the area of interest.	Environmental Planners
Heritage (Archaeological, Natural and Built))	Extent of effects on - Sites and places of valued heritage buildings, trees (with heritage value). - Sites and places of archaeological value. - Sites and places of European cultural heritage value	Environmental Planners

Criterion	Explanation / Measure	Subject Matter Expert
Cultural	Potential impact of the option on: - Waahi Tohu (waahi tapu and waahi tuupuna) - Maori Archaeology - Whenua (geologic features and productive soils) - Hau Takiwa (air quality, dark skies, and viewshafts) - Moana (sea, roto/lake) - Wai Maaori (puna, awa, repo/wetland) - Rerenga Rauropi (native fauna and flora) - Tangata Ora (human safety and wellbeing)	Nga Maunga Whakahii o Kaipara Development Trust,, Te Kawerau a Maki
Property	Impacts on property. Additional property purchases required (full or partial acquisition). Property risks for delivery and management. Effects on utilities and agreements with these providers.	Transport Property Acquisition Manager

The above 'scored' assessment was supplemented by a review against 'non-scored criteria' outlined in Table 2 below. This includes quantitative criteria (cost) and other criteria (consentability and stakeholder feedback) that inform the overall decision-making process but are better suited to be external to the scored MCA process.

Table 2: Non-scored criteria for the Project corridor-wide options assessment

Criteria	Assessment Measure(s)	Subject Matter Expert
Financial considerations	• Provide an indication of likely construction and operation costs	Civil Engineer, Project Manager
Consentability	• What is the level of complexity/difficulty anticipated in gaining statutory approvals and measure of significance of costs of mitigation in order to gain statutory approvals? • Key considerations are: New designations / alterations to designations and 'avoid' policies or prohibited activities • Are there risks of this adversely impacting on required project timeframes or other aspects of delivery?	Environmental Planners
Stakeholder feedback	• Stakeholder feedback for each option identifying scale / validity of objections, identified preference / proposed changes to options etc. • Feedback provided by other key partners / stakeholders	Communications & Engagement Advisor

4.1.2 Scoring methodology

SME's were appointed to undertake an assessment of the shortlisted options against their nominated criteria which aligned with their subject matter area of expertise. The experts were required to assess the potential effects of the option in terms of magnitude of impact on the existing environment.

Table 3 below outlines the 7-point scoring system that was utilised for the assessment. A gradual scale ranging from -3 for 'significant adverse effect' to +3 'significant positive effect' was used to score the options. A neutral score is similar to a Do-Minimum scenario.

The experts were required to record their assessment commentary which explained the rationale for the assessment score given to each option.

Table 3: MCA scoring system

Rating	Definition	Score
Significantly Positive	Significant positive impact, likely resulting in long term improvements	+3
Moderately positive	Moderate positive impact, which may provide improvements and opportunities	+2
Slightly Positive	Minor positive impact	+1
Neutral	Similar impact to the do-minimum	0
Slightly Adverse	Minor adverse impact, which can be mitigated or managed	-1
Moderately Adverse	Moderate adverse impact that may be managed or mitigated	-2
Significantly Adverse	Significant adverse impact with serious long term effects	-3

4.1.3 Baseline option

The options were assessed against the Do Minimum (baseline) option in accordance with the Waka Kotahi Updated MCA Guidance published in August 2020, which was the existing environment of the corridor (without any Project improvements).

If the Do Minimum (baseline) option was assessed in its own right, it would score neutral.

The following sub-sections summarise the outcome of the 'Corridor Options Assessment'.

4.2 Walking and Cycling Short-List Options Assessment

Three shortlisted walking and cycling 'location' options were considered for the shared use path, including:

- Option 1: A shared use path along each side of the SH16;
- Option 2: A shared use path along the northside of SH16; and
- Option 3: A shared use path along the south side of SH16.

These options are detailed in Appendix B – Walking and Cycling Options.

4.2.1 Shared Use Path: MCA Assessment

An assessment of the options was undertaken using the shortlisted option MCA Framework. The detailed MCA is provided in Appendix C – Walking and Cycling Option Assessment. Table 4 below provides a summary of the option assessment scores.

Table 4: MCA assessment scores for short listed walking and cycling options

Criterion	Option 1: Both sides	Option 2: North side	Option 3: South side
Safety	+3	+2	+2
Efficiency	+3	+2	+2

Systems Integration and Modal Shift	+3	+1	+2
Technical	-2	-1	-1
Operational/ Maintenance	-2	-1	-1
Safety in design consideration (Zero Harm)	-2	-1	-1
Social	+3	+2	+2
Natural environment	+1	+1	+1
Human health	0	0	0
Heritage (Archaeological, Natural and Built)	-1	0	0
Cultural	-1	+2	+1
Property	-2	-1	-1

Table 5 below summarises the commentary on each option including the key reasons options were discounted and why the recommended option was chosen.

Table 5: Summary of the assessment of each option.

Option	Assessment Analysis
Option 1 A shared use path along each side of SH16	This option was discounted for the following reasons: • Option 1 scored a +3 for Safety as it provides for users on both sides of the state highway and removes the need for users to cross the highway in order to use the path. There is a greater safety risk to cyclists and pedestrians from the increased number of vehicle crossings which exposes them to potential collisions. This includes heavy vehicle access to a landfill site, a large number of driveways, Riverhead Road, Old Railway Road and Coatesville Riverhead Highway. However, the exposure to this risk is assumed to be less in Option 1 compared to other options as the presence of active users is split to either side of the facility. • Option 1 scored a -2 for Technical as it will require three new bridges, one on each side of Brigham Creek culvert due to the required additional width of the shared use path and one over Kumeū River. Additionally, the Regional Variable Message Sign (VMS) is located on the north side of the highway near Brigham Creek culvert. Option 1 and Option 2 will require the potential relocation of the Regional VMS. • Option 1 scored the lowest against the Heritage effects criteria due to potential impacts on heritage values (which are located on both sides of SH16) due to encroachment into the Historic Heritage Extent of Place overlay for Sinton House and the group of notable trees at 191 SH16. • Option 1 had the lowest score against the Cultural effects criteria, primarily due to the larger footprint. • Option 1 scored -2 for property effects due to it requiring land on both sides of the State Highway (i.e. twice the amount of the other options). In addition, Option 1 will require additional maintenance given the larger footprint when compared with Options 2 and 3. **Non-scored criteria:** • Option 1 results in a land requirement on both sides of the corridor and therefore more land overall than the other options. This would require an increase in designation footprint. This alongside other approvals, means it is potentially more complex for consenting as it would be hard to justify the need/requirement for a SUP on both sides of the SH. • Option 1 is the most expensive option.
Option 2	This option was discounted for the following reasons:

Option	Assessment Analysis
A shared use path along the north side of SH16	• There is a safety risk with having a shared path on one side of the carriageway, as people may want to cross the state highway to access various facilities. As with Option 1, the proposed shared path will be in close proximity to a number of residential properties with short driveways along the north side of the highway. This will require significant accommodation works within the affected private properties such as the residential properties between Brigham Creek Road and Kennedys Road, Kumeū Produce Market, lifestyle properties between Taupaki Road and Old Railway Road, Building Blocks Childcare, Juice Strawberry Shop, Kumeū Village Rest Home. The shared use path would also have five local side road conflict points (whereas Option 3 would have less). • Option 2 scored the lowest against Systems Integration and Modal Shift as Options 1 and 3 provide better connectivity to existing cycle facilities (from Fred Taylor Drive and Access Road) and can potentially provide the longest uninterrupted travel due to the higher number of side roads and vehicle crossings located on the north side. • The Regional VMS is located on the north side of the highway near Brigham Creek culvert which may need to be relocated as part of this option. • Option 2 scored the same as Option 3 against Technical, Operation/Maintenance and the Safety in Design criteria where Option 1 scored the lowest in each. • Option 2 is the preferred option under the Cultural criteria. Option 2 is preferred as it has the smallest footprint in sensitive areas such as streams, it would utilize the existing footbridge at Kumeū Bridge and reduce the works in and around the stream. • Option 2 requires land from an additional 8 properties (permanently) with a total additional area of approximately 8,300m² required so it scored better than Option 1. Option 3 scored the best against this criterion. **Non-scored criteria:** • Option 2 has similar consenting requirements to Option 3 as the land requirements are largely confined to one side of the road. • Option 2 is the second most expensive option.
RECOMMENDED **Option 3** A shared use path along the south side of SH16	Option 3 was the preferred option for the following reason: • There is a safety risk with having a shared path on one side of the carriageway, as people may want to cross the state highway to access various facilities. However, Option 3 will still provide the longest uninterrupted pathway from vehicle crossings, improving the safety of the shared path. Whilst scoring the same as Option 2, Option 3 has a lower number of local side roads and vehicle crossings that users have to cross compared with Option 2. The uninterrupted access provided by Option 3 also requires significantly less land impact than Option 1 or Option 2. • Option 3 scored +2 for Systems Integration and Modal Shift as it has better connectivity to the current north-western cycle facility (from Fred Taylor Drive) and it is anticipated to connect to the existing Auckland Transport cycleway at Access Road (as they are on the same side of the road). • Option 3 does not require any work at Boric Market and Kumeū Produce Market which have high traffic movements, allowing a safer construction process. Option 3 will have no significant Safety in Design risks, any minor risk can be managed through standard management process. • Option 3 scored the same and Option 2 and better than Option 1 against the Technical criterion. Existing retaining walls will need to be laterally shifted to

Option	Assessment Analysis
	allow for the 3.5m wide shared path. Subsequently, this may require larger retaining walls. • Option 3 will also have heritage and ecological risks as the path will encroach into the Historic Heritage Overlay Extent of Place for Sinton House and natural wetlands near the project corridor. However, it scored the same as Option 2 but better than Option 1 against the Heritage criterion and the same as other Options against the Natural criterion. • Option 3 scored the same as Option 2 against the Property criterion. Both of these options scored better than Option 1 however, Option 3 requires slightly less land area and impacts less properties than Option 2. **Non-scored criteria:** • Option 3 has similar consenting requirements to Option 2. • Option 3 has the lowest cost of all three options.

Overall, Option 3 was preferred as it improves Safety, will provide less Technical and Property challenges than Option 1, was viewed positively by mana whenua and was a lower cost option than Option 1 and Option 2.

In summary, the preferred option (Option 3), being a shared use path on the south side of SH16, was selected for the following reasons and added as a common element to each of the options considered in other stages of the option assessments:

- Improves safety for pedestrians and cyclists between Brigham Creek Road and Kumeū
- Provides a safe connection into the existing north-western cycle facility from Fred-Taylor Drive.
- Provides connectivity to the Heartland Ride 'Kaipara's Missing Link' (a key link between Auckland and Northland's touring routes and Great Rides) that dissects the corridor at Old North Road
- Provides the longest uninterrupted active travel path. The south side of SH16 has the least number of side roads and vehicle crossings.
- Enhances connectivity and transport mode choice for the Kumeū / Huapai communities.
- Continues promotion of walking and cycling as an attractive and viable means of transport.
- The south option provides fewer technical challenges than providing a path on both sides of the road.
- Provides a recreational walking and cycling route for the area that will promote tourism – connecting to wineries, cafes and attractions.
- Lesser infrastructure to be constructed and reduced ongoing operational and maintenance costs
- Less programme duration for construction as only construction on one side of the highway
- Improved social outcomes through accessibility to shops, jobs and services
- Less landscape impacts through less land modification and retaining walls.

4.3 Section B Short List Options Assessment

The location of Section B within the wider Project Corridor is illustrated in Figure 5 below.

The preferred safety and efficiency improvements to the SH16 / Coatesville Riverhead Highway intersection (Section B) influence what improvements are feasible on either side of this intersection within Section A and Section C. Therefore, Section B was assessed separately to determine a preferred option which was then

added as a ‘common’ element to the remaining options assessments for Sections A and C.

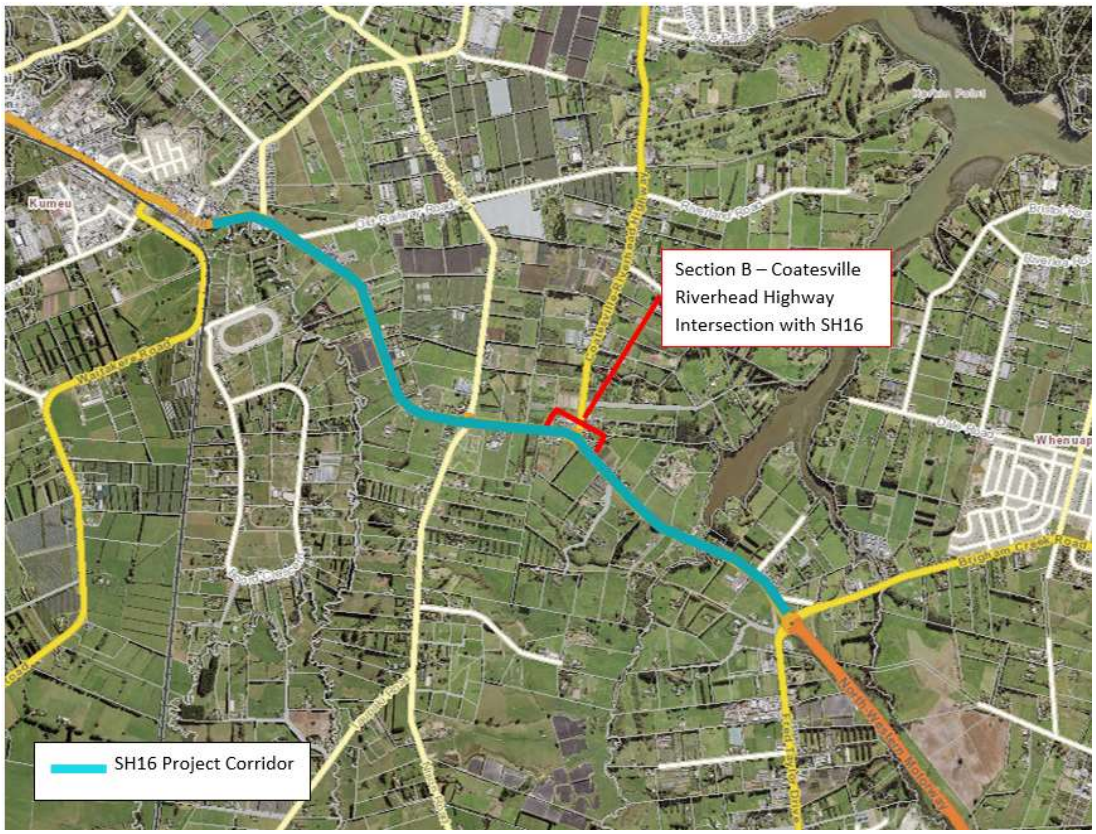

Figure 5: Section B on the SH16 Stage 2 Project Corridor.

Four shortlisted options were considered for the SH16/Coatesville-Riverhead Highway intersection:

- Option 1: Roundabout (with form being a 2-lane roundabout configuration)
- Option 2: Signalised seagull
- Option 3: Signalised intersection
- Option 4: Slip lane

Each option assessed involved four laning (or one additional lane) in Section A and Section C, either side of the potential Coatesville Riverhead intersection. Adding to the existing single lane each way in these sections was the only option to improve efficiency either side of the intersection. Section B was always assessed with Section A or C. As these options were assessed together, to maintain efficiency and minimise potential conflict points where SH16 and Coatesville Riverhead Highway intersect, the roundabout (RAB) was designed to be two lanes to integrate with the additional lanes on either side of the RAB as merging at the RAB to one lane would not be efficient or feasible.

The SSBC outlines existing congestion issues from 2015, which noted congestion at the Taupaki Road RAB where cars have to merge in and out of the two lane roundabout. To reduce this congestion issue, additional lanes in Section A and C were considered to remove the merging conflict points (at both Brigham Creek and Taupaki RAB). The existing road context means a one lane roundabout is not a feasible option as it would cause another conflict point along the alignment where cars would need to merge and induce more congestion, safety risks and a longer travel time.

These are detailed in Appendix D Coatesville Riverhead Highway Intersection Options.

4.3.1 Section B: MCA Assessment

An assessment of the options was undertaken using the shortlisted option MCA Framework. The detailed MCA is provided in Appendix

E – Section B: Coatesville Riverhead Highway Intersection Option Assessment. Table 6 below provides a summary of the option assessment scores.

Table 6: MCA scores for Section B options assessment

Criterion	Option 1: Roundabout	Option 2: Signalised seagull	Option 3: Signalised intersection	Option 4: Slip lane
Safety	+2	+1	+1	0
Efficiency	+2	+1	+1	0
Systems Integration and Modal Shift	+2	+1	+1	0
Technical	-2	-1	-1	0
Operational/ Maintenance	-2	-1	-1	0
Safety in design consideration (Zero Harm)	0	0	0	0
Social	+1	+1	+2	+1
Natural environment	0	0	0	0
Human health	0	-1	-1	0
Heritage (Archaeological, Natural and Built)	0	0	0	0
Cultural	+1	-1	-1	0
Property	-1	-1	-1	0

Table 7 below summarises the commentary on each option including the key reasons options were discounted and why the recommended option was chosen.

Table 7: MCA assessment for Section B options assessment

Options	Assessment Analysis
RECOMMENDED **Option 1** Roundabout	The roundabout was the recommended option for the following reasons: • The roundabout was considered the safest design, as roundabouts generally provide a safer alternative to signalised and other unsignalised intersections. The speed of all vehicles can be reduced at the conflict points, reducing the risk of fatal and serious injuries. Crash reductions at roundabouts are primarily attributed to two factors, reduced traffic speeds and elimination of high-energy conflicts that typically occur at other types of at-grade intersections. • Facilities for cyclists crossing and turning can be provided in the design similar to Taupaki roundabout. • The roundabout scored the highest for Efficiency as it will reduce the existing congestion (particularly along Coatesville Riverhead Highway) and would create a Level of Service B (AM peak) and C (PM peak) (modelled for the year of 2026). • Regarding System Integration and Modal Shift, there are currently 2 existing roundabouts within the SH16 Stage 2 corridor extent. Provision of a roundabout at the Coatesville-Riverhead Highway (CRH) intersection scored the best as it would be consistent with the existing Taupaki roundabout to the north and the existing Brigham Creek roundabout to the south (the adjacent intersections). This would provide the customer with a consistent journey. The two lane roundabout will integrate well with the four lanes north to the Taupaki roundabout and the proposed four lane capacity improvement option between the CRH and the Brigham Creek

Options	Assessment Analysis
	Roundabout. The roundabout also acts as a safe turnaround facility for road users. The proposed wire rope median barriers will prohibit road users from turning in other locations. The roundabout also provides the opportunity for a fourth leg in the future as the area urbanises. • The roundabout will have Technical and Operation and Maintenance constraints since a roundabout has the largest footprint. • The roundabout scored the highest from a Cultural perspective as it improves road safety and is the only option to provide a space for cultural interpretation. • The roundabout has positive Social benefits. The proposed design will make accessing and exiting popular local businesses on Coatesville-Riverhead Highway such as Boric Food Market and Blossoms Café safer for all users, compared to the existing T-intersection which has a history of unsafe vehicle movements and incidents which impact on community well-being. • The roundabout scored neutral against Human Health (which was better than the signalised intersections). The proposed solution will reduce congestion at the intersection, particularly congestion backed up along CRH, resulting in less stationary traffic. When compared to the signalised options, the Roundabout option would provide a more balanced approach to delays to all approaches. The Roundabout option has therefore been ranked slightly higher than two of the alternatives in terms of effects on air quality. **Non-scored criteria:** • The options were made public during an open day and were available online for viewing. The majority of the community and stakeholders surveyed in during public consultation for the business case phase preferred the roundabout option. During this time, initial conversations were held with the owners of Boric Food Market who did not oppose the acquisition of some of their land for a roundabout.
Option 2 Signalised Seagull	This option was discounted for the following reasons: • Did not provide the level of road safety design as the roundabout. • Did not provide the level of efficiency as the roundabout. • Did not integrate well with existing intersection designs and Brigham Creek and Taupaki • This design integrates better with bus services along the corridor • Scored slightly negative against Human Health as there could be more temporary queues that increase the noise of traffic near dwellings. • Scored slightly negative against Cultural as it does not provide for cultural interpretation like the roundabout can and requires more impervious surface area than the roundabout.
Option 3 Signalised intersection	This option was discounted for the following reasons: • Did not provide the level of road safety design as the roundabout. • Did not provide the level of efficiency that that the roundabout provides. • Did not integrate well with existing intersection designs and Brigham Creek and Taupaki • The traffic lights would support bus, cycle, and pedestrian movements better than other options • Scored slightly negative against Human Health as there could be more temporary queues that increase the noise of traffic near dwellings.

Options	Assessment Analysis
	• Scored slightly negative against Cultural as it does not provide for cultural interpretation like the roundabout can and requires more impervious surface area than the roundabout.
Option 4 Slip lane	This option was discounted for the following reasons: • This option scored neutral for Safety as it would not address historic or current safety issues at this intersection. A slipe lane still has a risk of high severity outcomes from T-bone type crashes. • The slipe lane has a neutral score for Efficiency as it will only allow more left turns out of CRH. This only improves one movement. The overall intersection LOS is unacceptable with significant delays expected on the east approach and CRH approach. A zero score is given as this does not make any significant improvement to the intersection. • The design does not integrate well with bus services provided along the corridor, as the existing bus stop is located at the turning point of the corridor which cannot be easily accessed by pedestrians • Scored neutral for Cultural as it does not provide for cultural interpretation like the roundabout can

The recommended option (Option 1), being a roundabout, was selected as it scored the best against the project objectives (safety, efficiency and modal shift).

The roundabout option is considered to be more consistent with the intersection designs at Taupaki and Brigham Creek and with the existing corridor treatments in this peri-urban environment. The 2-lane roundabout will require 4-laning of SH16 to the west to tie-in with the new 2-lane roundabout at the Taupaki Road intersection. It integrates well with the proposed SH16 4-lane capacity improvement option between the Coatesville Riverhead highway and the Brigham Creek Road roundabout. The implementation of the roundabout also provides an opportunity to improve the existing bus stop facility with a formed and marked bus stop bay in front of Boric Food Market on State Highway 16.

4.4 Section A and C Short List Options Assessment

4.4.1 Section C: Coatesville Riverhead Highway Intersection to Taupaki Road Roundabout

The location of Section C within the wider Project Corridor is illustrated in Figure 6 below.

Due to the proposed two lane roundabout at the Coatesville Riverhead Highway intersection (Section B)[2] and the existing two lane roundabout at the Taupaki Road intersection, it was determined that there was only one practical option for Section C: Coatesville Riverhead Highway Intersection to Taupaki Road Roundabout. A one lane option was not feasible and was fatally flawed. Accordingly, it was not included as an option. The inclusion of one lane would have potentially increased safety and congestion issues from vehicles being required to merge. Additionally, this section of the corridor is relatively short (approximately 550m) between the existing roundabout at the Taupaki intersection and the Coatesville-Riverhead Highway intersection which would likely compound potential single lane merging, safety and congestion issues.

[2] As noted above, a one lane roundabout was not considered a feasible option as it would cause another conflict point along the alignment where cars would need to merge and induce more congestion, safety risks and a longer travel time. A one lane roundabout option was therefore fatally flawed.

The two lanes each way option allows for efficient traffic flow between the two roundabouts, plus the installation of a median barrier which is appropriate given the two roundabouts act as a turnaround facility placed 700m apart.

Therefore, the two lane option was added for Section C and was assessed during the Section A-C options assessment.

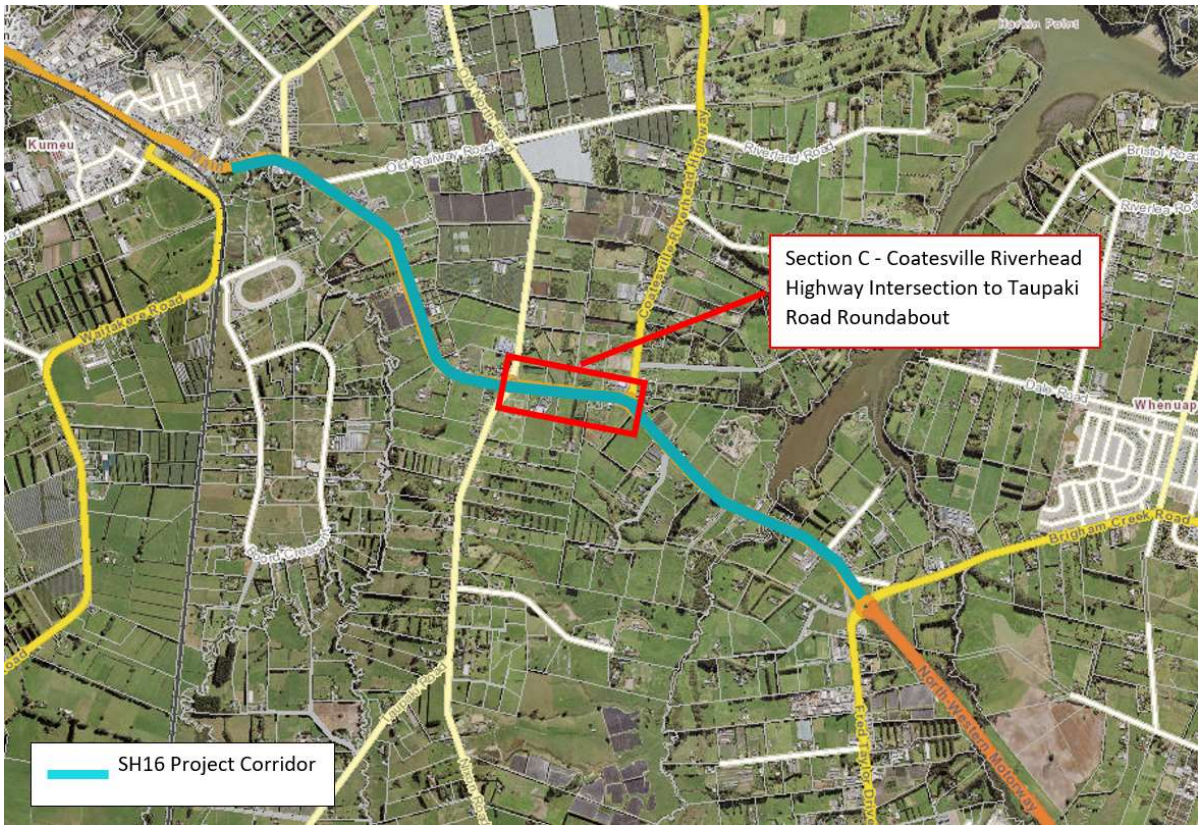

Figure 6: Location of Section C in the SH16 Stage 2 Project Corridor.

4.4.2 Section A-C: Brigham Creek Road to Taupaki Road Roundabout

The location of Section A within the wider Project corridor is illustrated in Figure 7 below.

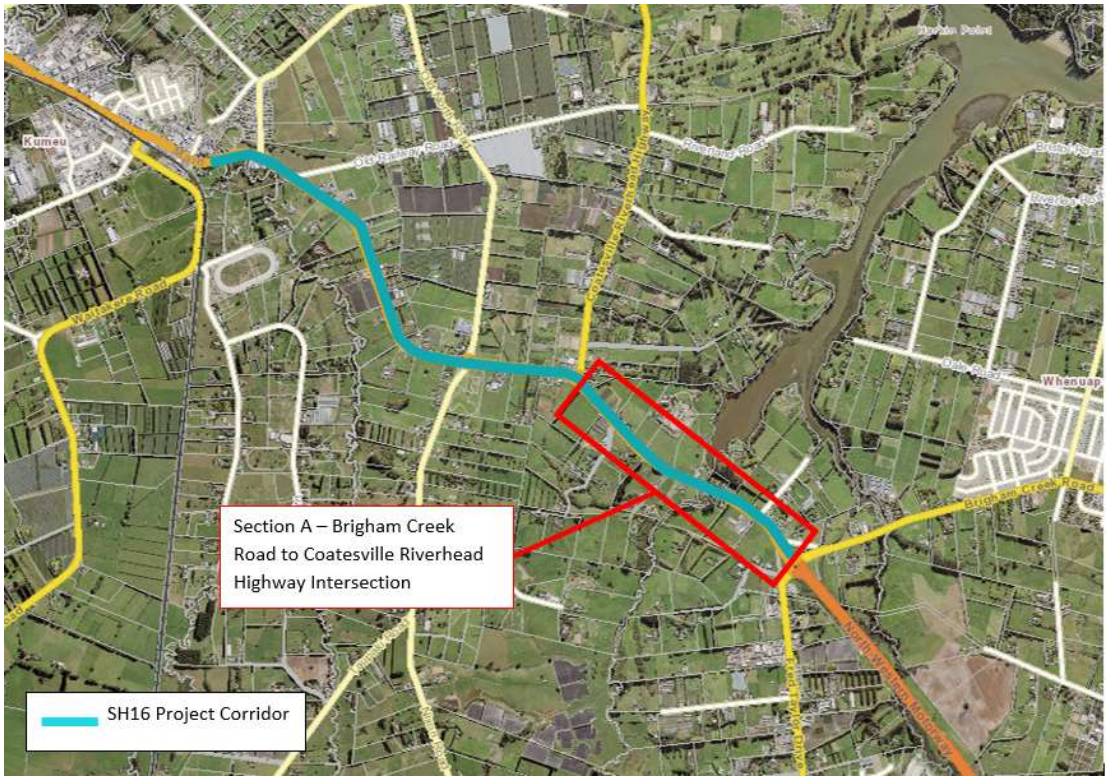

Figure 7: Section A of SH16 Stage 2 Project Corridor.

Three shortlisted options were considered for Section A-C, from Brigham Creek Roundabout to Taupaki roundabout, with each option including road widening to allow for the installation of median barriers, plus the 'common elements' (shoulder widening, side barriers, shared use path on south side, roundabout at Section B: SH16/Coatesville Riverhead Highway intersection, plus two lanes each way through Section C):

- **Option 1:** Existing layout of the corridor though Section A, with the addition of median barriers
- **Option 2:** Existing westbound corridor layout through Section A, with an additional lane eastbound[3], with the addition of median barriers
- **Option 3:** Provision for 2 lanes in each direction through Section A, with the addition of median barriers.

These are detailed in Appendix F – Section A-C: Brigham Creek Road to Taupaki Road Roundabout Options.

4.4.3 Section A-C: MCA Assessment

An assessment of the options was undertaken using the shortlisted option MCA Framework. As with previous assessments, each option was assessed against the baseline (being the existing environment). The detailed MCA is provided in Appendix G – Section A-C Brigham Creek Road to Taupaki Road Roundabout Option Assessment.

[3] As part of the Long List Treatment Assessment, the efficiency treatments for Section A included four-laning and an additional east bound lane specifically to improve the AM travel time. Traffic modelling (Flow Transportation, August 2017) demonstrated that Section A eastbound is already at capacity, with most of the traffic joining the SH16 corridor from Old North Road, Taupaki Road and Coatesville-Riverhead Highway. In addition, forecast vehicle trip demand for SH16 eastbound will increase by 115% between 2013 and 2046. As the focus was on improving the efficiency of the AM travel time, a treatment option of an additional westbound lane only was not considered.

Table 8 below provides a summary of the option assessment scores.

Table 8: MCA scores for Section A-C options assessment

Criterion	Option 1: Median barriers	Option 2: Additional lanes eastbound and barriers	Option 3: Additional lanes east and west, and barriers
Safety	+3	+3	+3
Efficiency	0	+1	+2
Systems Integration and Modal Shift	+1	+1	+1
Technical	-1	-2	-2
Operational/ Maintenance	-2	-1	-1
Safety in design consideration (Zero Harm)	0	0	0
Social	0	+1	+2
Natural environment	+1	+1	+1
Human health	0	-1	-1
Heritage (Archaeological, Natural and Built)	-1	-1	-1
Cultural	+2	+1	-1
Property	-1	-1	-2

Table 9 below summarises the commentary on each option including the key reasons options were discounted and why the recommended option was chosen.

Table 9: Summary of the assessment of each option.

Options	Assessment Analysis
Option 1 Existing layout of the corridor, with the addition of median barriers, minor road widening,	This option was discounted for the following reasons: • In terms of Efficiency, capacity improvements included in Option 1 are limited to this section as there are no additional lanes provided east of the Coatesville Riverhead Highway intersection. Therefore, this is considered to be only a minor improvement, as the benefit is limited to the westbound PM peak (160 seconds) and is therefore scored the worst of the three options. • This design scored the worst (-2)against Operation and Maintenance, as it reduces workable space for maintenance. Routine maintenance works will create traffic congestion. Due to traffic volumes, work will have to be undertaken at night with one lane closed and traffic working on stop go in the alternate carriageway.
Option 2 This option comprises the existing westbound corridor layout, and provides for an additional lane eastbound, with the addition of median barriers	This option was discounted for the following reasons: • Option 2 scored a +1 for Efficiency as it will increase capacity eastbound but did not score as well as Option 3 as it does not also include additional westbound widening or increase access to local business when compared with Option 3. • In terms of Technical, Option 2 scored -2 (the same as Option 3) due to the additional land requirement on the north side, complexity of retaining required above the Brigham Creek Culvert, consideration of the international cable and potential to encroach further into 191 SH16 (where notable trees that have protected heritage value are located).

Options	Assessment Analysis
	• Option 2 scored the same as Option 3 against Operational/Maintenance (-2) as Option 3 requires more maintenance due to its larger footprint.
RECOMMENDED **Option 3** This option provides for 2 lanes in each direction, with the addition of median barriers	This option was chosen as the recommended option for the following reasons: • Option 3 scored a +3 against Safety (same as other options). • Option 3 scored the best against Efficiency as it provided the most efficiency improvements for the road network with the additional lanes in each direction despite introducing a roundabout and slowing down traffic through section B. • The improved capacity will strengthen the resilience of the road network. This will benefit all users including freight, businesses, and local and regional through-traffic. • Option 3 scored -1 against Operational/Maintenance (the same as Option 2) however it was preferred from maintenance perspective as Option 3 will allow more space for vehicles to stop with four lanes as a lane can be closed and traffic can be directed into the other lane for emergency and maintenance works. Four lanes provide greater flexibility to safely manage an incident. • Option 3 scored the best against Social with a +2 as the increase capacity of four lanes will increase accessibility and improve journeys for people in the local community. • All options scored +1 against Natural Environment as they will introduce water quality treatment for all new impervious surfaces where treatment was not previously required. This would improve the quality of stormwater runoff that enters surrounding waterways and result in increased vegetation mitigation that can contribute to existing ecological values.

Overall, Option 3 (additional lanes each direction with median barriers) was selected as the recommended option as it scored the best against the project objectives (safety and efficiency). Whilst Option 3 had mixed scores against all other criteria when compared with Options 2 and 3, these adverse effects can be mitigated through design and works management.

4.5 Section D: Taupaki Road Roundabout to Kumeū Town Centre

The location of Section D within the wider Project corridor is illustrated in Figure 8 below.

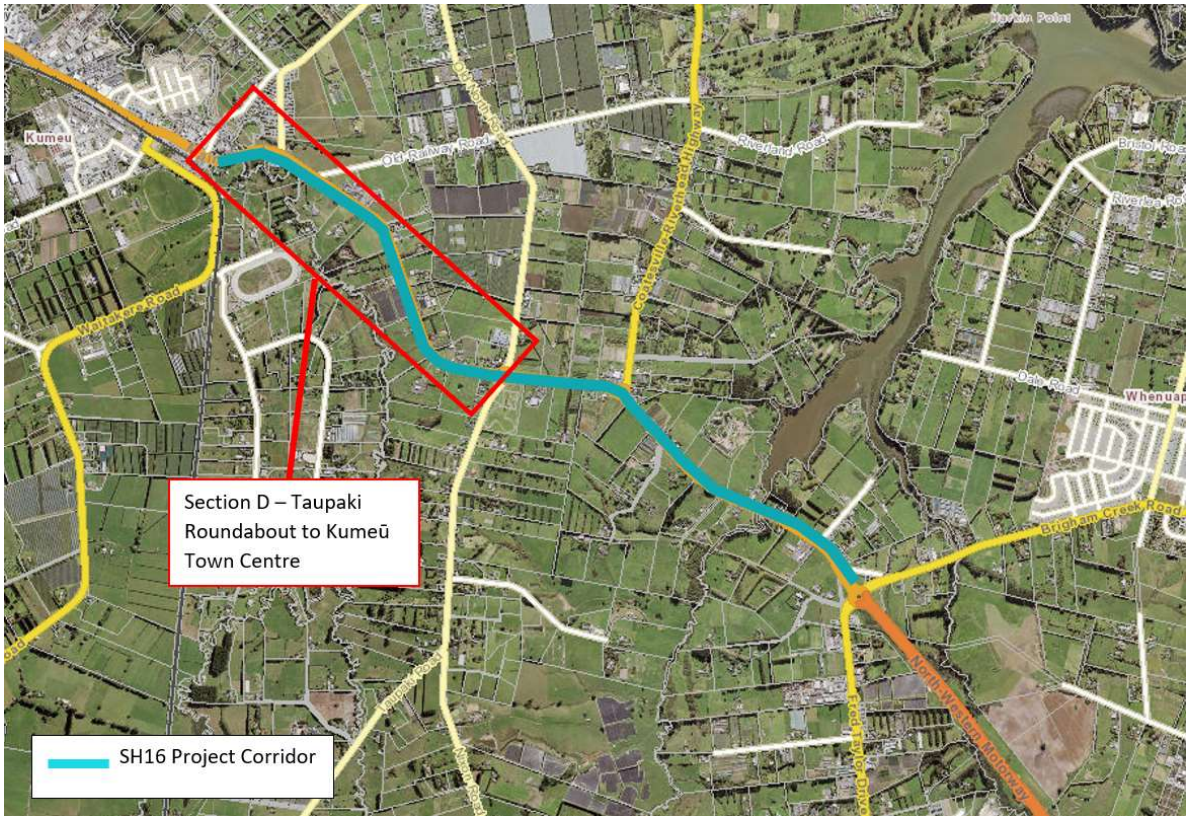

Figure 8: Section D of the SH16 Stage 2 Project Corridor.

Five shortlisted options were considered for Section D, from Taupaki roundabout to Weza Lane in Kumeū. Each of these five options include the 'common elements' (shoulder widening, side barriers, shared use path on south side):

- **Option 1:** Existing layout of the corridor with addition of double yellow line median
- **Option 2:** Existing layout of the corridor with addition of wide centreline
- **Option 3:** Existing layout of the corridor with addition of flush median
- **Option 4:** Existing layout of the corridor with addition of wire median (turnarounds required)
- **Option 5:** Existing westbound corridor layout, and provides for an additional lane eastbound, with the addition of wire median (turnarounds required).

These options are detailed in Appendix H – Section D: Taupaki Road Roundabout to Kumeū Town Centre Options.

4.5.1 Section D: MCA Assessment

An assessment of the options was undertaken using the shortlisted option MCA Framework. As with previous assessments, each option was assessed against the baseline (being the existing environment and described as the 'do minimum'). The detailed MCA is provided in Appendix I – Section D: Taupaki Road Roundabout to Kumeū Town Centre Options Assessment. Table 10 below provides a summary of the option assessment scores.

Table 10: MCA scores for Section D options assessment

Criterion	Option 1: Double yellow	Option 2: Wide centreline	Option 3: Flush median	Option 4: Wire median and	Option 5: Additional lane

	line median			turnarounds	eastbound, wire median and turnarounds
Safety	+2	+2	+2	+3	+3
Efficiency	+1	+1	+1	+1	+1
System Integration and Modal Shift	+1	+1	+1	+1	+1
Technical	-1	-1	-1	-2	-2
Operational/ Maintenance	0	0	-1	-2	-1
Safety in design consideration (Zero Harm)	0	0	0	0	-1
Social	+1	+1	+1	-1	-1
Natural environment	+1	+1	0	0	-1
Human health	0	0	0	0	-1
Heritage (Archaeological, Natural and Built)	0	0	0	0	0
Cultural	+1	0	-1	+1	-2
Property	-1	-1	-1	-1	-2

Table 11 below summarises the commentary on each option including the key reasons options were discounted and why the recommended option was chosen.

Table 11: Summary of the assessment of each option.

Options	Assessment Analysis
Option 1 Existing layout of the corridor with addition of double yellow line median	Options 1 and 2 are similar in design and received the same scores, therefore these options will be discussed together in this table. The only exception was the score for cultural effects, with Option 1 being assessed more positive than Option 2 in terms of Tangata Ora because a double yellow line median (option 1) provides a visual separation and is safer than a wide centreline (option 2) which was assessed as relatively neutral. Options 1 and 2 were discounted for the following reason: • These types of medians do not significantly improve the safety of this section of the highway corridor compared to the other options.
Option 2 Existing layout of the corridor with addition of wide centreline	
RECOMMENDED **Option 3** Existing layout of the corridor with addition of flush median	Option 3 was the recommended option for the following reasons: • Option 3 scored a +2 for Safety (along with Options 1 and 2) as the addition of a flush median will provide a refuge area for turning vehicles, reducing the risk of rear-end crashes. The addition of a flush median to separate the traffic lanes would also improve the safety of the corridor to justify maintaining the existing speed limit of 80km/hr. Treatments such as safe hit posts and profiled markers could be considered to encourage overtaking in the median which would undermine the safety improvement. • Option 3 maintains access to businesses and residential properties compared to Options 4 and 5, as a safer space for vehicles is accommodated in the flush median to allow turning in and out of properties and businesses. • Option 3 does not preclude the installation of median barriers in the future. • Option 3 does not preclude a future speed reduction as the area urbanizes.

Options	Assessment Analysis
	• Traffic modelling that supported the optioneering (Flow Transportation, August 2017) concluded that until more significant capacity and additional transport solutions are provided to the Kumeu/Huapai area to serve the future North-West growth area (via Supporting Growth Programme), the current delays experienced in Section D will continue and additional lanes cannot be justified. This is because any additional lanes (i.e. Options 4 and 5) would not achieve efficiency improvements sought by the investment due to the SH16 corridor being saturated by 2036 due to the upstream issue of the SH16/Access Road intersection traffic volumes which constrain the wider corridor's capacity and flows. **Non Scored Criteria:** • The community supported a flush median to maintain access. • Similar in cost to Options 1 and 2, all of which are considerably lower than Options 4 and 5
Option 4 Existing layout of the corridor with addition of wire median (turnarounds required)	This option was discounted for the following reasons: • Regarding efficiency, some businesses along the corridor would be affected by the median barrier. People accessing the businesses would be required to travel to the nearest turnaround facility to access their destination, adding to their journey time. This additional distance travelled is between approximately 2.6km and 3.8km to certain businesses and residential properties, depending on the restricted movement. • In regard to the Social criteria, Options 4 and 5 scored negatively as they will represent more construction impacts for people and businesses in the area (although they will be temporary effects). The wire medians for both Options 4 and 5 will restrict access to dwellings and places of work. • Options 4 (and 5) contain turnaround facilities which will increase volume of traffic (including heavy traffic) and noise on the side roads where the turnaround facilities are located. These factors influenced the human health scores. • Options 4 and 5 would require more land to provide turnaround facilities. • Option 4 will reduce the space required for maintenance due to the median barrier, thus scoring -2 for maintenance. **Non Scored Criteria** • Option 4 and 5 were also considerably more expensive than other options.
Option 5 Existing westbound corridor layout, and provides for an additional lane eastbound, with the addition of wire median (turnarounds required).	This option was discounted for the following reasons (in addition to the matters outlined above): • The additional lane requirement only offered marginal capacity improvements due to the constraint at Access Road intersection in Kumeū town centre, which limits the volume of traffic that could travel through the corridor.. • Option 5 has the largest footprint (including turnaround facilities) and thus imposes Property and technical challenges. • Option 5 received a -1 score for Human Health. Option 5 has a more negative score as the additional lane will increase the proximity of the highway to houses and other sensitive receivers. **Non Scored Criteria** • Option 4 and 5 were also considerably more expensive than other options

Overall, Option 3 (existing layout of the corridor with addition of flush median) was selected as the recommended option as:

- Option 3 scored positively against the project objectives (safety and efficiency) and would improve the safety of the corridor more than Options 1 and 2 .
- Whilst Options 4 and 5 scored better against safety, Option 3 scored better against all other criteria
- In terms of non-scored criteria, Option 3 is less expensive than Options 4 and 5 and was also supported by the community.

4.6 Summary of Waka Kotahi Preferred Corridor Options

Corridor Section	Preferred Option
A-D Active Mode Facility	A shared use path along the south side of SH16
A	Two lanes each way plus the installation of a median barrier
B	Roundabout
C	Two lanes each way plus the installation of a median barrier
D	Existing layout of the corridor with addition of flush median

5 Assessment of Alternatives – Localised Options

This section summarises the localised options assessment process.

Three localised options assessments were undertaken, including:

1. An assessment of the stormwater design options at 'Discharge Point 7' (DP7)
2. An assessment of noise mitigation options at various locations across the alignment
3. An assessment of the Project design interface with the natural inland wetland at 522 SH16.

Each of these assessment processes used a bespoke MCA Framework that was developed by the Project team in partnership with Mana Whenua to enable a robust and transparent design refinement process.

5.1 DP7 Stormwater Design Assessment

Following site investigations, preliminary design and initial technical assessments, it was determined there were multiple options for the stormwater diversion and discharge at DP7.

5.1.1 Existing stormwater discharge at DP7

DP7 is located between SH16 / Taupaki Road roundabout and Kumeū Township, on the western side of SH16 in the vicinity of 464 SH16 and 472 SH16. The stormwater from the wider stormwater catchment and SH16 currently discharges to 464 SH16 through a piped stormwater network and overland flow path. The catchment area is approximately 16 hectares and can be seen in Figure 9 below. At the western end of 464 SH16, there is an existing stormwater pond that attenuates stormwater runoff before discharging to Kumeū River. This pond is located on private property. It is understood from previous discussions with the landowner of 464 SH16 that the stormwater pond is also used to irrigate the strawberry farm on the property known as Phil Greig Strawberry Gardens. Waka Kotahi would need to acquire property rights in relation to the pond and retrofit it in order to provide for treatment of runoff prior to discharging into Kumeū River.

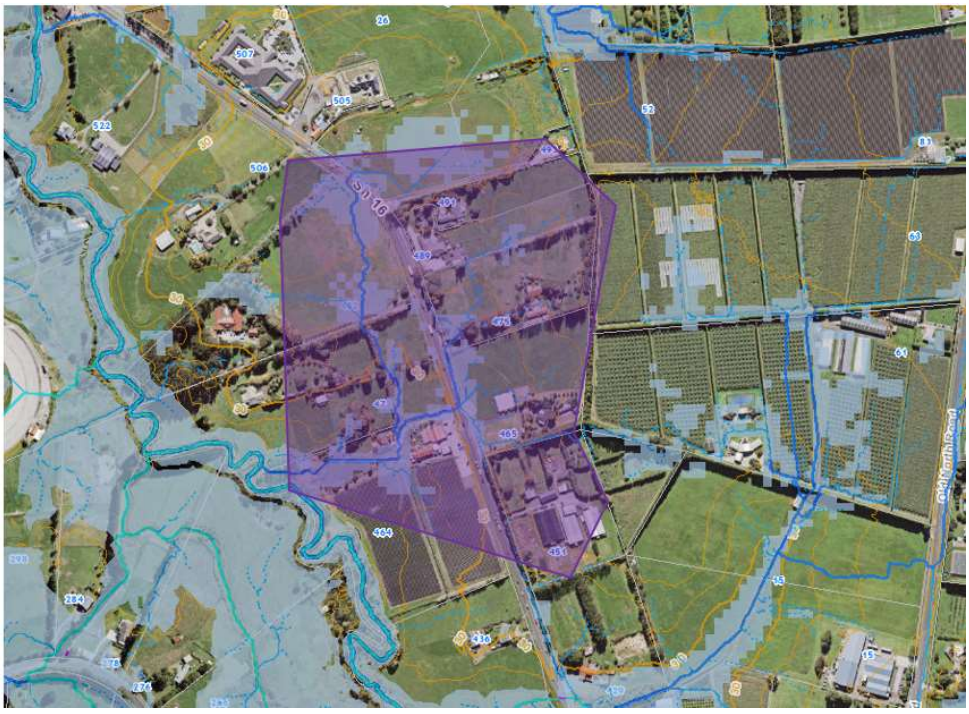

Figure 9: Catchment area (purple) discharging to Kumeū River through 464 SH16. Catchment area is approximately 16Ha.

There is an existing 450Ø stormwater pipe which conveys water from the eastern side of the SH16 to the west. Stormwater runoff also travels along the open channels on the western side of SH16 into a grated manhole and flows through an existing 450Ø stormwater pipe and discharges to the pond at 464 SH16. The outlet pipe from the pond to Kumeū River is located in the southwest corner of the pond.

Figure 10: Schematic Image showing the existing stormwater on SH16 and at 464 SH16

5.1.2 Alternative stormwater design options

Six design options were developed and considered for the DP7 Stormwater Design Assessment:

- Option 1: Discharge directly to the Pond at 464 SH16
- Option 2: Stormwater treatment (SW360 Filter) then Pond within 464 SH16 then to Kumeū River
- Option 3: Swale to be constructed at 472 SH16 then discharge via Pond at 464 SH16 then to Kumeū River
- Option 4: Retention swale then Kumeū River via overland flow / open channel at 472 SH16
- Option 5: Retention swale then Kumeū River via stormwater pipe at 472 SH16
- Option 6: Stormwater treatment (SW360 Filter) and discharge to Kumeū River through a stormwater pipe at 472 SH16

For further information on refer to the SH16 Stage 2 Project Technical Memo titled ‘Stormwater Technical Memorandum for localised alternatives assessment process for stormwater management design solution at DP7’ in Appendix J – Localised Stormwater Design Options.

5.1.3 MCA Framework for stormwater design assessment

Criteria

The following criteria were used for the stormwater design option assessment.

Table 12: MCA Criteria descriptions used for the Localised Stormwater Design Assessment

Criteria Name	Criteria Description
Scored Criteria	
Stormwater design solution	The extent to which the option will achieve conveyance, water quality treatment, retention/detention and manage flooding hazards.
Constructability	The degree of design and construction complexity.
Cost	The degree of cost / affordability of the option
Property	The degree of complexity or level of risk associated with formal legal access for the construction, operation and maintenance of the stormwater management system (whether via land requirement, drainage easement or access to drains and conduits in accordance with section 61(4)(j) of the Government Roading Powers Act 1989), including potential impact on business operations.
Ecological effects	The potential of the option to avoid, remedy or mitigate effects on: • Fauna (likelihood or Value of Habitat) e.g. bats and lizards • Protected vegetation (presence and value of vegetation) • Coastal marine area (current ecological/coastal values) • Lakes, rivers or streams or margins (current ecological value) • Wetlands (current ecological value)
Operations and maintenance	The degree of complexity or level of risk associated with safe access for the purposes of operation and maintenance of the stormwater management system.
Cultural effects	Potential impact of the option on: - Waahi Tohu (waahi tapu and waahi tuupuna) - Maori Archaeology - Whenua (geologic features and productive soils) - Hau Takiwa (air quality, dark skies, and viewshafts) - Moana (sea, roto/lake) - Wai Maaori (puna, awa, repo/wetland) - Rerenga Rauropi (native fauna and flora)
Non-Scored Criteria	
Consentability	The degree of complexity or level of risk associated with the Notice of Requirement to alter the existing designation and stormwater consenting
Stakeholder feedback	Consideration of stakeholder feedback (e.g. Auckland Council and landowners) on the option (if applicable)

Consentability and Stakeholder Feedback were 'non-scored' criteria, with provision of comments only (to avoid the risk of double counting).

Scoring System

The same 7-point scoring system used for the corridor-wide alternatives assessment detailed in Section 3.1.2 was applied to the localised stormwater design option assessment.

The options were assessed against the Do Minimum (baseline) option in accordance with the Waka Kotahi Updated MCA Guidance published in August 2020. The baseline is the current stormwater management situation at this location with no project development in place.

The Do Minimum (baseline) option is not assessed in its own right, as it would score 'neutral' as it is being scored against itself.

Independent Assessment

The options assessment involved input from several SME from the following disciplines:

- Civil Engineering

- Contaminated Land Management
- Construction Management
- Cost Management
- Property
- Environmental
- Ecology
- Operations and Maintenance
- Mana Whenua
- Environmental Planning
- Stakeholder Management
- Project Management.

SMEs undertook an independent assessment of the options and the results were collated by the Planning Lead and shared prior to the MCA workshop for consideration.

MCA Workshop

The provisional assessment of options against each criteria was discussed at an online workshop held between Waka Kotahi and the relevant SME's, where each experts assessment was discussed and challenged as required. Any changes to the scores or commentary was captured. The workshop allowed for the identification of the preferred option which was Option 4 (Retention swale then Kumeū River via overland flow / open channel at 472 SH16).

5.1.4 DP7 Stormwater Design: MCA Assessment

The detailed MCA is provided in Appendix K – Localised Stormwater Design Option Assessment.

Table 13 below provides a summary of the option assessment scores.

Table 13: MCA scores for Localised Stormwater Design assessment

Criteria	Option 1: Direct discharge to pond	Option 2: SW 360 to pond	Option 3: Swale at 472 then to pond	Option 4: Retention swale at 472 then overland flow / open channel to river	Option 5: Retention swale at 472 then stormwater pipe to river	Option 6: SW360 at 472 then stormwater pipe to river
Technical Stormwater Design solution	-2	-2	-1	+1	-1	-3
Constructability	-2	-2	-2	0	-1	-2
Cost	-1	-2	-1	0	-1	-2
Property effects	-2	-2	-2	-1	-1	-1
Ecological effects	0	0	0	-1	-1	-1
Contamination Human Health effects	-1	-1	-1	-1	-1	-1
Operations and Maintenance effects	-1	-1	-1	-1	-1	-1

Cultural effects	0	+1	+1	+2	0	-1

The assessment discusses several stormwater design assumptions. If an option involving the stormwater pond is chosen, improvement upgrades are required to the pond to ensure appropriate treatment of stormwater, for discharge to the Kumeu River. These improvements include reshaping the pond and bathymetry for water quality performance and safety, upgrading the pond side batters and fencing, removing sediment, and a new inlet and outlet structure to the pond.

Early engagement with the landowner of 464 SH16 indicated that the business operator uses the pond for irrigation of the strawberry fields. The ongoing use of the pond for irrigation would be compromised if it were to also be used for ongoing stormwater treatment.

Table 14 below summarises the commentary on each option including the key reasons options were discounted and why the preferred option was chosen. It is noted that ‘hard infrastructure’ is considered physical infrastructure such as piping and SW360 filters as opposed to ‘green infrastructure’ such as a swale.

Table 14: Summary of the assessment of each option.

Options	Assessment
Option 1 Stormwater conveyance through pipes and discharge directly to the pond at 464 SH16	This option was discounted for the following reasons: • Option 1 involves the use of the pond, which will require significant upgrades, thus receiving negative scores for Technical Stormwater Design, Constructability and Cost. • Larger project footprint impacting a third party landowner (and use of the pond for irrigation) • Only a single level of inground treatment • Involved hard infrastructure
Option 2 Stormwater treatment through SW360 Filter, before discharging into the pond within 464 SH16 then to Kumeū River	This option was discounted for the following reasons: • Option 2 involves the use of the pond which will require significant upgrades, thus receiving negative scores for Technical Stormwater Design, Constructability and Cost. • Larger option footprint impacting a third party landowner (and use of the pond for irrigation) • Although Option 1 and 2 are scored the same against Property Effects, Option 2 is slightly more negative than Option 1 because of the proposed use of the stormwater vault under the car park at 464 SH16 • Involved hard infrastructure.
Option 3 Swale to be constructed at 472 SH16 on then discharge via Pond at 464 SH16 then to Kumeu River	This option was discounted for the following reasons: • Option 3 involves the use of the pond which will require significant upgrades, thus receiving negative scores for Technical Stormwater Design, Constructability and Cost. • Larger option footprint impacting a third party landowner (and use of the pond for irrigation). • Involved hard infrastructure
RECOMMENDED **Option 4** Treatment via a retention swale (overland flow / open channel at 472 SH16) before discharging into the Kumeū River via a new outfall required to Kumeū River	• Option 4 was the only option with a positive score for Technical Stormwater Design solution. The treatment and conveyance of stormwater through a retention swale channel prior to a new outfall at Kumeū River will avoid the use of the stormwater pond (and subsequent stormwater pond upgrades). • The avoidance of hard infrastructure resulted in a neutral score against Constructability and Cost compared to the other scores that received a negative score. • Option 4 scored the best from a Cultural perspective, noting mauri of water and tikanga need to rejuvenate mauri of water from contaminants through filtration of Papatūānuku (ground-based/'natural' mechanisms). Therefore, Option 4 was the preferred option as it provides two levels of inground treatment before entering the stream. • Option 4, 5 and 6 would discharge directly into the stream (as opposed to option 1, 2 and 3) and thus present minimal degradation to Kumeū Stream resulting in a negative score against ecology. However, it is assumed that the discharge outfall for Option 4 will be designed to meet permitted activity standards of the Auckland Unitary Plan (Operative in Part). Any negative ecological effects can be mitigated through design and restoration planting if riparian vegetation clearance is needed.
Option 5 Treatment and conveyance of stormwater through a retention swale then	This option was discounted for the following reasons • Similar benefits to Option 4 but involves hard infrastructure through the form of the pipe, resulting in a slightly negative score.

Options	Assessment
a pipe at 474 SH16 Prior to discharging to Kumeū River	• Option 5 did not score as well as Option 4 from a Cultural perspective as it only provides one level of in-ground treatment and a direct pipe to the Kumeū River is not considered tika.
Option 6 Stormwater treatment (SW360 Filter) and discharge to Kumeū River through a stormwater pipe at 472 SH16	This option was discounted for the following reasons: • Option 6 scored the lowest overall. • Involves hard infrastructure. • The filter would need to be maintained. No attenuation treatment is provided through the stormwater pond either. • Option 6 is not able to provide the hydrology mitigation requirements, which may cause downstream scour and flooding issues.

5.2 Noise Mitigation Best Practical Option Assessment

5.2.1 New Zealand Standard NZS 6806:2010 Acoustics - Road-traffic noise - New and altered roads

Transport noise and vibration can cause a range of impacts on people and communities including annoyance and interference with daytime activities such as work, study and domestic living. Other effects include potential sleep disturbance, and long-term health impacts such as increased stress and hypertension. The noise generated by the existing corridor is already high and the Project will result in changes to the noise environment that are undiscernible.

However, Waka Kotahi has also applied New Zealand Standard NZS 6806:2010 *Acoustics - Road-traffic noise - New and altered roads* (NZS 6806:2010). NZS 6806:2010 was adopted by Waka Kotahi to allow for strategic infrastructure to develop while mitigating adverse traffic noise effects on the environment. By applying NZS 6806:2010, the existing noise environment will in fact be improved within some parts of the project corridor.

5.2.2 Assessment Methodology

The assessment method in NZS 6806 requires consideration of a number of noise mitigation options depending on the scale of a project. These options are subject to an integrated design process, in which the costs and benefits of the mitigation are considered to find the Best Practical Option (BPO). This includes an assessment of several different scenarios which are then compared to find the BPO. These are:

- The “existing environment” which, for altered roads, represents the current road layout and traffic volume, and for new roads the ambient noise environment as determined by survey and modelling. Both are determined based on the existing year (i.e. approximately 2021)
- A future “Do-nothing” scenario, which represents a scenario at the design year where the Project has not been implemented, however, traffic volumes and subsequent sound levels have changed – generally increased – over time
- A future “Do-minimum” scenario, which represents the circumstances at the design year where the Project has been implemented without any specific noise mitigation. This means that the selection of road surface material has not been undertaken on its sound generating characteristics, and the only barriers included are safety barriers, which are required for reasons other than noise mitigation. Note that the Do Minimum scenario is intended to assess the effect of the new/altered road. Therefore, this scenario does not include noise contributions from local roads that are outside of the Project works/designation
- Where required, mitigation options would be assessed to determine the best practicable mitigation for the circumstance.

An Assessment of Acoustic Effects has been prepared to address the requirements of NZS 6806. A noise mitigation Best Practical Option (BPO) workshop was held to assess the effects on various identified sensitive receivers. These sensitive receivers include dwellings and educational facilities and are identified as ‘protected

premises and facilities' (PPF). Commercial and business uses are not PPFs and are excluded from the assessment.

Noise Categories

Buildings within 100 to 200m of the alignment were assessed against the altered road criteria of NZS 6806 and in relation to the noise level with the Project in place. These buildings were assessed against Category A, B and C under NZS6806. Noise mitigation options are to be assessed, and if practicable, the Category A criterion should be achieved. If this is not practicable, then mitigation should be assessed against Category B. However, if it is still not practicable to comply with Categories A or B then mitigation should be implemented to ensure the internal criterion in Category C is achieved internally through the building, see Table 15 below.

Table 15: Assessment noise categories under NZS 6806

Category	Criterion	Altered roads
A	Primary	64db
B	Secondary	67db
C	Internal	40db

The Acoustic Specialist identified which category each building along the alignment would fall into. This informed the mitigation needed to reduce the category and therefore noise effects on the receiver. A BPO assessment matrix was developed which set out assessment areas, criteria, the various options that had been identified and the input required.

Independent assessment was undertaken by several SMEs from the Project team. The assessment was collated and shared for reading prior to an online BPO Assessment Workshop. The workshop was then held to assess what noise mitigation was most practicable in each location to achieve the desired noise standards under NZS6806.

5.2.3 Assessment Areas / Options

There were 10 assessment areas along the corridor that were assessed in the workshop. These areas are listed in Table 16 below. The clusters of dwellings are shown on a map in Appendix L – Noise Mitigation BPO Options Map. Three main options were developed. These included:

- a 2 - 2.5m barrier (fence),
- installing PA10 30mm along the assessment area of SH16 (low noise road surface treatment),
- or a combination of the first two options (fence and PA10 30mm).

It is noted all three options were not necessarily considered for each assessment area, and certain areas required an additional 'option'. Additionally specific design, final location and materiality of barriers are subject to landowner feedback.

Note: An extra option was considered at Area 1, which included a 2m barrier continuous along SH16 and a slip lane behind the barrier.

Table 16: List of assessment areas and options considered

Area Name	Address	Options considered
East 1	181-173 SH16	Option 1: 2m barrier Option 2: PA10 30mm Option 3: PA10 30mm and 2m barrier Option 4: 2m barrier continuous between SH16 and slip lane

East 3	299 and 291 SH16	Option 1: 2m barrier Option 2: 2.5m barrier Option 3: PA10 30mm and 2/2.5m barrier
East 4	315 SH16	Option 1: 2m barrier Option 2: PA10 30mm Option 3: PA10 30mm and 2m barrier
East 7	451 SH16	Option 1: 2m barrier
East 8	491 and 489 SH16	Option 1: 2m barrier Option 2: PA10 30mm Option 3: PA10 30mm and 2m barrier
East 9	507 and 505 SH16	Option 1: 2m barrier Option 2: 2.5m barrier
West 1	218 SH16	Option 1: 2m barrier Option 2: PA10 30mm Option 3: PA10 30mm and 2m barrier
West 3	238 SH16	Option 1: 2m barrier Option 2: PA10 30mm Option 3: PA10 30mm and 2m barrier
West 4	264A SH16	Option 1: 2m barrier
West 5	340 Sh16	Option 1: 2m barrier
West 6	506 – 455 SH16	Option 1: PA10 30mm
West 7	550 SH16	Option 1: 2m barrier

5.2.4 Noise Mitigation: BPO Assessment

The Noise Mitigation BPO assessment involved input from several SME from the following disciplines:

- Acoustics
- Built Heritage
- Property
- Operations and Maintenance
- Civil Engineering
- Landscape and Visual
- Urban Design
- Environmental Planning
- Project Management.

The full Noise Mitigation BPO Options Assessment is provided in Appendix M of this report and is also appended to the Acoustic Assessment supporting the NoR (which explains the assessment process and outcome in detail).

In summary, the BPOs for each area are outlined in Table 17 : Summary of Best Practical Options below.

Table 17 : Summary of Best Practical Options

Area Name	Address	Best Practical Option
East 1	181-173 SH16	**Option 1: 2m barrier** – This will achieve a noise level reduction of 2-3 dB at the most affected houses, reducing their noise level generally to be within Category A or B
East 2	191-239 SH16	**Do minimum** - PPFs fall within Category A
East 3	299 and 291 SH16	**Option 1: 2m barrier** – as Option 3 (with PA10 surfacing) was not an acceptable solution for short lengths and Option 1 achieved a better noise reduction than Option 2. Option 1 (2m barrier) will reduce the noise levels slightly at the upper floor, but noticeably at the ground floor.
East 4	316 SH16, 1411, 1409, 1403 and 1397 Coastville Riverhead Highway	**Option 2: 2.5m barrier** – This will reduce the noise level to within Category B. An alternative road surface is not feasible due to the intersection requiring high shear and skid resistance.
East 5	331 SH16	**Do minimum** - PPFs fall within Category A
East 6	16 Old North Road, 393-429 SH16	**Do minimum** - Majority of PPFs fall within Category A, exception being 429 SH16 which falls within Category B yet located on a road curve and therefore a noise barrier and/or low noise road surface treatment were not feasible.
East 7	465 and 457 SH16 451 SH16	**Do minimum** – PPFs fall within Category A **Option 1: 2m barrier -** This will reduce noise levels by nearly 2 dB so the dwelling falls into Category A.
East 8	491 and 489 SH16	**Option 1: 2m barrier** – This will reduce noise levels by nearly 6 dB so the dwellings fall into Category A.
East 9	505 and 507 SH16 (Kumeū Retirement Village)	**Option 2: 2.5m barrier** – This will reduce noise levels so the building can fall into Category B. Further investigation of any existing building insulation will determine whether internal ventilation can be provided as an alternative, so no mitigation is required.
East 10	21-23 Riverhead Rd	**Do minimum** - PPFs fall within Category A
West 1	218 SH16	**Option 1: 2m barrier** – This would achieve a small noise level reduction of slightly more than 3 dB, which would reduce noise levels to within Category B. An alternative road surface is not feasible due to the intersection requiring high shear and skid resistance.
West 2	222A SH16	No mitigation recommended as a 2m barrier would reduce the historic value by blocking views to the building, and only achieve limited noise levels reductions of less than 2 dB.
West 3	238 and 256 SH16	No mitigation recommended as a 2.5m barrier would reduce the historic value by blocking views to the building, and only achieve limited noise levels reductions of less than 2 dB.
West 4	264 and 300 SH16 264A SH16 (minor dwelling)	**Do minimum** - PPFs fall within Category A. **Option 1: 2m barrier** - This will have a significant positive effect given that it provides a 6db noise reduction and has a neutral effect from most disciplines' perspective. The noise wall

Area Name	Address	Best Practical Option
		will move this property from category B with no mitigation, to a category A.
West 5	340 SH16	Option 1: 2m barrier – The 2m barrier is recommended as it provide sufficient noise reduction to put the dwelling into Category A.
West 6	436 SH16	No mitigation is recommended as noise at 436 SH16 is predicted to reduce as a result of the Project. An alternative road surface is not feasible due to the intersection requiring high shear and skid resistance.
West 7	550 SH16	**Option 1: 2m barrier** – This will significantly reduce noise levels (by nearly 7 dB) to put the dwelling into Category A.
West 8	7 Main Road	**Do minimum -** PPFs fall within Category A.

5.2.5 BPOs and Landowner Engagement

The BPO process enabled the project team to recommend which PPFs should receive noise mitigation in the form of a noise barrier. This was an indicative BPO and the actual provision, specific design and materials, were subject to landowner engagement.

Following landowner engagement, one noise barrier was removed at 507 SH16 as the landowner confirmed they did not want the noise wall so the BPO is not to have the noise barrier at this PPF.

5.3 Localised option assessment for Project design interface with a wetland

5.3.1 Background

The Project Ecologist completed a Watercourse Classification Assessment (Beca, dated 21 August 2021) to identify all the watercourses potentially impacted by the Project's preliminary design. Two wetlands were confirmed within the Project extent, located within 436 SH16 and 522 SH16.

The Government's National Policy Statement for Freshwater Management 2020 (NPS: FM) provides local authorities with updated direction on how they should manage freshwater under the Resource Management Act 1991 (RMA). This came into effect on 3 September 2020 and provides clear policy direction that New Zealand is required to *"Avoid any further loss or degradation of wetlands…map existing wetlands and encourage their restoration"*. The Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (NES:F), which also came into force 3 September 2020, regulates activities that pose risks to the health of freshwater and freshwater ecosystems, including wetlands

The Project Consenting Strategy (Beca, March 2021) identified the consenting risks associated with any proposed works within and adjacent to wetlands and the need for a robust alternatives assessment to support both the Notice of Requirement to alter the existing SH16 designation and the national/regional resource consent applications for the SH16 improvements.

During the wider Alternatives Assessment for Section D outlined in Section 4.3.4 of this report, the preferred option was the provision of a flush median, shoulder widening and side barriers (extending from Taupaki Road to Weza Lane in Kumeū). The preferred form and location for the new walking and cycling facility is a shared use path along the southern side of the SH16. Yet it was noted that given the presence of wetlands on the southern side of SH16 within Section D of the wider Project Corridor, further investigation was required in relation to the impact of the preliminary design on the wetlands and a Localised Options Assessment would be required to inform the detailed design of the safety, efficiency, walking and cycling improvements in the vicinity of the wetlands.

The Project Team advised that the wetland at 436 is a natural wetland under the NPS:FM and the NES:F but the wetland at 522 does not fall within that definition. During the detailed design phase in January 2022, the project team confirmed the design would not affect the wetland at 436 SH16 but would have a direct impact on the wetland at 522 SH16 (Wetland 2). Although not covered by the NPS:FM or NES:F, the Project Team decided to undertake an assessment of alternatives to determine the extent to which the wetland could be avoided. The wetland extent and existing environment are illustrated in Figure 11and Figure 12 respectively.

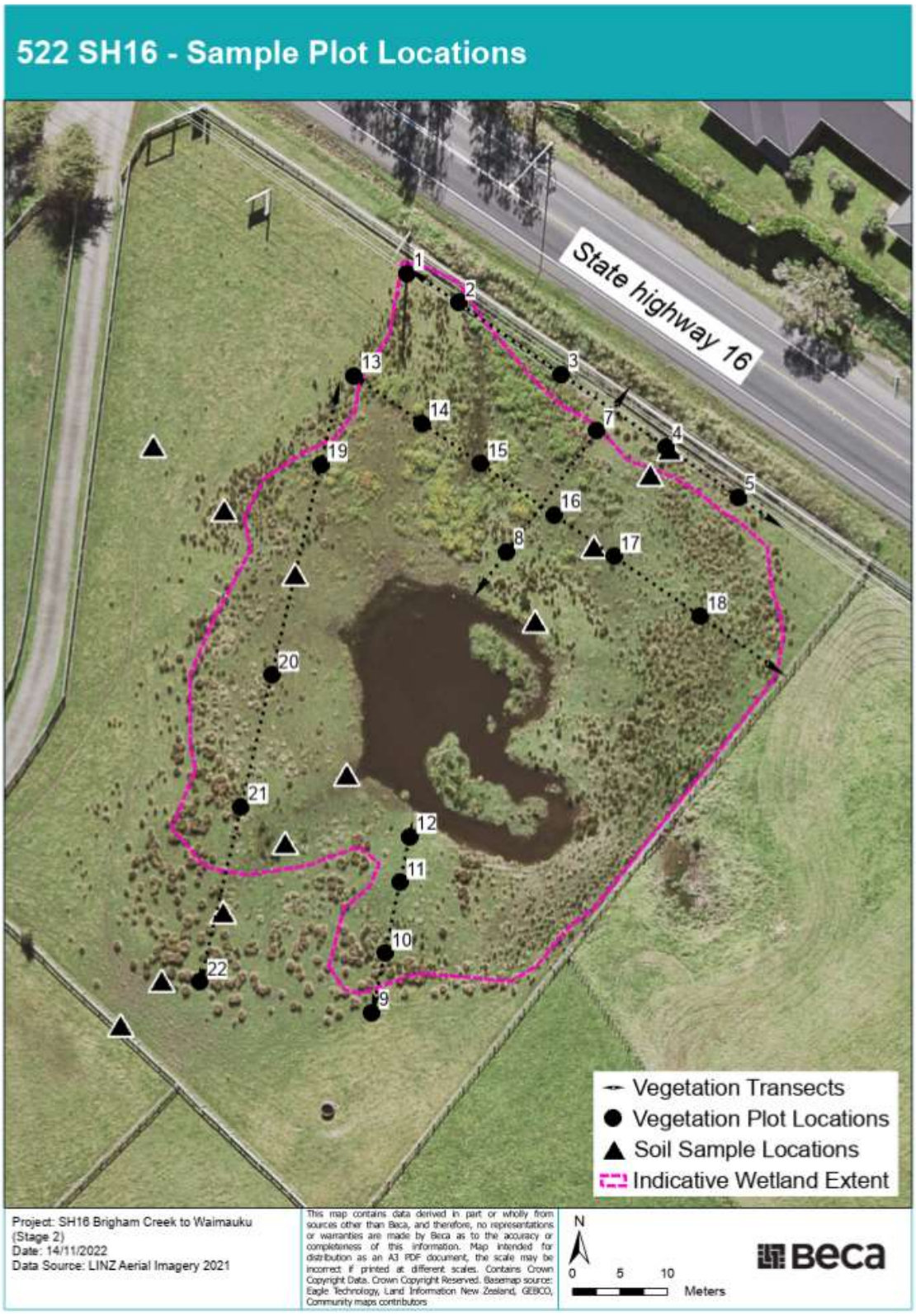

Figure 11: Indicative wetland extent located at 522 SH16 (Source: Ecological Impact Assessment, Beca November 2022)

Figure 12: The vegetation (left) and open water area (right) within the wetland (Source: Ecological Impact Assessment, Beca November 2022)

5.3.2 Alternative Wetland Design Options

Nine design options were developed and considered for this Localised Option Assessment for the design interface with the wetland at 522 SH16:

- Option 1 – SUP South side existing alignment (i.e. per the early draft detailed design)
- Option 2a – North side SUP (long) existing alignment
- Option 2b – North side SUP (short) existing alignment
- Option 3 – SUP South side around wetland
- Option 4 – SUP Bridge existing alignment
- Option 5 – SUP Boardwalk existing alignment
- Option 6 – SUP South Realigned alignment
- Options 7a – North side SUP (long) realigned alignment
- Option 7b – North side SUP (short) realigned alignment

The details of the various design options are outlined in Appendix N – Wetlands Options.

5.3.3 MCA Framework for wetland design assessment

An assessment of the options was undertaken using a bespoke MCA Framework.

Criteria

The following criteria were used for the wetland design option assessment.

Table 18: MCA Criteria for the localised wetland design options assessment

Criteria Name	MCA Criteria Assessment
Project Objective: Safety	Consider safety for different types of transport users. Gainers/losers in terms of safety. Impacts on personal safety/security. Impact on fatal and serious incidents. Does this option comply with the safe system approach?

Project Objective: Transport Efficiency	Effects on travel volumes, journey times or reliability of journey times. Gainers and losers – impacts on users and operators of different transport modes.
Project Objective: Supports modal shift	Fit with wider government policy including national transport targets. The extent to which the option will achieve the Project objective relating to provision for active mode of travel between Brigham Creek and Kumeū on SH16 corridor.
Technical SUP Design solution	The degree of design complexity and any engineering design constraints – need to confirm whether difficult yet still technically feasible vs not feasible and state rationale.
Constructability	The degree of construction complexity and any construction constraints.
Property	The degree of complexity or level of risk associated with formal legal access for the construction, operation and maintenance of the shared use path, including potential impact on business operations.
Wetland effects	The degree of potential effect on the wetland (current ecological value)
Ecological effects – freshwater	The degree of potential ecological effects (freshwater excluding wetlands) and the ability avoid, remedy or mitigate effects
Ecological effects – terrestrial	The degree of potential ecological effects (terrestrial) and the ability avoid, remedy or mitigate effects
Cultural effects	Potential impact of the option on: - Waahi Tohu (waahi tapu and waahi tuupuna) - Maori Archaeology - Whenua (geologic features and productive soils) - Hau Takiwa (air quality, dark skies, and viewshafts) - Moana (sea, roto/lake) - Wai Maaori (puna, awa, repo/wetland) - Rerenga Rauropi (native fauna and flora)
Social effects	The degree of potential effect on social infrastructure and community facilities
Landscape and Visual effects	The degree of potential landscape and visual effects, including CPTED (safety and security) considerations
Operations and maintenance	The degree of complexity or level of risk associated with safe access for the purposes of operation and maintenance of the state highway including shared use path

Scoring System

The same 7-point scoring system used for the corridor-wide alternatives assessment detailed in Section 3.1.2 was applied to the localised wetland design option assessment.

The options were assessed against the Do Minimum (baseline) option in accordance with the Waka Kotahi Updated MCA Guidance published in August 2020.

The baseline is the current SH16/wetland situation at this location with no project development in place.

Independent Assessment

The options assessment involved input from several SME from the following disciplines:

- Road Safety Engineering
- Civil Engineering
- Transport Planning
- Environmental Planning
- Construction Management
- Property
- Environmental
- Ecology
- Mana Whenua
- Social Impact
- Landscape and Visual Impact
- Operations and Maintenance
- Cost Management
- Stakeholder Management
- Project Management.

SMEs undertook an independent assessment of the options and the results were collated by the Project Planning Lead and shared prior to the MCA workshop for consideration.

MCA Workshop

The provisional assessment of options against each criteria was discussed at an online workshop held on Wednesday 23 March 2022 between Waka Kotahi and the relevant SME's, where each experts assessment was discussed and challenged as required. Any changes to the scores or commentary was captured. The workshop allowed for a robust assessment and comparison of the options.

5.3.4 Wetland Design: MCA Assessment

The detailed MCA is provided in Appendix O – Localised Wetland Design Option Assessment.

The performance of the options against each individual criteria are set out in the unweighted MCA table below.

Criteria	Option 1	Option 2A	Option 2B	Option 3	Option 4	Option 5	Option 6	Option 7A	Option 7B
Project Objective: Safety	+2	+1	+1	+1	+2	+2	+2	+1	+1
Project Objective: Transport Efficiency	+3	+1	+1	+2	+3	+3	+3	+1	+1
Project Objective: Supports Modal Shift	+3	+2	+2	+2	+3	+3	+3	+2	+2
Technical SUP Design solution	0	-2	-1	0	-1	0	-1	-2	-1
Constructability	-1	-1	-1	-1	-2	-1	-2	-2	-2
Property	-1	-2	-1	-2	-1	-1	-1	-2	-1
Wetland effects[4]	-2	0	0	-2	-1	-1	0	0	0
Ecological effects (Freshwater excluding wetlands)	-1	-1	-1	-1	-1	-1	-1	-1	-1
Ecological effects (Terrestrial)	-1	-1	-1	-1	-1	-1	-1	-1	-1
Cultural effects									
Social effects	+1	+2	+3	+1	+1	+1	+1	+2	+3
Landscape and Visual effects (CPTED and Urban Design included)	-1	-2	-1	-1	-2	-1	-2	-2	-1
Operations and maintenance	-1	-1	-1	-2	-2	-2	-1	-1	-1

The comparative analysis undertaken by the Design Manager and Planning expert of the final MCA table indicated there was one clear option which performed the best across most of the criteria (except Wetland effects and Social effects) and performs the best overall – being Option 1 'SUP South side existing alignment'.

Table 19 below summarises the assessment commentary for the best performing options based on the unweighted MCA table.

Table 19: Summary of MCA localised wetland options assessment – best performing options

Option	Assessment Analysis
RECOMMENDED **Option 1** SUP South side existing alignment	• Option 1 (along with Options 4, 5, 6) performed best against the Project Objectives of safety, efficiency, and infrastructure that supports modal shift. • Option 1 scored a moderate negative (-2) effect against the Wetland Effects criteria (along with Option 3) given the minor encroachment into the natural

[4] It is noted that the quality of the existing wetland is low (refer to Ecological Impact Assessment by Beca, November 2022)

Option	Assessment Analysis
	wetland due to the permanent infrastructure. Options 4 and 5 scored better with a slight negative (-1) effect. Options 2a, 2b, 6, 7a and 7b scored even better with a neutral (0 rating. • With regard to both Freshwater (excluding wetlands) and Terrestrial Ecological Effects all Options scored the same. • Option 1 (along with Options 3 and 5) performed best against the Technical Shared Use Path Design Solution criterion. • In terms of Constructability Option 1 (along with Options 2a, 2b, 3 and 5) performed best with a slight negative (-1) effect. • Option 1 (along with Options 2b, 4, 5, 6, and 7b) performed best against the Property criterion with a slight negative (-1) effect. • In terms of Social Effects, Option 1 (along with Options 3, 4, 5, and 6) scored slight positive (+1) effect. However, Options 2a and 7a scored moderate positive (+2) effect and Options 2b and 7b performed even better with significant positive (+3) effect. • Option 1 (along with Options 2b, 3, 5 and 7b) performed best against the Landscape and Visual Effects criterion. Option 1 was selected as an alternative to the preferred Option 5 by this Subject Matter Expert. • Option 1 (along with Options 2a, 2b, 6, 7a and 7b) performed the best against the Operations and Maintenance Criterion.
Option 5 SUP Boardwalk existing alignment	• Option 5 'SUP Boardwalk existing alignment' also performs the best overall. • It scored better than Option 1 against Wetland Effects criteria, poorer than Option 1 against Operations and maintenance criteria, and the same as Option 1 against the Social Criteria. • They key difference between Option 1 and Option 5 is that Option 1 performed the best (on occasion equal with other Options) across all but two criteria (Wetland effects and Social effects), whereas Option 5 performed the best (on occasion equal with other Options) across all but three criteria (Wetland effects, Social effects, Operations and maintenance effects).
Option 6 SUP South Realigned alignment	• Option 6 'SUP South Realigned alignment' **avoids** effects on the wetland and performs the best (and significantly better than the other four options that avoid the wetland) against the Project Objectives. Option 6 scored a slight positive (+1) Social effect. For all other criteria, Option 6 scored slight negative (-1) to moderate negative (-2) effects, yet these effects may be managed or mitigated.
Option 2b North side SUP (short) existing alignment	• Option 2b 'North side SUP (short) existing alignment' also **avoids** effects on the wetland whilst scoring positively against the Project Objectives and the best against Social Effects. Option 2b then scores a consistent slight negative (-1) effect against all other criteria, yet these effects may be managed or mitigated.

5.3.5 Cost Considerations

To assist Waka Kotahi with decision making, the Project team provides the following indication of option costs (using a Low/Medium/High range):

- Option 1 has low lost.
- Option 3, 5 has medium cost.
- Option 4, 6 have a higher medium range of cost.
- Option 2b, 7b, have a higher range of cost.
- Options 2a, 7a, have highest cost.

Whilst Option 1 performs best overall based on the collated unweighted MCA table (and has low cost), it does encroach the wetland. Two alternative options have been identified following sensitivity analysis (Option 6 and Option 2b). Option 6 has a higher medium range of cost, whereas Option 2b has a higher range of cost.

5.3.6 Waka Kotahi Preferred Option Decision

The wetland was assessed as having low ecological value (refer to Ecological Impact Assessment by Beca dated November 2022). It is not a natural wetland for the purpose of the NPS:FM or NES:F, however consideration has been given as to whether it can be avoided. Consideration was also given to the potential ecological value the wetland after reasonable restoration (fencing and native vegetation planting). The wetland could be restored to provide native habitat and have improved ecological functionality. However, the wetland is owned by a private landowner and even if the landowner agreed to restoration, the wetland would still be isolated within a highly modified, rural land usage landscape, and would likely be exposed to continuous weed invasion.

Option 1 would require partial reclamation of the wetland where the SUP (and associated retaining wall) would extend into it. This would only affect 83m^2 of the wetland area located at the north-western corner. The extent of the reclamation has been reduced as far as practicable by measures such as the use of retaining walls rather than batter slopes. Option 1 performed best against the Project Objectives of safety, efficiency, and infrastructure that supports modal shift. This option also scored the best in relation to against the Property criterion, in relation to Landscape and Visual Effects and performed the best against the Operations and Maintenance Criterion. This Option could also include planting of wetland and riparian planting mix.

6 Conclusion

Waka Kotahi has evaluated a wide range of options for each section of the corridor and its unique challenges. The preferred option for Section A was to convert the two lane highway into a four lane highway with wire rope median barriers. This option improves the corridor's efficiency and resilience while improving the road corridor's safety by creating a physical separation between oncoming traffic lanes. This option will integrate well with the two lane Brigham Creek Roundabout and proposed Roundabout at Coatesville Riverhead Highway (Section B).

The roundabout was the preferred option for Section B, as it would significantly improve the intersection efficiency and provided a more balanced approach to all legs of the intersection. The two lane roundabout will integrate well with the surrounding road layout by connecting into the existing and proposed four lane road corridor. It will also act as a turnaround facility, due to the proposed installation of wire rope median barriers.

Options C already has four lanes and will be boarded by two roundabouts, thus wire rope median barriers will be installed given the roundabouts will act as a turnaround facility.

The preferred option for Section D was the flush median. It improves the safety of the existing corridor and does not have the technical and property implications of the other options that include median barriers and additional lanes.

The shared-use path along the south side of the alignment was the preferred option. It provides the longest uninterrupted pathway from vehicle crossings, improving the safety of the shared path and having the opportunity to connect into the current north-western cycle facility (from Fred Taylor Drive).

The localised stormwater design option assessment for DP7 found that a retention swale running away from SH16 along 472 SH16 was the best option. It does not involve hard infrastructure and does not require the significant upgrades needed if the existing pond on 464 SH16 was used.

The noise mitigation BPO assessment under NZS 6806 found that noise barriers were the most appropriate noise mitigation option and PA30mm is not an effective road surface for a high use road.

The localised design interface with the wetland option assessment for Wetland 2 found that a shared use path on the south side following the existing alignment as selected during the active mode facility option assessment process was selected as the preferred option. This was because there would only be a small extent of wetland reclamation which could be limited by design solutions (i.e. retaining wall rather than embankment at this location). The wetland has low ecological values and mitigation planting will result in an overall improvement of the ecological values of the wetland. This design would best achieve the Project Objectives of safety, efficiency, and infrastructure that supports modal shift and will have a minimal impact on complexity of land access. Landscape and Visual Effects arising from this design can be mitigated.

A

Appendix A – Long List Corridor Treatment Assessment

Long List Corridor Treatment Assessment

The following tables outline all the options considered for the Long List Treatments and an assessment of them against the project objectives. This assessment determined if the options would be considered for the short list assessments.

Table 1: Corridor safety treatments - Considered for all Sections

GENERAL OPTIONS – CONSIDERED FOR ALL SECTIONS		
Description	**Adopt/Reject /Defer**	**Assessment against Project Objectives – Commentary**
Median treatments		
Wide-centre line	Adopt	A wide centerline provides additional space between opposing traffic flows and provides safety benefits.
Flush median (hatched)	Reject	Intended primarily for urban (50 km/hr) and semi urban (70 km/hr) roads. Not recommended for use on rural roads due to difficulties in controlling overtaking vehicles in higher speed environments (MOTSAM). It is possible to install a flush median in special circumstances on rural roads however not on posted speed limits of greater than 80km/hr. Due to the number of accesses off SH16, there is increasing risk of head on crashes for turning vehicles. A flush median will not contribute to reducing the severity of these crashes. This treatment was later considered to be taken forward as an efficiency treatment for Section D of the corridor.
Median wire-rope barrier	Adopt	A median barrier treatment provides the highest benefit for head-on safety risk. Continuous barrier (wire rope). Application depends on access and intersection, and implementing minimum 3-rope system cross section.
Roadside treatments		
Widening shoulders	Adopt	Wide shoulders allow for greater separation between the traffic lane and the roadside environment, as well as allowing for additional potential recovery time. Desirable minimum 1.5m or 2.0m allowing adequate room for cyclists.
Roadside wire barrier	Adopt	Wire rope barriers provide the highest safety benefit to roadside safety risk. Continuous barrier (wire rope). To be installed wherever possible. Consider in parallel with widening. Barriers often reduce safe stopping distances and shoulders need to be widened more.
Roadside W barrier	Adopt	Roadside W barrier provides roadside safety benefit where wire rope cannot be used.

		High risk locations (W-section barrier) – protection of culverts, trees, light-poles, and other roadside hazards. To be installed in high-risk locations wherever roadside wire barrier is not possible. W-section barrier can have a much shorter length from the start of the barrier to the point of redirection than wire rope
Road-side hazard removal	Adopt	If roadside hazards cannot be isolated through the use of barrier protection, then consideration should be given to the removal of these hazards to reduce roadside hazard risk.
Other treatments		
Curve realignment	Adopt	There are a number of out context curves on the corridor. Consideration should be made as to the practicality of curve realignment to improve safety.
Intersection improvements	Adopt	Excluding Coatesville-Riverhead Highway (which is considered in the section below), there are a number of other intersections along this corridor which could benefit from safety improvements.
Maintenance intervention levels	Defer	It is anticipated that as Crash Reduction Studies are undertaken on this corridor, regular maintenance and assessments would be done on high risk areas. There are no reported Fatal and Serious Incidents (FSI) resulting from Loss of Control in 2011 to 2015 period.
Pavement improvements	Reject	Initially selected to address pavement distress issues but review of evidence base indicated that there are no reported FSI resulting from pavement deficiencies between 2006 and August 2017 period. There are alternative treatments that could be provided for lower cost and similar safety benefits and therefore this treatment was not taken forward.
Improved delineation	Adopt	This includes a number of treatment options including ATP, HPLL markings and RRPMs. These all provide potential safety benefits.
Signage improvements	Adopt	Appropriate signage provides for advanced warnings of road layout.
Lighting	Adopt – retain where currently exists	Lighting in sections that have existing lighting will be retained. Opportunities to improve the lighting technology will be explored where lighting is replaced.
Pedestrian facility	Reject	Pedestrian facility separated from the carriageway to provide safer movements for this mode of transport. Could consist of one footpath or footpaths on both sides of the corridor. Does not provide for cyclists.
Cycle facility	Reject	Cycle facility separated from the carriageway. to provide safer movements for this mode of transport. Could consist of one cycle facility or two facilities on

		both sides of the corridor. Does not provide for pedestrians.
On road cycleway	Reject	Provision of on road cycle lane utilising wide shoulders on both sides of the carriageway to provide safer movements for this mode of transport. Guidance width of >= 2.0m + shoulders. Does not provide for pedestrians.
Shared use path	Adopt	Combination of pedestrians and cyclists on a shared use path separated from the carriageway to provide safer movements for these modes of transport. Could consist of one shared use path or a path on each side of the corridor. A shared use path provides for the movement of both modes in a potentially safer manner.
Speed limits	Adopt	Reduction in speeds may result in reduction of DSIs.

Table 2: Corridor efficiency treatments - Section B: SH16/Coatesville-Riverhead Highway intersection

SECTION B - SPECIFIC OPTIONS		
Description	**Adopt/Reject /Defer**	**Commentary**
Roundabout	Adopt	Roundabout is a safe system approach (fewer serious incidents occur at roundabouts than at intersections containing traffic signals, stop, or give-way signs).
Signalised seagull	Adopt	A signalised seagull would provide safety and efficiency benefits for the Coatesville-Riverhead Highway intersection, whilst providing free flow for westbound through traffic.
Signalised intersection	Adopt	A signalised intersection would provide the greatest efficiency benefits to through traffic on SH16.
Minor intersection improvements	Adopt	Minor intersection improvements such as alignment, stopping locations, signage and space allowed for stacking would provide some safety benefits.
Intersection grade separation	Reject	The scale of potential investment and impact on surrounding land use for this treatment is out of context with the observed efficiency issues at this intersection.
Left turn slip lane from C-R highway	Adopt	The addition of a free left turn slip lane out of Coatesville-Riverhead highway and a length of merge (or lane gain at this point to two eastbound lanes) could assist with the morning peak.
Reconfiguring left turn into C-R highway	Adopt	This option would improve the safety of the left turn which is currently through a carpark with reversing vehicles.
Left-in-left-out only (closing right turn to C-R)	Reject	This option would improve the intersection safety but would have significant effects on the efficiency of vehicle movement, with traffic required to use Old North Road roundabout for right hand turning

		movements. With approximately 6000 vehicles turning right at Coatesville-Riverhead intersection closing this movement is likely to be undesirable.
Close intersection	Reject	Closing the intersection would remove safety issues associated with the intersection, but would require all turning movements to take place at Old North Road or Old Railway Road, contributing to efficiency dis-benefit, and disrupting existing business activity at the intersection.

Table 3: Corridor efficiency treatments - Section A: Brigham Creek to Coatesville-Riverhead Highway

SECTION A SPECIFIC OPTIONS		
Description	**Adopt/Reject /Defer**	**Commentary**
Four-laning	Adopt	Four-laning provides efficiency benefits, by providing additional capacity. This option would be considered with a median barrier treatment, with left in/left out for all access points and side road intersections. This option provides the future potential use of the additional lanes for public transport.
2+1 lanes (Additional lane city bound to improve AM travel time).	Adopt	Additional lanes provides efficiency benefits, by providing additional capacity.

Table 4: Corridor efficiency treatments - Section C: Coatesville-Riverhead Highway to Taupaki Road

SECTION C SPECIFIC OPTIONS		
Description	**Adopt/Reject/Defer**	**Commentary**
Four-laning	Adopt	Four-laning provides efficiency benefits, by providing additional capacity. This option would be considered with a median barrier treatment, with left in/left out for all access points and side road intersections. This option would be consistent with a roundabout option at Coatesville-Riverhead Highway, as that intersection and the existing Taupaki intersection roundabout are very close together with two circulating lanes.

2+1 lanes (Additional lane city bound to improve AM travel time).	Adopt	Additional lanes provides efficiency benefits, by providing additional capacity.

Table 4: Corridor efficiency treatments – Section D: Taupaki Road to Kumeū

SECTION D SPECIFIC OPTIONS		
Description	**Adopt/Reject/Defer**	**Commentary**
Four-laning	Defer	Four-laning provides efficiency benefits, by providing additional capacity. This option would be considered with a median barrier treatment, with left in/left out for all access points and side road intersections. The current and projected vehicle volumes for this section of the state highway does not support the requirement of additional lanes to improve efficiency. This is because the SH16 corridor will be saturated by 2036 due to the existing upstream congestion issue at the SH16/Access Road intersection which controls the traffic flows further downstream as the vehicles enter and exit the Kumeu township. This can only be resolved by more significant capacity and additional transport solutions for the future North West growth which are being investigated by the Supporting Growth Programme.
2+1 lanes (Additional lane city bound to improve AM travel time).	Adopt	Additional lanes provides efficiency benefits, by providing additional capacity.
Flush median (hatched)	Adopt	This section of the corridor has multiple businesses and residential properties. The stakeholders have strongly suggested to keep full access to their properties in this section. Further detail is discussed in Appendix P: SH16 Section D Flush Median.

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B

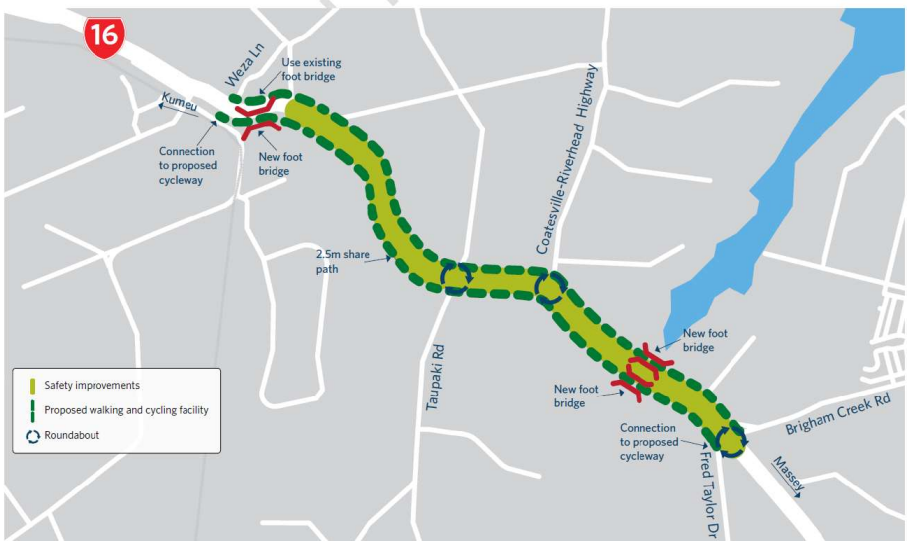
Appendix B – Walking and Cycling Options

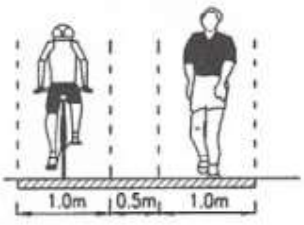
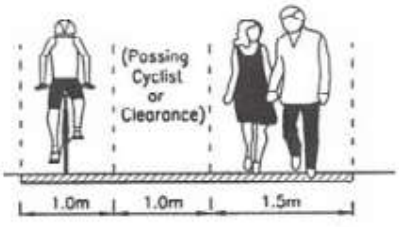
Walking and Cycling Options

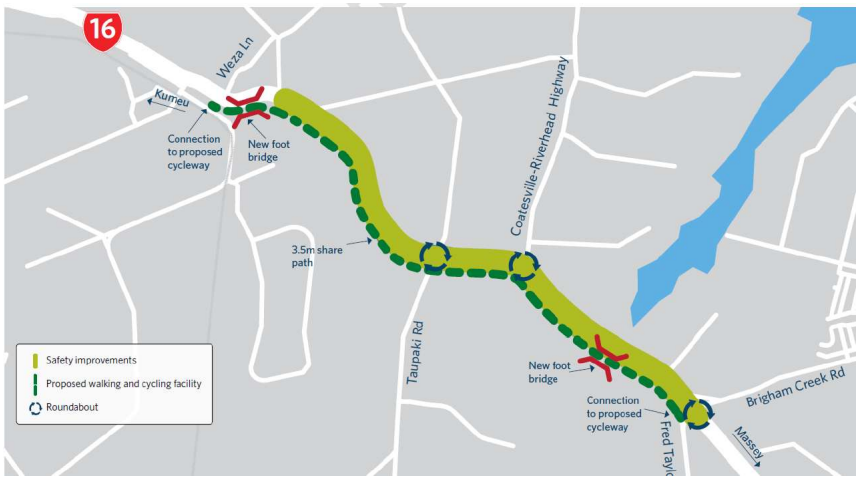
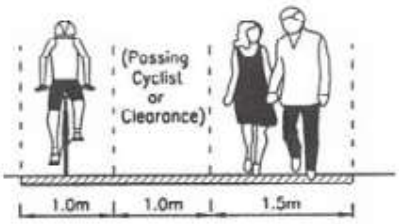
Short list of walking and cycling options descriptions

Each of the shortlisted walking and cycling (shared use path) options is described in Table 1 below.

Table 1 Short listed walking and cycling options

Option	Option description
Option 1: A shared use path on each side of the road corridor	Option 1 comprises a 2.5m wide concrete shared path facility on both sides of SH16 to allow for walking and cycling in the direction of roadway travel. The facility located on both sides of SH16 will feature the following: • Connection to existing facilities at the Brigham Creek Roundabout and Fred Taylor Drive on both sides of SH16 • Cut and fill retaining walls adjacent to the roadway to minimise encroachment into adjacent properties • Implementation of two new footbridges over Brigham Creek, on both sides of SH16 • Walking and cycling facilities at the new Coatesville-Riverhead Highway roundabout and connections into existing facilities at the Taupaki roundabout • Implementation of a new footbridge adjacent to the southern side of the existing Kumeū No.1 bridge and utilising the existing footbridge to the north • Connection to new pedestrian and cycling facilities at the Access Road/SH16 intersection. • Continuous edge barrier protection between the roadway and shared path facility will be required with a 1m buffer for barrier deflection. • Pedestrian lighting will be provided independently from the roadway lighting, typically at 30m spacing. • Drainage will typically be via kerb and channels, catchpit-manholes and pipes to either wetlands or mechanical treatment devices. • Relocation and undergrounding of significant lengths of overhead power on the southern side of SH16 

Option	Option description
	
Option 2: A shared use path along the northside of the road corridor	Option 2 comprises a 3.5m wide concrete shared path facility on the northern side of SH16, allowing bi-directional travel. The facility located to the north of SH16 will feature the following: • Connection to existing facilities at the Brigham Creek Roundabout on the northern side of SH16, requiring connection to Fred Taylor Drive facilities to be made by crossing the highway • Cut and fill retaining walls adjacent to the roadway to minimise encroachment into adjacent properties. • Implementation of one new footbridge over Brigham Creek, to the north of SH16 • Walking and cycling facilities at the new Coatesville-Riverhead Highway roundabout and connections into existing facilities at the Taupaki roundabout • The utilisation of the existing footbridge to the north of Kumeū No.1 Bridge • Connection to new pedestrian and cycling facilities at the Access Road/SH16 intersection. • Continuous edge barrier protection between the roadway and shared path facility will be required with a 1m buffer for barrier deflection. • Pedestrian lighting will be provided independently from the roadway lighting, typically at 30m spacing. • Drainage will typically be via kerb and channels, catchpit-manholes and pipes to either wetlands or mechanical treatment devices. • Relocation and undergrounding of significant lengths of overhead power on the southern side of SH16.  

Option	Option description
Option 3: A shared use path along the south side of the road corridor	Option 3 comprises a 3.5m wide concrete shared path facility to the southern side of SH16 to allow for walking and cycling in the direction of roadway travel. The facility located to the south of SH16 will feature the following: • Connection to existing facilities at the Brigham Creek Roundabout and Fred Taylor Drive • Cut and fill retaining walls adjacent to the roadway to minimise encroachment into adjacent properties • Implementation of one new footbridge over Brigham Creek, to the south of SH16 • Walking and cycling facilities at the new Coatesville-Riverhead Highway roundabout and connections into existing facilities at the Taupaki roundabout • Implementation of a new footbridge adjacent to the southern side of the existing Kumeū No.1 bridge. • Connection to new pedestrian and cycling facilities at the Access Road/SH16 intersection. • Continuous edge barrier protection between the roadway and shared path facility will be required with a 1m buffer for barrier deflection. • Pedestrian lighting will be provided independently from the roadway lighting, typically at 30m spacing. • Drainage will typically be via kerb and channels, catchpit-manholes and pipes to either wetlands or mechanical treatment devices. • Relocation and undergrounding of significant lengths of overhead power on the southern side of SH16  

C

Appendix C – Walking and Cycling Options Assessment

Walking and Cycling Options Assessment

This Appendix details the MCA scoring and commentary for the shortlisted Walking and Cycling (shared use path) options assessment, analysis notes and identification of the preferred option for a Walking and Cycling Facility along SH16 between Brigham Creek and Kumeū.

Option 1: A shared use path on each side of the road corridor

Option 2: A shared use path along the northside of the road corridor

Option 3: A shared use path along the south side of the road corridor

Criteria	Opt 1	Opt 2	Opt 3	Commentary
Safety	+3	+2	+2	Currently, pedestrians must walk on the shoulder of an 80km/hr state highway and cyclists use the road corridor. All options provide a significant safety benefit for cyclists and pedestrians through the provision of facilities separate to the main highway corridor. An assessment was undertaken (below) for each option relating to access to the facility and crossing points. <u>Shared Path access and Crossing State Highway</u> Options 2 and 3 encourage crossing the state highway if arriving from opposite side to access the proposed facility on either side of the state highway. These crossing points are located at roundabouts except for western end of the proposed extent between Riverhead Road and Weza Lane (A midblock crossing treatment would be required). The roundabout will slow the vehicles along the main state highway. Option 1 does not require the above as the facility is proposed on both sides of the corridor. There is also the risk of users crossing the state highway at random locations to get to either side of the corridor. This is inherent to all options however more so for Option 2 and Option 3. As the speed environment and volumes along the state highway is greater the safety risk is greater compared to side roads where speeds and volumes are not as high as the state highway. The likelihood of having to cross the state highway is greater for Options 2 and 3. <u>Crossing side roads</u> All options have to cross the side roads (at-grade). Option 1 has to cross 6 side roads along the corridor (both sides). Option 2 has to cross 5 side roads on the northern side of the corridor. (Two roundabouts and two Stop control and one Give-way control) Option 3 has to cross 1 side road on the southern side of the corridor and potentially 2 once the forth leg is built at Coatesville-Riverhead Highway intersection. (One roundabout) The likelihood of a crash occurring is the lowest in Option 3 compared to the other options as it only needs to cross a side road at one point. The volumes at this point is similar to the crossing points on the other side of the corridor. <u>Crossing private property accesses along the corridor</u> All options have to cross private accesses. Option 1 has to cross 47 private accesses which includes approximately 13 commercial properties.

Criteria	Opt 1	Opt 2	Opt 3	Commentary
				Option 2 has to cross 24 private accesses which includes approximately 8 commercial properties. Option 3 has to cross 23 private accesses which includes approximately 5 commercial properties. The likelihood of a crash occurring is expected to be greater for Option 1 as the number of accesses to cross is double. However, Option 1 reduces the frequency of pedestrians wanting to cross the road. Although the exposure is assumed to be less in Option 1 compared to other options due to the demand being split on either side of the facility. Options 2 and 3 are considered to have similar risk.
Efficiency	+3	+2	+2	Better accessibility for all ages and abilities to amenities and businesses along the route. Option 1 will be slightly better with accessibility along both sides of the corridor. Yet all options will improve travel time for pedestrians and cyclists (compared to existing environment) due to the provision of a separate active mode facility.
Systems Integration and Modal Shift	+3	+1	+2	All options i.e. the provision of a walking and cycling facility are consistent with the GPS 2021 (in particular travel choice). All options have the opportunity to connect both sides of the road at key crossing points (consistent with desire lines). All three options will meet forecast transport demand and provide connectivity for pedestrians and cyclists. Options 1 and 3 provide better connectivity to current north-western cycle facility (from Fred Taylor Drive) and existing AT cycleway at Access Road as they are on the same side of the road. Options 1 and 2 will future proof connectivity between future developments beyond the north of the corridor (i.e. Riverhead and Whenuapai Future Urban Zones). Providing a shared path on both sides of the road (Option 1) is consistent with facilities provided for an urban arterial. This is planned in the future (within Supporting Growth Programme's plan for this stretch of SH16, once the Alternative State Highway is implemented 20+ years). Protecting the land now (Option 1) provides for flexibility for the future reallocation of facilities within the widened corridor. In the future this cross section will be relevant for a Mixed Use Collector which is classified as 'medium movement' and 'place significance' or a Neighbourhood Collector which is classified as ''medium movement significance and 'low place significance'. Both scenarios are applicable to what the future environment is anticipated to look like. Options 1 and 3 have the potential to provide the longest un-interrupted travel as the number of side roads and vehicle crossings on the south side is less than Option 2. Note: the options are assessed based on the existing environment. (https://at.govt.nz/about-us/manuals-guidelines/roads-and-streets-framework-and-the-transport-design-manual/).
Technical	-2	-1	-1	Both Option 1 and Option 2 require additional retaining walls and re-construction of existing footpath between Riverhead Road and Weza Lane. The proposed shared paths will be in close proximity to a number of residential properties with short driveways. There will be significant accommodation works within the affected private properties such as the residential properties between Brigham Creek Rd and Kennedys Rd, Kumeu Produce Market, lifestyle properties between Taupaki Road and Old Railway Road, Building Blocks Childcare, Juice Strawberry Shop, Kumeu Village Rest Home. Option 1 and Option 2 will require relocation of the Regional VMS. There will be issues in achieving visibility of the VMS to the approaching eastbound traffic. A cantilevered gantry design is desirable but SH16 is an over-dimension route and vertical clearance of 6.5m is required. This will be a significant structure. Alternatively, the shared path alignment to be deviated further north requiring more private property. Option 2 will require the de-construction of the existing pedestrian bridge and constructing a new wider shared path bridge at Kumeu No. 1 Bridge.

Criteria	Opt 1	Opt 2	Opt 3	Commentary
				Option 3 has been scored slightly negative as additional land will be required, retaining walls will need to be shifted laterally to allow for the 3.5m wide shared path cycleway and will subsequently be bigger walls. Existing road side services may be affected. The design also retains the existing footpath and pedestrian bridge on the northern side of SH16 between Riverhead Rd and Weza Ln (Kumeu).
Operational/ Maintenance	-2	-1	-1	Additional maintenance of a new asset required for all options, however, Option 1 will require more maintenance than Options 2 and 3 due to a larger footprint.
Safety in Design (Zero harm)	-2	-1	-1	The do nothing base approach is the safest approach as all risk is avoided. Therefore, all options are assessed as negative. Option 2 requires the de-construction of existing pedestrian bridge near Kumeu township. This bridge is adjacent and in close proximity of the road bridge. Options 1 and 2, require more work at Boric Market and Kumeu Produce Market which have high traffic movements. Option 3 will have no significant SiD risks, any minor risk can be managed through standard process and assurance. Lastly, Option 1 is considered twice the risk of Options 2 and 3.
Social	+3	+2	+2	All options provide for increased access for the community to areas of value (where people live, work and play) for people who want to walk and cycle. They will have a positive health and wellbeing impact. Overall, this also gives an opportunity for cyclists to use a dedicated and safer facility rather than cycling on the state highway amongst general traffic. Access to areas of value to the community is enhanced most through Option 1. Options 2 and 3 require some people to cross to the opposite side of the corridor to access the cycleway; crossing points are likely to only be provided at key intersections in the short to medium term.
Natural Environment	+1	+1	+1	Option 3 presents less landscape impacts as there are no facilities along the southern side of the road. Options 1 and 2 require additional earthworks cutting to achieve appropriate grades and levels. Additional land take required for all options. All options result in an increase in impervious surface area due to the cycleway width and all options will provide an opportunity for mitigation planting in the road reserve that will enhance native vegetation and biodiversity. All options include new bridges (Brigham Creek and Kumeu River) therefore there is a potential impact on the natural features. Impacts on the natural environment are most likely to be short term during construction. Option 1 has more bridges than the other options as two bridges are required at Brigham Creek (to accommodate the cycleway on both sides of the corridor). All of the wetlands near the project corridor are on the south side of the corridor, Option 3 may encroach into some wetlands. All streams along the corridor bisect the road, therefore all options may cause temporary construction effects on these streams. All options have increased impervious surface area resulting in additional detention and treatment required for stormwater. The stormwater runoff from SH16 is currently not treated. All three design options will collect and treat the runoff and provide an improvement to the water quality discharge in the area. Stormwater treatment swales will be provided along the carriageway sides as mitigation. Additional vegetation removal would be required to construct the cycleway along the northern side of the corridor (Option 1 and 2). Little additional vegetation clearance is required with Option 3. Whilst there is a potential encroachment into the wetlands for construction for options 1 and 3, the project can minimise the footprint or marginal loss of portions of those features, including streams and riparian planting. These can be mitigated by controls and replating to minimise the effects (on habitats/biodiversity and ecology) or offset from a project perspective. Purely from an ecology perspective there is a difference between option 2 and options 1 and 3 which would have less ecological effect but the differentiation

Sensitivity: General

Criteria	Opt 1	Opt 2	Opt 3	Commentary
				between these would be marginal and not warrant a difference in scoring. Environmental specialists view that the project could leave an environmental legacy. On balance, all options would result in slightly positive natural environment outcomes.
Human Health	0	0	0	There will be no noticeable impact on air quality from any option. There may be potential noise impacts at construction and operation stages for all options as the shared use path increases the width of the corridor, bringing transport activities closer to habitable dwellings. Noise effects at both stages will need to be effectively managed, however it is anticipated that during construction there will be standard construction management and effects can be managed through a Construction Noise and Vibration Management Plan (CNVMP). All options will likely encroach on a number of known HAIL sites along the corridor (including historic and current horticultural and viticultural activities), yet potential effects can be managed through the development of a CSMP to manage and mitigate the potential contaminant discharge risks during the works.
Heritage	-1	0	0	Options 1 and 3 both have a small area of encroachment into the Historic Heritage Overlay Extent of Place (AUP reference 525) relating to the former Sinton House property (238 State Highway 16) which will need to be assessed as part of the NoR process. Both options also encroach into 222a SH16, which has another Sinton House Homestead (associated with Alex Sinton). This site is listed on the AC Cultural Heritage Index yet have not been scheduled (yet). It is understood that Auckland Council has evaluated this site in 2017 and there was an intention to schedule them. Albeit AC has not notified any intentions to schedule the sites via a Plan Change as at 20 October 2021. The site has an old shed formally used as a stables and will be affected by the south alignment. Option 2 does not have any effect on the AUP Historic Heritage Overlay Extent of Place, however there is a group of notable trees within the property at 191 SH16 which are scheduled in the AUP CHI and have natural heritage values. Proposal design may be able to avoid the notable trees. Option 1 has twice the effect due to the encroachment into the Historic Heritage Extent of Place overlay and group of notable trees (on both sides of the road).
Cultural	-1	+2	+1	***Mana Whenua Input - Te Kawerau o Maki (endorsed by Ngati Whatua o Kaipara)*** Option 1 had the lowest score, primarily due to the larger footprint. The larger footprint increases the inherent risk of disturbing Maori Archaeology, productive soils and trees, as well as increases stormwater runoff into local streams and works within waterways. Option 2 is the preferred option under the Cultural Effects criteria. Option 2 is preferred as it has the smallest footprint in sensitive areas such as streams, it would utilize the existing footbridge at Kumeū Bridge and reduce the works in and around the stream. Option 3 has slightly more work in the Ngongetepara stream compared to Option 2, giving Option 3 a slightly lower score against cultural criteria. The design will require the deconstruction of the existing pedestrian bridge on Kumeū Bridge as well. However, the effects of this can be mitigated through stormwater discharge quality and treatment.
Property	-2	-1	-1	All three options require additional private property, both temporary and permanent. Option 1 requires land from an additional 14 properties (permanently), a total additional area of approximately 10,000m² is required. Option 2 requires land from an additional 8 properties (permanently), a total additional area of approximately 8,300m² is required. Option 3 requires land from an additional 6 properties (permanently), a total additional area of approximately 7,200m² is required. Underground services are predominantly along the northern side including the Chorus international data cable.

Sensitivity: General

Comments for Non-Scored criteria

Criteria	Comments
Financial considerations	An options assessment was undertaken which considered the costs and benefits. A rough order of costs (RoC) was prepared to estimate the cost to design and construct the three short list options, based upon a high-level engineer's assessment of property and physical works impacts. The RoCs established are: • Option 1 $23.67M • Option 2 $15.58M • Option 3 $13.46M An economic assessment for the shared path has been completed. This assessment uses the NZ Transport Agency Economic Evaluation Manual (EEM) Simplified Procedure 11 (SP11) as updated in August 2017. The EEM methodology is based on a catchment analysis of surrounding buffer zones to provide a benchmark on likely demand levels within the catchment. As all three options involve variants of similar off-road infrastructure, identical economic benefits have been applied as the SP11 does not distinguish between different design layouts. The outcome of the economic assessment demonstrates that $1.6M of benefits over 40 years can be expected from the provision of any of the three short listed options.
Consentability	Option 1 results in a land requirement on both sides of the corridor and would require more land than the other options and an increase in designation footprint. This alongside other approvals, means it is potentially more complex for consenting. Options 2 and 3 also result in a land requirement, however given that these options confine the works to one side of the road the number of properties impacted by land requirement is more limited in number. (Note: The 2017 business case design affected 53 properties. Adding a shared use path increases the land requirement, with Option 1 affecting 67 properties, Option 2 affecting 61 properties and Option 3 affecting 59 properties). All three options result in an increase in impervious area, which has implications for the stormwater consenting of the proposal. Yet Options 2 and 3 would result in less additional impervious surface than Option 1. All three options require vegetation removal, and this can be mitigated by replanting. Option 1 will require three new bridges – one on each side of Brigham Creek due to the required additional width of the cycleway and one over Kumeu River. This has consenting implications depending on the way the bridge structure is designed and whether the structure has a footprint in the watercourse. Options 2 and 3 would require a bridge each on one side only of Brigham Creek, and Option 3 would require a bridge over Kumeu River. Options 1 and 3 would require encroachment into a natural inland wetland, yet a localised option assessment could investigate options to avoid or reduce the encroachment (loss) and ecological effects.

Stakeholder feedback	Option 1 has far greater impact on landowners. Both Options 2 & 3 have land impacts but Option 3 has significantly less. Bike Auckland have signalled they are very happy with the work that has gone in to get these options together. They feel that having it on both sides would mean greater risk. They have yet to state that they have a preference out of Option 2 or 3. However they do acknowledge Option 3 will connect better with other infrastructure. Walking Access NZ and Living Streets Aotearoa are both positive towards all walking and cycling facility proposed. General public: feedback will be gained during consultation in September 2018. However previous consultation rounds indicated that people were wanting further walking and cycling facilities and thought cycling even with a 2m shoulder (the previous preferred option at business case phase) would still be dangerous. There have been further areas that they have identified as areas for crossing points. Option 1 is assessed positively – but not as high as the other options due to the risks and impacts this option presents. Option 2 is assessed more positively due to mitigating stakeholder risk through less impact. Option 3 is assessed as the most positive due to having the most benefit and less risk and mitigation required.

MCA Assessment Analysis Notes

The MCA found a number of similarities between all options. All options that provide the provision of a walking and cycling facility are consistent with the Government Policy Statement 2021 (in particular travel choice). Each option provides the opportunity to connect both sides of the road at key crossing points, consistent with desire lines. All three options will meet forecast transport demand and provide connectivity for pedestrians and cyclists.

The three options have some similar effects that do not differentiate a preferred option between the scores. For example, all streams along the corridor bisect the road, therefore each option may cause temporary construction effects on these streams. Each option will likely encroach on a number of known HAIL sites along the corridor (including historic and current horticultural and viticultural activities), yet potential effects can be managed through the development of a CSMP to manage and mitigate the potential contaminant discharge risks during the works

The following sections will discuss the scores for each option and why Option 3 was the preferred option.

Option 1: 2.5m shared path on both sides of the road corridor

Option 1 has scored lowest of the three short list options considered.

Option 1 was scored to have significant positive effects with Safety, Efficiency, Systems Integration and Modal Shift, Social. Option 1 would significantly improve access to community areas such as dwellings, business and places of work. It would provide the safest option for active mode users as a path on both sides of the road would decrease the frequency of pedestrians and cyclists crossing the road. A path on both sides would integrate into the existing network on both sides of the highway. Option 1 scored the highest against Social as it results in twice the benefits that come with a path on only one side of the highway (i.e. Options 2 and 3). Additionally, Option 1 provides for better travel times for active mode users as it requires less need for crossings compared to Options 2 and 3.

Although Option 1 scored a +3 for Safety, a shared path on both sides of the highway would mean greater safety risk to cyclists and pedestrians due to the increased number of vehicle crossings. This includes heavy vehicle access to a landfill site, a large number of driveways, Riverhead Road, Old Railway Road and Coatesville Riverhead Highway. However, the exposure of this risk is assumed to be less in Option 1 compared to other options due to the demand of active users being split on either side of the facility.

However, Option 1 received a moderately negative score for Technical, as it requires additional retaining walls compared to Options 2 and 3 and re-construction of the existing footpath between Riverhead Rd and Weza Lane. The proposed shared paths will be in close proximity to a number of residential properties with short driveways along the north side of the road corridor. This will require significant accommodation works within the affected private properties such as the residential properties between Brigham Creek Road and Kennedys Road, Kumeū Produce Market, lifestyle properties between Taupaki Road and Old Railway Road, Building Blocks Childcare, Juice Strawberry Shop, Kumeū Village Rest Home. Option 1 will also require three new bridges, one on each side of Brigham Creek culvert due to the required additional width of the cycleway and one over Kumeū River. This has consenting implications depending on the way the bridge structure is designed and whether the structure has a footprint in the watercourse.

Additionally, the regional VMS is located on the north side of the highway near Brigham Creek culvert. Options 1 and 2 will require the potential relocation of the Regional VMS. There will be issues in achieving visibility of the VMS to the approaching eastbound traffic. A cantilevered gantry design is desirable but SH16 is an over-dimension route and vertical clearance of 6.5m is required and this will be a significant structure. Alternatively, the shared path alignment could be deviated further north to avoid relocation of the VMS, however this would require more private property to be acquired.

Option 1 had a slightly negative score for Heritage. This option has a small area of encroachment into Historic Heritage Overlay Extent of Place (AUP reference 525) relating to the former Sinton House property (238 SH16). In the same area, on the other side of the road, Option 1 will likely have implications on the notable trees on 191 SH16 on the north side of the highway. Whilst Options 2 and 3 would each encroach properties with heritage values (on the north side or south side of the corridor respectively), it was considered that Option 1 would have twice the effect given it would encroach heritage values on both sides.

Option 1 would require encroachment into a natural inland wetland, yet a localised option assessment could investigate options to avoid or reduce the encroachment (loss) and ecological effects.

Option 1 has the largest footprint of all the options. Therefore, it is not surprising that it scored the lowest for Operations/Maintenance, Property and Cultural effects.

Option 2: 3.5m shared path on the north side of the road corridor.

Similar to Option 1, the proposed shared path will be in close proximity to a number of residential properties with short accessways. There will be significant accommodation works within the affected private properties such as the residential properties between Brigham Creek Road and Kennedys Road, Kumeū Produce Market, lifestyle properties between Taupaki Road and Old Railway Road, Building Blocks Childcare, Juice Strawberry Shop, Kumeū Village Rest Home. Option 2 also requires additional retaining walls, re-construction of the existing footpath between Riverhead Rd and Weza Lane, and the de-construction of the existing pedestrian bridge and constructing a new wider shared path bridge at Kumeū No. 1 Bridge. Therefore, the Technical risk is similar to Option 1 just halved, due to the footpath being on one side of the road.

As mentioned, this option may require the relocation of the Regional VMS located on the North West side of the Brigham Creek culvert, this will impose Technical challenges on the Project.

Option 2 is the preferred option under the Cultural Effects criteria as it has the smallest footprint in sensitive areas such as streams. Option 2 would utilize the existing footbridge at Kumeū Bridge and reduce the works in and around the stream.

Option 3: 3.5m shared path on the south side of the road corridor

Option 3 scored the highest of the three short list options in the MCA assessment.

Option 3 was scored to have moderately positive effects with Safety, Efficiency, Systems Integration and Modal Shift, Social.

Option 3 has the potential to provide the longest un-interrupted travel path (out of the three options) as the number of side roads and vehicle crossing is less than the other options and provides for a safer environment for cyclists and pedestrians.

This option had a moderately positive score for Systems Integration and Modal Shift as it has better connectivity to the current north-western cycle facility (from Fred Taylor Drive) as it is anticipated to connect to the existing Auckland Transport cycleway at Access Road (as they are on the same side of the road).

Option 3 does not require any work at Boric Market and Kumeū Produce Market which have high traffic movements, allowing a safer construction process for Option 3. Option 3 will have no significant SiD risks, any minor risk can be managed through standard process and assurance.

Option 3 imposes technical challenges, like Option 2, as additional land will be required and retaining walls will need to be =shifted laterally to allow for the 3.5m wide shared path cycleway. Subsequently this may require larger retaining walls. The design will require the deconstruction of the existing pedestrian bridge on Kumeū Bridge.

This option has a small area of encroachment into Historic Heritage Overlay Extent of Place (AUP reference 525) relating to the former Sinton House property (238 State Highway 16) yet no direct impact on the feature itself.

Option 3 would require encroachment into a natural inland wetland, yet a localised option assessment could investigate options to avoid or reduce the encroachment (loss) and ecological effects.

Option 3 has slightly more work in the Ngongetepara stream compared to Option 2, therefore it received a slightly lower score against Cultural Effects criteria. However, it was noted that the effects of this can be mitigated through stormwater discharge quality and treatment.

This option has significantly less land impact than either Option 1 or 2.

Recommended Option

Option 3 was identified as the recommended option because it:

- Improves safety for cyclist and pedestrians between Brigham Creek Road and Kumeū
- Enhances connectivity and transport mode choice for the Kumeū / Huapai communities.
- Provides a safe connection into the existing north-western cycle facility from Fred-Taylor Drive.
- Provides connectivity to the Heartland rail ‘Kaipara’s Missing Link’ (cycle tour route from Auckland to Dargaville) that dissects the corridor at Old North Road
- Provides the longest uninterrupted active travel path. The south side of SH16 has the least number of side roads and vehicle crossings.
- Continues promotion of cycling and walking as an attractive and viable means of transport
- Provides fewer technical challenges than providing a path on both sides of the road.
- Provide a recreational cycle and walking route for the area that will promote tourism – connecting to wineries, cafes and attractions.
- Requires less infrastructure to be constructed and reduces ongoing operational and maintenance costs
- Requires less programme duration for construction as only construction on one side of the highway
- Improves social outcomes through accessibility to shops, jobs and services
- Has less landscape impacts through less land modification and retaining walls

D

Appendix D – Section B Coatesville Riverhead Highway Intersection Options

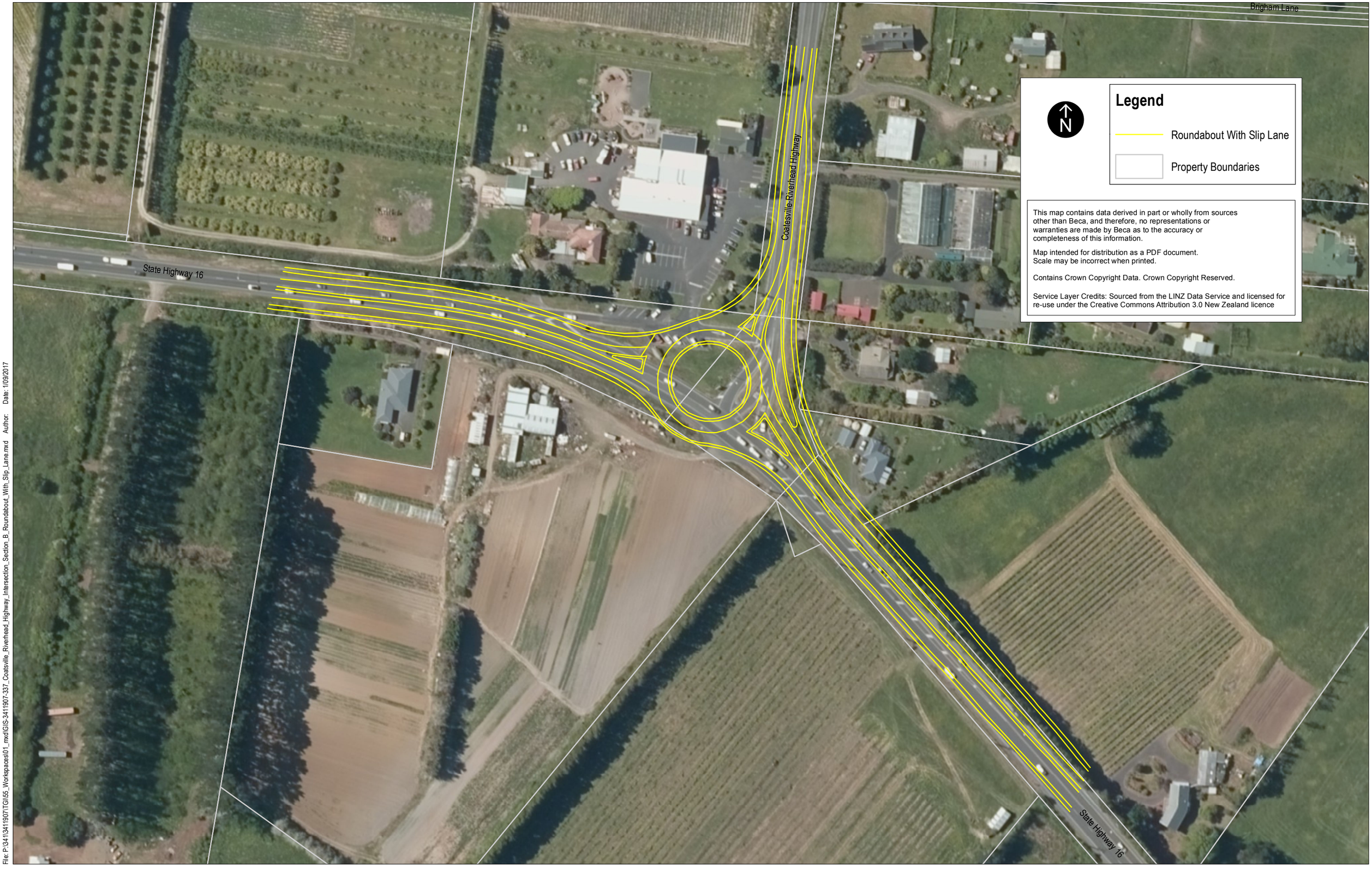
Section B Coatesville Riverhead Highway Intersection Options

The following plans illustrate the three options considered for the design of the Coastville-Riverhead Highway intersection with State Highway 16. These options include:

- Option 1: Roundabout (with form being a 2-lane roundabout configuration)
- Option 2: Signalised seagull
- Option 3: Signalised intersection
- Option 4: Slip lane

It is noted that inn FLOW's 2017 assessment, each option they assessed involved four laning (or one additional lane) in Section A and Section C, either side of the potential Coatesville Riverhead intersection. Section B was always assessed with Section A or C. As these options were assessed together ,it appears that it was automatically assumed that the roundabout (RAB) would be two lanes to integrate with the additional lanes on either side of the RAB.

The SSBC outlines existing congestion issues from 2015, which noted congestion at the Taupaki Road RAB where cars have to merge in and out of the two lane roundabout. To reduce this congestion issue, additional lanes in Section A and C were considered to remove the merging conflict points (at both Brigham Creek and Taupaki RAB). Although it is not explicitly stated anywhere, it is not unreasonable to assume that a one lane roundabout was not considered a feasible option as it would cause another conflict point along the alignment where cars would need to merge and induce more congestion and a longer travel time.



Legend

Roundabout With Slip Lane

Property Boundaries

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Map intended for distribution as a PDF document. Scale may be incorrect when printed.

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File: P:\3411\3411907\TGIS\5_Workspaces\01_mxd\GIS-3411907-337_Coatsville_Riverhead_Highway_Intersection_Section_B_Roundabout_With_Slip_Lane.mxd Author: Date: 1/09/2017

Map Scale @ A3: 1:1,500

0 50 100

Metres

Revision	Author	Verified	Approved	Date
1	BAP	AMO	LDB	11/08/2017

Coatesville Riverhead Highway Intersection

Section B : Roundabout with Slip Lane

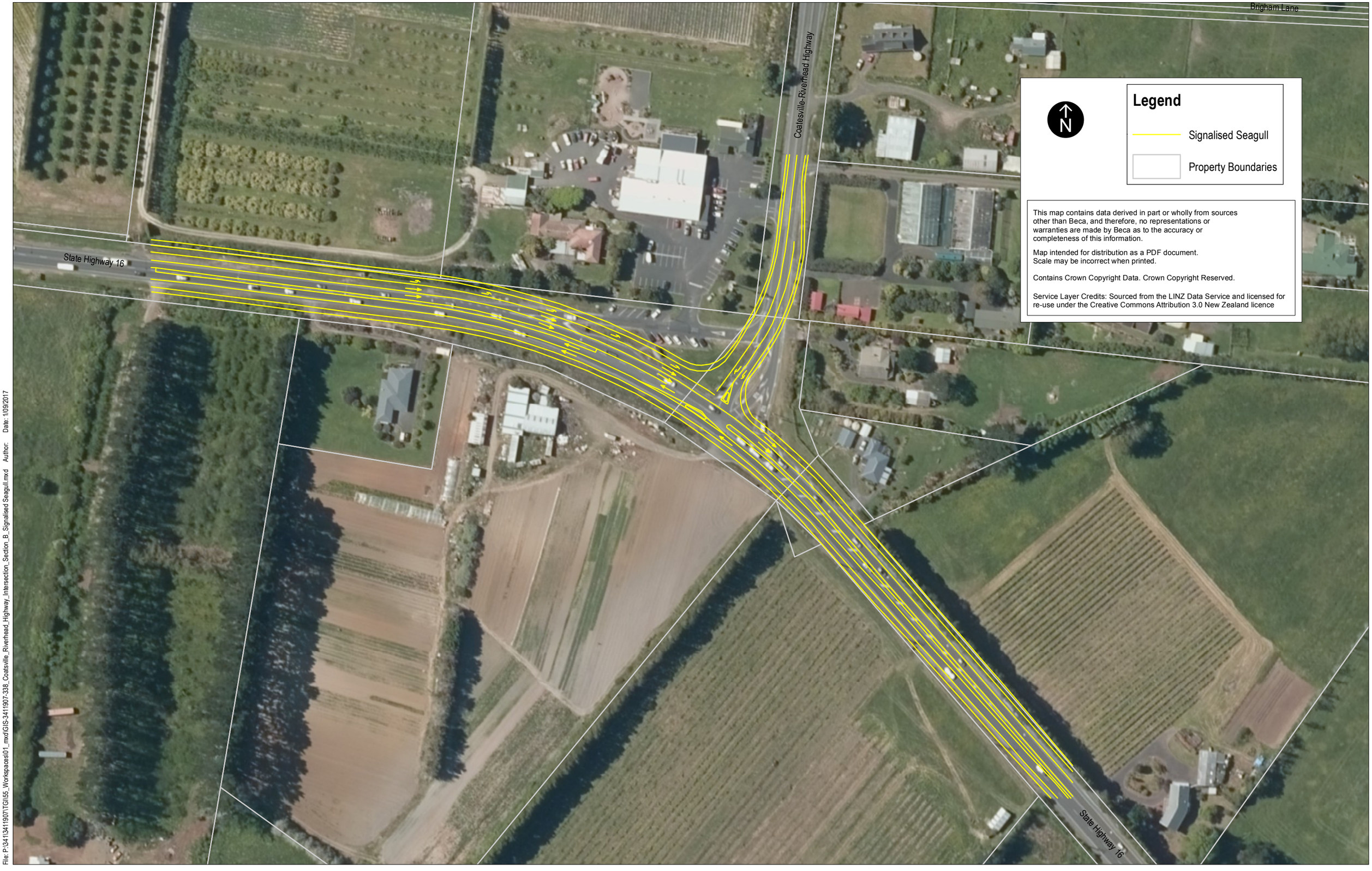
Client: **NZ Transport Agency**

Project: **Safe Road Alliance - Core Project**

NZ TRANSPORT AGENCY WAKA KOTAHI | Safe Roads

Discipline: **GIS**

Drawing No: GIS-3411907-337



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Map Scale @ A3: 1:1,500

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Metres

Revision	Author	Verified	Approved	Date
1	BAP	AMO	LDB	11/08/2017

Coatesville Riverhead Highway Intersection

Section B : Signalised Seagull

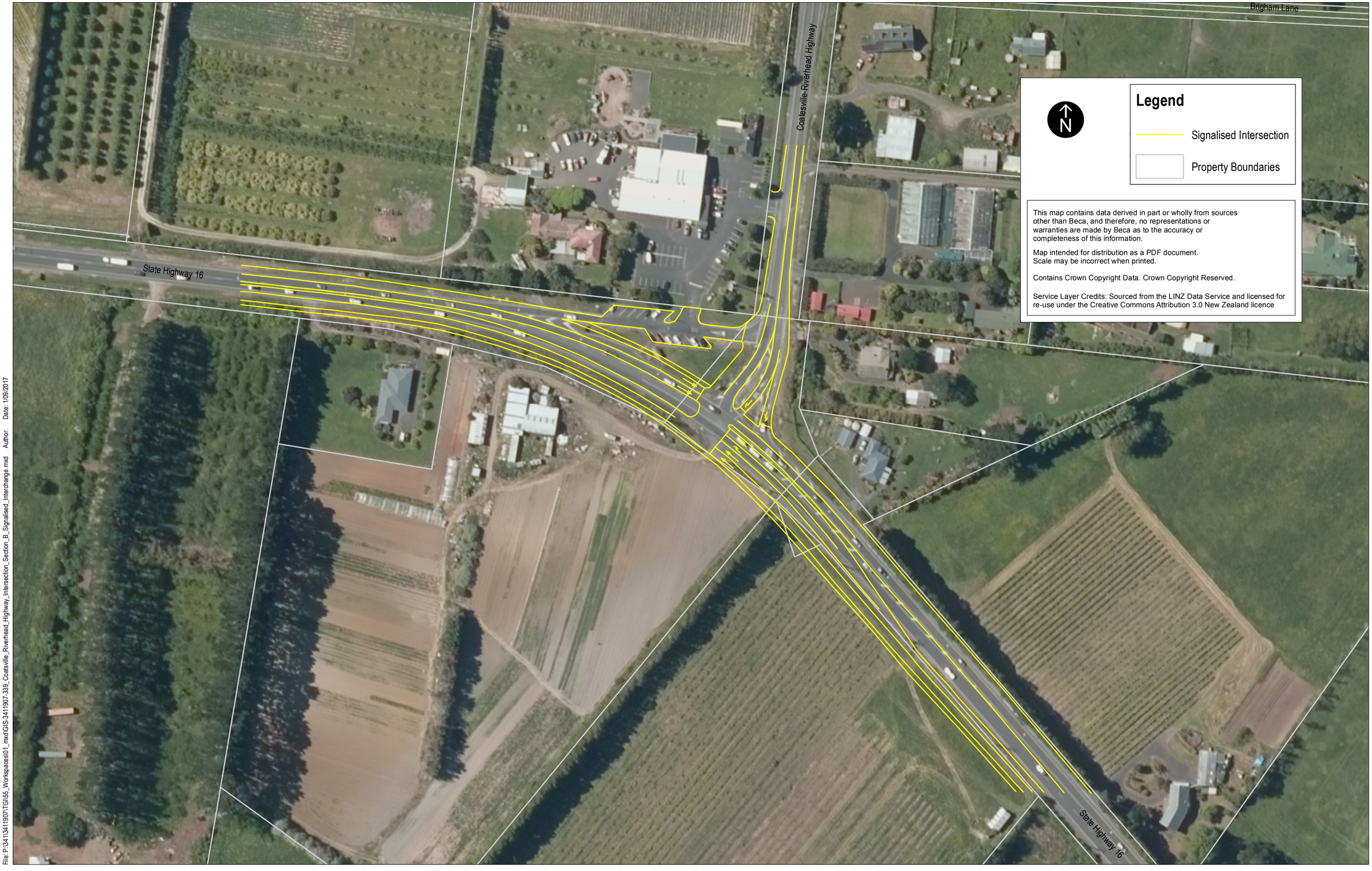
Client: **NZ Transport Agency**

Project: **Safe Road Alliance - Core Project**

NZ TRANSPORT AGENCY WAKA KOTAHI | Safe Roads

Discipline: **GIS**

Drawing No: GIS-3411907-338



Legend

- Signalised Intersection
- Property Boundaries

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Map intended for distribution as a PDF document. Scale may be incorrect when printed.

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File: P:\3411341190\1TGIS\5_Workspaces\01_mxd\GIS-3411907-339_Coatsville_Riverhead_Highway_Intersection_Section_B_Signalised_Interchange.mxd Author: Date: 1/09/2017

Map Scale @ A3: 1:1,500

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Metres

Revision	Author	Verified	Approved	Date
1	BAP	AMO	LDB	11/08/2017

Coatesville Riverhead Highway Intersection

Section B : Signalised Intersection

Client: **NZ Transport Agency**

Project: **Safe Road Alliance - Core Project**

NZ TRANSPORT AGENCY WAKA KOTAHI | Safe Roads

Discipline: **GIS**

Drawing No: GIS-3411907-339

File: P:\3411341190\1TGI\55_Workspaces\01_mxd\GIS-3411907-340_Coatsville_Riverhead_Highway_Intersection_Section_B_Left_Turn_Slipway.mxd Author: Date: 1/09/2017

Map Scale @ A3: 1:1,500

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Metres

Revision	Author	Verified	Approved	Date
1	BAP	AMO	LDB	11/08/2017

Coatesville Riverhead Highway Intersection

Section B : Left - Turn Slip Lane

Client: **NZ Transport Agency**

Project: **Safe Road Alliance - Core Project**

NZ TRANSPORT AGENCY WAKA KOTAHI

Safe Roads

Discipline: **GIS**

Drawing No: GIS-3411907-340

E

Appendix E – Section B Coatesville Riverhead Highway Intersection Assessment

Section B - Coatesville Riverhead Highway Intersection Options Assessment

The table below details the MCA scoring and commentary for the Coatesville Riverhead Highway (CRH) Intersection shortlisted options assessment, analysis notes and identification of the preferred option for the intersection.

CRITERION	ROUNDABOUT	SIGNALISED SEAGULL	SIGNALISED INTERSECTION	SLIP LANE	COMMENTARY
Safety	+2	+1	+1	0	The existing 5 year has had 3 injury crashes. There has been 1 FSI in 2016. The HRIG predicts • 6 injury crashes per 10 year which equates to 2.2 DSI with a Priority T intersection. • 0.6 injury crashes per 10 year which equates to 0.04 DSI with a Signalised intersection. • 0 injury crashes per 10 year which equates to 0 DSI with a roundabout intersection. Roundabout: Safe system approach - roundabouts generally provide a safer alternative to signalised and other unsignalised intersections as the speed of all vehicles is reduced at the conflict points, reducing the risk of fatal and serious injuries. Crash reductions at roundabouts are primarily attributed to two factors: reduced traffic speeds and elimination of high-energy conflicts that typically occur at other types of at-grade intersections. The roundabout does not have grade separation which is why a +3 score is not achieved. High-quality pedestrian and cycling crossing facilities can be provided. The roundabout option also provides a safe turnaround facility if medium barriers are proposed along the corridor (in Sections A and C either side of this intersection). Signalised seagull: Provides an opportunity for vehicles to access SH16 from Coatesville Riverhead Highway while SH16 vehicles are held at a red light. This separates conflicting movements, although there remains a risk of high speed crashes when red light running occurs. Traffic heading west from Coatesville Riverhead Highway will merge with potential speed differential. It was considered that the option would be an improvement on the existing environment. Signalised intersection: It was considered that the option would be an improvement on the existing environment. Allows for improvements to all conflicting movements. Most ideal treatment for cyclist. Not considered to be a consistent treatment between

Criterion	Roundabout	Signalised Seagull	Signalised Intersection	Slip Lane	commentary
					Brigham Creek and Taupaki roundabout. Potential risk of high severity outcome from T-bone type crashes Slip lane: This option would not address historic or current safety issues. No improvement to number of conflicting movements, still has potential risk of high severity outcome from T-bone type crashes. Slip lane migrates the conflict point downstream and slightly improves the left turn movement out of CRH. This is not significant enough and a zero score is given. A neutral score indicates that it was considered that the option would not achieve the investment objectives for the project.
Efficiency	+2	+1	+1	0	A high level analysis (using SIDRA INTERSECTION software) has been undertaken for design and evaluation of the options. The outcome of this analysis is set out below: (Note: data to fully understand traffic signal impact during off peak hours is not yet available at the time of this assessment) Level of service (LOS) is a qualitative measure used to relate the quality of traffic service. LOS is used to analyse highways by categorizing traffic flow and assigning quality levels of traffic based on performance measure like queuing, delay, etc. If this intersection is not upgraded, the following LOS is expected: 1. CRH – LOS F 2. SH16 East approach – LOS F 3. SH16 West approach – LOS A This is quite evident that the east approach waiting to turn right onto CRH will need to give way to the EBD through movement whilst the queue length keeps increasing. The average delay and queue lengths are significantly high. Roundabout: intersection Level of Service B (AM peak) and C (PM peak) (2026). AM peak - The CRH leg has LOS C for the SH west approach as LOS A and SH east approach as LOS B and C. Metering for west approach (PM peak) would improve LOS for the Left turn out of CRH. The Left turn out can also be improved by providing a slip lane that merges further down. PM peak - The CRH leg has LOS F for the left turn out of CRH. Metering for west approach (PM peak) would improve LOS for the Left turn out of CRH. The Left turn out can also be improved by providing a slip lane that merges further down. It is likely that

CRITERION	ROUNDABOUT	SIGNALISED SEAGULL	SIGNALISED INTERSECTION	SLIP LANE	COMMENTARY
					the left turn slip lane can be provided with minimal impact on the adjacent properties by adjusting the position of the roundabout to the west. A Roundabout with left turn slip lane has an intersection Level of Service B (AM peak) and A (PM peak) (2026). This changes the Left turn movement out of CRH from LOS F to LOS A. Metering the west approach will not cause significant adverse effect compared to the traffic signals. The SH east approach is LOS A and SH west approach is LOS B for both lanes. The Roundabout option would provide a more balanced approach to delays to all approaches. These LOS are much better than do-nothing and slip lane option. Intersection Level of Service A (2036 with forth leg). This is due to more balanced flows. Metering can be removed at this stage. Implementing RAB earlier will have economic benefits. <u>Signalised seagull:</u> intersection Level of Service B (2026). AM and PM peak both perform similarly. Left turn out of CRH is has a LOS B for both peaks. Right turn into CRH is LOS D with an average delay of 45 - 48 sec for the two peaks. This option is slightly better than full signalisation as it has better LOS for through movement west approach (AM peak) and Right Turn out of CRH (AM peak). 8.5 and 10 sec difference respectively. This effect is not significant and is scored same as full signalised layout. ***No modelling for 2036 as forth leg is proposed and intersection will need to be upgraded to Signals or RAB.*** <u>Signalised intersection:</u> intersection Level of Service B (2026). The difference with AM and PM performance is the right turn out of CRH and SH16 west approach through movement. In the AM peak, the through movement faces an additional 6 sec delay and the right turn out has an additional 10 sec delay compared to PM peak. This is 8 – 12 sec more compared to the signalised seagull layout. For this

Criterion	Roundabout	Signalised Seagull	Signalised Intersection	Slip Lane	commentary
					movement, the RAB layout has about 20sec delay compared to the signalised options that has an average delay of 45 – 60 sec. The double right turn into CRH performs similar to the signalised seagull layout. Intersection Level of Service C (2036 with forth leg). Signals affects all approaches. IP assessment crucial to understand economic impact. Implementing Traffic Signals earlier also has economic benefits. Slip lane: Improving from existing layout to allow more left turn out of CRH. This only improves one movement. The overall intersection LOS is unacceptable with significant delays expected on the east approach and CRH approach. A zero score is given as this does not make any significant improvement to the intersection as a whole. ***No modelling for 2036 as forth leg is proposed and intersection will need to be upgraded to full signals or RAB.***
Systems Integration and Modal Shift	+2	+1	+1	0	Roundabout: The roundabout option is considered to be more consistent with the intersection designs at Taupaki and Brigham Creek and with the existing corridor treatments in this peri-urban environment. The 2-lane roundabout will require 4-laneing of SH16 to the west to tie-in with the new 2-lane roundabout at the Taupaki Road intersection and integrates well with the proposed SH16 4-lane capacity improvement option between the Coatesville Riverhead Highway and the Brigham Creek Road roundabout. The implementation of the roundabout also provides an opportunity to improve the existing bus stop. Given it may be more difficult for buses, cyclists, and pedestrians to travel through the intersection there is an opportunity during detailed design to consider crossing points, signage etc. The roundabout also acts as a safe turnaround facility for road users. The roundabout provides the opportunity for a fourth leg in the future. Signalised Seagull: The signalised seagull intersection is not considered to be a consistent treatment to the intersection designs at Brigham Creek and Taupaki or the peri-urban environment. On the other hand, this design integrates better with bus services along the corridor. Providing a signalised intersection will be an improvement from the existing intersection to effectively manage the vehicle movements. Signalised Intersection: This design is not considered to be consistent with the intersection designs at Taupaki and Brigham Creek or with the corridor treatments in a

CRITERION	ROUNDABOUT	SIGNALISED SEAGULL	SIGNALISED INTERSECTION	SLIP LANE	COMMENTARY
					peri-urban environment. However, traffic lights would support bus, cycle, and pedestrian movements better than other options and as per the roundabout option, the signalised option would integrate well with the SH16 4-lane options to the west and east of the intersection. Slip Lane: This treatment is consistent with the peri-urban environment, however it is not consistent with the intersection treatments at Brigham Creek or Taupaki. Furthermore, the design does not integrate well with bus services provided along the corridor, as the existing bus stop is located at the turning point of the corridor which cannot be easily accessed by pedestrians. Both the roundabout and the signalised intersection could be future proofed to provide for a ('fourth –leg') connection to support planned for future growth in the Redhills area. With regards to the future form of the corridor (integration with future programmers and plans for this corridor and area – i.e. Supporting Growth), the Roundabout and Signalised Intersections are typically consistent with an 'urban' environment and therefore appropriate for a potential future urban arterial.
Technical	-2	-1	-1	0	Roundabout: The roundabout occupies the largest footprint and requires the most significant lane configuration change of any of the options. As such the staged construction of the roundabout will be the most difficult of the options and will likely take the longest construction time to complete. Signalised Seagull / Signalised Intersection: Both of these options are likely to occupy a similar footprint. It may be possible to retain significant amounts of the existing intersection and approaches thus reducing the complexity of the construction staging and timing, compared to the roundabout but will be more complex than the southbound slip lane. Slip Lane: The southbound slip lane generally retains the existing intersection in its current configuration and only requires a minor adjustment to the left turn out of the Coatesville Riverhead Highway and pavement widening on the southbound carriageway south of the intersection. This option has the least impact on constructability, staging and timing compared to the signalised or roundabout options.

Criterion	Roundabout	Signalised Seagull	Signalised Intersection	Slip Lane	Commentary
Operational / Maintenance	-2	-1	-1	0	Roundabout: Low maintenance requirements with landscape maintenance only required once or twice per year (if hard landscaping is used). However, this option has a larger footprint to maintain. Maintenance of a roundabout can cause road safety and network disruptions. Signalised Seagull / Signalised Intersection: Low maintenance requirement, standard treatment unlikely to affect the ability to operate and maintain this option. However, providing signalised options is still an increase of maintenance than the existing situation. Slip Lane: Low maintenance requirements – no difference from status quo
Safety in design consideration (Zero Harm)	0	0	0	0	All standard treatments with risks consistent with working on high volume roads. There are no special circumstances identified at this stage and risks will be mitigated through temporary traffic management and hours of work.
Social	+1	+1	+2	+1	All options provide improved access for the community in and around the area. Roundabout: The proposed design will make accessing and existing popular local businesses in the area such as Boric and Blossoms Café safer for all users, compared to the existing T-intersection which has a history of unsafe vehicle movements and incidents which impact on community well-being. However, the roundabout design is less friendly for cyclists, pedestrians. Therefore, benefits are predominantly for car users. This option provides the opportunity to relocate the bus stop which is currently located at the island. This option will require the relocation of the existing bus stop and informal park-n-ride. Signalised Seagull: Signals provided by this option reduces some friction between cyclists and drivers. This option also provides the opportunity to relocate the bus stop. Under this option it would be more difficult to accommodate a pedestrian crossing. Signalised Intersection: The proposed design will make accessing and exiting popular local businesses in the area such as Boric and Blossoms Café much safer for all users, compared to the existing T-intersection which has a history of unsafe vehicle movements and incidents which impact on community well-being. In general, a signalised intersection manages the conflict between cyclists, pedestrians, buses, and drivers better. Signalized intersection provides more of those legible crossing points and overall improvement to access into the facilities on CRH. This option has the least impact on the existing bus stop and park-n-ride.

Sensitivity: General

Criterion	Roundabout	Signalised Seagull	Signalised Intersection	Slip Lane	Commentary
					Slip Lane: The proposed design will not improve the current movement in and out of the popular local businesses in the area such as Boric and Blossoms Café for all users, compared to the existing T-intersection which has a history of unsafe vehicle movements and incidents which impact on community well-being. Yet it will be a slight improvement on existing environment.
Natural Environment	0	0	0	0	Roundabout / Signalised Seagull / Signalised Intersection: Although, there are no significant natural features in the area, these options will require earthworks (land disturbance). However, the environmental effects of these are considered temporary. Slip Lane: This option requires less land disturbance and the environmental effects are considered temporary. All options will decrease the contaminants that runoff into the surrounding environment and increase the planting around the intersection. However, the intersection is still a relatively small area of the wider corridor only and the natural environment benefits would not be significant enough to increase the scores.
Human Health	0	-1	-1	0	Roundabout: The proposed solution will reduce congestion at the intersection particularly along Coatesville-Riverhead Highway, therefore less stationery traffic. When compared to the signalised options, the Roundabout option would provide a more balanced approach to delays to all approaches. The Roundabout option has therefore been ranked slightly better in terms of effects on air quality. An increase in noise could be expected due to breaking and acceleration at the intersection, and the active traffic lanes will be closer to existing residential properties adjacent to this intersection (e.g. 315 SH16, 1411 CRH). However, as the existing environment is a busy state highway, the effects of this could be considered minor and may be mitigated. Signalised Seagull / Signalised Intersection: The proposed solution will reduce congestion at the intersection, particularly along Coatesville-Riverhead Highway. An increase in noise could be expected due to breaking and acceleration at the intersection, and the active traffic lanes will be closer to existing residential properties adjacent to this intersection (e.g. 315 SH16, 1411 CRH). However, as the existing environment is a busy state highway, the effects of this could be considered minor and may be mitigated.

Sensitivity: General

Criterion	Roundabout	Signalised Seagull	Signalised Intersection	Slip Lane	commentary
					Slip Lane: The proposed solution is unlikely to alleviate existing congestion at the intersection and therefore has no anticipated effect on air quality or noise levels in this area. All options will likely encroach on a number of known HAIL sites along the corridor (including historic and current horticultural activities), yet potential adverse effects can be managed through the development of a CSMP to manage and mitigate the potential contaminant discharge risks during the works.
Heritage	0	0	0	0	No known archaeological, natural or built heritage features or values identified at this intersection or immediate surrounding area. Potential archaeological discoveries along whole corridor could be managed via standard Accidental Discovery Protocols. All options considered to have a neutral / similar effect to the do minimum.
Cultural	+1	-1	-1	0	***Note:*** *Numerous presentations on the project have been provided to the Iwi Integration Group – Central West and a early options were discussed at Reweti Marae with Ngati Whatua o Kaipara. The IIG have confirmed that Ngati Whatua o Kaipara and Te Kawerau o Maki are the interested parties to provide input for this project.* ***Mana Whenua Input - Te Kawerau o Maki (endorsed by Ngati Whatua o Kaipara)*** From a cultural perspective, the options can be differentiated based on Waahi Tohu (waahi tapu and waahi tuupuna), Wai Maaori (puna, awa, repo/wetland), Rerenga Rauropi (native fauna and flora) and Tangata Ora (human safety and wellbeing). The roundabout will result in a slight positive impact as it is understood to be the safest type of intersection and it provides the physical space suitable to acknowledge entry into the Kaipara district as people transition from Hikurangi (west Auckland) by including cultural interpretation via a sculpture or pou whenua. In addition, the stormwater runoff from the increased impervious surface can be mitigated.
Property	-1	-1	-1	0	Roundabout: Property purchase is likely to be required from the Boric food market site and the properties on the south-eastern corner of the intersection, as well as 299 State Highway 16. This option is likely to affect both the access to and land uses occurring on these sites. Signalised Seagull: Property purchase is likely to be required from the Boric food market site as well as two properties along the northern side of the state highway. This option is likely to affect both the access to and land use occurring on these sites.

Criterion	Roundabout	Signalised Seagull	Signalised Intersection	Slip Lane	Commentary
					Signalised Intersection: This option will require additional land outside the designation from the properties to the south of the intersection. This option is likely to affect the vehicle access to and existing land use on these properties (growing crops). Slip lane: This option could be constructed within the existing designation and would not require property purchase.

Non scored criteria

Criteria	Comments
Finical consideration	Capital costs are able to be funded from the National Land Transport Fund. At this stage there are no perceived cashflow risks for the capital cost or whole of life costs.
Consentability	Roundabout: As the footprint of the design is beyond the existing designation, an application will need to be made to alter the designation. Because of this, notification may be required, unless landowner approval is obtained. The works outside the designation will involve six landowners. In terms of environmental effects during construction, any adverse effects will be temporary and can be managed through construction management plans. Permanent effects of the additional impervious surface can be mitigated through the implementation of appropriate stormwater treatment and flow management. Signalised Seagull / Signalised Intersection: The design will require some works beyond the existing designation, therefore an application to alter the existing designation will be required. Because of this, notification may be required, unless landowner approval is obtained. The works outside the designation affect between two and four landowners depending on the design. In terms of environmental effects during construction, any adverse effects will be temporary and can be managed through construction plans. Permanent effects of the additional impervious surface can be mitigated through the implementation of appropriate stormwater treatment and flow management. Slip Lane: Due to minimal works required for this option, it is anticipated that the option could be constructed within the existing designation. It is anticipated that regional resource consents for earthworks and stormwater would be applied for, for the entire corridor works. However, it is relevant to consider that this option would require less earthworks and a minimal increase in impervious area.
Public / Stakeholders feedback	The options have been made public during open days and online. Based on feedback from the open days, the majority (nearly half) of the responses received showed a preference for the roundabout design, with the signalised intersection as the second most preferred option. Roundabout: Based on feedback received, the roundabout is the most supported solution by attendees. Of the respondents who indicated they preferred a roundabout, a number considered that including signals at the roundabout would ensure that traffic flow is managed efficiently, especially at peak times. A number of respondents noted that they feel that traffic lights will only further exacerbate congestion at the intersection. Some respondents suggested that a left turn slip lane from the Coatesville Riverhead Highway can be incorporated into

	the roundabout design. A few people also acknowledged that the roundabout may not be the safest option for cyclists. Initial discussions with the owners of 1404 Coatesville Highway (Boric Foodmarket) indicated that they do not oppose an option which requires land take from their property. No direct discussions have been held to-date with landowners of the other properties affected by this option. Signalised Seagull: Although there are no obvious objections towards this design, the public generally want to see significant improvements or changes at the intersection (such as a signalised intersection or a roundabout). There is a risk that the public do not understand how a seagull intersection functions. Signalised Intersection: Based on the feedback from the open days, the signalised intersection is a solution supported by the attendees. Respondents who preferred the signalised intersection, considered that it would be the safest option for cyclists and manage traffic flow the best. However, a few were opposed to the idea as they feel that traffic lights will not address congestion issues. No direct discussions have been held to-date with landowners of the other properties affected by this option. Slip Lane: Based on feedback, the implementation of this solution is likely to trigger strong opposition from the community as it is perceived not to provide significant safety of efficiency benefits.

MCA Assessment Analysis Notes

A high-level analysis (using SIDRA INTERSECTION software) has been undertaken for the design and MCA process. Level of service (LOS) is a qualitative measure used to relate the quality of traffic service. LOS is used to analyse highways by categorising traffic flow and assigning quality levels of traffic based on performance measures like queuing and delays. If the CRH intersection is not upgraded, the following LOS is expected in the future:

- CRH – LOS F
- SH16 East approach – LOS F
- SH16 West approach – LOS A

Roundabout:

The roundabout was considered the safest design, as roundabouts generally provide a safer alternative to signalised and other unsignalised intersections. The speed of all vehicles can be reduced at the conflict points, reducing the risk of fatal and serious injuries. Crash reductions at roundabouts are primarily attributed to two factors, reduced traffic speeds and elimination of high-energy conflicts that typically occur at other types of at-grade intersections.

A roundabout scored the highest for Efficiency as it would create a Level of Service B (AM peak) and C (PM peak) (2026).

For the AM peak, the CRH leg of the roundabout would have a LOS C. The state highway west approach would be a LOS A and state highway east approach lane would be a LOS B and C. Metering for west approach would improve the LOS for the left turn out of CRH in the PM peak. The left turn out can also be improved by providing a slip lane that merges further down.

For the PM peak, the CRH leg has a LOS F for the left turn out of CRH. Metering the west approach lane would improve the LOS for the left turn out of CRH. The left turn out can also be improved by providing a slip lane that merges further down. It is likely that the left turn slip lane can be provided with minimal impact on the adjacent properties by adjusting the position of the roundabout to the west.

A Roundabout with left turn slip lane has an intersection Level of Service B (AM peak) and A (PM peak) (2026). This changes the left turn movement out of CRH from LOS F to LOS A.

Metering the west approach will not cause significant adverse effect compared to the traffic signals.

The state highway east approach lane is a LOS A and the west approach lane is a LOS B for both lanes.

The intersection would be considered Level of Service A with a fourth leg by 2036, due to more balanced flows. Metering can be removed at this stage. Implementing the roundabout earlier will have benefits to the efficiencies of the road network.

In regards to System Integration the roundabout scored the best as it is consistent with the Taupaki roundabout to the north and the Brigham Creek roundabout to the south. The two lane roundabout will integrate well with the four lanes north to the Taupaki roundabout and the proposed four lane capacity improvement option between the CRH and the Brigham Creek Road roundabout. The roundabout also acts as a safe turn around facility for road users, as median barriers will be provided both north and south of the CRH intersection. The implementation of the roundabout also provides an opportunity to improve the existing bus stop. Given, it may be more difficult for buses, cyclists, and pedestrians to travel through a roundabout there is an opportunity during detailed design to consider crossing points and signage. The roundabout also provides the opportunity for a fourth leg in the future as the area urbanises.

The roundabout has the largest footprint of the four options and therefore imposes the most Technical challenges, warranting an adversely negative score against Technical. Additionally, an adverse negative score was received for Operation and Maintenance. Although the roundabout can be designed with hard

landscaping to ensure limited maintenance is needed, accessing the roundabout can cause road safety and network disruptions. The roundabout wasfavoured under the Cultural criteria, as it is the only option to provide a space for cultural interpretation.

The roundabout has slight positive benefits against Social. The proposed design will make accessing any existing popular local businesses in the area such as Boric and Blossoms Café safer. However, the roundabout design is less friendly for cyclists and pedestrians. Therefore, benefits are predominantly for car users. This option provides the opportunity to relocate the bus stop which is currently located near the existing island. This option will require the relocation of the existing bus stop and informal park-n-ride.

The roundabout scored neutral against Human Health. The proposed solution will reduce congestion at the intersection, particularly congestion backed up along CRH, resulting in less stationary traffic. When compared to the signalised options, the Roundabout option would provide a more balanced approach to delays to all approaches. The Roundabout option has therefore been ranked slightly higher in terms of effects on air quality. An increase in noise could be expected due to breaking and acceleration at the intersection, and the active traffic lanes will be closer to existing residential properties adjacent to this intersection (e.g. 315 SH16, 1411 CRH). However, as the existing environment is a busy state highway, the effects of this could be considered minor and may be mitigated.

As discussed, the roundabout has the largest footprint, and therefore has slight negative effects under the Property criteria. The roundabout will have the most consenting challenges as more landowners will be affected.

Signalised seagull:

This option is considered to have positive Safety improvements compared to the existing intersection, as it will provide an opportunity for vehicles to access SH16 from CRH while SH16 vehicles are held at a red light. This separates conflicting movements, although there remains a risk of high-speed crashes when vehicles run red lights. Traffic heading west from CRH will merge with vehicles driving at different speeds, which could impose a safety risk. Although the addition of a signalised intersection is an improvement, this option still imposes potential safety risks (greater than those of other options), resulting in a slight positive score (+1) only.

This option scored slightly positive against Economy as it would improve the intersection to a LOS B (2026).

A signalised seagull would perform similar in the AM as it would in the PM peak. The lane turning left out onto CRH has a LOS B for both peaks. Right turn into CRH is a LOS D with an average delay of 45 - 48 sec for the two peaks.

This option is slightly better than a full signalisation option, as it has better LOS for through movement from the west approach (AM peak) and the right turn out of CRH (AM peak), which is a 8.5 and 10 sec difference respectively. This effect is not significant and is scored same as a full signalised layout. No modelling was included for 2036 as a fourth leg is proposed. Therefore, the intersection will need to be upgraded to signals or a roundabout.

A signalised seagull scored slightly positive for Systems Integration as it still allows the integration of buses, but is not consistent with the other roundabouts along this stretch of highway (Brigham Creek Roundabout and Taupaki Roundabout).

Both the Signalised Seagull and the Signalised Intersection were scored slightly negative against Technical. Both of these options are likely to occupy a similar footprint. It may be possible to retain significant amounts of the existing intersection and approaches thus reducing the complexity of the construction staging and timing, compared to the roundabout but will be more complex than the southbound slip lane option.

Signals provided by this option reduce some friction between cyclists and drivers, resulting in a slightly positive score against Social. This option also provides the opportunity to relocate the bus stop. This design would be more difficult to accommodate a pedestrian crossing.

The Signalised Seagull and the Signalised Intersection scored slightly negative against Human Health. The proposed solution will reduce congestion at the intersection, particularly along CRH. An increase in noise could be expected due to breaking and acceleration at the intersection, and the active traffic lanes will be closer to existing residential properties adjacent to this intersection (e.g. 315 SH16, 1411 CRH). However, as the existing environment is a busy state highway, the effects of this could be considered minor and could be mitigated.

Property purchase is likely to be required from the Boric food market site as well as two properties along the northern side of the state highway. This option is likely to affect both the access to and land use occurring on these sites, resulting in a '-1' score.

Signalised intersection

This option is considered to have positive Safety improvements from the existing intersection, as it allows for improvements to all conflicting vehicle movements. However, this option also has a risk of severe crashes with vehicles that run a red light, resulting in T-bone type crashes. A signalised intersection is not considered to be a consistent treatment between Brigham Creek and Taupaki roundabout. However, a signalised intersection is the safest design for on-road cyclists.

The signalised intersection also scored slightly positive for Efficiency (+1), as it would achieve a LOS B (2026). The difference between the AM and PM peak performance is the right turn out of CRH and SH16 west approach through movement. In the AM peak, the SH16 west approach through movement faces an additional 6 second delay and the right turn out of CRH has an additional 10 second delay compared to PM peak. This option is 8 – 12 seconds more compared to the Signalised Seagull. For this movement, the Roundabout has about 20 second delay compared to the signalised options that has an average delay of 45 – 60 seconds. The double right turn into CRH performs similar to the signalised seagull layout. If a fourth leg is added, this Option would have a LOS C (2036).

A signalised intersection scored slightly positive for Systems Integration, as the traffic lights would support bus, cycle, and pedestrian movements better than the other options. Similar to the roundabout option, the signalised intersection would integrate well with the SH16 four lane options to the west and east of the intersection. However, this design is not considered to be consistent with the intersection designs at Taupaki and Brigham Creek or with the corridor treatments in a peri-urban environment.

Both the Signalised Seagull and the Signalised Intersection scored slightly negative against Operations and Maintenance, although both options will require low maintenance, they are still a new asset to manage.

In regards to the Social criteria, this option has the same benefits and the Signalised Seagull. However, it will have the least impact on the existing bus stop and informal park-n-ride.

In regards to Property, this option will require additional land outside the designation from the properties to the south of the intersection. This option is likely to affect the vehicle access and existing horticultural land use on these properties.

Slip lane:

This option scored neutral for Safety as it would not address historic or current safety issues at this intersection. A slipe lane still has a risk of high severity outcomes from T-bone type crashes.

The Slipe lane option has a neutral score for Efficiency as it will only allow more left turns out of CRH. This only improves one movement. The overall intersection LOS is unacceptable with significant delays expected on the east approach and CRH approach. A zero score is given as this does not make any significant improvement to the intersection as a whole.

This option proposes the lowest risk for consenting, as all of the physical work could be done within the existing designation.

Recommended Option

The Roundabout scored the best against the Safety criteria and Efficiency criteria, as it significantly improves the efficiency of the intersection through a road safe design. The Roundabout option would provide a more balanced approach to delays to all approaches compared to the other options.

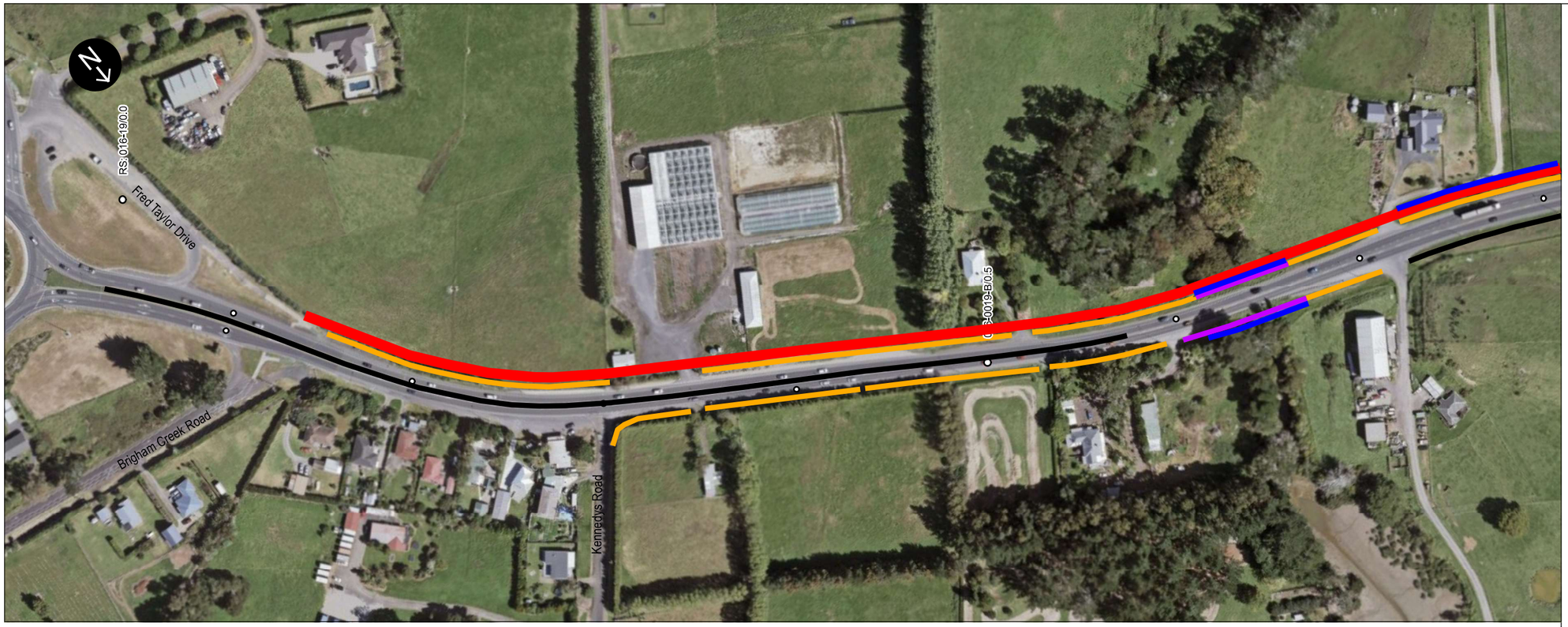
The Roundabout also scored the best against the Systems Integration and Modal Shift criteria and it was preferred by mana whenua.

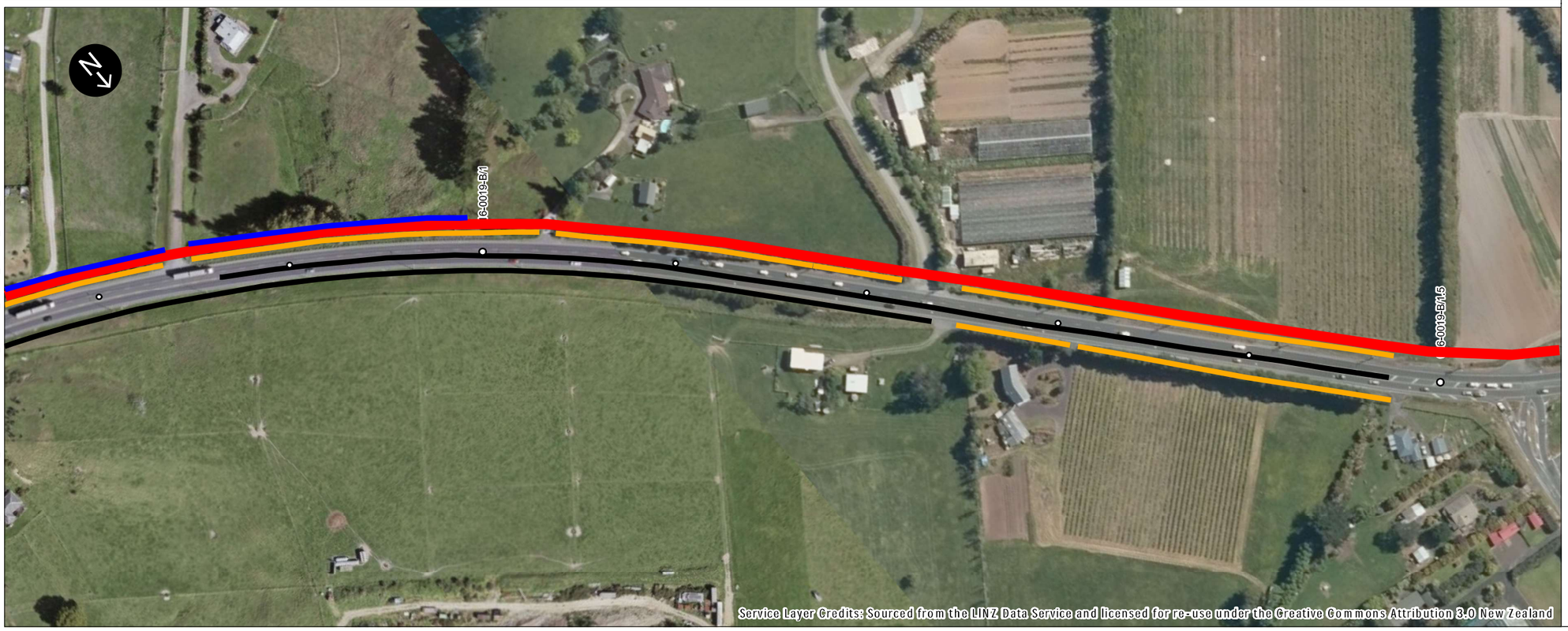
The options are all relatively similar with respect to Social impacts as this is an existing state highway corridor and the options will not result in any community severance effects. The construction impacts and the amenity effects are also considered similar for all options with respect to social impacts. The options were made public during an open day and were available online for viewing. The majority of the community and stakeholders preferred the roundabout option. During this time, initial conversations were held with the owners of Boric Food Market who did not oppose the acquisition of some of their land for a roundabout.

Although the roundabout received lower scores for Technical, Maintenance and Property, the effects of these can be mitigated. The benefits of a roundabout outweigh the challenges that come with constructing and maintaining the asset.

F

Appendix F – Section A - C Brigham Creek Road to Taupaki Road Roundabout Options





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- Retaining Wall
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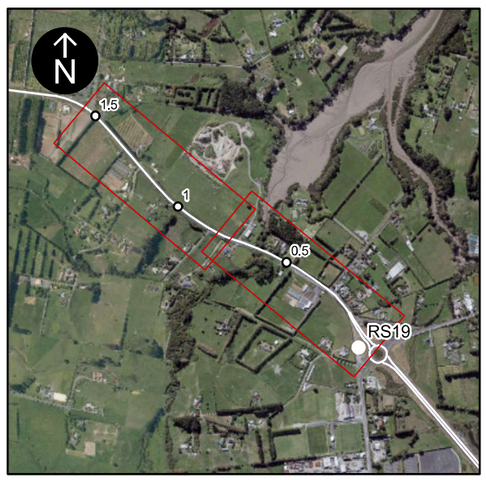
- Wire Rope Barrier



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Revision	Author	Verified	Approved	Date
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SH16: Brigham Creek to Waimauku

Section A - Option 1

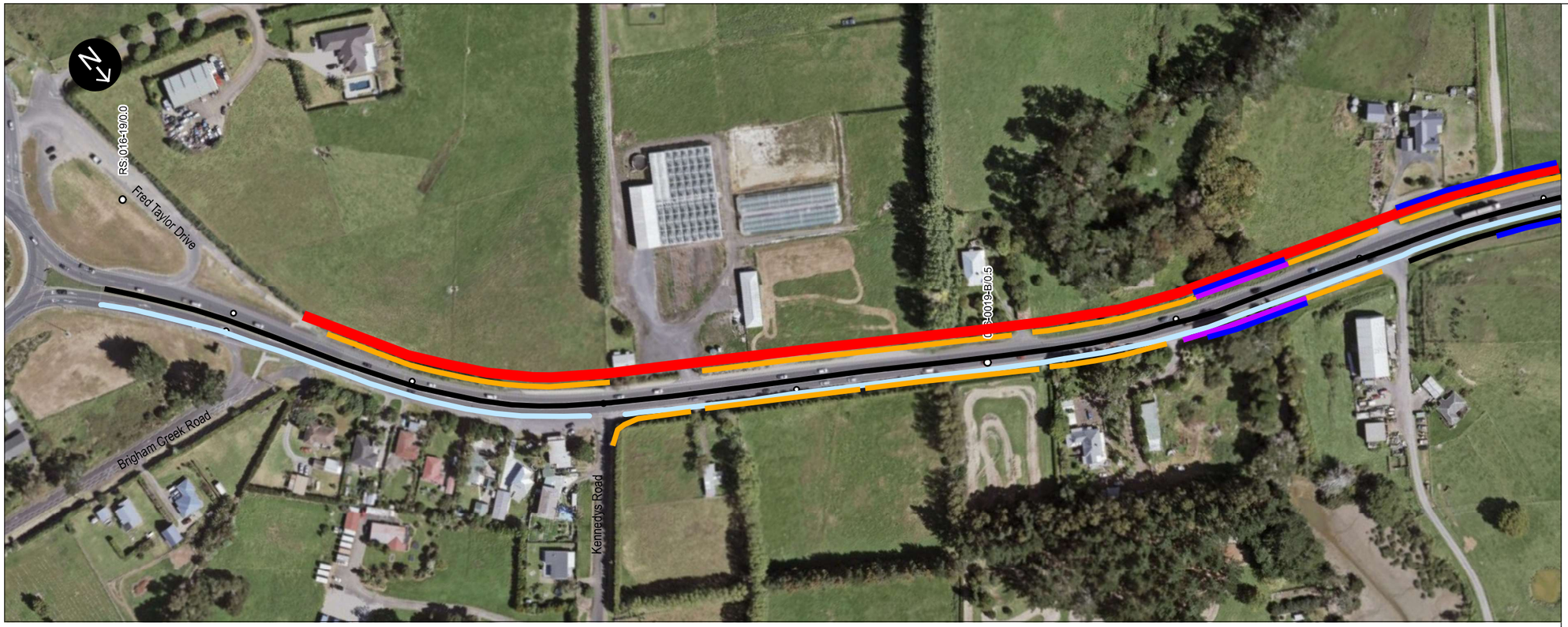
Client: NZ Transport Agency

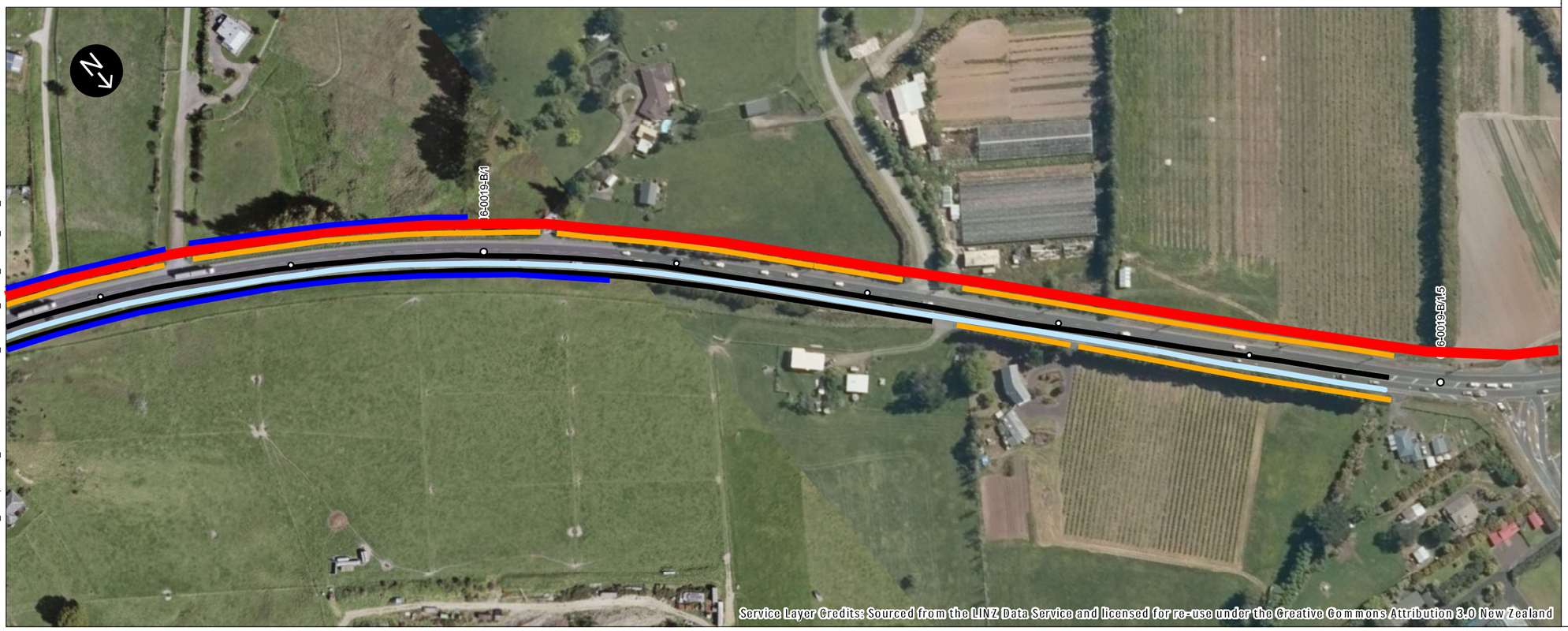
Project: Safe Road Alliance - Core Project

NZ TRANSPORT AGENCY WAKA KOTAHI | Safe Roads

Discipline: GIS

Drawing No: GIS-3411907-316-A1





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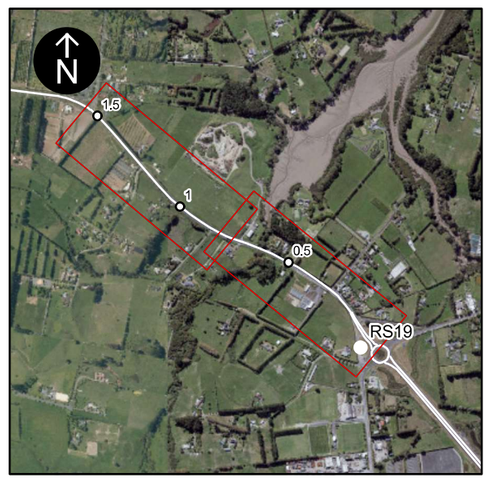

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Revision	Author	Verified	Approved	Date
1	RR	BAP	LDB	30/06/2017

SH16: Brigham Creek to Waimauku

Section A - Option 2

Client: NZ Transport Agency

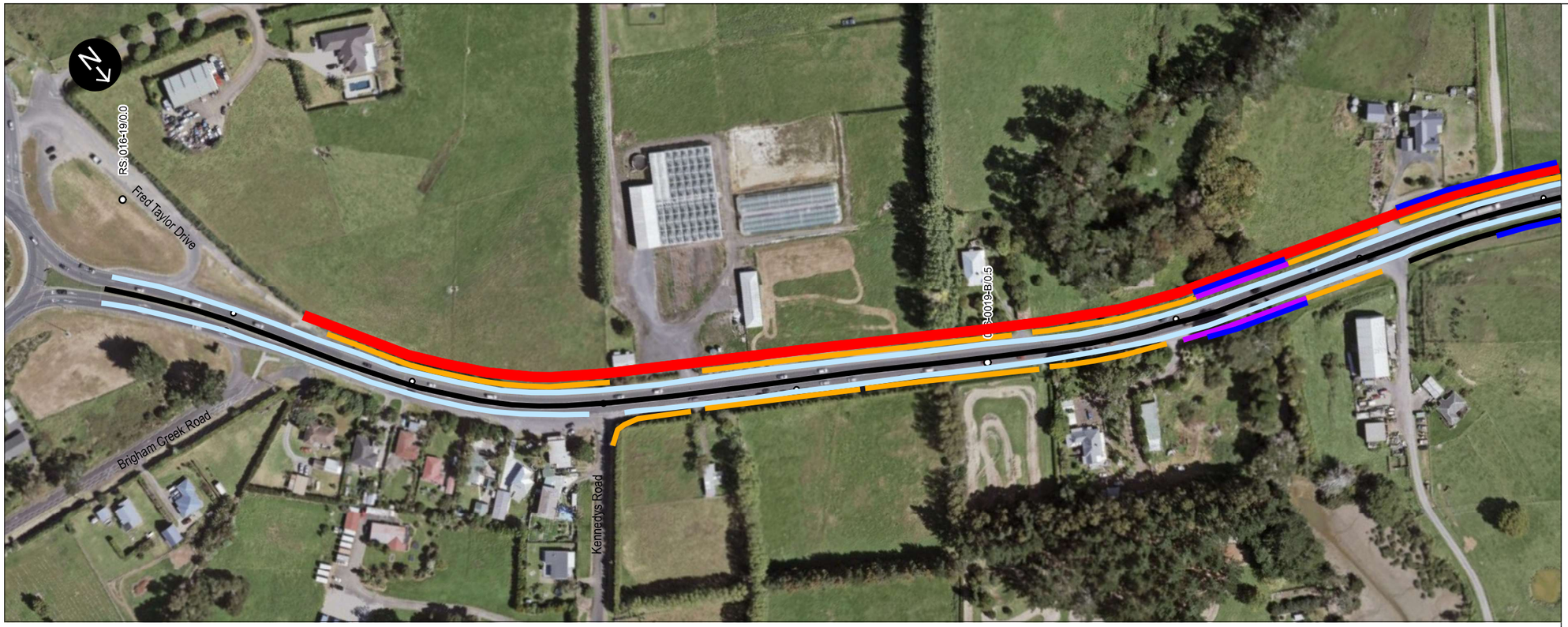
Project: Safe Road Alliance - Core Project

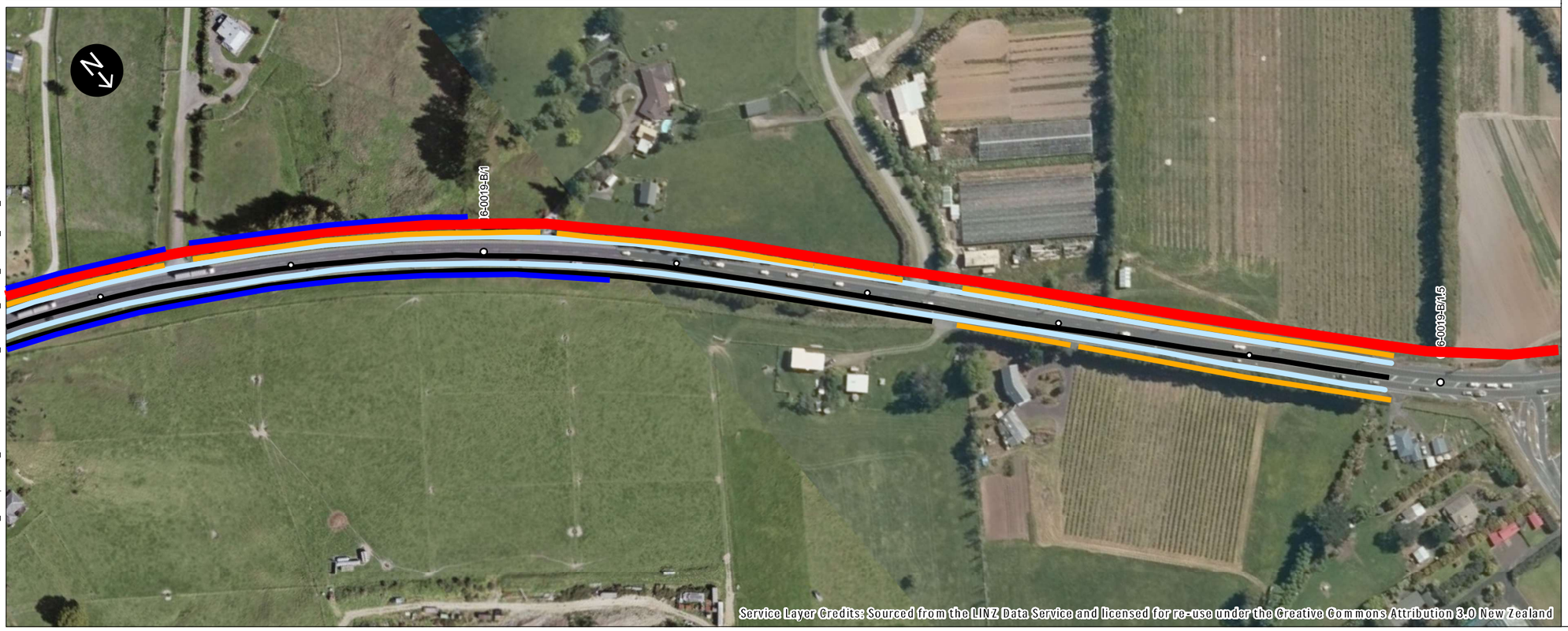
NZ TRANSPORT AGENCY WAKA KOTAHI | Safe Roads

Discipline: GIS

Drawing No: GIS-3411907-316-A2

Page 1 of 1





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- Extra Lanes
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- W-Section Barrier
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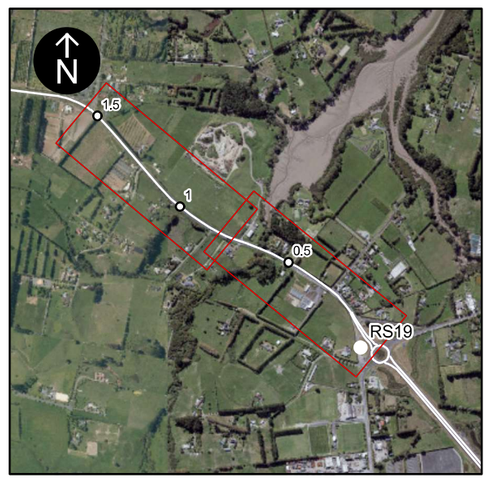

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Revision	Author	Verified	Approved	Date
1	RR	BAP	LDB	30/06/2017

SH16: Brigham Creek to Waimauku

Section A - Option 3

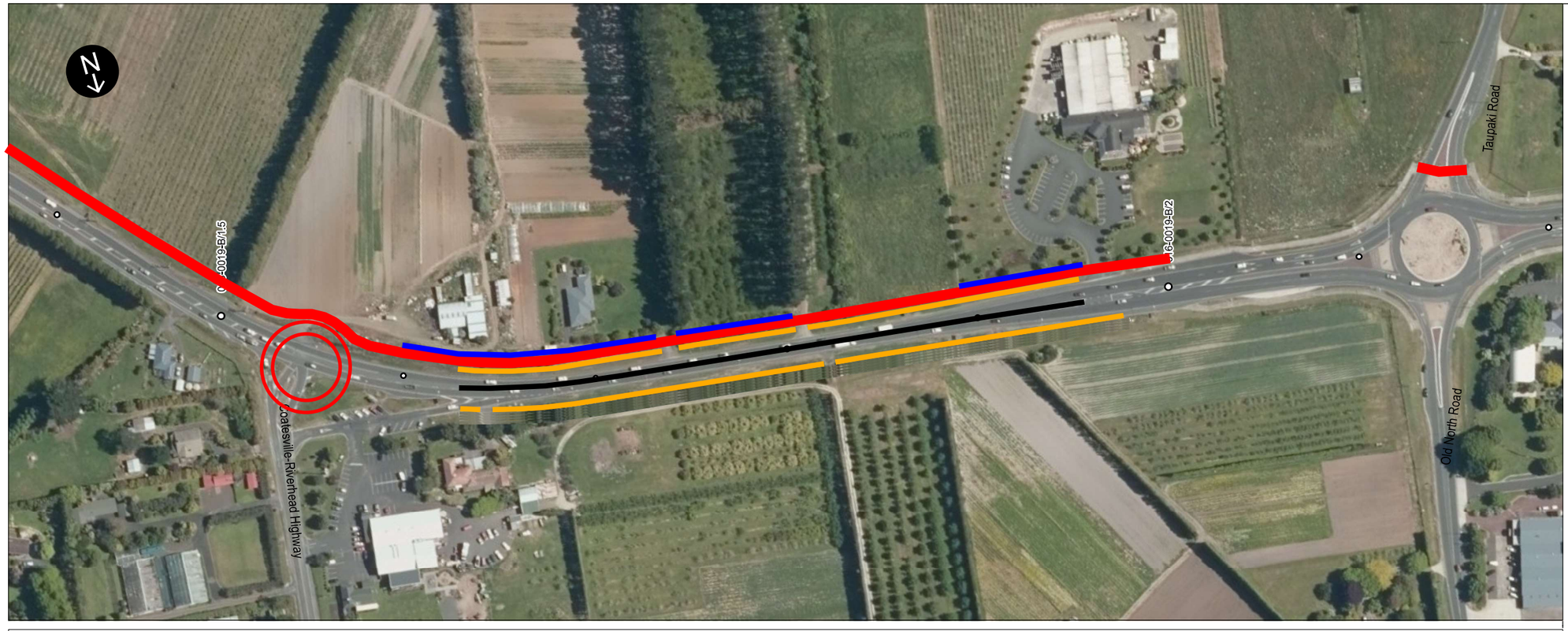
Client: NZ Transport Agency

Project: Safe Road Alliance - Core Project

NZ TRANSPORT AGENCY WAKA KOTAHI | Safe Roads

Discipline: GIS

Drawing No: GIS-3411907-316-A3



Legend

- Shared Path
- W-Section Barrier
- Wire Rope Barrier
- Retaining Wall

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Revision	Author	Verified	Approved	Date
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SH16: Brigham Creek to Waimauku

Section C - Option 1

Client: NZ Transport Agency

Project: Safe Road Alliance - Core Project

NZ TRANSPORT AGENCY WAKA KOTAHI | Safe Roads

Discipline: GIS

Drawing No: GIS-3411907-316-C1

G

Appendix G – Section A - C Brigham Creek Road to Taupaki Road Roundabout Options Assessment

Section A - C – Brigham Creek Road to Taupaki Road Roundabout Options Assessment

Three short list options were proposed for Section A-C, with each option including the confirmed common elements (i.e. the shared use path on south side of SH16 was added as a common element.):

Option 1: Existing layout of the corridor, with the addition of median barriers, plus common elements (i.e. side barriers, shoulder widening, shared use path on south side of SH16, roundabout at SH16/Coatesville-Riverhead Highway intersection, and 2 lanes each way with new median barriers from Coatesville Riverhead Highway to Taupaki Road roundabout)

Option 2: Existing westbound corridor layout, provision of an additional lane eastbound, with the addition of median barriers, plus common elements (i.e. side barriers, shoulder widening, shared use path on south side of SH16, roundabout at SH16/Coatesville-Riverhead Highway intersection, and 2 lanes each way with new median barriers from Coatesville Riverhead Highway to Taupaki Road roundabout)

Option 3: Provides for 2 lanes in each direction, with the addition of median barriers, plus common elements (i.e. side barriers, shoulder widening, shared use path on south side of SH16, roundabout at SH16/Coatesville-Riverhead Highway intersection, and 2 lanes each way with new median barriers from Coatesville Riverhead Highway to Taupaki Road roundabout).

The table below details the MCA scoring and commentary for Section A-C shortlisted options assessment, analysis notes and identification of the preferred option for this section of the corridor.

CRITERION	OPTION 1: MEDIAN BARRIERS	OPTION 2: ONE ADDITIONAL LANE EASTBOUND PLUS MEDIAN BARRIERS	OPTION 3: ONE ADDITIONAL LANE IN EACH DIRECTION PLUS MEDIAN BARRIERS	COMMENTARY
Safety	+3	+3	+3	For all options, a median barrier will be provided along the full length of the corridor, reducing the risk of head-on collisions and resulting death or serious injuries. Roadside hazard protection is also to be provided where possible, together with additional shoulder width, allowing more recovery space for vehicles that lose control. The majority of safety benefits will be gained by the provision of median and roadside barriers, which occur in all options. There is likely to be additional benefits associated with the ability to maintain the carriageway where there are additional lanes (i.e. Options 2 and 3), although appropriate traffic controls will be in place for

<table>
<tr><th>CRITERION</th><th>OPTION 1: MEDIAN BARRIERS</th><th>OPTION 2: ONE ADDITIONAL LANE EASTBOUND PLUS MEDIAN BARRIERS</th><th>OPTION 3: ONE ADDITIONAL LANE IN EACH DIRECTION PLUS MEDIAN BARRIERS</th><th>COMMENTARY</th></tr>
<tr><td></td><td></td><td></td><td></td><td>all options to mitigate any risks. Therefore, it is considered that there is no significant difference between options.
These options reduce the 10 year predicted DSI from 16 to 6 for this section and increase the length of highway with a KiwiRAP star rating of 3.5 or greater by an additional 1.2km.
All three options have a shared path which will remove pedestrians and some cyclists from the road. The median barriers will discourage pedestrians from crossing the carriageway. Each option is a significant safety improvement from the existing situation.</td></tr>
<tr><td>Efficiency</td><td>0</td><td>+1</td><td>+2</td><td>The improvement in travel time arises mainly from the increase in capacity provided by the additional traffic lanes, although provision of a roundabout at Coatesville Riverhead Highway (CRH) will introduce delays when approach volumes are unbalanced.
All options provide increased capacity between the CRH and Taupaki roundabouts, reducing westbound travel times in the evening peak. Capacity improvements included in Option 1 are limited to this section as there are no additional lanes provided east of the CRH intersection. Therefore, this is considered to be a minor improvement, as the benefit is limited to the westbound PM peak (160 seconds) and is therefore scored a 0.
Options 2 and 3 both include additional eastbound widening between Coatesville Riverhead Highway and the Brigham Creek Road roundabout, resulting in travel time savings in the eastbound AM peak direction of 55 seconds. Option 3 also includes westbound widening between the Brigham Creek Road roundabout and the CRH intersection, which further reduces the travel time in this direction and peak period by 145 seconds. Option 3 will also increase access to local business and efficient travel time to work more than Option 2 can.

<table>
<tr><th>Option</th><th>Direction</th><th>Period</th><th>Travel Time (sec)</th><th>Percentage</th></tr>
<tr><td rowspan="4">1</td><td rowspan="2">EASTBOUND</td><td>AM</td><td>No change 0</td><td>0%</td></tr>
<tr><td>PM</td><td>Increase by 10</td><td>10%</td></tr>
<tr><td rowspan="2">WESTBOUND</td><td>AM</td><td>Increase by 5</td><td>5%</td></tr>
<tr><td>PM</td><td>Decrease by 160</td><td>-39%</td></tr>
<tr><td>2</td><td>EASTBOUND</td><td>AM</td><td>Decrease by 55</td><td>-30%</td></tr>
</table>
</td></tr>
</table>

Sensitivity: General

<table>
<tr><th>CRITERION</th><th>OPTION 1: MEDIAN BARRIERS</th><th>OPTION 2: ONE ADDITIONAL LANE EASTBOUND PLUS MEDIAN BARRIERS</th><th>OPTION 3: ONE ADDITIONAL LANE IN EACH DIRECTION PLUS MEDIAN BARRIERS</th><th>COMMENTARY</th></tr>
<tr><td></td><td></td><td></td><td></td><td>
<table>
<tr><td></td><td></td><td>PM</td><td>Increase by 10</td><td>10%</td></tr>
<tr><td></td><td>WESTBOUND</td><td>AM</td><td>Increase by 5</td><td>5%</td></tr>
<tr><td></td><td></td><td>PM</td><td>Decrease by 160</td><td>-39%</td></tr>
<tr><td>3</td><td>EASTBOUND</td><td>AM</td><td>Decrease by 55</td><td>-30%</td></tr>
<tr><td></td><td></td><td>PM</td><td>Increase by 5</td><td>5%</td></tr>
<tr><td></td><td>WESTBOUND</td><td>AM</td><td>Increase by 5</td><td>5%</td></tr>
<tr><td></td><td></td><td>PM</td><td>Decrease by 305</td><td>-73%</td></tr>
</table>
In addition to capacity improvements, wide shoulders and median treatments provide additional width to keep the highway operational in the event of an incident (crashes / breakdowns), providing greater resilience. This will benefit all users including freight and businesses (local and regional through-traffic).
An adverse effect on the economy would be the additional journey time required due to the reduced accessibility for those businesses affected by median barrier. Turn-around facilities have been identified to mitigate this effect.
Plan Change 69 has proposed transport efficiently upgrades along Brigham Creek Road, the plan change will not affect the scores.</td></tr>
<tr><td>System Integration and Modal Shift</td><td>+1</td><td>+1</td><td>+1</td><td>TFUG: All options do not preclude future offline corridors such as the Alternative State Highway (being investigated by the Supporting Growth Programme). Option 3 provides the opportunity for future bus lanes through Supporting Growth work (via reallocation of road space from vehicles to buses), however other options do not preclude this.
Other modes: All options have widened shoulders and a shared use path to the south of SH16 for Section A-C and will result in improved space for cyclists and pedestrians, and a safe continuous active mode facility.</td></tr>
</table>

CRITERION	OPTION 1: MEDIAN BARRIERS	OPTION 2: ONE ADDITIONAL LANE EASTBOUND PLUS MEDIAN BARRIERS	OPTION 3: ONE ADDITIONAL LANE IN EACH DIRECTION PLUS MEDIAN BARRIERS	COMMENTARY
Technical	-1	-2	-2	The technical differences mostly relate to different options for Section A. Sections B and C remain the same for all options with a roundabout at CRH for Section B and 2 lanes in each direction for Section C. All Section A options include a wire rope median barrier within a 1.5m wide median and carriageway widening above the Brigham Creek culvert (width dependent on lane arrangement of option). Option 1- Small carriageway width change to Section A to accommodate the 1.5m wide median. Small impact of carriageway widening on Brigham Creek Culvert. Extension of westbound passing lane to the new C/R Highway roundabout. Some land requirement east of C/R Highway roundabout on Southern side and for the shared path. The minor widening works would still require retaining works along these sections. Option 2 – Adds full length eastbound lane to Section A. Risky retaining works required on northern side of carriageway above Brigham Creek Culvert. More land requirement on northern side. Option 3 – Widest Carriageway arrangement through Section A with full length 2 lanes in each direction. Risky retaining works required on both sides of carriageway above Brigham Creek Culvert. Retaining works required on southern side adjacent to passing bay. Significant land requirement on both sides of carriageway. Options differentiated because of Brigham Creek Culvert works. Assumed that for all options can do works without widening the Brigham Creek Culvert – however more technically challenging for Options 2 and 3. Option 2 and particularly Option 3 would have to consider the potential effects the design could have on the international cable. All options will involve the relocation of other services in the road reserve. The works for the rest of the corridor are BAU.
Operational / Maintenance	-2	-1	-1	Median barriers with single lane traffic create a maintenance liability by reducing available work space. Introducing median barriers has been proven to increase the maintenance load due to the need for increased repairs, and single lanes will require the closure of that lane for repairs under Health & Safety legislation. Routine maintenance works will create traffic congestion. Due to traffic volumes works will have to be undertaken at night with one lane closed and traffic working on stop/go systems in the alternate carriageway. This requires regular maintenance crossing points. Option 1 has limited space for vehicles to stop. If traffic needs to be redirected, the wire rope can be temporarily removed to contraflow traffic to the other side of the road. However, Option 3 will allow more space for vehicles to stop with four lanes. One lane can be closed and traffic can be directed into the other

Sensitivity: General

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				lane for emergency and maintenance works. Four lanes provides greater flexibility to safely manage an incident. Option 3 will require more maintenance due to the larger footprint. Routine works can be undertaken by lane closure without the need for contraflow. Pavement renewal works can be undertaken by double lane closure with traffic contra flowed in the alternate carriageway. Will need MCP at both roundabouts and at regular intervals (suggest 1.50km spacing).
Safety in design consideration (Zero Harm)	0	0	0	Ability to design out of risks that are present. The safety in design risk associated with Section A will relate to the design and construction of the carriageway widening and retaining above the Brigham Creek Culvert. The greater the widening option, the greater the design and construction safety risk. All options will require the existing road to be widened, involving contractors working close to live traffic. Specific traffic management planning will be required as part of the design, as the construction will be on a "live" State Highway. Construction and maintenance of retaining walls will be undertaken beyond the carriageway under adequate temporary traffic management, and therefore the construction and maintenance safety risks can be mitigated. Safe access to the bottom of all retaining wall can be appropriately managed for each option. Option 1 may have less work required for retaining works, but not enough to differentiate scores. All option will require relocation of power poles and other services. None of the options have been identified as requiring work in confined spaces or in water. Therefore, construction activity is considered within normal practice and the ability to design out safety risk is not considered significantly different between options. A detailed Safety in Design Workshop will be undertaken on the preferred option.
Social	0	+1	+2	The potential social impact associated with median barriers is a result of the change to the community's way of life in regards to access into homes, business and community facilities. Different people experience the impact in different ways. Community facilities in the area include the Blossoms Cafe and Boric Food market at Coatesville-Riverhead Highway as well as informal community park n ride outside the cafe. The café is popular for truck drivers who park on both sides of the road and may walk across the road to get to the Café. There are no other notable community facilities and open space in this area.

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				All options may have potential negative social impacts due to the restrictions of right turns in/out of existing private driveways. However, all options include a new roundabout at the CRH intersection with SH16 which provides for an opportunity for a safe and convenient turning facility to access homes, businesses and community facilities. All options include a shared use path on the southern side of SH16 which would have positive social impacts for the community providing a new choice for travel to access facilities along the corridor and connect into existing active mode facilities as well as the Kumeu town centre. This would improve the community's journey experience and day to day life as travel is quicker and can be undertaken in a safer manner. All options will also likely have negative impacts on people during construction such as increased traffic diversions and changes to accessways, however this will be temporary and likely mitigated through management plans and reinstatement. Option 3 will improve efficiency for the community with additional lanes which can lead to an improved journey experience as the community have the ability to undertake day to day tasks quicker and in a safer manner. However, installing safe crossing points for two lanes is more challenging. Noted: mitigation for the loss of the informal park n ride may be difficult to provide for all options – i.e. because of the restricted ability to provide more car parking, although relocation of the existing bus stop is part of the proposed design.
Natural environment	+1	+1	+1	A notable environmental feature in this section of the corridor is Brigham Creek, however it is already highly modified in this area. There are no areas of significance or outstanding natural features. No significant vegetation alteration or removal is required for all options. Option 1: provides the least number of lanes; requires the least amount of bridge widening; and has the smallest impervious area increase. As such, this option has minimal environmental impact on the surrounding environment, especially in regards to the CMA, riparian vegetation, wetlands, and flood plains. Options 2 and 3: involve more road widening. Option 3 includes additional pavement on both sides of SH16. However all additional impervious surface areas for each option will be mitigated and water quality treatment will be provided (where it currently is not) which will result in positive outcomes. The road carriageway and shared use path will likely encroach a natural wetland, however the wetland / ecological effects can be managed through design and mitigation.

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				These scores assume that there is the ability to put in the level of stormwater retention and treatment required and planting that is proposed. Treatment swales provided for along the carriageway. Whilst there is a potential encroachment into the wetlands for construction for options 1 and 3, the project can minimise the footprint or marginal loss of portions of those features, including streams and riparian planting. These can be mitigated by controls and replating to minimise the effects (on habitats/biodiversity and ecology) or offset from a project perspective. Purely from an ecology perspective there is a difference between option 2 and options 1 and 3 which would have less ecological effect but the differentiation between these would be marginal and not warrant a difference in scoring.
Human health	0	-1	-1	The potential human health impacts are a result of potential change to air quality and noise effects due to bringing transport activities closer to sensitive receivers on the existing corridor. There is also the potential for human health impacts to be experienced by construction workers/local receivers as a result of disturbing potentially contaminated land (i.e. the identified HAIL sites) along the corridor. Option 1 will have less of a noticeable impact on human health (as is within the existing road corridor – no additional traffic lanes proposed). Options 2 and 3 include road widening to provide for additional lanes and will therefore bring the road and vehicle noise/emissions closer to dwellings along the alignment, however this will be a minor impact. Proximity of the road to dwellings within Section B is increased for all options due to the new RAB. There is an opportunity for potential adverse construction and operational noise effects to be mitigated via a CNVMP and other mitigation measures (if required). All options involve the addition of a shared use path to the south of SH16, yet the human health impact of bringing pedestrians and cyclists closer to existing dwellings (from an air quality and noise perspective) would be negligible. For all options, there is an opportunity to mitigate the potential adverse effects on human health that may result from works within HAIL sites via the implementation of a Contaminated Soils Management Plan.

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Heritage (Archaeological, Natural and Built)	-1	-1	-1	*Note that this has been assessed based on existing archaeological and built heritage records not an assessment of Mana Whenua values (this will be done by Mana Whenua).* There are archaeological and heritage values associated with the area around Brigham Creek – refer to Preliminary Archaeological Report (Clough & Associates, 2017) that was prepared for the SSBC. Sinton House (former) at 238 SH16 has a Built Heritage and Character: Historic Heritage Overlay Extent of Place [rcp/dp] - 525, Sinton House (former) and is listed on the AC Cultural Heritage Index. Other Sinton House Homesteads at 191 SH16 (Janet Sinton) and 222A SH16 (Alex Sinton) are listed on the AC Cultural Heritage Index yet have not been scheduled (yet). It is understood that Auckland Council has evaluated these two sites in 2017 and there was an intention to schedule them. Albeit AC has not notified any intentions to schedule the two additional sites via a Plan Change as at 20 October 2021 (i.e. the time of this assessment). There is potential for all options to have an impact on recorded natural/built heritage and archaeological sites in the area as each option involves works in the vicinity of Brigham Creek and some degree of road widening to the south of SH16 to implement the shared use path. In addition: Options 1 involves shoulder widening/barriers on north side which may be able to avoid encroachment into 191 SH16 which has a group of notable trees (ID1808) which are also listed on the AC Cultural Heritage Index given their association with the former Sinton Family. It is understood that the protected root zone of these trees extends beyond the property boundary into the berm of the existing SH16. There is an opportunity for the design and physical works to be managed to avoid or minimise effects on the trees. Option 2 has an additional eastbound lane and the shoulder widening/barriers on north side which may encroach further into 191 SH16 and result in potential adverse effects on the notable trees which have heritage value. This site is also a former Sinton House Homestead (Janet Sinton) that is listed on AC Cultural Heritage Index. Option 3 has an additional westbound lane, shoulder widening/barriers on the south side and the shared use path on south side of SH16 which may encroach into the grounds of former Sinton House Homesteads located at 222A SH16 (Alex Sinton) and 238 SH16 (Sinton Family) and result in potential adverse effects on the built heritage values of these places. Whilst only the homestead at 238 SH16 is scheduled in the AUP as a heritage extent of place, the actual and potential effects on built heritage will need to be assessed in the Notice of Requirement to expand the SH designation, including the effects associated with temporary works,

Sensitivity: General

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				tree removals, demolition or changes to existing structures on the sites, driveway upgrades, and changes to the curtilage setting of these heritage places. Whilst the options don't appear to have any direct impacts on the heritage houses, both an Archaeological Assessment and Built Heritage Assessment will be required to support the AEE on the preferred option, that would form part of any Notice of Requirement to expand the existing designation footprint.
Cultural	+2	+1	-1	***Note:*** *Numerous presentations on the project have been provided to the Iwi Integration Group – Central West and early options were discussed at Reweti Marae with Ngati Whatua o Kaipara. The IIG have confirmed that Ngati Whatua o Kaipara and Te Kawerau o Maki are the interested parties to provide input for this project.* ***Mana Whenua Input - Te Kawerau o Maki (endorsed by Ngati Whatua o Kaipara)*** There are no recorded Maaori sites within the footprint of any options, however risks increase slightly with size of footprint, meaning 2 extra lanes (option 3) caries higher risk down to no extra lanes (option 1) having the lowest risk. The impact to productive soils is likely less than minor, however impact generally increases slightly with and increased footprint, meaning 2 extra lanes (option 3) caries higher impact down to no extra lanes (option 1) having the lowest impact. 2 extra lanes (Option 3) provides transport efficiency and t lowers emissions. Yet 2 extra lanes (Option 3) also has larger footprint, generation of stormwater and therefore potential impact on the awa (watercourses) and adjacent habitat. Brigham Creek – significant watercourse in this area. Significance due to portage connection to other waterways. Cultural monitoring required for all options. Area already highly modified and is an existing corridor.
Property	-1	-1	-2	Option 1 requires land from 16 properties (permanently), 10 are more than 200m2, 5 greater than 500m2.

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				Option 2 requires land from 19 properties (permanently), 12 are more than 200m2, 6 are greater than 500m2. Option 3 requires land from 34 properties (permanently), 19 are more than 200m2, 10 are greater than 500m2. Option 3 has an increase in land take, almost double the other options in terms of area, value and number of properties involved. All options will require additional land for the shared path. **Workshop discussion** Note: have differentiated based on property risk for delivery and management. The number of properties may have slightly changed since the first MCA workshop (2017), however the original property numbers are not deemed to affect the scoring of the options in this revisit workshop (2021).

Non-Scored Criteria

Criteria	Comments
Financial considerations	Options increase in cost as more lanes are added. The higher the cost, the more likely the original project estimate discussed with NZTA BUMDT and VAC teams ($43mill) will be exceeded. Option 3 is the highest expected cost, however it is noted that similar works are required to be undertaken irrespective of lane numbers (i.e. retaining walls, road widening, barrier installation) hence the differences between options from a funding point of view are minimal. Price of property would have increased between 2017 and 2021 assessment. Options costs would have increased, but the ranking of options would remain the same.
Consentability	Options 2 and 3 have a larger footprint, are in close proximity to Brigham Creek and a historic heritage place (grounds of former Sinton House). This will require a Notice of Requirement to alter the existing SH16 designation extent and may increase the complexity of the resource consent application with potentially more mitigation required. Extra approvals required for utilities is considered here. Option 3 will likely require approval from Watercare and Chorus (relating to impacts/changes required to existing assets in this section of the Corridor). All options have increased impervious surface area resulting in additional detention and treatment of stormwater runoff. Option 3 would have a larger land requirement (compared to other options) to increase the existing SH16 designation extent. This alongside other approvals may result in a more complex approvals process. Yet the suite of resource consents required appears to be BAU (similar to those needed for large infrastructure projects), there are no prohibited activities or significant overlays along this section of the route.
Stakeholder feedback	Early consultation revealed that there was strong landowner and public support for two lanes in eeach direction and a roundabout at Coatesville Riverhead Highway (with 43% of respondents supporting the roundabout option at Section B). The landowners of Soljans Winery did not support a median barrier outside their business (Section C) and have an agreement with NZTA for the existing right turn bay and wish for it to remain. The general public will be most concerned about increased congestion during works. There is general support for the shared path within the community.

MCA Assessment analysis notes

Each option had a positive score for Safety as they all provide a significant improvement from the existing situation and could not be differentiated as to what one was the preferred design in relation to Safety. For each option, a median barrier will be provided from Section A to C, reducing the risk of head-on collisions and resulting in death or serious injuries. Roadside hazard protection is also to be provided where possible, together with additional shoulder width, allowing more recovery space for vehicles that lose control.

Option 3 results in the most efficiency benefits.

There was no differentiation between System Integration with the wider network as each option has a shoulder widening and shared use path that allows active road users to connect into the Kumeū township.

The Social impacts associated with median barriers is a result of the change to the community's way of life in regards to access into homes, businesses and community facilities due to the installation of the median barriers, requiring extra travel time to use the turn around facilities. Each of the options increase in positive scores with the addition of another lane, with Option 3 scoring the best from a Social perspective.

Option 1:

Median barriers with a single lane in each direction is proposed for Option 1. This design scored negatively against Operation and Maintenance, as it is thought to create a Maintenance liability by reducing available workspace. Introducing median barriers increases the maintenance load due to the need for increased repairs, and single lanes will require the closure of that lane for repairs under Health and Safety legislation. Routine maintenance works will create traffic congestion. Due to traffic volumes, work will have to be undertaken at night with one lane closed and traffic working on stop go in the alternate carriageway. This requires regular maintenance crossing points.

Option 1 provides the least number of lanes, requires the least amount of bridge widening, and has the smallest impervious area increase. As such, this option has the least Natural Environment impact on the surrounding environment, especially in regards to Coastal Marine Area, riparian vegetation, wetlands, and flood plains (do minimum approach). For the same reasons, it imposes the least Technical risk and scored neutral against Economy.

In relation to Heritage, Options 1 involves shoulder widening and barriers on north side which may avoid encroachment into 191 SH16. This property has a group of notable trees (ID1808) which are protected under the Auckland Unitary Plan - Operative in Part and are associated with the former Sinton Family. It is understood that the protected root zone of these trees extends beyond the property boundary into the berm of the existing SH16 corridor. There is an opportunity for the design and physical works to be managed to avoid or minimise effects on the trees for all options.

Option 2:

Options 2 includes an additional eastbound lane between CRH and the Brigham Creek Road roundabout, resulting in travel time savings in the eastbound AM peak direction of approximately 55 seconds (Economy criteria). This also applies to the additional eastbound lane for Option 3. Option 2 also involves median barriers through the corridor.

Option 2 received a fairly negative score against Technical. The widening of the road corridor will require more land and retaining work on the northern side of the carriageway above Brigham Creek Culvert, imposing Technical challenges in Section A. Option 2 and particularly 3, would have to consider the potential effects the design could have on the international cable.

Options 2 and 3 scored slightly negative against Human Health, as they both include road widening to provide for additional lanes and will therefore bring the road and vehicle noise/emissions closer to existing dwellings

along the alignment. The proximity of the road to dwellings within Section B is increased for all options due to the proposed roundabout.

Regarding Heritage, Option 2 has an additional eastbound lane and the shoulder widening with barriers on north side which may encroach further into 191 SH16 and result in potential adverse effects on the notable trees that have protected heritage value. Any effects on these trees would cause consenting challenges.

Option 3:

Option 3 involves an additional lane in each direction and median barriers. Option 3 scored the highest against Economy, the improvement in travel time arises mainly from the increase in capacity provided by the additional traffic lanes. Although, provision of a roundabout at CRH will introduce delays when approach volumes are unbalanced. The additional westbound lane will further reduce travel time during peak periods by approximately 145 seconds. In addition to capacity improvements, additional lanes and wide shoulders provide additional width to keep the highway operational in the event of an incident (crashes / breakdowns), providing greater resilience to the road network. This will benefit all users including freight, businesses, and local and regional through-traffic.

Option 3 has the largest footprint which will impose Technical challenges. The widening of the road corridor will require more land and retaining work on both sides of carriageway, particularly above Brigham Creek Culvert, imposing Technical risks in Section A. Unsurprisingly, the larger footprint of Option 3 caused a negative score against Property, compared to Option 1 and 2.

Option 3 had a positive score for Operation and Maintenance, as it will allow more space for maintenance vehicles to stop with four lanes. One or two lanes can be closed and traffic can be directed into the other lanes for emergency and maintenance works. Four lanes provide greater flexibility to safely manage an incident or repair. However, Option 3 will require more maintenance due to the larger footprint, resulting in the overall negative score.

In relation to the Social criteria, Option 3 will improve efficiency for the community with additional lanes. However, installing safe crossing points for two lanes can be more challenging. Option 3 received the lowest score against the Cultural criteria, as it has the largest footprint, increasing the risk of disruption to potential Maori Archaeology, productive soils and surrounding natural habitat. A larger footprint also increases the stormwater runoff needing to be treated. Although during discussions around the cultural scoring mana whenua representatives acknowledged that an additional two lanes would improve safety and efficiency.

The additional westbound lane involves shoulder widening and barriers and the shared use path on the south side of SH16 which may encroach into the grounds of former Sinton House Homesteads located at 222A SH16 (Alex Sinton) and 238 SH16 (Sinton Family) and result in potential adverse effects on the built heritage values of these places. Whilst only the homestead at 238 SH16 is scheduled in the AUP as a heritage extent of place, the actual and potential effects on built heritage will need to be assessed in the Notice of Requirement to expand the state highway designation. This will include the effects associated with temporary works, tree removals, demolition or changes to existing structures on the sites, driveway upgrades, and changes to the curtilage setting of these heritage places.

Recommended Option

The MCA workshop concluded that Option 3 was the preferred design.

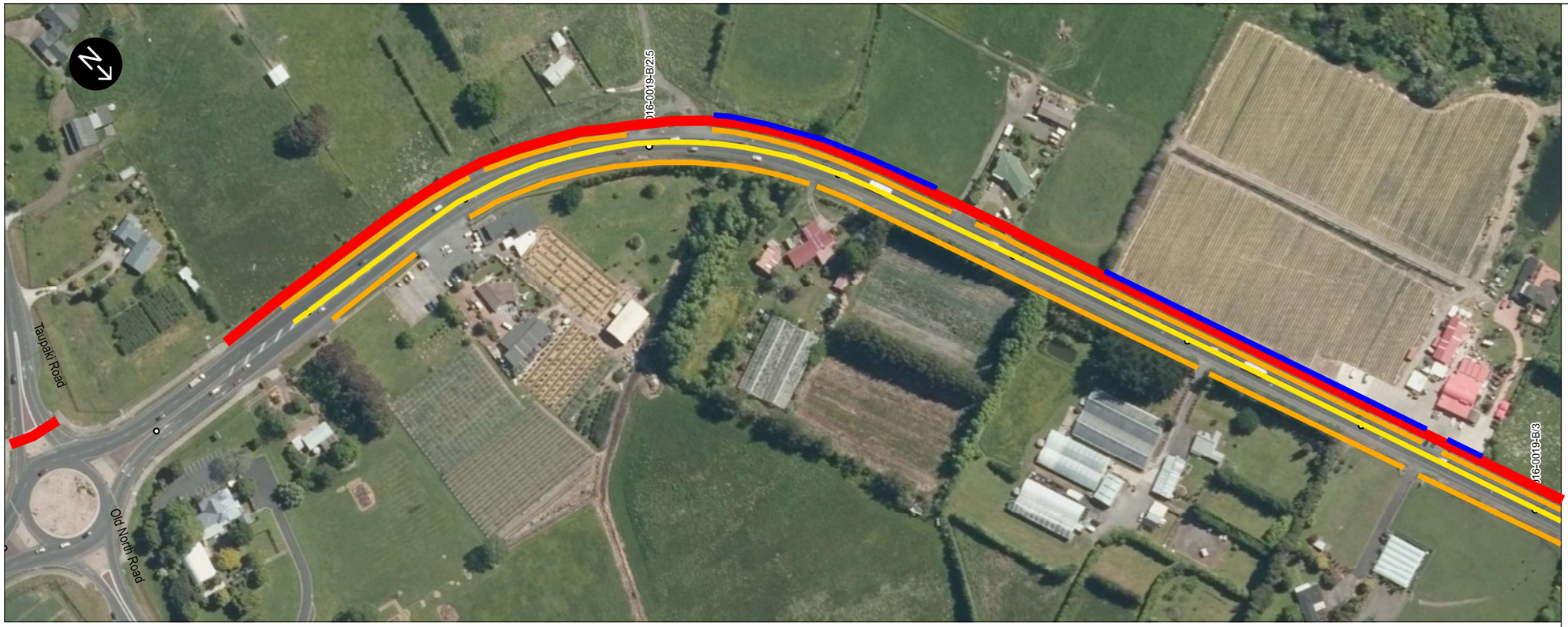
Option 3 would result in significant positive safety benefits. Option 3 scored the strongest against Efficiency as it provided the most efficiency improvements for the road network with the additional lanes in each direction. For similar reasons, Option 3 scored the highest for Social, as it improves accessibility with two additional lanes to improve accessibility for the local community. Option 3 did not differentiate from the other options against many criteria. Each option scored highly positive for Safety, slight positive for Systems Integration and

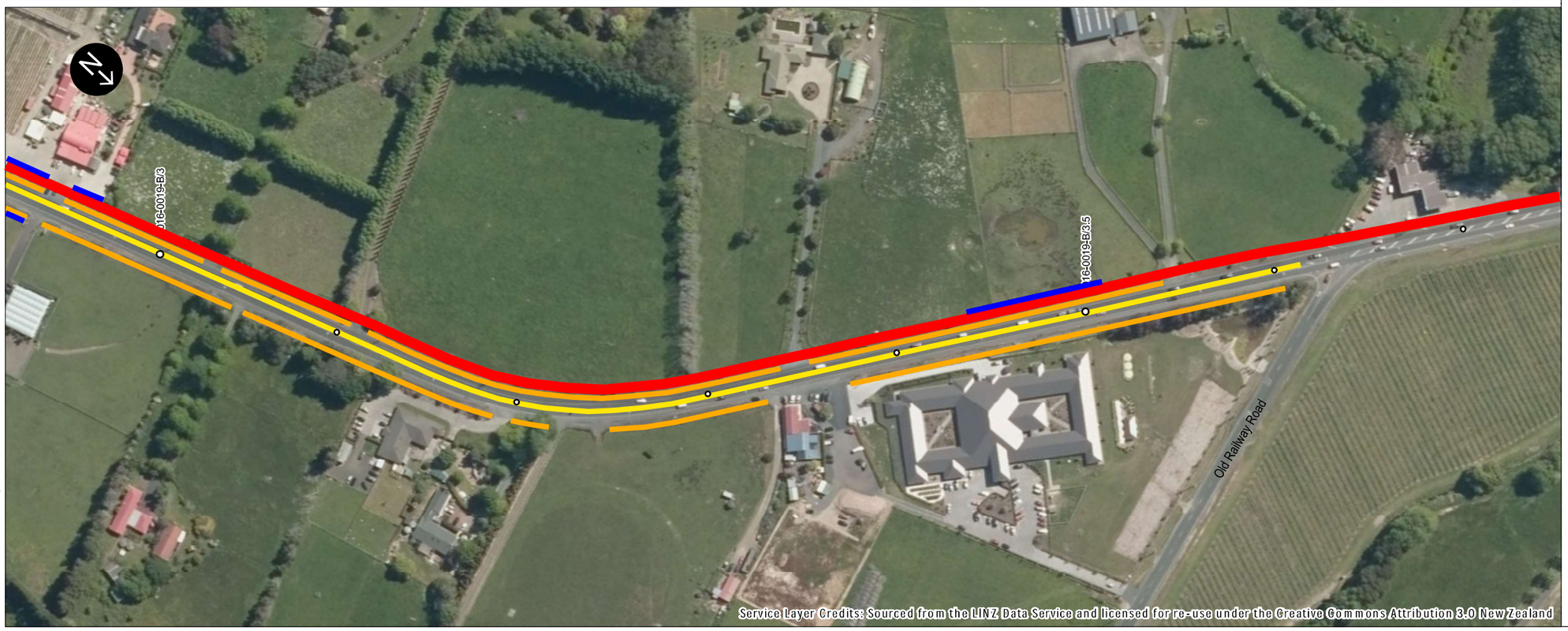
Modal Shift, and has similar effects on the Natural Environment and Heritage around Brigham Creek. Therefore, it was reasonable to choose Option 3 as it scored the best against the project objectives when compared with Option 1 and 2.

Although Option 3 scored more negatively against Property and Technical (due to the larger footprint), these can be mitigated through design, consenting and the land acquisition phases.

H

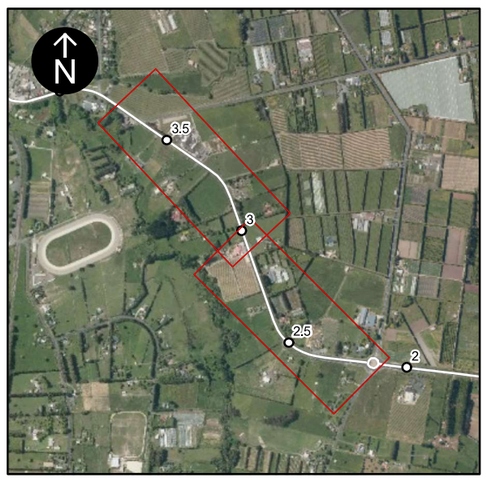
Appendix H – Section D: Taupaki Road Roundabout to Kumeū Town Centre Options





Legend

- Double Yellow Line
- Retaining Wall
- W-Section Barrier
- Shared Path



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Map Scale @ A3:1:2,500

0 50 100

Metres

Revision	Author	Verified	Approved	Date
1	RR	BAP	LDB	03/07/2017

SH16: Brigham Creek to Waimauku

Section D - Option 1

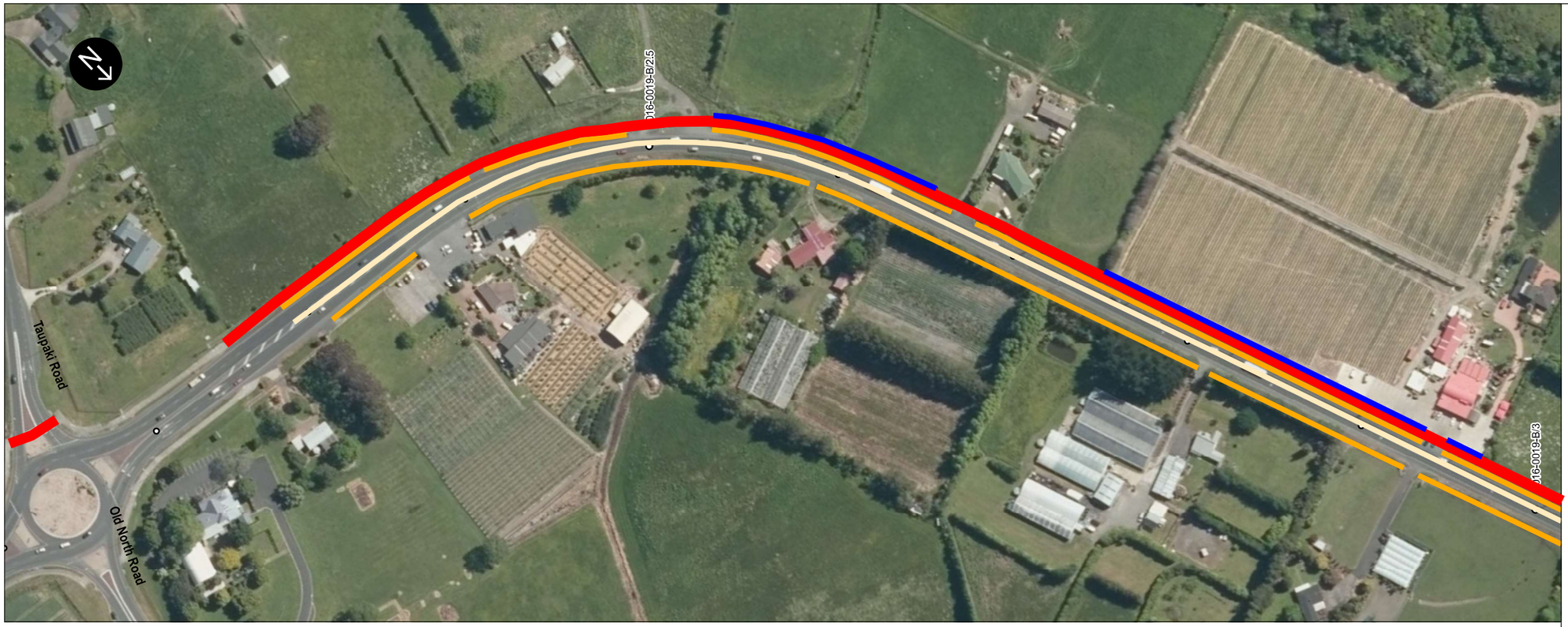
Client: NZ Transport Agency

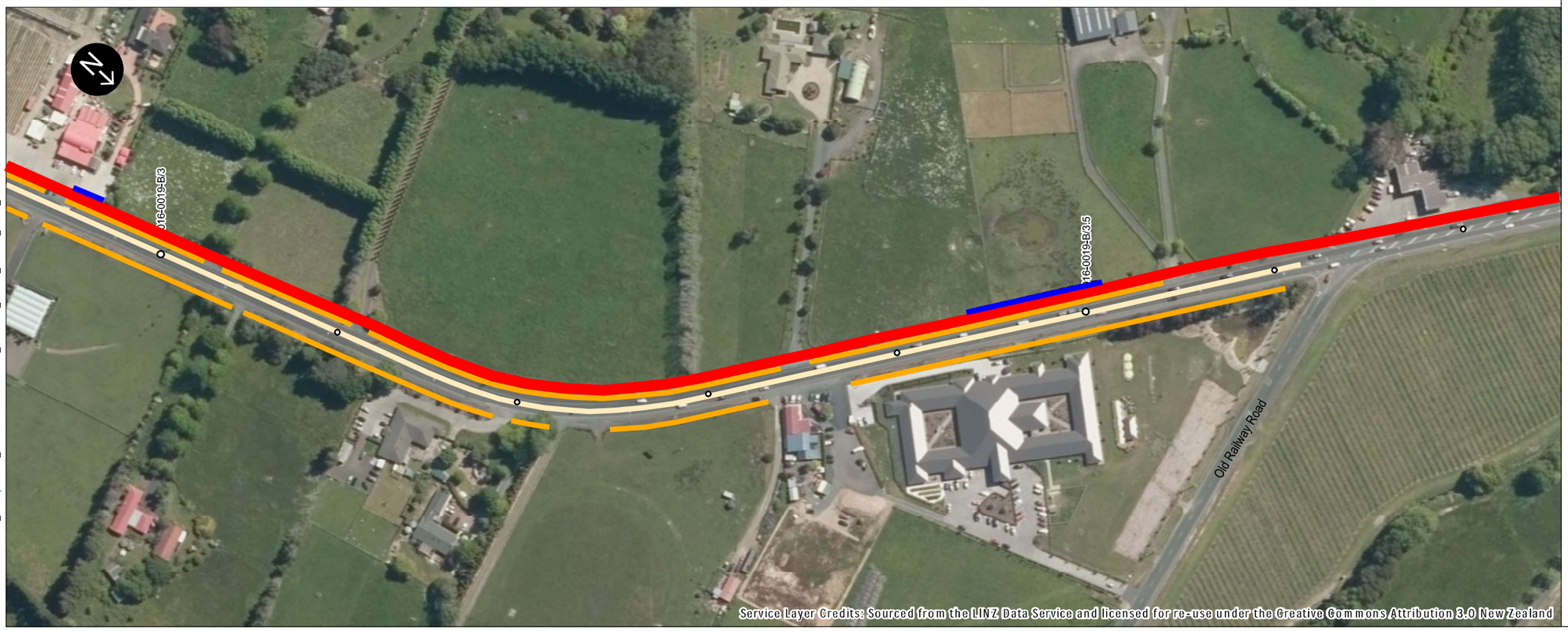
Project: Safe Road Alliance - Core Project

NZ TRANSPORT AGENCY WAKA KOTAHI | Safe Roads

Discipline: GIS

Drawing No: GIS-3411907-316-D1





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Legend

- Retaining Wall
- W-Section Barrier
- Wide Centreline
- Shared Path

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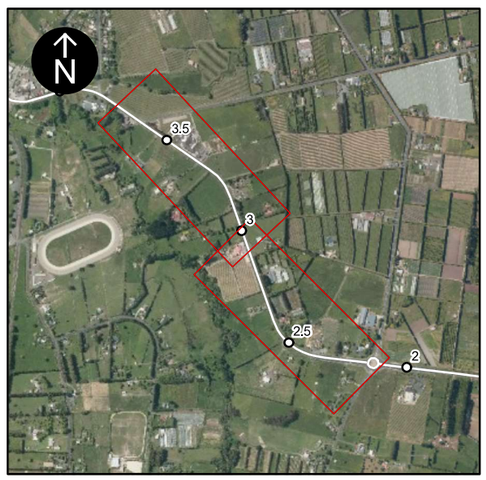

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Map Scale @ A3:1:2,500

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Metres

Revision	Author	Verified	Approved	Date
1	RR	BAP	LDB	03/07/2017

SH16: Brigham Creek to Waimauku

Section D - Option 2

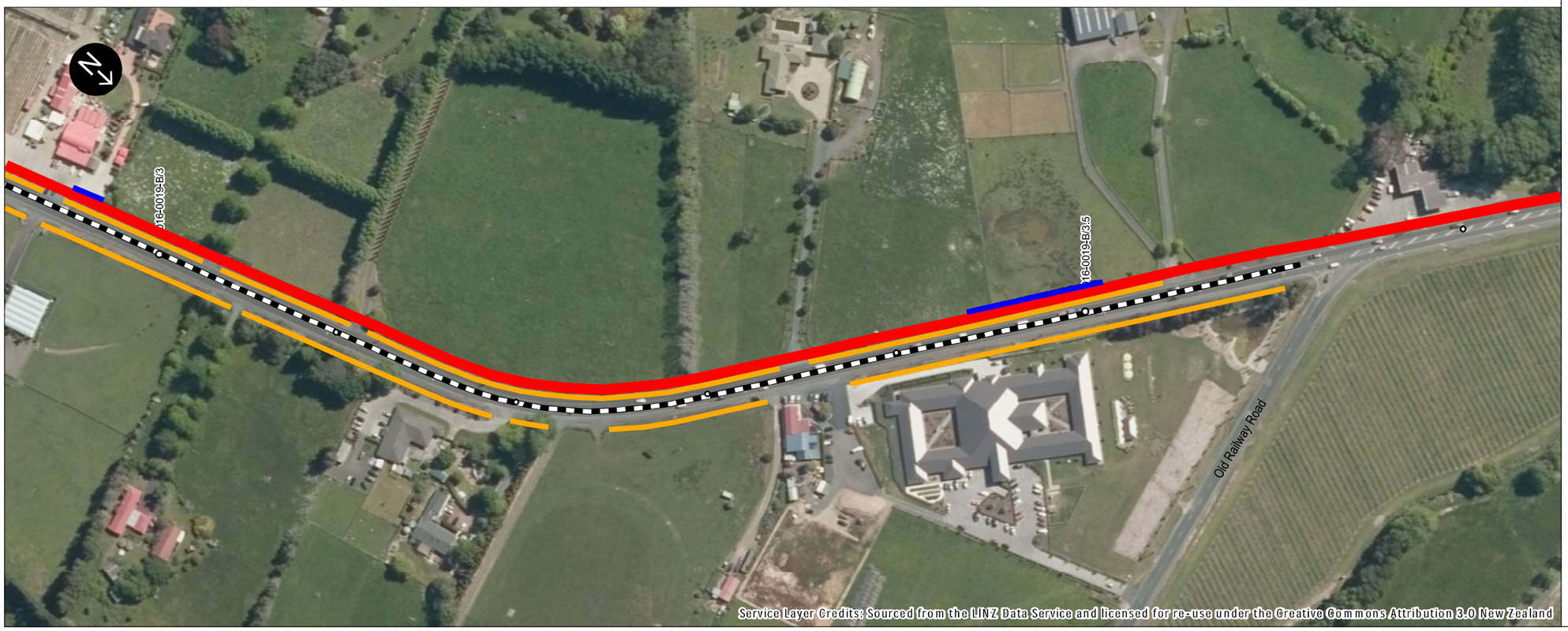
Client: NZ Transport Agency

Project: Safe Road Alliance - Core Project

NZ TRANSPORT AGENCY WAKA KOTAHI | Safe Roads

Discipline: GIS

Drawing No: GIS-3411907-316-D2



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Legend

- Flush Median
- Retaining Wall
- W-Section Barrier
- Shared Path

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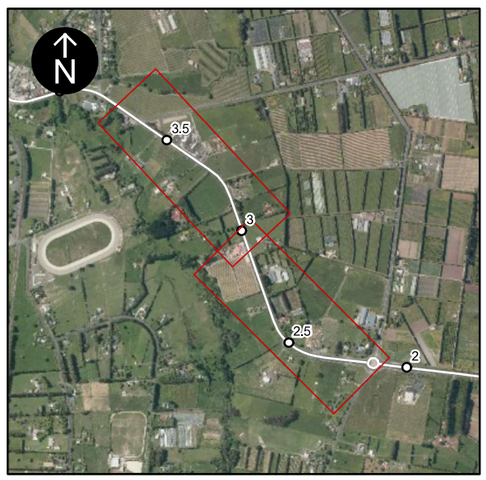

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Map Scale @ A3:1:2,500

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Metres

Revision	Author	Verified	Approved	Date
1	RR	BAP	LDB	07/03/2017

SH16: Brigham Creek to Waimauku

Section D - Option 3

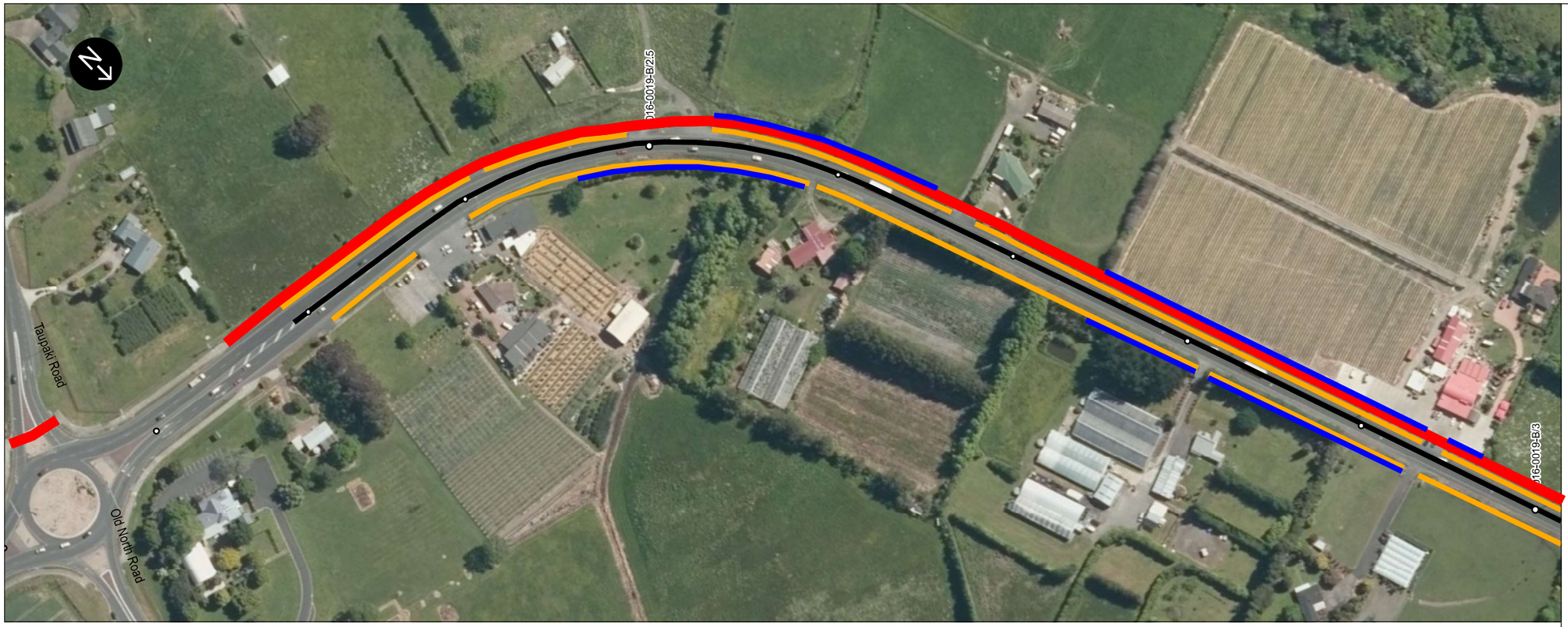
Client: NZ Transport Agency

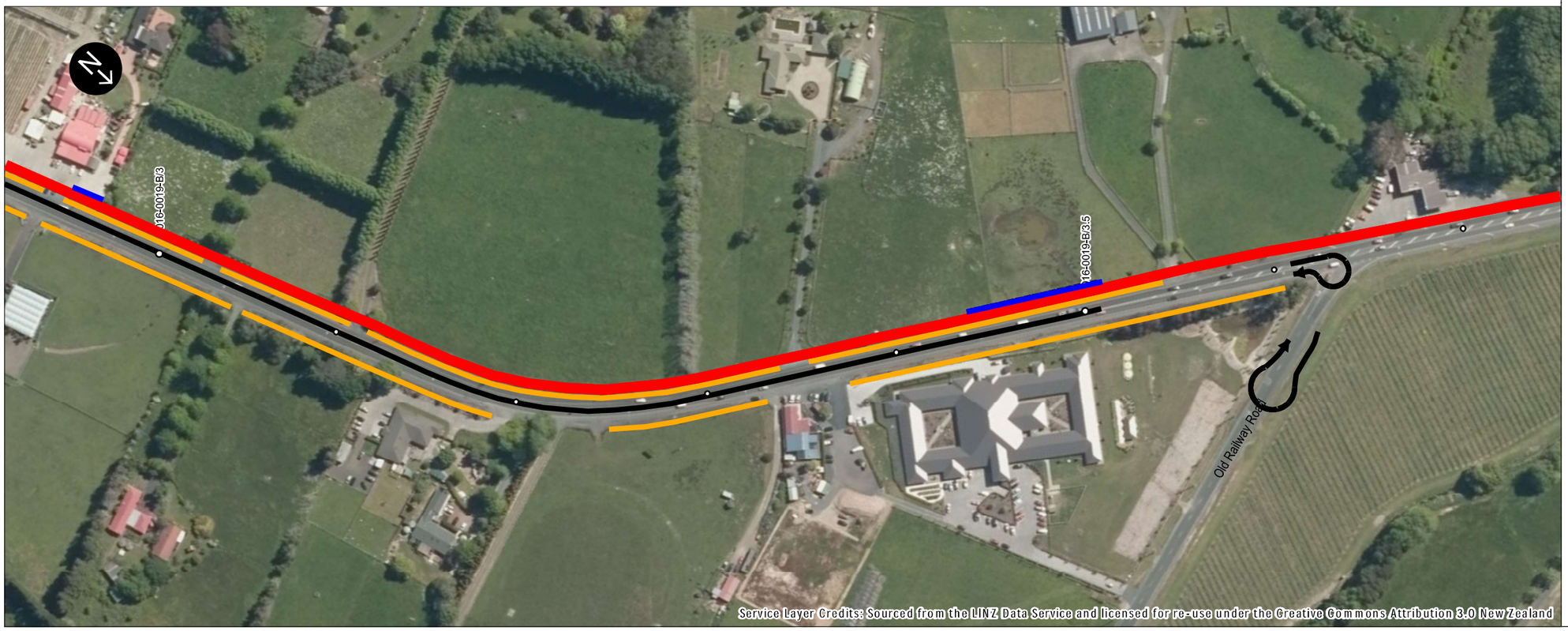
Project: Safe Road Alliance - Core Project

NZ TRANSPORT AGENCY WAKA KOTAHI | Safe Roads

Discipline: GIS

Drawing No: GIS-3411907-316-D3





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Legend

- Retaining Wall
- Turning Circle
- W-Section Barrier
- Wire Rope Barrier
- Shared Path

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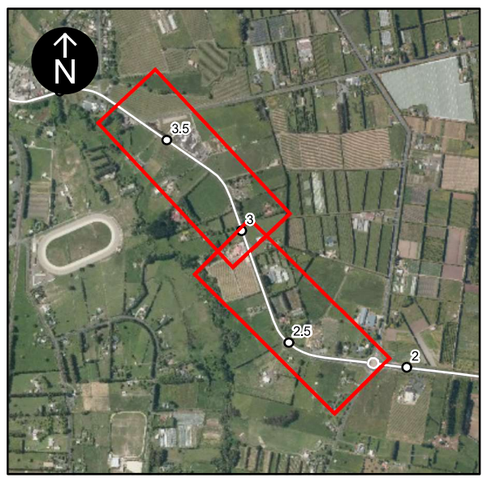

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Map Scale @ A3:1:2,500

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Metres

Revision	Author	Verified	Approved	Date
1	RR	BAP	LDB	03/07/2017

SH16: Brigham Creek to Waimauku

Section D - Option 4

Client: NZ Transport Agency

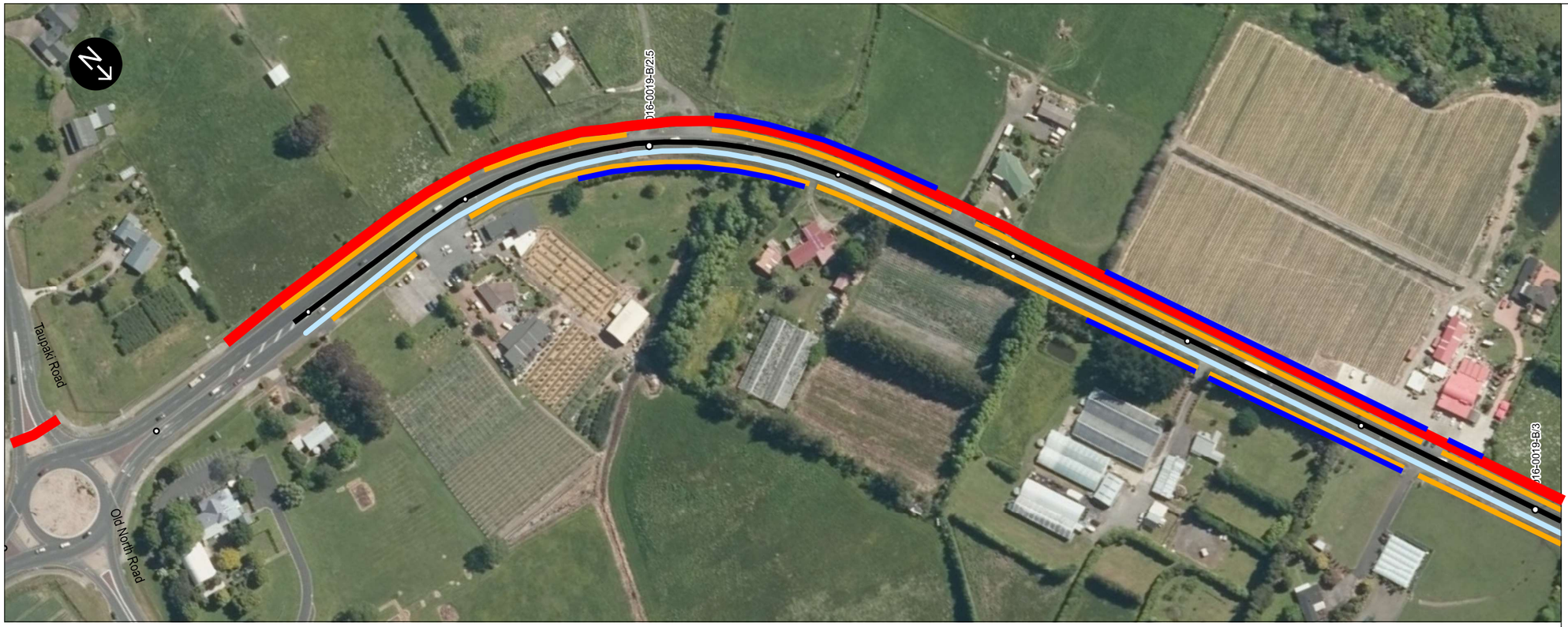
Project: Safe Road Alliance - Core Project

NZ TRANSPORT AGENCY WAKA KOTAHI | Safe Roads

Discipline: GIS

Drawing No: GIS-3411907-316-D4

Page 1 of 1



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Legend

- Extra Lanes
- Retaining Wall
- Turning Circle
- W-Section Barrier
- Wire Rope Barrier
- Shared Path

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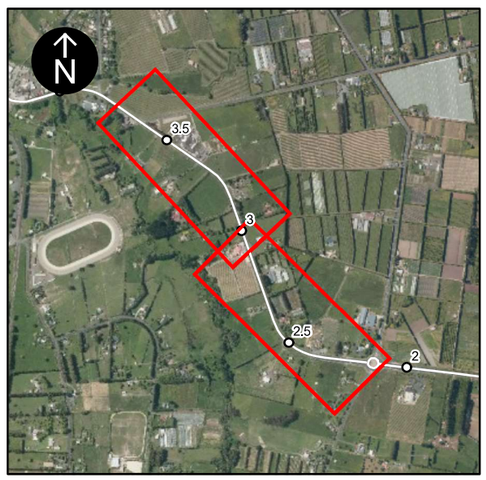

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Map Scale @ A3:1:2,500

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Metres

Revision	Author	Verified	Approved	Date
1	RR	BAP	LDB	11/08/2017

SH16: Brigham Creek to Waimauku

Section D - Option 5

Client: NZ Transport Agency

Project: Safe Road Alliance - Core Project

NZ TRANSPORT AGENCY WAKA KOTAHI | Safe Roads

Discipline: GIS

Drawing No: GIS-3411907-316-D5

Appendix I – Section D: Taupaki Road Roundabout to Kumeū Town Centre Options Assessment

Section D - Taupaki Road Roundabout to Kumeū Town Centre Options Assessment

Five short list options were proposed for Section D, with each option including the confirmed common elements:

Option 1: Existing layout of the corridor with addition of double yellow line median plus common elements (i.e. side barriers, shoulder widening, shared use path on south side of SH16)

Option 2: Existing layout of the corridor with addition of wide centreline plus common elements (i.e. side barriers, shoulder widening, shared use path on south side of SH16)

Option 3: Existing layout of the corridor with addition of flush median plus common elements (i.e. side barriers, shoulder widening, shared use path on south side of SH16)

Option 4: Existing layout of the corridor with addition of wire median plus common elements (i.e. side barriers, shoulder widening, shared use path on south side of SH16) - turnarounds required

Option 5: Existing westbound corridor layout, and provides for an additional lane eastbound, with the addition of wire median plus common elements (i.e. side barriers, shoulder widening, shared use path on south side of SH16) - turnarounds required.

These options are detailed in the plans in Appendix H.

The table below details the MCA scoring and commentary for Section D shortlisted options assessment, analysis notes and identification of the preferred option for this section of the corridor.

CRITERION	OPTION 1:	OPTION 2:	OPTION 3:	OPTION 4:	OPTION 5:	COMMENTARY
Safety	+2	+2	+2	+3	+3	All options provide moderate safety improvements with the shared path. Pedestrians and cyclists are protected from traffic behind physical barriers. This is a significant safety improvement from the existing situation (meaning the starting point for each option would be a +2 moderate positive safety improvement). Option 1 – Provision of a double yellow lines along the full length of the corridor provides a legal deterrent to prevent vehicles passing without physically preventing it. Roadside hazard protection is provided where possible, together with additional shoulder width, allowing more recovery space for vehicles that lose control. Therefore, this option is considered to provide a 'positive' effect. While this option will reduce the likelihood of crashes associated with dangerous overtaking manoeuvres, loss of control crashes may still result in high severity head on crashes. As there is no additional median width provided to allow right turning traffic to

Sensitivity: General

CRITERION	OPTION 1:	OPTION 2:	OPTION 3:	OPTION 4:	OPTION 5:	COMMENTARY
						move clear of the highway, the existing risk of rear end crashes remains. Rear-end crashes could potentially result in head on crashes in high speed and volume environments where the impacted vehicle is moved to the opposing lane. The wide shoulders may assist turning traffic, although this becomes difficult in corridors with high traffic volumes traveling in high speed. Option 2 – As with option 1, this option provides wide shoulders and roadside barrier along the length, resulting in a 'positive' road safety outcome. The additional width created by the wide centreline will further reduce the likelihood of a head on collision, although the risk still remains. Therefore, this option is also considered to deliver a 'positive' road safety outcome. Option 3 – As with both Options 1 and 2, this option delivers a good road safety outcome through provision of roadside barrier and wide shoulders. The addition of a flush median will also provide a refuge area for turning vehicles, reducing the risk of rear-end crashes. However, flush medians are generally not suitable in high speed areas (such as this 80km/h speed environment) as they are sometimes used for overtaking. This creates a direct conflict between high speed overtaking vehicles and stationary turning vehicles, potentially resulting in high severity crashes. This would also extend to pedestrians who also take refuge in the median when crossing the road. Site observations indicate that the there is a high pedestrian movement across the highway from vehicles parked opposite some of the retail developments, indicating the high likelihood of pedestrians waiting in the median. Although there are safety risks to a flush median in a high speed environment a recent speed audit was undertaken to assess the current speed. The audit concluded that the current 80km/hr is an appropriate safe speed for the existing environment. Therefore, the addition of a flush median to separate the traffic lanes would further justify the speed of 80km for the road corridor. Therefore, this option is also scored a +2 ('positive' effect). Treatments such as safe hit posts and profiled markers could be considered to discourage overtaking in the median. Options 1-3 do provide a different range of safety benefits, and some appear to have more safety improvements than others. They are scored a minimum of +2 due to the safety improvements from a safe separated shared path and wide shoulders. The scores cannot be increased to differentiate between them as they do not provide the safety benefits that a median barrier provides like options 4-5. Option 4 – This option would result in a 3-rope system. Provision of a median barrier along the full corridor significantly reduces the risk of head-on crashes, subsequently reducing death or serious injury. Roadside hazard protection is also provided where possible, together with additional shoulder width, allowing more recovery space for

Sensitivity: General

<table>
<tr><th>CRITERION</th><th>OPTION 1:</th><th>OPTION 2:</th><th>OPTION 3:</th><th>OPTION 4:</th><th>OPTION 5:</th><th>COMMENTARY</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>vehicles that lose control. Therefore this option would have a ‘significant positive’ effect (score +3).
Vehicle turn-around areas would be required to provide an opportunity for vehicles to turn, and there would be some residual risk associated with turning movements at these locations. This risk is considered minor, as it can be mitigated through establishing clear sight distance and controls to minimise this risk.
Option 5 – As with Option 4, this option includes a median barrier along the full corridor, as well as roadside hazard protection and additional shoulder width. Therefore, this option is also considered to result in a ‘significant positive’ effect (score +3). Vehicle turn-around areas would also be required to provide an opportunity for vehicles to turn.</td></tr>
<tr><td>Economy</td><td>+1</td><td>+1</td><td>+1</td><td>+1</td><td>+1</td><td>All options will see a slight benefit from the shared path, as access for active modes is improved.
For all options, the eastbound travel time through Section D is influenced by the treatment in section A, B and C. The provision of an additional eastbound lane (and associated removal of the existing merge) enables traffic to clear this section quicker, reducing the delay at the Taupaki/ Old North Road roundabout. This improves the eastbound peak travel time by 35 - 45 secs.
Option 5, which includes provision of an additional eastbound lane, has only a marginal improvement in travel time when compared to the other options (5 seconds). This is due toconstraints at the Access Road intersection in Kumeu town centre, which limits the volume of traffic that can travel through the corridor. The roundabout at Taupaki/ Old North Road becomes the limiting factor for all options.
<table>
<tr><th>Option</th><th>Direction</th><th>Period</th><th>Travel Time (sec)</th><th>Percentage</th></tr>
<tr><td rowspan="4">1-4</td><td rowspan="2">EASTBOUND</td><td>AM</td><td>Decrease by 40</td><td>-14%</td></tr>
<tr><td>PM</td><td>Decrease by 35</td><td>-18%</td></tr>
<tr><td rowspan="2">WESTBOUND</td><td>AM</td><td>No change</td><td>0%</td></tr>
<tr><td>PM</td><td>No change</td><td>0%</td></tr>
<tr><td rowspan="3">5</td><td rowspan="2">EASTBOUND</td><td>AM</td><td>Decrease by 45</td><td>-16%</td></tr>
<tr><td>PM</td><td>Decrease by 35</td><td>-18%</td></tr>
<tr><td>WESTBOUND</td><td>AM</td><td>No change</td><td>0%</td></tr>
</table></td></tr>
</table>

Sensitivity: General

CRITERION	OPTION 1:	OPTION 2:	OPTION 3:	OPTION 4:	OPTION 5:	COMMENTARY
						<table><tr><td></td><td></td><td>PM</td><td>No change</td><td>0%</td></tr></table> There are likely to be minor benefits to the local businesses and local economy as a result of the travel time saving, with travel time benefits relating more so to reliability (due to reduced crashes) rather than overall capacity and improved accessibility. Wider shoulders (all options) improve resilience through providing greater pull off area in the event of incidents (crashes / breakdowns), benefiting all users including freight and local and regional through-traffic. Some businesses along the route potentially affected by median barrier (Options 4 & 5), would be required to travel to the nearest turn-around location to access property adding to their journey time. This additional distance travelled is 2.6km for businesses and 3km for some residential properties, depending on the particular restricted movement. Option 3 would maintain the access to businesses by creating a safer space for vehicles to turn into each business. Overall, there is likely to be a minor positive effect on the economy for all options in this section (score +1). This is predominantly due to the reduced travel time savings in the eastbound direction that result from the improvements in sections A, B and C. The shared path will create a positive benefit for all options.
System Integration	+1	+1	+1	+1	+1	TFUG: All options do not preclude future offline corridor such as the Alternative State Highway (being investigated by the Supporting Growth Programme). Other modes: All options have widened shoulders and a shared use path to south of SH16 for Section D and will result in improved space for cyclists and pedestrians and a safe continuous active mode facility.
Technical	-1	-1	-1	-2	-2	Option 1 - adds a double yellow line centreline and maintains a single lane in each direction. No impact on carriageway width as most of Section D already has a double line centreline. Option 2 - adds a 1m wide centreline and maintains a single lane in each direction. Small amount of carriageway widening required, probably on northern side. Small retaining wall required on southern side west of Kumeu Produce Market. Small land requirement on northern side for sight distance near Kumeu Produce Market. Option 3 - adds a flush median and maintains a single lane in each direction. 2.5m of carriageway widening required, probably on northern side. Small retaining wall required

Sensitivity: General

CRITERION	OPTION 1:	OPTION 2:	OPTION 3:	OPTION 4:	OPTION 5:	COMMENTARY
						on southern side west of Kumeu Produce Market. More land requirement on northern side including for sight distance near Kumeu Produce Market and to the west. Option 4 - adds a wire rope median barrier in a 1.5m wide median and maintains a single lane in each direction. Similar carriageway width increase as Option 2. Small amount of carriageway widening required, probably on northern side. Small retaining wall required on southern side west of Kumeu Produce Market. Requires a turnaround facility at western end of section, probably at Old Railway Road. Small land requirement on northern side for sight distance near Kumeu Produce Market. Option 5 - adds a wire rope median barrier in a 1.5m wide median plus two lanes in the eastbound direction. Widest carriageway arrangement through Section D. Small retaining wall required on southern side west of Kumeu Produce Market. Requires a turnaround facility at western end of section, probably at Old Railway Road. Greater land requirement on northern side for sight distance near Kumeu Produce Market and for extra carriageway width to the west. Options 4 and 5 have more infrastructure to build than the other options and subsequently have more technical constraints, resulting in a negative score. All options have the shared use path, which will have technical constraints with additional land being required.
Operational / Maintenance	0	0	-1	-2	-1	Option 1 and 2 acceptable but will have little effect on operational traffic safety. The preferred option would be Option 3, which creates vehicle separation and visual narrowing to reduce speeds while preserving the ability of the operational teams to both maintain the road without major issues, and for emergency services to move traffic quickly if incidents do occur which is crucial to the operation of the corridor. A flush median is difficult to mark as the maintenance vehicle has to drive diagonally to paint the road around moving traffic. Option 4 and 5 have adverse effects, and reduce space for maintenance work. It will require stop go traffic management Option 4: Creates maintenance, Health and Safety and traffic congestion liability. Will increase turning movements into Old Railway Road. Median barriers with single lane traffic (Option 4) create a maintenance liability by reducing available work space. Introducing median barriers has been proven to increase the maintenance load due to the need for increased repairs, and single lanes will require the closure of that lane for

Sensitivity: General

CRITERION	OPTION 1:	OPTION 2:	OPTION 3:	OPTION 4:	OPTION 5:	COMMENTARY
						repairs under H&S legislation. Routine maintenance works will create traffic congestion. Due to traffic volumes works will have to be undertaken at night with one lane closed and traffic working on stop go in the alternate carriageway. This requires regular maintenance crossing points. Pavement renewal will require the removal of the median barrier before work can take place. Option 5: Creates maintenance, Health and Safety and traffic congestion liability. Will increase turning movements into Old Railway Road. Yet Option 5 would have a slight adverse effect compared to Option 4 which would have a moderate adverse effects – due to Option 5 including an additional lane and therefore more space for maintenance work than Option 4 would.
Safety in design consideration (Zero Harm)	0	0	0	0	-1	All options will require the existing road to be widened, involving contractors working close to live traffic. Specific traffic management planning will be required as part of the design, as the construction will be on a "live" State Highway. Construction and maintenance of retaining walls will be undertaken beyond the carriageway under adequate temporary traffic management, and therefore the construction and maintenance safety risks can be mitigated. None of the options have been identified as requiring work in contamination sites, confined spaces or in water. Therefore construction activity is considered within normal practice and the ability to design out safety risk is not considered significantly different between options. A detailed Safety in Design Workshop will be undertaken on the preferred option. Option 5 has more works involved with an additional lane and therefore more risks.
Social	+1	+1	+1	-1	-1	All options will have a positive effects with the shared path for active modes. Options 4 and 5 will represent more construction impact for people and businesses in the area (although will be temporary impact). Options 4 and 5 have wire medians resulting in restricted access to dwellings and places of employment along the alignment with increased journey time as a result of diversions. Key community facilities in this section include: • Building Blocks childcare and preschool; and • Kumeu Village rest home • Kumeu produce market • Phil Greig strawberry café

Sensitivity: General

CRITERION	OPTION 1:	OPTION 2:	OPTION 3:	OPTION 4:	OPTION 5:	COMMENTARY
						These community facilities will have restricted access and potentially an increase in diversion (and therefore impact on access to employment), however there are roundabouts nearby so the impacts are likely to be slight adverse effect only. Option 5 will result in significantly more land take than Option 4 which would likely impact the community facilities' ability to operate.
Natural environment	+1	+1	0	0	-1	Option 5 will result in an increase in impervious surface area due to the extra lane and having the widest footprint of all options. Increased proximity to nearby stream and high use stream overlay. However, all options will treat stormwater runoff, creating a positive effect for the surrounding water quality. Any option that may affect a wetland would be negative. Options 1 and 2 will have a minor effect on the wetlands compared to Option 3-5.
Human health	0	0	0	0	-1	For all options (which include the common elements such as shoulder widening and SUP on the south side), there is the potential for human health impacts to be experienced by construction workers/local receivers as a result of disturbing potentially contaminated land (i.e. the identified HAIL sites) along the corridor. Yet there is an opportunity to mitigate the potential adverse effects on human health that may result from works within HAIL sites via the implementation of a Contaminated Soils Management Plan. The potential human health impacts are a result of potential change to air quality and noise effects due to bringing transport activities closer to sensitive receivers on the existing corridor. For Options 1 – 4 potential human health impacts would be negligible, as the road transport activities would not be brought closer to sensitive receivers i.e. no additional traffic lanes proposed. Options 4 and 5 contain the installation of median barriers with turnarounds which will increase volume of traffic (and potentially heavy traffic) and noise on side roads where turnarounds are located. Yet Option 5 does increase the width of the road (due to the provision of an additional lane) and will therefore bring the road and vehicle noise/emissions closer to dwellings along the alignment therefore this will be a slight adverse impact.
Heritage (Archaeological, Natural and Built)	0	0	0	0	0	No recorded archaeological and built heritage sites in proximity to this section.

Sensitivity: General

CRITERION	OPTION 1:	OPTION 2:	OPTION 3:	OPTION 4:	OPTION 5:	COMMENTARY
Cultural	+1	0	-1	+1	-1	***Note:*** *Numerous presentations on the project have been provided to the Iwi Integration Group – Central West and early options were discussed at Reweti Marae with Ngati Whatua o Kaipara. The IIG have confirmed that Ngati Whatua o Kaipara and Te Kawerau o Maki are the interested parties to provide input for this project.* ***Mana Whenua Input - Te Kawerau o Maki (endorsed by Ngati Whatua o Kaipara)*** There are no recorded Maaori sites within the footprint of any options, however risks increase slightly with size of footprint, meaning an extra lane (Option 5) carries higher risk. The impact to productive soils is likely less than minor, however impact generally increases with size of footprint increasing, meaning an extra lane (Option 5) carries higher impact. An extra lane (Option 5) will require a larger footprint and thus impact on adjacent habitat. All options considered equal in terms of impact on streams / wetlands.
Property	-1	-1	-1	-1	-2	Option 1-3 involve works largely within the existing corridor. Some land acquisition and driveway works for shoulder widening will require land acquisition from 9 properties. Option 4 requires land for turnarounds (300sm2 more). Option 5 has the most land acquisition for additional lane and turnarounds – 2 additional properties required – one minor and the other 585m2 approx.

Non scored criteria

Criteria	Comments
Financial considerations	Options increase in cost as the cross section of the roadway increases. The higher the cost, the more likely the original project estimate discussed with NZTA BUMDT and VAC teams ($43mill) will be exceeded. Option 5 is the most expensive and allows for an additional eastbound lane. The other options are reasonably similar in cost. Option 1 and 2 maintain a minimum width median, while Option 3 and 4 widen the median to allow for median barrier or flush median.
Consentability	Option 1-3 are largely contained within the existing designation – BAU consenting. Option 4 contains turnaround facilities which will require alteration to the existing SH16 designation. Option 5 contains turnaround facilities and an additional lane which will require alteration to the existing SH16 designation and the increase in impervious surface area will require an upgrade to stormwater detention and water quality treatment as none currently provided in this section of the corridor (for stormwater discharge consent). There are HAIL sites nearby. The additional lane will result in works within these HAIL sites (additional reason for consent). For all options the shoulder widening, safety and efficiency treatments and the shared use path on southern side of SH16 are likely to interface with the wetlands in this section of the corridor. Works within or in setback of a wetland may trigger additional resource consent requirements under both the AUP and NPS:FM / NES:F regulations. This consenting risk may be addressed via a localised option assessment for preferred option interface with the wetland(s).
Stakeholder feedback	The public are concerned about parking on the current shoulder width in this section and people accessing business along section D e.g. Phil Greigs Strawberry Gardens. The public recommended right turn bays and/or a wide flush median and wide shoulders. Cyclists want wider shoulders and more consistent shoulder width throughout the length of the corridor. Speed was an issue on this length of corridor. The public will be most concerned about increased congestion during works. Option 1 and 2 are not addressing safety issues based on what the community is after – addressing turning and flush median. Option 3 includes a median which is positive from the public perspective. Option 4 has positive safety benefits but was viewed negatively by some due to access restrictions to some properties. Option 5 addresses congestion so favourable for the community – but just on one side of the road so only a minor positive effect. From Taupaki roundabout to Kumeu congestion was a primary concern, specifically capacity and provision for right turning along the corridor at key intersections and businesses. Therefore, public are more favourable to increased lanes and provisions for right turns and less favourable to median barrier that restricts right turn access. Options 1 and 2 would score lowest in terms of responsiveness to the communities concerns for the corridor and Options 3 and 5 are the most reflective of the communities' preferences.

MCA Assessment notes

Each option provides road side barriers providing moderate safety improvements with the shared path. Pedestrians and cyclists are protected from traffic behind physical barriers. This is a significant safety improvement from the existing situation.

All options will see a slight benefit under the Efficiency criteria, as the shared path will improve access for active modes. For all options, the eastbound travel time through Section D is influenced by the treatment in Section A, B and C. The provision of an additional eastbound lane (and associated removal of the existing merge) enables traffic to clear this section quicker, reducing the delay at the Taupaki roundabout. This improves the eastbound peak travel time by 35 - 45 secs. See the table below for travel times for each option.

Option	Direction	Period	Travel Time (sec)	Percentage
1-4	EASTBOUND	AM	Decrease by 40	-14%
		PM	Decrease by 35	-18%
	WESTBOUND	AM	No change	0%
		PM	No change	0%
5	EASTBOUND	AM	Decrease by 45	-16%
		PM	Decrease by 35	-18%
	WESTBOUND	AM	No change	0%
		PM	No change	0%

It is likely that there will be minor benefits to the local businesses and the community as a result of the travel time saving, with travel time benefits relating more so to reliability (due to reduced crashes) rather than overall capacity and improved accessibility.

Each option will involve widening the shoulders, which will improve the resilience of the road network by providing more space for vehicles to pull over in the event of an incident (crashes / breakdowns), benefiting all users including freight and local and regional through-traffic.

All options scored slightly positive against System Integration and Modal Shift as the shared path will allow active mode users to integrate with the wider network more than the existing situation. Similarly, all options present a slightly positive score for Social, due to the access of the shared path for active mode users.

Option 1 and Option 2

Option 1 and 2 are similar in design and received the same scores, these options will therefore be discussed together in this section.

In relation to Safety, Option 1 will involve a double yellow line along the full length of corridor, which provides a legal deterrent to prevent vehicles from passing without physically preventing it. Roadside hazard protection is provided where possible, together with additional shoulder width, allowing more recovery space for vehicles that lose control. Therefore, this option is considered to provide a positive effect.

Option 2 will provide wide shoulders and roadside barriers along the corridor, resulting in a positive road Safety outcome. The

additional width created by the wide centreline will further reduce the likelihood of a head on collision, although the risk still remains. Both Options 1 and 2 will provide the same positive effects for road safety.

In relation to Technical, Option 1 adds a double yellow line centreline and maintains a single lane in each direction. There will be no impact on the carriageway width as most of Section D already has a double centreline. However, widening will still be required for the shared path, imposing technical challenges. Option 2 adds a 1m wide centreline and maintains a single lane in each direction. A small amount of carriageway widening would be required, most likely on the northern side. Small retaining walls will be needed on the southern side west of Kumeū Produce Market. A small amount of land may be required on the northern side for sight distance near Kumeū Produce Market. Although Option 1 appears to have less Technical risk, the risk is not low enough to differentiate the scores.

All options will treat stormwater runoff, creating a positive effect for the surrounding water quality and Natural Environment. Any option that may affect a wetland would be negative. Options 1 and 2 will have a minor effect on the wetlands compared to Option 3-5.

Option 3

As with both Options 1 and 2, this option delivers a good road safety outcome through the provision of roadside barriers and wide shoulders. The addition of a flush median will also provide a refuge area for turning vehicles, reducing the risk of rear-end crashes. However, flush medians are generally not suitable in high-speed areas (such as this 80km/h speed environment) as they can be used for overtaking. This creates a direct conflict between high speed overtaking vehicles and stationary turning vehicles, potentially resulting in high severity crashes. This would also extend to pedestrians who take refuge in the flush median when crossing the road. Site observations indicate that the there is a high pedestrian movement across the highway from vehicles parked opposite some of the retail developments, indicating the likelihood of pedestrians waiting in the median. Although there are safety risks to a flush median in a high-speed environment, a recent speed audit was undertaken to assess the current speed. The audit concluded that the current 80km/hr speed environment is an appropriate speed for the existing environment. Therefore, the addition of a flush median to separate the traffic lanes would improve the safety of the corridor and further justify the speed of 80km/hr. Therefore, this option is also scored a +2 (‘positive’ effect). Treatments such as safe hit posts and profiled markers could be considered to discourage overtaking in the median. Options 1-3 do provide a different range of safety benefits, and some appear to have more safety improvements than others. They are scored a minimum of +2 due to the safety improvements from a separated shared path and wider shoulders. The scores cannot be increased to differentiate between them as they do not provide the safety benefits that a median barrier provides, like options 4 and 5. The Cultural criteria also scored option 3 slightly negative due to the aforementioned safety risks.

Option 3 scored slightly negative for Technical. It adds a flush median and maintains a single lane in each direction. 2.5m of carriageway widening would be required, most likely on the northern side. Small retaining walls would be installed on the southern side, west of Kumeū Produce Market. Like Option 2, additional lane would be required on the northern side of the road for sight distance near Kumeū Produce Market and to the west. Although Option 3 has more Technical constraints compared to Option 1 and 2, it cannot justify a ‘-2’ score as it has less severe effects compared to Options 4 and 5. However, Options 4 and 5 are not severe enough to be scored ‘-3’.

The preferred option would be Option 3 for Maintenance and Operation. This option creates vehicle separation and visual narrowing to reduce speeds while preserving the ability of the operational teams to

both maintain the road without major issues, and for emergency services to move traffic quickly during an incident, which is crucial for the operation of the corridor. However, a flush median is difficult to mark as the maintenance vehicle will have to drive diagonally to paint the road around moving traffic.

Option 4

This option scored positively in relation to Safety. This option proposes a three-rope system as a provision for a median barrier, which significantly reduces the risk of head-on crashes, subsequently reducing death or serious injury. Roadside hazard protection is also provided where possible, together with additional shoulder width, allowing more recovery space for vehicles that lose control. Therefore, this option would have a 'significant positive' effect.

Regarding Efficiency, some businesses along the corridor may be affected by the median barrier. They would be required to travel to the nearest turnaround facility to access their destination, adding to their journey time. This additional distance travelled is 2.6km for businesses and 3km for some residential properties, depending on the particular restricted movement.

In regards to the Social criteria, Options 4 and 5 scored negatively as they will represent more construction impacts for people and businesses in the area (although they will be temporary effects). The wire medians for both Options 4 and 5 will restrict access to dwellings and places of work. Key community facilities in this section include Building Blocks Childcare, Kumeū Village Rest Home, Kumeū Produce Market, Phil Greig Strawberry Café.

Option 4 and 5 scored the worst for Technical, a wire rope median barrier in a 1.5m wide median is required. Option 4 will require minor road widening and retaining walls. Due to the median barrier, a turnaround facility will be required, resulting in more land to be acquired, most likely on the northern side for sight distance near Kumeū Produce Market.

Option 4 will reduce the space required for maintenance due to the median barrier, thus scoring negatively for Maintenance. Due to the traffic volumes, works will have to be undertaken at night with one lane closed and traffic working on stop go contraflow in the alternate carriageway. This will require regular maintenance crossing points. A median barrier along Section D will increase turning movements into Old Railway Road. As mentioned for Section A, introducing median barriers often increases the maintenance load due to the need for increased repairs.

Option 5

As with Option 4, this option is also considered to result in a 'significant positive' effect (score +3) for Safety. It would include a median barrier, and an additional eastbound lane, as well as roadside hazard protection and additional shoulder width.

In relation to Efficiency, Option 5 only has a marginal improvement in travel time when compared to the other options (5 seconds). This is due to the constraint at Access Road intersection in Kumeū town centre, which limits the volume of traffic that could travel through the corridor. The roundabout at Taupaki/ Old North Road becomes the limiting factor for all options.

Same as Option 4, Option 5 has a wire median barrier that will require additional land for a turnaround facility. The extra eastbound traffic lane will also impose technical challenges with additional land that will also require retaining walls. Options 4 and 5 have more infrastructure to build and subsequently have more technical constraints, resulting in a negative score.

All options will require road widening and contractors working next to live traffic. Option 5 has the lowest score in relation to Safety in Design as it has a larger footprint, and therefore more work.

Option 5 received a negative score for Natural Environments, as it has the largest footprint and therefore will increase the proximity to streams and potential wetlands.

Option 5 received a slight negative score for Human Health. Both Options 4 and 5 contain turnaround facilities which will increase volume of traffic (including heavy traffic) and noise on the side roads where the turnaround facilities are located. However, Option 5 has a more negative score as the additional lane will increase the proximity of the highway to residential dwellings and other sensitive receivers.

All options require additional land, however Option 5 had the lowest score for Property as it requires the most land due to the additional lane and turnaround facility. The large footprint of Option 5 also resulted in a slight score against the Cultural criteria due to the increased risk of disruption to maori archelogy, productive soils and native habitat.

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Appendix J – Localised Stormwater Options

To:	Gareth Clayton, Ashlie Carlyle	**Date:**	[Document Date]
From:	Samantha Fraser	**Our Ref:**	3235084-1390048858-10535
Copy:			
Subject:	SH16 Stage 2 Project: Stormwater Technical Memorandum for localised alternatives assessment process for stormwater management design solutions Location: SH16 Project Discharge Point 7		

1 Purpose

This document supports the Localised Alternatives Assessment process for stormwater management design solutions which was outlined in a Technical Memo dated 11 November 2021 to Waka Kotahi. This document also sets out the relevant Auckland Unitary Plan – Operative in Part (AUP) requirements and the stormwater design philosophy for the project.

2 Location – Discharge Point 7

The Localised Alternatives Assessment process is required to confirm the stormwater management design for Discharge Point 7.

The Site is located in the general vicinity of 464-472 SH16, which is located between Taupaki Road / SH16 roundabout and Kumeu Township. The image below shows the location of the discharge points for Stage 2, with Discharge Point 7 (DP7) circled in yellow.

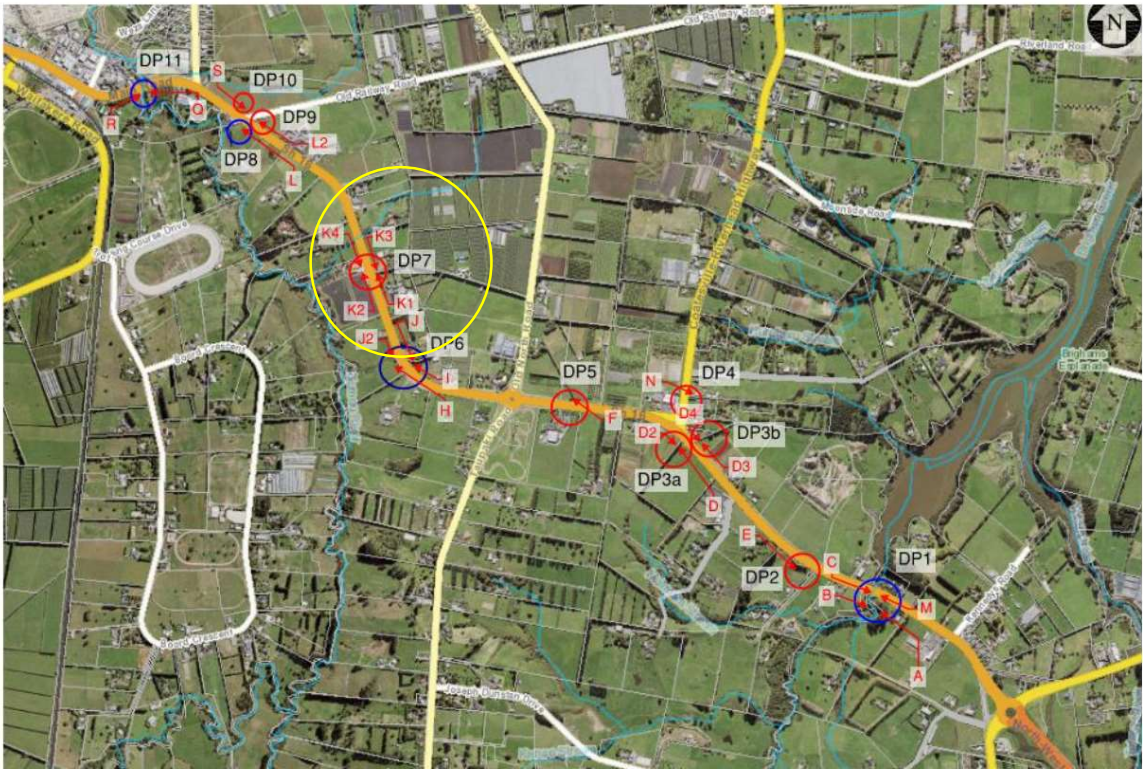


Figure 1: Aerial of SH16 Stage 2 showing the discharge points (yellow circle indicating DP7).

3 Existing Discharge Site

The stormwater from the wider stormwater catchment and SH16 currently discharges to 464 SH16 through a piped stormwater network and overland flow path. 464 SH16 has a large pond on site where the stormwater discharges prior to entering Kumeu River. This discharge location is referred to as Discharge Point 7 (DP7) for the State Highway Project.

3.1 Location Description

Property 464 SH16 is located on the western side of SH16 between Taupaki Road / SH16 Roundabout and Kumeu Township. The Site is operated as a Phil Greig Strawberry Gardens.

The Site falls from RL30 to RL25 at 2.5% over 200m. At the western end of the property is an existing stormwater pond which attenuates stormwater runoff prior to discharging to Kumeu River at the western end of the Site.

3.2 Catchment

The existing catchment which discharges to the Kumeu River at the back of 464 SH16 is approximately 16Ha. The north eastern side of SH16 is zoned for Rural Mixed Urban and the south western side is zoned a Rural – Countryside Living Zone. A summary of pervious and impervious area of the catchment is shown below in Table 1.

Table 1 Catchment Area discharging to Kumeu River through 464 SH16

	Existing Scenario		Post Development (With Maximum Probable Development)	
	m^2	%	m^2	%
Total impervious area (including roads)	20,984	13%	23,967	15%
Total pervious area	138,366	87%	140,169	85%
TOTAL	159,340	100%	164,136	100%

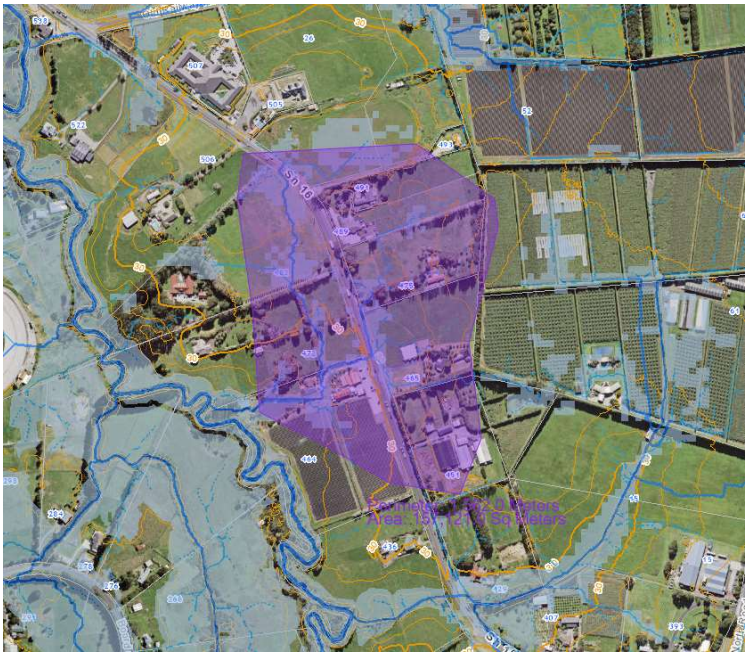


Figure 2: Catchment discharging to Kumeu River through 464 SH16

Peak flow rates and discharge volumes have been assessed for the 2-, 10- and 100-year ARI rainfall event for the MPD scenario. Climate change has also been considered in this assessment using a temperature increase of 3.8°C to reflect Version 3 of Auckland Council's Stormwater Code of Practice (Version 3 will be fully operative from January 2022).

A summary of these results is provided in Table 2 below.

Table 2: SCS Hydrologic Results and rainfall with allowance for 3.8 degrees climate change.

Climate Change Scenario	Event	Rainfall Depth (mm)	Peak Flow (m^3/s)
3.8°C increase (SWCoP V3)	2 year	102	1.95
	10 year	170	3.97
	100 year	252	6.55

3.3 Overland Flow Paths and Flood Plain

The overland flow from the catchment flows through 464 SH16 and discharges into the Kumeu River. Information has been sourced from Auckland Council Geo Maps and the Catchment Management Plan to understand the flood level along Kumeu River at this location. It is important to note, that these flood levels do not reflect the high increase in future climate change in the future, as identified by Version 3 of the SWCoP.

AC Geo Maps indicate the 100year flood plain at the western end of the section to be at approximately RL26.

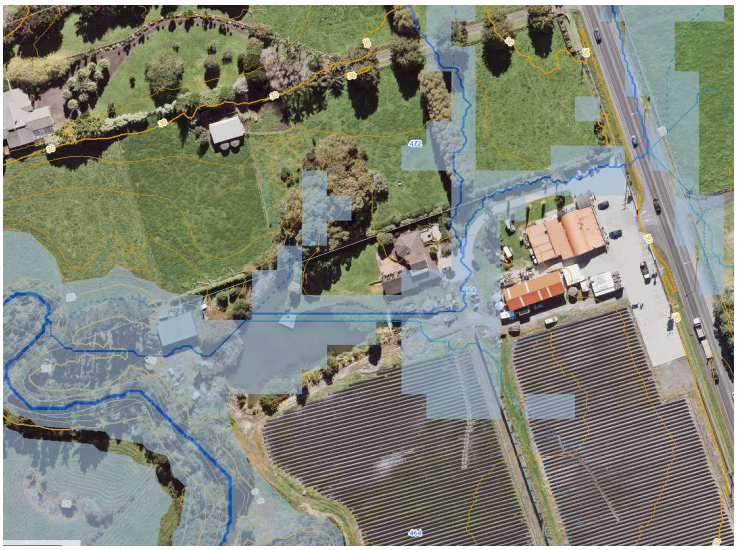


Figure 3: OLFL and Flood Plain

The Kumeu Catchment Management plan have modelled the Kaipara/Kumeu Catchment and at this location the Kumeu River is RL26.1m in the 100 year event and RL25.8m in the 10 year event.

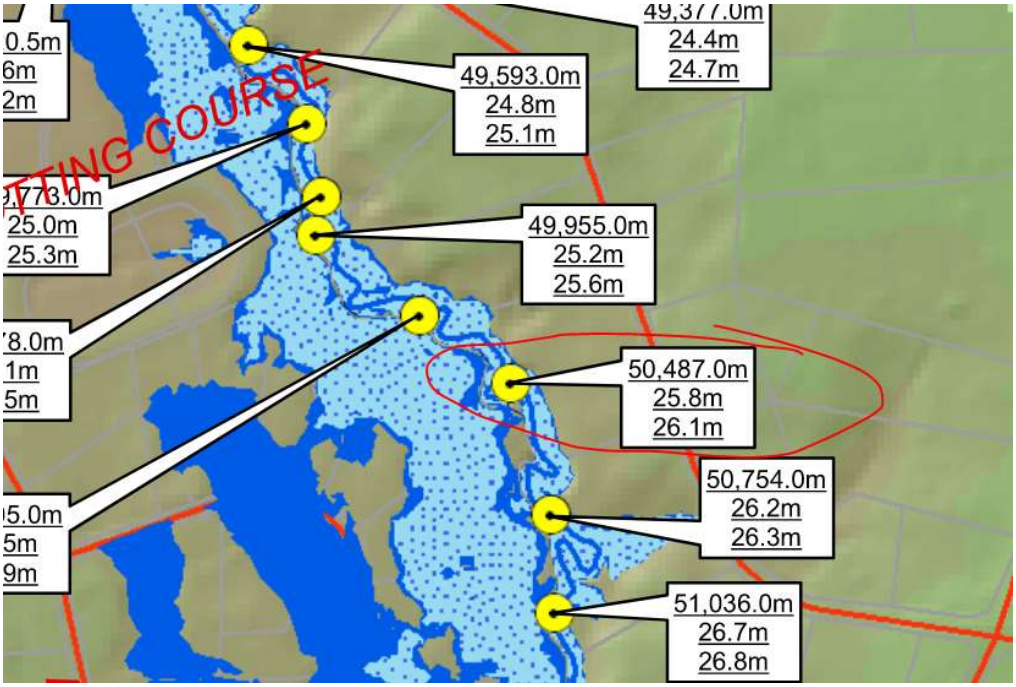


Figure 4: Catchment Management Plan Flood Levels

3.4 Assets on 464 SH16

State Highway 16 is located on the eastern side of property 464 SH16. The stormwater runoff from the road is collected in roadside open channels which flow towards 464 SH16.

3.4.2 Stormwater pipes

There is an existing 450Ø stormwater pipe which conveys water from the eastern side of the road to the west. Stormwater runoff in the open channels on the western side of SH16 discharge into a grated manhole and flow through an existing 450Ø stormwater pipe and discharge to the pond 464 SH16.

Figure 5: Schematic Image showing the existing stormwater on SH16 and at 464 SH16

3.4.3 Stormwater Pond

The existing stormwater pond has been surveyed by Beca in September 2021.

The inlet pipe is a 450Ø stormwater pipe with an IL of RL26.025. The outlet is located in the southwest corner and discharges to Kumeu River. This outlet is a 375Ø with an RL25.495

The length of the main section of the pond is ~67m by 20m wide. There is another inlet pipe located at the northern end of the pond from 472 SH16. This is a 5m long 150Ø pipe with an upstream IL of RL25.959 and downstream IL of RL25.673m.

The top of the pond is typically at RL26.2 and the base is typically RL23.3-24. The side slopes also vary from 1:1.5 to 1:3 around the pond.

The total volume of the pond to RL26.2 is 3,060m^3. The permanent water level (based on the outlet pipe level at RL25.495) is 1,760m^3.

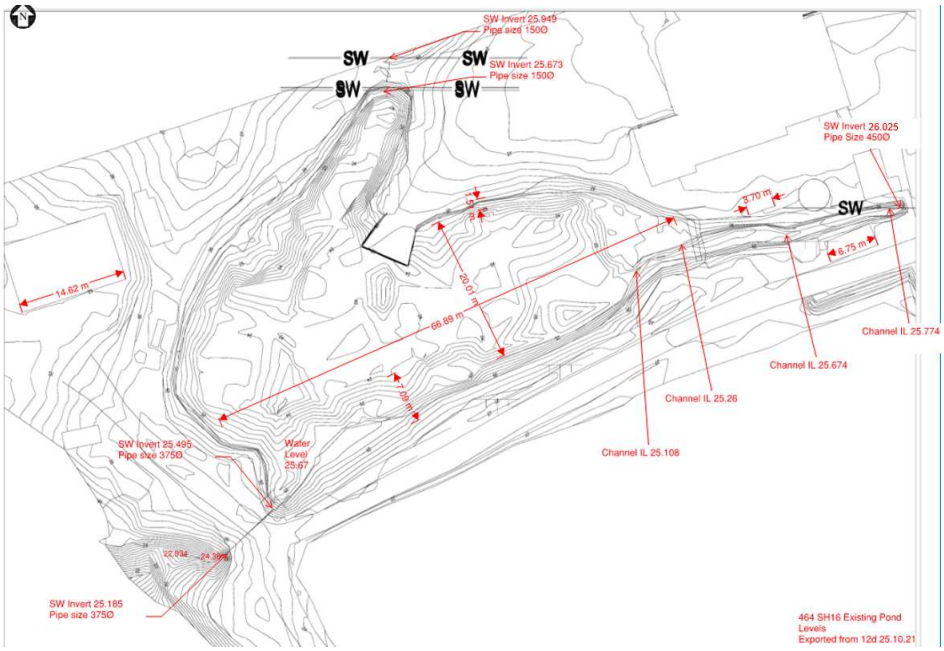


Figure 6: Image showing the survey of the existing pond at 464 SH16

4 Proposed Development

The modifications to SH16 at this location include minor road widening on the eastern side of the road and the addition of the 3m wide shared path on the eastern side of the State Highway. The stormwater runoff from the road will be collected through kerb and channel, catchpits and stormwater pipes. The road will maintain the dual crossfall.

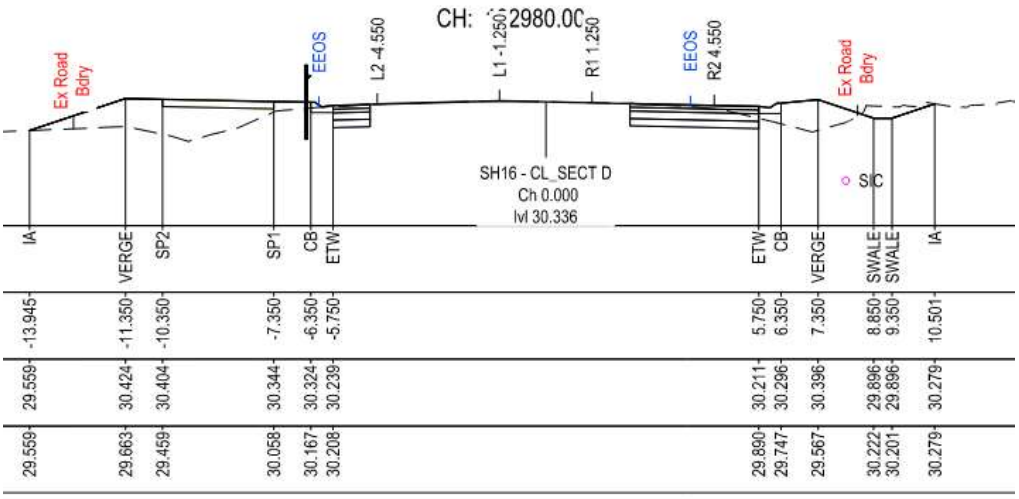


Figure 7: SH16 typical cross section proposed outside 464 SH16 (dashed line is existing ground)

The existing road has no formal stormwater treatment and the runoff is collected through open channel drains. The discharge from this area is to Kumeu River, a stream environment, and therefore hydrology mitigation is required for the additional impervious area

4.1 State Highway 16 Catchment

Below is a summary of the State Highway catchment, reflecting the current impervious area as pre development and the proposed impervious area (road and shared path) for the design. The post development includes an increase in rainfall of 3.8 degrees for Climate Change.

Table 3: Area, Flow and Volume from SH16 catchment to 464 SH216

Scenario	Area Total m^2	Impervious Area m^2	Peak Flow (l/s)		Volume (m^3)	
			10 year	**100 year**	**10 year**	**100 year**
Pre Development	11,553	6,253	0.242	0.377	1168	1818
Post Development [1]	11,533	9,066	0.358	0.543	1762	2690
Increase (decrease (-))	0	2,818	0.115	0.166	594	872

The increase in impervious area created by the SH16 project for the catchment discharging to Kumeu River through 464 SH116 pond is 1.7%.

As this stormwater runoff discharges to a stream environment, hydrology mitigation is required under SMAF1. This is for the additional impervious area. A total retention volume of $14m^3$ and a detention volume of $52m^3$ is required, with a total hydrology mitigation of $66m^3$.

5 Stormwater Design Options

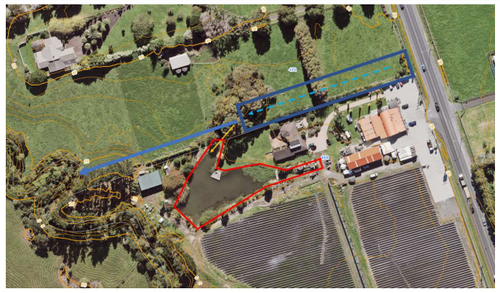
Table 2 below sets out the six options that will be assessed for this localised alternatives assessment process.

The assessment framework is provided separately, as Appendix 1.

Table4: Table summarising the Options to discharge stormwater to Kumeu River at 464 SH16 and 472 SH16

Option	Description	E8 Diversion and Discharge	E9 Stormwater Quality	Hydrology Mitigation	Assets Required	Opportunities/Concerns	Schematic Image
1	Discharge directly to the Pond at 464 SH16	▪ Attenuation provided in the Pond ▪ Increased flood effects on property is less than minor ▪ Increased flood effects on dwelling is less than minor	Stormwater runoff will be treated through the existing pond	Hydrology mitigation is achieved in the pond	▪ New 450Ø Stormwater pipe from SH16 drainage to Existing Pond. ▪ Improvements to existing pond –Pond improvements including: Reshape pond and bathymetry for water quality performance and safety –Upgrade of pond side batters / fencing / removal of sediment –New inlet structure to pond –New outlet structure from pond to Kumeu River ▪ Modify existing stormwater pipe within 464SH16 (keeping the property drainage in the existing pipe)	• Construction works within 464 SH16 • Ownership and maintenance of the new stormwater pipe from SH16 to the pond • Ownership and maintenance of the existing pond • Maintenance access to pond and area to allow sediment to dry • Landowner appears to utilise the water from the pond on site for irrigation • Pond not designed to GD01 design guidelines.	
2	Stormwater treatment (SW360 Filter) then Pond within 464 SH16 then to Kumeu River (preliminary Design)	▪ Attenuation provided in the Pond ▪ Increased flood effects on property is reduced ▪ Increased flood effects on dwelling is reduced	Stormwater runoff will be treated through a SW360 propriety device prior to discharge to the pond.	Hydrology mitigation is achieved in the pond	▪ New SW360 Storm filter Vault under the carpark at 464 SH16 ▪ New 450Ø Stormwater pipe from SW360 to Existing Pond. ▪ Improvements to existing pond –Pond improvements including: Reshape pond and bathymetry for safety –Upgrade of pond side batters / fencing / cleaning –New inlet structure to pond –New outlet structure from pond to Kumeu River ▪ Modify existing stormwater pipe within 464 SH16 (keeping the property drainage in the existing pipe)	▪ Construction works on 464 SH16 ▪ Maintenance of SW360 device within 464 SH16 – 2-3 times per year ▪ Ownership and maintenance of the existing pond ▪ Maintenance access to pond and area to allow sediment to dry ▪ Landowner appears to utilise the water from the pond on site for irrigation ▪ Pond not required for stormwater treatment ▪ Pond not designed to GD01 design guidelines.	
3	Swale to be constructed at 472 SH16 on then discharge via Pond at 464 SH16 then to Kumeu River	▪ Attenuation provided in the Pond ▪ Increased flood effects on property is reduced ▪ Increased flood effects on dwelling is reduced	Stormwater runoff will be treated through a swale	Hydrology mitigation is achieved both within the pond and the swale	▪ New swale along 472 SH16 ▪ New pipe outfall to the pond at 464 SH16 ▪ Improvements to existing pond (if required): –Pond improvements including: Reshape pond and bathymetry for safety –Upgrade of pond side batters / fencing / cleaning –New inlet structure to pond –New outlet structure from pond to Kumeu River ▪ Modify existing stormwater pipe within 464 SH16 (keeping the property drainage in the existing pipe)	▪ Land is required at 472 SH16 ▪ Minor construction works on 464 SH16 ▪ Maintenance access will be required swale ▪ SH16 stormwater runoff discharges to the pond at 464 SH16. ▪ Who has ownership and maintenance responsibility of the existing pond. ▪ Swale will intercept current Overland Flow Path from 472 SH16 to 464 SH16 reducing flow through 464 SH16	

Sensitivity: General

Option	Description	E8 Diversion and Discharge	E9 Stormwater Quality	Hydrology Mitigation	Assets Required	Opportunities/Concerns	Schematic Image
4	Retention swale then Kumeu River via overland flow / open channel at 472 SH16	▪ Attenuation is not provided ▪ Increased flood effects on property is reduced ▪ Increased flood effects on dwelling is reduced	Stormwater runoff will be treated through a swale	Hydrology mitigation is achieved within the swale	▪ Swale can either be planted or grassed (grassed requires a 6m wide swale) for 120m. ▪ Open channel to convey flow from end of swale to Kumeu River. ▪ Maintenance access will be required next to swale. ▪ New outfall to Kumeu River (Rock Rip Rap). ▪ Vegetation removal at 472 SH16.	▪ Stormwater runoff will bypass the pond at 464 SH16 ▪ The Stormwater in the pond at 464 SH16 will be more stagnant with less water entering and water level may drop (due to evaporation, infiltration, and on-site use) ▪ Land is required at 472 SH16 ▪ Construction work required at 472 S16 ▪ Maintenance access will be required swale. ▪ Open channel required to remain operational	
5	Retention swale then Kumeu River Via stormwater pipe at 472 SH16	▪ Attenuation is not provided ▪ Increased flood effects on property is reduced ▪ Increased flood effects on dwelling is reduced	Stormwater runoff will be treated through a swale	Hydrology mitigation is achieved within the swale	▪ Swale can either be planted or grassed (grassed requires a 6m wide swale) for 120m. ▪ Stormwater pipe with scruffy dome to convey stormwater from end of swale to Kumeu River for 10-year event. Large events flow overland. ▪ Maintenance access will be required next to swale. ▪ New outfall to Kumeu River (headwall for stormwater pipe and rock rip-rap). ▪ Vegetation removal at 472 SH16.	▪ Stormwater runoff will bypass the pond at 464 SH16 ▪ The Stormwater in the pond at 464 SH16 will be more stagnant with less water entering and water level may drop (due to evaporation, infiltration, and on-site use) ▪ Land is required at 472 SH16 ▪ Construction work required at 472 SH16 ▪ Maintenance access will be required swale. ▪ Open channel required to remain. ▪ Stormwater assets including underground pipes, manholes with scruffy domes and outfall to be maintained.	
6	Stormwater treatment (SW360 Filter) and discharge to Kumeu River through a stormwater pipe at 472 SH16	▪ Attenuation is not provided ▪ Increased flood effects on property is reduced ▪ Increased flood effects on dwelling is reduced	Stormwater runoff will be treated through a SW360 propriety	No Hydrology Mitigation is required	▪ New SW360 Storm filter Vault at 472 SH16. ▪ Stormwater pipe from SW360 vault to convey stormwater to Kumeu River for 10-year event. Large events flow overland between 464 SH16 and 472 SH16. ▪ Maintenance access will be required for SW360 mainenant and stormwater outfall ▪ New outfall to Kumeu River (headwall for stormwater pipe and rock rip-rap). ▪ Vegetation removal at 472 SH16.	▪ Stormwater runoff will bypass the pond at 464 SH16 ▪ The Stormwater in the pond at 464 SH16 will be more stagnant with less water entering and water level may drop (due to evaporation, infiltration, and on-site use) ▪ Land is required at 472 SH16 ▪ Construction work required at 472 SH16 ▪ Maintenance of SW360 device within 472 SH16 – 2-3 times per year ▪ Stormwater assets including underground pipes, manholes and outfall to be maintained. ▪ Ground surface can be utilised above stormwater pipe. ▪ No Hydrology Mitigation is required which can have adverse effects on Kumeu River	

Appendix K – Localised Stormwater Options Assessment

DP7 Stormwater Design Assessment

An assessment of the stormwater design at 464 and 471 SH16, referred to as 'Discharge Point 7' (DP7) was undertaken. Six different design options were considered in the alternatives assessment these are listed below. The options were assessed against the Do Minimum (baseline) option in accordance with the Waka Kotahi Updated MCA Guidance published in August 2020. The baseline is the current stormwater management situation at this location with no project development in place. Refer to Appendix J for the Indicative plans of each options.

Option 1: Stormwater conveyance through pipes and discharge directly to the pond at 464 SH16.

Option 2: Stormwater treatment through SW360 Filter, before discharging into the pond within 464 SH16 then to Kumeū River

Option 3: Swale to be constructed at 472 SH16 on then discharge via Pond at 464 SH16 then to Kumeū River.

Option 4: Treatment via a retention swale (overland flow / open channel at 472 SH16) before discharging into the Kumeū River via a new outfall required to Kumeū River.

Option 5: Treatment and conveyance of stormwater through a retention swale then a pipe at 474 SH16 Prior to discharging to Kumeū River

Option 6: Stormwater treatment (SW360 Filter) and discharge to Kumeū River through a stormwater pipe at 472 SH16

The table below details the MCA scoring and commentary for the DP7 Stormwater Design shortlisted options assessment, analysis notes and identification of the preferred option.

Criteria	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Commentary
Technical Stormwater Design solution	-2	-2	-1	1	-1	-3	*The extent to which the option will achieve conveyance, water quality treatment, retention/detention and manage flooding hazards:* Option 1: Stormwater conveyance and pipes within private property. Significant improvements required to existing pond for water quality and safety. Utilise existing outfall to Kumeu River. Option 2: As per option 1, treatment of stormwater through SW360 device is beneficial prior to utilising pond. Pond would still be utilised for attenuation and existing outfall to Kumeu River maintained. Significant improvements required to existing pond. Option 3: As per option 1, treatment of stormwater through swale device (natural system) prior to utilising pond. Pond would still be utilised for attenuation and existing outfall to Kumeu River maintained. Significant improvements required to existing pond. Option 4: Treatment and conveyance of stormwater through swale device (natural system) prior to new outfall required to Kumeu River. Intercepts and reduces overland flow path from extending onto 464 SH16. No pipes required and no flow into existing pond.

Sensitivity: General

Criteria	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Commentary
							Option 5: Treatment and conveyance of stormwater through swale device (natural system) prior to new outfall required to Kumeu River. Intercepts and reduces overland flow path from extending onto 464 SH16. No flow into existing pond. Option 6: Treatment of stormwater through SW360 device and pipe network. Physical assets to be maintained and no hydrology mitigation or attenuation provided. No flow into existing pond.
Constructability	-2	-2	-2	0	-1	-2	*The degree of design and construction complexity:* No options warrant discounting from a constructability perspective. Comparative assessment provided. Option 1: Modification of the pond to comply with design and safety requirements will involve significant works on private property. Potential for contaminated sediment within existing pond. Installation of pipes within 464 SH16 property will require temporary works to private carpark/access area and works adjacent to existing buildings/foundations. Option 2: As per option 1 pond works including provision of SW360 device requiring further temporary works to private carpark/access area. Option 3: As per option 1 pond works but generally excluding any works to the private carpark/access area and works adjacent to existing buildings/foundations. Construction of swale in relatively open area (472 SH16) and pipe outlet to pond. Option 4: Construction of swale in relatively open area (472 SH16) and open channel to Kumeu river with riprap outlet. Simple construction with minor difficulty. Potential for reduced vegetation clearance when compared to piped options. Option 5: As per option 4 with the additional of a piped outlet and headwall for Q10 event. Includes overland flow path to Kumeu river. Option 6: Provision of SW360 device (vault) within open private property construction of a piped outlet and headwall for Q10 event with overland flow path to Kumeu river.
Cost	-1	-2	-1	0	-1	-2	*The degree of cost / affordability of the option (i.e. stormwater assets):* All cost more than 'do nothing'. Comparative assessment provided. Option 1-3 includes modification of the pond to comply with design and safety requirements. This will involve reasonable costs including the potential for contaminated sediment within existing pond. Option 4 has a cost, yet wanted to differentiate from other options (this is the lowest cost option). Likely additional cost to make good carpark and access areas for options 1 & 2. The inclusion of propriety stormwater treatment devices increases cost significantly for option 2 and 6. Generally, installation of pipe reticulation with associated headwalls will be more expensive than construction of a swale and open channel with riprap energy dissipation.

Sensitivity: General

Criteria	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Commentary
Property effects	-2	-2	-2	-1	-1	-1	*The degree of complexity or level of risk associated with formal legal access for the construction, operation and maintenance of the stormwater management system, including potential impact on business operations:* Waka Kotahi Property team's starting position is to always own the land containing our stormwater assets. Yet there is an opportunity to have a negotiated outcome with specific landowners. Option 1: Scored moderately negative as more land required for the pond footprint. Although Option 2 is scored the same, Option 1 is a slightly less adverse option for reasons given under Option 2. Option 2: Scored moderately negative as more land required for the pond footprint. It is a slightly more negative option than Option 1 because of the stormwater vault under the carpark at 464 SH16 but doesn't warrant a score of -3 as it assumes an easement for vault footprint (which is located in carpark area) to provide for future access rights for maintenance of vault rather than a land requirement. Option 3: Scored moderate negative as more land area required (includes pond). Option 4: Scored slight negative as smaller land area required. Option 5: Scored slight negative as smaller land area required. Option 6: Scored slight negative as smaller land area required. Stormwater vault makes this a slightly more adverse option that 4 & 5 but does not warrant a score of -2 as it assumes an easement for the vault footprint rather than a land requirement.
Ecological effects	0	0	0	-1	-1	-1	*The extent of options impact on riparian vegetation and streams:* Option 1, 2, 3, do not require the installation of a discharge directly into stream, minimal to no works within riparian vegetation margins. Conversely Option 4, 5, 6 require the installation of the discharge directly into the stream and thus present minimal degradation of the stream. It is assumed that the discharge outfall will be designed to meet PA standards with the AUP. Slight negative effects could be mitigated however.
Contamination Environmental effects	0	2	2	1	1	1	*The potential of the option to avoid or manage public health effects on construction workers, landowners, nearby residents' and the community from contaminants in stormwater runoff, contaminated soils or groundwater:* Environmental scores based on long term treatment from proposed options giving the ability to better treat discharges derived from transport corridor = better outcome than existing situation (base case).

Sensitivity: General

Criteria	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Commentary
							Options 2 and 3 are scored slightly higher than the remaining options on the basis of new treatment devices being installed in conjunction with the treatment provided by the existing pond, as opposed to Options 4, 5 and 6 which bypass the pond. Workshop discussion: All options have different 'treatment' method. Where options include a swale/proprietary device, the pond is not required for treatment yet may be used for retention/detention. Contaminants will build up in pond and swale over time, and would need to be monitored/managed. **Workshop participants felt this assessment overlapped with WQT considerations assessed under the Technical Stormwater Design solution criteria, so the score was greyed out and removed from option aggregate scores, to avoid risk of double-counting. Comments retained for information.**
Contamination Human Health effects	-1	-1	-1	-1	-1	-1	Human Health score all consistent with each option on the basis of the proposed works involving excavation within a HAIL than can be managed via implementation of the CSMP. Difference in volume of excavation does not present an increased human health risk, but will increase the Contractor's risk associated with potential contaminated soil disposal offsite (if required).
Operations and Maintenance effects	-1	-1	-1	-1	-1	-1	*The degree of complexity or level of risk associated with safe access for the purposes of operation and maintenance of the stormwater management system:* Key issue with all options is access to clear, clean and remove any build up. Current Waka Kotahi maintenance requirements, unless specifically detailed, involve highway maintenance only to edge of road reserve. The ongoing record of ownership and maintenance responsibilities when handed over to the Network Operations Contract (NOC) needs to be clear for all options. These drainage situations are funded in maintenance as separate special locations requiring a special plan detailing what is to be maintained. Workshop discussion: All options will require ongoing monitoring/maintenance.
Cultural effects	0	1	1	2	0	-1	*Potential impact of the option on Waahi Tohu, Maori Archaeology, Whenua, Hau Takiwa, Moana, Wai Maaori, Rerenga Rauropi:* **Criteria comment: particular focus on wai māori – noting mauri of water and tikanga of need to rejuvenate mauri of water from contaminants through filtration through Papatūānuku (ground-based/'natural' mechanisms). Also noting preference for 'treatment-train' approaches, and that stormwater design standards do not include tikanga as they are currently designed. Finally, although focus is on mauri of waterways, if the pondwater is used for growing kai that could introduce contaminants into the foodchain.** Option 1: Piped discharge to pond then stream provides a single level of in-ground treatment via pond. However potential for contaminants into foodchain.

Sensitivity: General

Criteria	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Commentary
							Option 2: Proprietary device prior to pond then stream provides two levels of treatment (one in-ground). However potential for contaminants into foodchain. Option 3: Swale prior to pond then stream provides two levels of in-ground treatment. However potential for contaminants into foodchain. Option 4: Swale then overland flow to stream provides two levels of in-ground treatment – preferred option. Option 5: Swale then piped to awa. While one level of in-ground treatment, direct pipe to awa not considered tika. Option 6: Proprietary device and piped straight to the stream, least favoured because it does not interact strongly with Papatūānuku
Stakeholder Views	*Non-scored criteria*						*Consideration of stakeholder feedback on the option (if applicable):* • The project team met with the landowner at 464 SH16 in May 2021. From that meeting they indicated they are aware that stormwater discharges into the pipe. The indicated their support of the existing situation as they use the pond for irrigation. • It is anticipated from early engagement with the 464 SH16 landowner that the business operator would want to retain ownership and management of the stormwater pond. • It is possible the landowner won't be supportive of options 4-6 given the benefit the pond serves them for irrigation purposes. • There have been no recorded interactions with 472 SH16. • Considerations from AC Healthy Waters as a key stakeholder covered in 'Technical Stormwater Design Solution'.
Consentability	*Non-scored criteria*						*The degree of complexity or level of risk associated with the Notice of Requirement to alter the existing designation and stormwater consenting:* All options need some form of land requirement to include the stormwater mitigation within the state highway designation, yet the Property effects are not as large for Options 3, 4, 5 (which scored slight adverse property impacts). Option 4 appears to score best (slight positive impact) from a Technical Stormwater Design solution perspective, and scores best overall within the MCA. The slight adverse ecological effects and slight adverse contamination human health effects can be appropriately mitigated.

Sensitivity: General

CRITERIA	OPTION 1	Option 2	OPTION 3	OPTION 4	OPTION 5	OPTION 6	COMMENTARY
Workshop Decision (Preferred Option): ✓				✓			**Option Selection Rationale:** Option 6 was discounted due to the significant adverse effects from Technical Stormwater Design solution perspective, as it is not able to provide the hydrology mitigation requirements, which may cause downstream scour and flooding issues and would be a consenting risk (AUP SMAF 1 hydrological mitigation requirements not met) and doesn't achieve green infrastructure (nature-based solution), and cultural expert advised pipe to awa was not preferred. Options 1 & 2 do not score as well as Options 3-5. Option 4 was identified as the preferred option as it scored the best overall within the MCA and was supported by Design Manger/cultural expert/PM/WK Environmental Specialist/Ecologist/ Planners because Option 4: • scored best (slight positive impact) from a Technical Stormwater Design solution perspective • scored best (neutral) from a Constructability and Cost perspective • scored the same as Options 5 & 6 (slight negative impact) from a Property perspective due to the land area required, yet this would be mitigated via the Public Works Act process. • has a slight adverse ecological effect and slight adverse contamination human health effects, which are temporary (during construction/installation) and these effects (riparian vegetation removal and contaminated soil risks to construction workers) can be appropriately mitigated via riparian replanting and implementation of a contaminated soils management plan during construction activities. • Scored the same as all other options from an ongoing operational / maintenance perspective – no differentiation. • Scored the best from a cultural perspective, noting mauri of water and tikanga of need to rejuvenate mauri of water from contaminants through filtration through Papatūānuku (ground-based/'natural' mechanisms) is preferred. • provides certainty of environmental outcomes via Waka Kotahi control of the new green infrastructure (being a swale and overland flow path to the discharge point at the Kumeū River). • eliminates potential issue of the landowner at 464 SH16 desiring continued ownership and access to the existing stormwater pond for the strawberry farm operation.

Stormwater design MCA assessment notes

The assessment discusses a number of stormwater design assumptions. If an option involving the stormwater pond is chosen, improvement upgrades are required to the pond to ensure appropriate treatment of stormwater. These improvements include reshaping the pond and bathymetry for water quality performance and safety, upgrading the pond side batters and fencing, removing sediment, and a new inlet and outlet structure to the pond.

Early engagement with the landowner of 464 SH16 indicates that the business operator would want to retain ownership and management of the stormwater pond. However, Waka Kotahi need to secure an easement or pursue land requirements for legal access rights to maintain the stormwater management system and have ongoing liability for it. The landowner cannot maintain full access as the stormwater device will form part of the stormwater consents and the consents cannot rely on third party assets without some form of Waka Kotahi oversight as the consent holder.

The MCA table shows that all options have slightly negative scoring against Contamination Human Health effects and Operations and Maintenance effects. For Contamination Human Health effects, the score cannot be differentiated because each option involves excavations within a HAIL site. Various sites are marked as HAIL along the SH16 alignment due to current or previous horticultural use. The effects of this are scored slightly negative as opposed to significant negative as the effects can be managed through a Contaminated Soil Management Plan. The difference in the volume of excavation does not present an increased human health risk, but will increase the Contractor's risk associated with potentially contaminated soil disposal offsite (if required).

All options scored -1 against Operations and Maintenance because they will all require ongoing monitoring and maintenance. Each option would also require ongoing record of ownership and maintenance responsibilities when handed over to the Network Operations Contract, thus each option has the same effects with a new asset to maintain.

In relation to the assessment against Cultural Effects, there was a particular focus on wai māori, noting mauri of water and tikanga of need to rejuvenate mauri of water from contaminants through filtration through Papatūānuku (ground-based/'natural' mechanisms). Also noting there was a preference for 'treatment-train' approaches and that stormwater design standards do not include tikanga as they are currently designed.

Option 1

In regards to the Technical Stormwater Design solution, Option 1 received a -2 score due to the significant improvements required to the existing pond to improve water quality and safety. For the same reasons, Option 1 scored negatively against Constructability. Option 1 received a -1 score for contamination as there is an increased risk of potentially contaminated sediment entering the pond during construction. Additionally, the installation of the required pipes within 464 SH16 will require temporary works to private car parking, access area and works adjacent to existing buildings.

Options 1-3 all scored negatively against Property Effects as they all require more land for the acquisition or easement of the pond footprint.

The assessment against the Cultural Effects scored neutral for Option 1, as the piped discharge to the pond then the stream provides a single level of in-ground treatment via the pond, which has positive effects. However, there is a potential for contaminants (from the pond) to be used on crops which counteracts the slightly positive design down to a neutral score.

Option 2

Option 2 scored moderately negative against most criteria. All options that propose to utilise the stormwater pond scored negatively against Technical Stormwater Design solution, Constructability, Cost and Property Effects due to the significant upgrades required to the pond, the temporary works required for the car park and accessway and the acquisition of the pond footprint.

Although Option 1 and 2 are scored the same against Property Effects, Option 2 is slightly more negative than Option 1 because of the proposed use of the stormwater vault under the carpark at 464 SH16. However, the effects are not adverse enough to warrant a score of -3. It is assumed an easement would be applied to the vault footprint (in carpark area) to provide for future access rights for maintenance.

Option 2 scored a slight positive against the Cultural Effects. The proprietary device channelling runoff prior to the pond then the stream provides two levels of treatment (one in-ground treatment).

Option 3

Option 3 has less adverse scores compared to Options 1 and 2 for the Technical Stormwater Design solution. The treatment of stormwater through the retention swale before utilising the pond provided two treatment levels and reduced hard infrastructure. The double treatment resulted in a slightly positive score against the Cultural criteria. The reduction in hard infrastructure influenced the less adverse score against Cost compared to Options 1 and 2.

Option 4

On average, Option 4 scored the highest. It was the only option with a positive score for Technical Stormwater Design solution. The treatment and conveyance of stormwater through a retention swale channel prior to a new outfall at Kumeū River will avoid the use of the stormwater pond (and stormwater pond upgrades) and allow for inground treatment. This option will reduce the overland flow path from extending onto 464 SH16. No hard infrastructure is required and thus had a neutral score against Constructability and Cost. Option 4 and 5 have the least Property Effects as only a small area would be needed for the swale.

It was also noted that Option 4, 5 and 6 discharge directly into the stream (as opposed to option 1, 2 and 3) and thus present minimal degradation of the stream resulting in a negative score against ecology. However, it is assumed that the discharge outfall for Option 4 will be designed to meet permitted activity standards of the Auckland Unitary Plan – Operative in Part. Any negative ecological effects can be mitigated through design.

It is noted that the landowner at 464 SH16 uses the stormwater pond for irrigation.

Option 5

Option 5 is similar to Option 4 but involves a swale then a pipe directly into the stream. Therefore, the use of hard infrastructure results in slightly more negative scores compared to Option 4. Option 5 has slightly negative scores in all criteria except Cultural effects which is scored neutral as a pipe discharge to stream is not considered tika.

Option 6

Option 6 received the most negative scores out of all options. This option involves the treatment of stormwater through a SW360 vault and pipe network. The physical assets would need to be maintained and no hydrology mitigation is incorporated into the design. No attenuation treatment is provided through the stormwater pond either. Option 6 was discounted due to the significant adverse

effects from Technical Stormwater Design solution perspective, as it is not able to provide the hydrology mitigation requirements, which may cause downstream scour and flooding issues. This was also a consenting risk, as the AUP SMAF 1 hydrological mitigation requirements are not met and do not achieve green infrastructure.

L

Appendix L – Noise Mitigation BPO Options Map

dB $L_{Aeq(24h)}$

	<=	64 Category A
64 <	<=	67 Category B
67 <		Category C

East 3
East 2
East 1
West 4
West 3
West 2
West 1
East 6
East 4
East 5
West 6
West 5
East 10
East 9
East 8
East 7
West 7
West 8

M

Appendix M – Noise Mitigation BPO Assessment

SH16 Stage 2 Project - Noise Mitigation BPO Assessment

Assessment Areas

Area	Area name	Noise mitigation option #	Noise Mitigation description
E1	East 1	1	2m barrier
		2	PA10 30mm
		3	PA10 30mm and 2m barriers
		4	2m barrier continuous between SH16 and slip lane
Area	**Area name**	**Noise mitigation option #**	**Noise Mitigation description**
E3	East 3	1	2m barrier
		2	2.5m barrier
		3	PA10 30mm and 2/2.5m barriers
Area	**Area name**	**Noise mitigation option #**	**Noise Mitigation description**
E4	East 4	1	2m barrier
		2	PA10 30mm
		3	PA10 30mm and 2m barrier
Area	**Area Name**	**Noise mitigation Option #**	**Noise Mitigation description**
E7	East 7	1	2m barrier
Area	**Area name**	**Noise mitigation option #**	**Noise Mitigation description**
E8	East 8	1	2m barrier
		2	PA10 30mm
		3	PA10 30mm and 2m barrier
Area	**Area name**	**Noise mitigation option #**	**Noise Mitigation description**
E9	East 9	1	2m barrier
Area	**Area name**	**Noise mitigation option #**	**Noise Mitigation description**
W1	West 1	1	2m barrier
		2	PA10 30mm
		3	PA10 30mm and 2m barrier
Area	**Area name**	**Noise mitigation option #**	**Noise Mitigation description**
W3	West 3	1	2m barrier
		2	2.5m barrier
		3	PA10 30mm and 2m barrier
Area	**Area name**	**Noise mitigation option #**	**Noise Mitigation description**
W4	West 4	1	**2m barrier**
Area	**Area name**	**Noise mitigation option #**	**Noise Mitigation description**
W5	West 5	1	2m barrier
Area	**Area name**	**Noise mitigation option #**	**Noise Mitigation description**
W6	West 6	1	PA10 30mm

Area	Area name	Noise mitigation option #	Noise Mitigation description
W7	West 7	1	2m barrier

Project Team Assessors List

Discipline	Assessor Name
Acoustics	Siiri Wilkening, MDA
Heritage	John Brown, Plan.Heritage
Property	Don Harrington, Waka Kotahi
Ops/Maintenance	Glenn Flockhart, Fulton Hogan (WK NOC)
Roading	Gareth Clayton and Stan Lee, Beca
Urban design	Emily Cambridge, Beca
Visual and landscape	Emily Cambridge, Beca
Consenting	Ashlie Carlyle, Beca Tessa Robins, Waka Kotahi

AREA E1: NZS 6806 - Assessment matrix

Assessment criteria	Discipline	Issues / Risks	**Option 1** - 2m barrier	**Option 2** - PA10 30mm	**Option 3** - PA10 and 2m barriers	**Option 4** - 2m barrier continuous between SH16 and new slip lane
Value for money, including maintenance costs and consideration of benefit cost analysis	Acoustics	Using PA10 30mm may not be feasible. Fences have to allow driveway access	+ + +	+ + +	+ + +	+++
			BCR 4.11	BCR 4.37	BCR 5.37	BCR 8.02
Compliance with NZS 6806 noise criteria	Acoustics		– –	– –	+	+
			2x Cat B, 1x Cat C	3x Cat B, 1x Cat C	only 2x Cat B, rest Cat A	Only 1x Cat B, rest Cat A
Achievement of the NZS 6806 structural mitigation performance standards	Acoustics	cluster includes road surface (minor improvement) and fences for a few PPFs	–	– –	–	+
			1.9 dB	1.3 dB	2.2 dB	4 dB
Requirement for building-modification measures	Acoustics	ventilation and seals, potentially glazing	–	–	+	++
			1 Cat C	1 Cat C	no Cat C	no Cat C
Effect of changes to the do-nothing noise environment	Acoustics	reduction compared with Do nothing across the board	o	o	+	+
			average 1 dB reduction (highest –3dB)	average 1 dB reduction (highest –1.4 dB)	average 2 dB reduction (highest –3 dB)	average 2 dB reduction (highest –6 dB)
Potential effects on known heritage or cultural values	Heritage	historical commercial site identified at corner junction (CHI ref 3713) - unaffected by noise control requirements. No impact	o	o	o	o
Availability of sufficient land for construction and maintenance and the extent to which NZTA would need to acquire land, or interests in land	Property		–	o	–	–
			Likely requires land. If not, then neutral score.		Likely requires land. If not, then neutral score.	Likely requires land. If not, then neutral score.
Practicality of the noise mitigation in terms of operations and maintenance requirements	Ops/Maintenance	The only maintenance on noise barriers is really accident damage if someone hits one. In terms of longevity, these PA (commonly called OGPA) have a life of 6-7 years when installed onto an existing pavement like this with the projected traffic volumes. As a pourus asphalt with voids these fill up with detritus and road film so their performance at end of life may not be as good as the initial years as sound/tyre noise aren't absorbed into it. I expect some pavement maintenance to occur in 4-5 years which require a patch in road underneath of a "broken" section and replacement of the OGPA. OGPA general sits on top of the existing road surface as it allows rain to be collected within the asphalt mat and pushed out of the edges of it. The result is a 30mm lip on edge of lane.	o	o	o	o
Constructability/technical feasibility	Roading		o	– –	– –	-

Assessment criteria	Discipline	Issues / Risks	Option 1 - 2m barrier	Option 2 - PA10 30mm	Option 3 - PA10 and 2m barriers	Option 4 - 2m barrier continuous between SH16 and new slip lane
			no surface mitigation	PA10 surfacing in this area with horizontal radiis of 400m is likely to result in short surfacing life requiring frequent resurfacing. Also, change in final road surfacing from SMA at the Brigham Creek Roundabout to PA10 in this area and then SMA after Kennedy Road, over relatively short lengths are not practical and would result in high road surface roughness.	PA10 surfacing in this area with horizontal radiis of 400m is likely to result in short surfacing life requiring frequent resurfacing. Also, change in final road surfacing from SMA at the Brigham Creek Roundabout to PA10 in this area and then SMA after Kennedy Road, over relatively short lengths are not practical and would result in high road surface roughness.	no surface mitigation Not enough availability of width for the geometry of the slip lane to be feasible – would require larger permanent land requirement.
Compliance with relevant safety standards and guidelines	Roading		o	–	–	o
			no surface mitigation	PA10 asphalt surfacing in this area (with current surfacing as SMA) will result in a vertical lip (drop off) over concrete channel. This is considered a safety hazard for on-road cyclist.	PA10 asphalt surfacing in this area (with current surfacing as SMA) will result in a vertical lip (drop off) over concrete channel. This is considered a safety hazard for on-road cyclist.	no surface mitigation. Requirement for additional safety barrier in front of the noise wall.
Public safety and security	Roading		o	o	o	o
			no surface mitigation	neutral between PA10 and SMA surfacing	neutral between PA10 and SMA surfacing	no surface mitigation
Consistency with NZ urban design protocol	Urban design	Slight impact due to hard edges forming barriers and connections to the road corridor. Minor character change in an already modified and low quality road environment	–	o	-	-
			slight minor impact	Neutral change	slight minor impact	slight minor impact
Utilisation of materials that reflect the character of the location	Urban design	Timber is softer choice of material, however, will still create a hard boundary in comparison to the existing situation	–	o	–	–
			slight minor impact	Neutral change	slight minor impact	slight minor impact
The extent to which the mitigation option promotes integration and establishes visual coherence and continuity in form, scale and appearance of structures and landscape proposals along the route	Visual and landscape	Location of noise walls in proximity to road and in place of existing vegetation is an issue Limited space reduces opportunities for other noise mitigation options (ie bund)	–	o	–	–
			2m barriers: 2m timber barrier aligns with height of an existing fence along the boundary of 171. Vegetation loss will disrupt the existing tree lined boundary of the corridor	No visual change	PA10 30mm and 2m barriers: As per Option 1	As per option 1
	Visual and landscape		–	o	–	–

Assessment criteria	Discipline	Issues / Risks	Option 1 - 2m barrier	Option 2 - PA10 30mm	Option 3 - PA10 and 2m barriers	Option 4 - 2m barrier continuous between SH16 and new slip lane
Road users' views to the surrounding landscape and key features/ locations in particular		The existing rural character and tree lined boundary in this location will be changed if replaced by timber noise walls. This will create a new hard edge to the corridor	Vegetation loss will disrupt the existing tree lined boundary of the corridor	No visual change	PA10 30mm and 2m barriers: As per Option 1	As per Option 1. Slightly greater impact with greater extent of fence
Maintenance or enhancement of visual amenity for surrounding residents	Visual and landscape	Removal of existing vegetation will result in reduced amenity for residents	– –	o	– –	– –
			Loss of visual amenity for residents if vegetation is removed	No visual change	PA10 30mm and 2m barriers: As per Option 1	As per Option 1
	Workshop Comments		The noise model is based on the existing speed of 80km/hr. However, a signalised raised table for pedestrians is being considered near the Brigham Creek Roundabout. A raised table would reduce the speed in this area and therefore the noise. There will still be noise associated with the acceleration of vehicles away from the raised table. Option1: Is the preferred option as the road surface cannot be changed due to limited skid resistance with PA10. We need to consider the form of the barriers - timber or durable concrete. Timber fits the aesthetic of the residential area, however concrete can be mitigated with planting. Timber is preferred. Emily – we need to form some kind of consistency in the barrier designs (with potential exception to the one outside of the winery). Option 2: installing PA10 on a road curve will not comply with skid resistance standard. PA10 is not recommended near roundabouts. SC suggested considering slowing cars down for pedestrians before the row of houses with visual cues. Andria said a speed review has been completed and concluded that there shall be no change to the speed. Please note that these notes are for Cluster 1 next to Brigham Creek Roundabout on the east side of the road.	
	Workshop Actions		Siiri to design a new option with a service lane, which would need more land in this area. Potentially need 5-6 meters for a service lane. There is an area for a bus to pull over outside 171 to 181 SH16. Would need to take into account SGA work on long terms plans for Brigham Creek Roundabout and Kennedys Road.			
	Project team recommended option		The recommended option is: Option 1 – 2m barrier, as the road surface cannot be changed due to limited skid resistance with PA10 and the slip lane option would require more land and additional safety barriers in front of the noise barrier.			

AREA E3: NZS 6806 - Assessment matrix

Assessment criteria	Discipline	Issues / Risks	Option 1 - 2m barrier	Option 2 - 2.5m barrier, over shorter length	Option 3 - PA10 30mm and 2/2.5m barriers
Value for money, including maintenance costs and consideration of benefit cost analysis	Acoustics	Using PA10 30mm may not be feasible. Fences have to allow driveway access	+ + +	o	+ +
			BCR 1.79	BCR 0.9	BCR 1.34
Compliance with NZS 6806 noise criteria	Acoustics		– – –	– – –	+
			No Cat A	No Cat A	1x Cat A, 1x Cat B
Achievement of the NZS 6806 structural mitigation performance standards	Acoustics	cluster includes road surface (minor improvement) and fences for both PPFs	o	– –	+ + +
			2.9 dB (up to	1.3 dB	5.1 dB
Requirement for building-modification measures	Acoustics	ventilation and seals, potentially glazing	–	–	+
			1 Cat C	1 Cat C	no Cat C
Effect of changes to the do-nothing noise environment	Acoustics	reduction compared with Do nothing for MO 1 and 3	o	o	+ +
			average 1 dB reduction (highest –2 dB)	No change	average 3 dB reduction (highest –3.4 dB)
Potential effects on known heritage or cultural values	Heritage	none identified	o	o	o
Availability of sufficient land for construction and maintenance and the extent to which NZTA would need to acquire land, or interests in land	Property		–	–	–
			Likely requires land. If not, then neutral score.	Likely requires land. If not, then neutral score.	Likely requires land. If not, then neutral score.
Practicality of the noise mitigation in terms of operations and maintenance requirements	Ops/Maintenance	Same comment as under E1 above.	o	o	o
Constructability/technical feasibility	Roading		o	o	– –
			no surface mitigation	no surface mitigation	PA10 surfacing is an acceptable solution between CH191190 to CH191440. Note that property no. 291 is approximately between CH191130-191190. If PA10 surfacing is specified in CH191130-191190 with longitudinal gradient of approximately 5%, it will result in short surfacing life requiring frequent resurfacing. This does not comply with Waka Kotahi pavement design standards. Also, change in final road surfacing between SMA and PA10 over relatively short lengths is not recommend as it would result in high road surface roughness.
	Roading		o	o	–

Assessment criteria	Discipline	Issues / Risks	Option 1 - 2m barrier	Option 2 - 2.5m barrier, over shorter length	Option 3 - PA10 30mm and 2/2.5m barriers
Compliance with relevant safety standards and guidelines			no surface mitigation	no surface mitigation	PA10 asphalt surfacing in this area (with current surfacing as SMA) will result in a vertical lip (drop off) over concrete channel. This is considered a safety hazard for on-road cyclist.
Public safety and security	Roading		o	o	o
			no surface mitigation	no surface mitigation	neutral between PA10 and SMA surfacing
Consistancy with NZ urban design protocol	Urban design	As per East 1	–	–	–
Utilisation of materials that reflect the character of the location	Urban design	As per East 1	–	–	–
The extent to which the mitigation option promotes integration and establishes visual coherence and continuity in form, scale and appearance of structures and landscape proposals along the route	Visual and landscape	Existing post and wire fence is distinctive of the existing rural environment. Noise walls will take away from the open rural view in this location	–	–	–
			2m barriers	2.5m barriers	PA10 30mm and 2/2.5m barriers
Road users' views to the surrounding landscape and key features/ locations in particular	Visual and landscape	New fence will have small impact on the rural outlook	–	–	–
Maintenance or enhancement of visual amenity for surrounding residents	Visual and landscape		–	–	–
			Existing low quality views from the dwellings reduce the impact for residential properties	as per option 1	as per option 1
	Workshop Comments		Option 1 and 2: Barriers can be installed; however, there are very reluctant landowners. We may need to offer ventilation. Engagement with landowner may determine BPO at this location. Option 3: We are on a slight uphill gradient. PA10 can be installed from the house to 200m north, the rest needs to be SMA. However there is a risk with the surface joint sections. There is also a risk that the future maintenance team will change it back to SMA in the future as a result of potentially lost information.		
	Project team recommended option		The recommended option is: Option 1 - 2m barrier, as Option 3 (with PA10 surfacing) was not an acceptable solution for short lengths and Option 1 achieved a better noise reduction than Option 2.		

AREA E4: NZS 6806 - Assessment matrix

Assessment criteria	Discipline	Issues / Risks	Option 1 - 2m barrier	Option 2 - PA10 30mm	Option 3 - PA10 30mm and 2m barrier
Value for money, including maintenance costs and consideration of benefit cost analysis	Acoustics	Using PA10 30mm may not be feasible. Fences have to allow driveway access	+ + +	+ + +	+ + +
			BCR 2.35	BCR 1.89	BCR 2.34
Compliance with NZS 6806 noise criteria	Acoustics		+	+	+
			3x Cat A, 2x Cat B	3x Cat A, 2x Cat B	3x Cat A, 2x Cat B
Achievement of the NZS 6806 structural mitigation performance standards	Acoustics	cluster includes road surface (minor improvement) and fences for both PPFs	– –	– –	–
			1.1 dB (up to 2.4 dB for 315 SH16)	0.9 dB (up to 1.2 dB for 315 SH16)	1.7 dB (up to 3.1 dB for 315 SH16)
Requirement for building-modification measures	Acoustics		+ +	+ +	+ +
			no Cat C	no Cat C	no Cat C
Effect of changes to the do-nothing noise environment	Acoustics	Generally, reductions and increases even out	o	o	o
			average no change (highest –0.4 dB)	average no change (highest –0.8 dB)	average 1 dB reduction (highest –1.6 dB)
Potential effects on known heritage or cultural values	Heritage	none identified	o	o	o
Availability of sufficient land for construction and maintenance and the extent to which NZTA would need to acquire land, or interests in land	Property		–	o	–
			Likely requires land. If not, then neutral score.	No land required.	Likely requires land. If not, then neutral score.
Practicality of the noise mitigation in terms of operations and maintenance requirements	Ops/Maintenance	Same comment as under E1 above.	o	o	o
Constructability/technical feasibility	Roading		o	– –	– –
			no surface mitigation	The use of PA10 (within 60m from roundabout) does not comply with Waka Kotahi pavement design standards. PA10 in high stress areas will result in very short surfacing life requiring frequent resurfacing and would also carry high risk of pavement/surfacing failure.	The use of PA10 (within 60m from roundabout) does not comply with Waka Kotahi pavement design standards. PA10 in high stress areas will result in very short surfacing life requiring frequent resurfacing and would also carry high risk of pavement/surfacing failure.
Compliance with relevant safety standards and guidelines	Roading		o	–	–
			no surface mitigation	PA10 surfacing in bus bay area (CH191410-191450), will result in asphalt lip (vertical drop) over concrete channel. This is considered a trip hazard.	PA10 surfacing in bus bay area (CH191410-191450), will result in asphalt lip (vertical drop) over concrete channel. This is considered a trip hazard.
Public safety and security	Roading		o	o	o
			no surface mitigation	neutral between PA10 and SMA surfacing	neutral between PA10 and SMA surfacing
Consistancy with NZ urban design protocol	Urban design	As per East 1	–	o	–
			slight minor impact	Neutral change	slight minor impact
Utilisation of materials that reflect the character of the location	Urban design	As per East 1	–	o	–
			slight minor impact due to hardened edge to corridor	Neutral change	As per option 1
	Visual and landscape		–	o	–

Assessment criteria	Discipline	Issues / Risks	Option 1 - 2m barrier	Option 2 - PA10 30mm	Option 3 - PA10 30mm and 2m barrier
The extent to which the mitigation option promotes integration and establishes visual coherence and continuity in form, scale and appearance of structures and landscape proposals along the route		The existing rural character provided by open pasture and post and rail fence in this location will be changed if replaced by timber noise walls. This will create a new hard edge to the corridor	Slight negative impact due to 2m barrier forms new hard edge	Neutral change	As per option 1
Road users' views to the surrounding landscape and key features/ locations in particular	Visual and landscape		–	o	–
			Highly modified environment given new roundabout adjacent will result in a minor impact	Neutral change	As per option 1
Maintenance or enhancement of visual amenity for surrounding residents	Visual and landscape	View of the proposed roundabout in this location will reduce the quality of the outlook for residential property further. Therefore view of high barrier may be perceived better than if existing arrangement was retained	–	o	–
			Existing low quality views from the dwellings reduce the impact for residential property	Neutral change	As per option 1
	Workshop Comments		315 SH16 will be a Category C if we don't do anything (67-68dB). Option 1: There is space for a fence, the property will have large visibility into the roundabout and could probably benefit from the privacy of the fence as well as the minor noise reduction. Noise reduction would still be minor. Option2: Siiri modelled a slower speed of 60km/hr near the roundabout. PA10 is not a practical option near a roundabout as PA10 will not meet the skid resistance surfaces criteria. Note that planting will be around the edges of the roundabout (not on it). Option 3: will include barrier and PA10. This would only reduce the noise from 1-2dB - negligible noise improvements. If we do have a raised table for pedestrian crossing points, this would increase the noise of large trucks going over the raised table. A signalised option would be preferred, but it still needs to go through a safety audit. We won't have feedback from the auditors until end Feb 2022. We may chat to the safety auditors before then to close that option out.		
	Workshop Actions		Gareth to provide the final design option on the crossing to Siiri in March 2022.		
	Project team recommended option		The recommended option is: Option 1 – 2m barrier, as Options 2 & 3 involving the use of PA10 (within 60m from roundabout) does not comply with Waka Kotahi pavement design standards. Yet it is noted that the mitigation is largely for the benefit of the dwelling located at 315 SH16 which would have a predicted reduction of 3 dB from the fence (bringing it from a Cat C without mitigation to a Category B).		

Area N East 7: NZS 6806 - Assessment matrix:

AREA E8: NZS 6806 - Assessment matrix

Assessment criteria	Discipline	Issues / Risks	Option 1 - 2m barrier	Option 2 - PA10 30mm	Option 3 - PA10 30mm and 2m barrier
Value for money, including maintenance costs and consideration of benefit cost analysis	Acoustics	Using PA10 30mm may not be feasible. Fences have to allow driveway access	+ + +	+ +	+ + +
			BCR 2.69	BCR 1.44	BCR 2.08
Compliance with NZS 6806 noise criteria	Acoustics		+ + +	+	+ + +
			All Cat A	1 Cat B, 1 Cat A	All Cat A
Achievement of the NZS 6806 structural mitigation performance standards	Acoustics	combination of surface and barrier	o	– –	+
			3 dB (up to 4.9 dB for ECEC)	1.1 dB (up to 1 dB for ECEC)	3.9 dB (up to 5.6 dB for ECEC)
Requirement for building-modification measures	Acoustics		+ + +	+ +	+ + +
			All Cat A	All Cat A	All Cat A
Effect of changes to the do-nothing noise environment	Acoustics	reduction for both PPFs for all mitigation options up to 6 dB	+ +	o	+ + +
			average 3 dB reduction (up to 4.8 dB for ECEC)	average 1 dB reduction (up to 1 dB for ECEC)	average 4 dB reduction (up top 5.5 dB for ECEC)
Potential effects on known heritage or cultural values	Heritage	None identified	o	o	o
Availability of sufficient land for construction and maintenance and the extent to which NZTA would need to acquire land, or interests in land	Property		–	o	–
			Likely requires land. If not, then neutral score.	No land required.	Likely requires land. If not, then neutral score.
Practicality of the noise mitigation in terms of operations and maintenance requirements	Ops/Maintenance	Same comment as under E1 above.	o	o	o
Constructability/technical feasibility	Roading		o	– –	– –
			no surface mitigation	Existing 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 standard PA10 will result in very short surfacing life and high risk of pavement failure.	Existing 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 standard PA10 will result in very short surfacing life and high risk of pavement failure.
Compliance with relevant safety standards and guidelines	Roading		o	o	o
			no surface mitigation	neutral	neutral
Public safety and security	Roading		o	o	o
			no surface mitigation	neutral	neutral
Consistancy with NZ urban design protocol	Urban design	Connection between early childhood centre and road lost as well as the rural character presented with the post and rail fence	–	–	–
			Slightly negative impact on urban design qualities		
Utilisation of materials that reflect the character of the location	Urban design	high barrier will change the character of this location	–	–	–
			Slightly negative impact on character of the location		
The extent to which the mitigation option promotes integration and establishes visual coherence and continuity in form, scale and appearance of structures and landscape proposals along the route	Visual and landscape	Change in fence along the Early childhood centre reduces rural feel for the centre. However, minimal impact within the centre due to this being on the carpark and driveway side	–	o	–
			2m barrier will change the rural character of the centre	PA10 30mm	PA10 30mm and 2m barrier
	Visual and landscape		–	o	–

Assessment criteria	Discipline	Issues / Risks	Option 1 - 2m barrier	Option 2 - PA10 30mm	Option 3 - PA10 30mm and 2m barrier
Road users' views to the surrounding landscape and key features/ locations in particular			Existing highly modified environment		As per option 1
Maintenance or enhancement of visual amenity for surrounding residents	Visual and landscape		–	o	–
			Existing highly modified environment		As per option 1
	Workshop Comments		Option 1: there is an early learning centre fairly close to the road. A barrier would be highly effective and reduce noise by more than 5dB. The outdoor play area around the back of the building would be Category A. From a L & V perspective, there will be minor adverse effects. Safety consideration is needed separately to consider safe vehicles access to the centre. Option 1 is preferred. Option 2 and 3: There is existing high strength OGPA in this area. It does not perform as well as normal OGPA, therefore additional mitigation is still required. High strength OGPA is preferred for this section as the road curve is not suitable for PA10. We discussed high strength OGPA with smaller chip sizes. Steve said he is not aware of this being used before, a contractor would need to investigate this option.		
	Project team recommended option		The recommended option is: Option 1 – 2m barrier, per workshop discussion – the barrier would be highly effective and this section of the route will have high strength OGPA (which may have noise mitigation qualities yet this is currently undocumented within the industry).		

AREA E9: NZS 6806 - Assessment matrix

Assessment criteria	Discipline	Issues / Risks	Option 1 - 2m barrier	Option 2 - 2.5m barrier
Value for money, including maintenance costs and consideration of benefit cost analysis	Acoustics	long barrier for both PPFs with little benefit	–	– –
			BCR 0.65	BCR 0.35
Compliance with NZS 6806 noise criteria	Acoustics	marginal improvement over Do nothing	– – –	+
			1x Cat A, 1x Cat C	1x Cat A, 1x Cat B
Achievement of the NZS 6806 structural mitigation performance standards	Acoustics		– –	–
			1.2 dB	1.7 dB
Requirement for building-modification measures	Acoustics	ventilation and seals, potentially glazing	– – –	+ +
			1 Cat C (out of 2 PPF)	No Cat C
Effect of changes to the do-nothing noise environment	Acoustics	Marginal improvements	o	+
			average 1 dB reduction (1dB for Resthome)	average 2 dB reduction (2.5 dB for Resthome)
Potential effects on known heritage or cultural values	Heritage	None Identified	o	o
Availability of sufficient land for construction and maintenance and the extent to which NZTA would need to acquire land, or interests in land	Property		–	–
			Likely requires land. If not, then neutral score.	Likely requires land. If not, then neutral score.
Practicality of the noise mitigation in terms of operations and maintenance requirements	Ops/Maintenance	Same comment as under E1 above.	o	o
Constructability/technical feasibility	Roading		o	o
			Design already included OGPA, which was included in the noise model.	Design already included OGPA, which was included in the noise model.
Compliance with relevant safety standards and guidelines	Roading		O	o
			Design already included OGPA, which was included in the noise model.	Design already included OGPA, which was included in the noise model.
Public safety and security	Roading		o	o
			Design already included OGPA, which was included in the noise model.	Design already included OGPA, which was included in the noise model.
Consistancy with NZ urban design protocol	Urban design	Little change from the existing boundary treatment given the rest home turns itself away from the road	o	o
Utilisation of materials that reflect the character of the location	Urban design	Timber is consistent with existing boundary treatment	o	o
The extent to which the mitigation option promotes integration and establishes visual coherence and continuity in form, scale and appearance of structures and landscape proposals along the route	Visual and landscape	Existing situation presents a retaining wall and hedge planting therefore a 2m or 2.5m barrier will not change the character of the area	o	o
			2m barrier	2.5m barrier presents the same rating at option 1
Road users' views to the surrounding landscape and key features/ locations in particular	Visual and landscape	Larger hard surface area will be presented by a barrier in this location, however, no significant change to the existing situation except for	–	–
Maintenance or enhancement of visual amenity for surrounding residents	Visual and landscape	No views to the fence from the property	o	o

Assessment criteria	Discipline	Issues / Risks	Option 1 - 2m barrier	Option 2 - 2.5m barrier
	Workshop Comments		The retirement village. They are right next to the road with no noise mitigation in their building design. They would be considered a Category C. Siiri strongly recommends a noise barrier here given the close proximity the building is to the road. PA10 has been modelled into Siiri's recommendation and she still recommends a barrier. They are slightly above the road by a 1-2m and they also have a retaining wall towards the end. There is a lot of vegetation along the boundary that would be affected by the noise wall. We need to confirm if this relatively new building has any ventilation. Decided to assume there is a ventilation system and that no noise wall is required at this location. Need to confirm assumption via landowner engagement, which is planned for March 2022.	
	Workshop Actions		Siiri - needs to confirm if the building has any ventilation system during the proposed landowner engagement in March 2022.	
	Project team recommended option		The recommended option is: Option 2 – 2.5m barrier (yet TBC after specialists have validated Option 2 assessment and after landowner engagement).	

AREA W1: NZS 6806 - Assessment matrix

Assessment criteria	Discipline	Issues / Risks	Option 1 - 2m barrier	Option 2 - PA10 30mm	Option 3 - PA10 30mm and 2m barrier
Value for money, including maintenance costs and consideration of benefit cost analysis	Acoustics	Using PA10 30mm may not be feasible. Fences have to allow driveway access	+ + +	+ + +	+ + +
			BCR 5	BCR 1.57	BCR 2.12
Compliance with NZS 6806 noise criteria	Acoustics	only 1 PPF in this cluster	+	– – –	+ + +
			Cat B	Cat C	Cat A
Achievement of the NZS 6806 structural mitigation performance standards	Acoustics	best outcome surface and barrier combined	+ +	– –	+ + +
			4.8 dB	1.3 dB	6.1 dB
Requirement for building-modification measures	Acoustics	ventilation and seals, potentially glazing	+ +	–	+ + +
			No Cat C	Cat C	No Cat C
Effect of changes to the do-nothing noise environment	Acoustics	Fence needed for noticeable reduction	+ + +	o	+ + +
			4 dB reduction	no change	5 dB reduction
Potential effects on known heritage or cultural values	Heritage	none identified	o	o	o
Availability of sufficient land for construction and maintenance and the extent to which NZTA would need to acquire land, or interests in land	Property		– –	o	–
			Likely requires extra land as L shaped barrier. If not, then neutral score.	No land required.	Likely requires land. If not, then neutral score.
Practicality of the noise mitigation in terms of operations and maintenance requirements	Ops/Maintenance	Same comment as under E1 above.	o	o	o
Constructability/technical feasibility	Roading		o	– –	– –
			no surface mitigation	PA10 surfacing in this area with horizontal radiis of 400m is likely to result in short surfacing life requiring frequent resurfacing. Also, change in final road surfacing from SMA at the Brigham Creek Roundabout to PA10 in this area and then SMA after Kennedy Road, over relatively short lengths are not practical and would result in high road surface roughness.	PA10 surfacing in this area with horizontal radiis of 400m is likely to result in short surfacing life requiring frequent resurfacing. Also, change in final road surfacing from SMA at the Brigham Creek Roundabout to PA10 in this area and then SMA after Kennedy Road, over relatively short lengths are not practical and would result in high road surface roughness.
Compliance with relevant safety standards and guidelines	Roading		o	–	–
			no surface mitigation	PA10 asphalt surfacing in this area (with current surfacing as SMA) will result in a vertical lip (drop off) over concrete channel. This is considered a safety hazard for on-road cyclist.	PA10 asphalt surfacing in this area (with current surfacing as SMA) will result in a vertical lip (drop off) over concrete channel. This is considered a safety hazard for on-road cyclist.
Public safety and security	Roading		o	o	o
			no surface mitigation	neutral between PA10 and SMA surfacing	neutral between PA10 and SMA surfacing
Consistancy with NZ urban design protocol	Urban design	Heritage cottage character is affected by the proposed wall	– –	o	– –
				PA10 30mm	

Assessment criteria	Discipline	Issues / Risks	Option 1 - 2m barrier	Option 2 - PA10 30mm	Option 3 - PA10 30mm and 2m barrier
Utilisation of materials that reflect the character of the location	Urban design	High 2m barrier does not reflect the character of the hertiage cottage	– –	o	– –
			barrier does not reflect the existing heritage character		
The extent to which the mitigation option promotes integration and establishes visual coherence and continuity in form, scale and appearance of structures and landscape proposals along the route	Visual and landscape	The extent of the wall will have a negative impact on the existing landscape setting of the historic Rose cottage	– –	o	– –
			The existing picket fence being replaced with 2m timber noise barrier will change the heritage character of the property.	PA10 30mm	PA10 30mm and 2m barrier: As per option 1
Road users' views to the surrounding landscape and key features/ locations in particular	Visual and landscape	Given the location of the fence on the inside of the bend the visual impact for road users is low	–	o	–
			The land adjacent to the Rose cottage is used for the storage of containers which will mean the high barrier will have a negligible impact for road users. Existing low quality surrounding environment		As per Option 1
Maintenance or enhancement of visual amenity for surrounding residents	Visual and landscape	The close proximity of the walls to the existing cottage will cause significantly change the visual outlook for the residents or users of the Rose Cottage	– –	o	– –
			Walls will enclose the cottage and cause significant change from the existing cottage setting		As per Option 1
	Workshop Comments		Option 1 : We discussed two barrier options, one is directly in front of the house with a dogleg around the southeastern boundary. The other runs further along into the next property towards the roundabout and would be within the designation. The dogleg would be a much smaller barrier but would extend into private property (out of the designation). We will need to talk to Don about the practicality of this - an easement may be required for the acoustic fence. There is an expectation that WK maintains the fence on private property if it is ever damaged. However, the landowner may not want a 2m fence around its property. Need to discuss future maintenance of the acoustic fence with Glenn Flockhart (NOC) – for all areas. Of all options, West 1 is the only barrier that would change the character of the property from a L & V perspective. Option 2 and 3 are not feasible as PA10 cannot be applied to areas with curves like this corridor section. Option 1 preferred.		
	Workshop Actions		Andria to speak to Don Harrington about legal mechanism for access for future maintenance of the acoustic fence. Ashlie / Andria to seek assessment of options from NOC from ops and maintenance perspective.		
	Project team recommended option		The recommended option is Option 1: - 2m barrier, per the workshop discussion.		

AREA W3: NZS 6806 - Assessment matrix

Assessment criteria	Discipline	Issues / Risks	**Option 1 –** 2m barrier, 80m length	**Option 2 –** 2.5m barrier, 80m length	**Option 3 -** PA10 30mm and 2m barrier	**Option 4 -** 2.5m barrier over 140m length (Higher longer barrier)
Value for money, including maintenance costs and consideration of benefit cost analysis	Acoustics		–	o	o	-
			BCR 0.61	BCR 0.84	BCR 0.92	BCR 0.53
Compliance with NZS 6806 noise criteria	Acoustics	2 PPFs in this cluster	+	+	+ + +	+
			1 each Cat A and B	1 each Cat A and B	All Cat A	1 each Cat A and B
Achievement of the NZS 6806 structural mitigation performance standards	Acoustics	Only slight reduction overall	– –	– –	–	–
			1.1 dB	1.3 dB	1.9 dB	1.5 dB
Requirement for building-modification measures	Acoustics		+ +	+ +	+ + +	++
			No Cat C	No Cat C	No Cat C	No Cat C
Effect of changes to the do-nothing noise environment	Acoustics	only slight changes, with reduction up to 2 dB	o	o	o	o
			No change	average 1 dB reduction	average 1 dB reduction	average 1 dB reduction
Potential effects on known heritage or cultural values	Heritage	Property will be largely concealed from view immediately in front, but may remain partially visible from opposite road due to changes in topography. Property will be seen from higher ground to northwest. Large fences will detract from setting and will need to be screened. Will provide additional privacy from occupier's perspective. Overall, would be happy with timber acoustic fencing of the type described, with space for planting in front. While this potentially limits visibility of existing houses from the public realm, the benefit to occupiers is also relevant for long-term use of the places.	– –	– –	– –	– – –
			moderate negative, requiring screening mitigation	moderate negative, requiring screening mitigation	moderate negative, requiring screening mitigation	a longer barrier will have a similar visual effect at 2m. An alternate option of a 2.5m barrier along the length will have a high, rather than moderate, adverse visual effect and is not preferred.
Availability of sufficient land for construction and maintenance and the extent to which NZTA would need to acquire land, or interests in land	Property		–	–	–	–
			Likely requires land. If not, then neutral score.	Likely requires land. If not, then neutral score.	Likely requires land. If not, then neutral score.	Likely requires land. If not, then neutral score.
Practicality of the noise mitigation in terms of operations and maintenance requirements	Ops/Maintenance	Same comment as under E1 above.	o	o	o	
Constructability/technical feasibility	Roading		o	o	– –	o

Assessment criteria	Discipline	Issues / Risks	**Option 1 –** 2m barrier, 80m length	**Option 2 –** 2.5m barrier, 80m length	**Option 3 -** PA10 30mm and 2m barrier	**Option 4 -** 2.5m barrier over 140m length (Higher longer barrier)
			no surface mitigation	no surface mitigation	If PA10 surfacing is specified in this road section with longitudinal gradient of approximately 6-8%, it will result in short surfacing life requiring frequent resurfacing and high risk of premature surfacing/pavement failure. This does not comply with Waka Kotahi pavement design standards. Also, change in final road surfacing between SMA and PA10 over relatively short lengths is not recommend as it would result in high road surface roughness.	no surface mitigation
Compliance with relevant safety standards and guidelines	Roading		o no surface mitigation	o no surface mitigation	– PA10 asphalt surfacing in this area (with current surfacing as SMA) will result in a vertical lip (drop off) over concrete channel. This is considered a safety hazard for on-road cyclist.	o no surface mitigation
Public safety and security	Roading		o no surface mitigation	o no surface mitigation	o neutral between PA10 and SMA surfacing	o No surface mitigation
Consistancy with NZ urban design protocol	Urban design	Minor change in context and character with change in boundary treatment	–	–	–	–
Utilisation of materials that reflect the character of the location	Urban design	Change in existing character if existing boundary planting is removed. Opportunity to retain the existing planting to retain character	–	–	–	–
The extent to which the mitigation option promotes integration and establishes visual coherence and continuity in form, scale and appearance of structures and landscape proposals along the route	Visual and landscape	Barriers will take away slightly from the existing rural environment. Not consistent with the existing surrounding environment	– Change to the existing rural character	– As per option 1	– As per option 1	– As per option 1
Road users' views to the surrounding landscape and key features/ locations in particular	Visual and landscape	Views will be slightly restricted to rural outlook	– Barrier will create a hard boundary in an existing open rural landscape	– As per option 1	– As per option 1	– As per option 1
	Visual and landscape		–	–	–	–

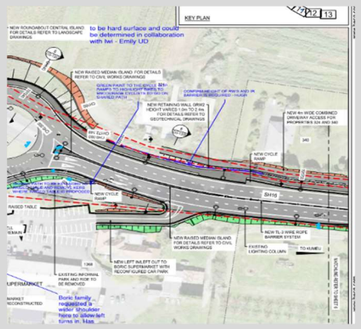
Assessment criteria	Discipline	Issues / Risks	Option 1 – 2m barrier, 80m length	Option 2 – 2.5m barrier, 80m length	Option 3 - PA10 30mm and 2m barrier	Option 4 - 2.5m barrier over 140m length (Higher longer barrier)
Maintenance or enhancement of visual amenity for surrounding residents		Residential dwelling will look over the barrier, however, it will still present a change to the existing outlook for property	2m barrier will present a change in the outlook for residential property	as per option 1	as per option 1	as per option 1
	Workshop Comments		There is one house located up on a hill, which will need extensive acoustic mitigation. From a noise perspective, none of the options significantly reduce the noise due to the house being set up on a hill. There is no significant change between the existing noise level and modelled noise level - none of the options (1-3) achieve much at this location. Option 1: A barrier of 2.5 meters is a better option. The homestead at 238 SH16 is a scheduled heritage item under the district plan. Putting a barrier along the boundary may change the heritage amenity and values of the property. Mitigation planting is needed for a barrier from a heritage and L&V perspective. The property has a number of accesses which will limit the effectiveness of the noise wall. We considered a longer barrier from the north end of the property boundary down to the stream. This would have the same effects as option 3. Discussed lack of BPO. Therefore Siiri to consider another option, being a higher, longer noise barrier, which may achieve a 3dB reduction. - Cannot achieve that. If the barrier is to benefit one property and that owner does not want the barrier then that is something to consider even though we can put the barrier up in the designation. If they signal that visual effects are more important, then we should consider that. If the owner does not want a fence we don't have to offer ventilation systems. Option 3: it would be difficult to resurface with PA10 as the site is on an uphill section of the road with a passing lane, gradience is about 6-8%. Vehicles are accelerating and large trucks are slowing. PA10 would last approximately 2-3 years only due to the breaking and car tyre erosion (requiring regular resurfacing). A barrier is the only practical option from pavement specialist perspective.		
	Workshop Actions		Siiri is going to look at a higher longer barrier - this will have a more negative impact on heritage- then John will review and update his assessment.			
	Project team recommended option		The recommended option is Do Minimum (Project with no mitigation at this location). Option 2 – 2.5m barrier, would have an average 1 dB reduction achieved in relation to the do nothing. Option 4 noise reduction from the additional length of barrier was minimal and would have other adverse effects. The dwelling is Cat B, noise level change is minimal, and there is a need to consider partner / stakeholder feedback and the potential adverse landscape, heritage effects. BPO may be no mitigation (i.e. do-minimum).			

Area L West 4: NZS 6806 - Assessment matrix:

Assessment criteria	Discipline	Issues / Risks	Option 1 – 2m high barrier
Value for money, including maintenance costs and consideration of benefit cost analysis	Acoustics		+ + + BCR 1.91
Compliance with NZS 6806 noise criteria	Acoustics		+ + + all Cat A
Achievement of the NZS 6806 structural mitigation performance standards	Acoustics	Fence for one PPF, others not significantly benefitting	o 3.4 dB
Requirement for building-modification measures	Acoustics		+ + + No Cat C
Effect of changes to the existing noise environment	Acoustics	For targeted PPF 6 dB reduction (average 2.4 dB)	+ + + 6 dB reduction
Potential effects on known heritage or cultural values	Heritage	N/A to location	N/A
Availability of sufficient land for construction and maintenance and the extent to which NZTA would need to acquire land, or interests in land	Property Don	Neutral as likely no additional land required. If land required then minor adverse (-).	O
Practicality of the noise mitigation in terms of operations and maintenance requirements	Ops/Maintenance Glenn	If a timber fence, then allowance for access for graffiti cleanup and responsibility for its maintenance after construction and any future possible maintenance repairs or damage to the timber fence (Mowers accessing the batter between fence and footpath) is required. If fence at top of an earthworks batter, it have planting in front of it to obscure the fence and minimise risk of vandalism and graffiti.	O
Constructability/technical feasibility	Roading Gareth	Construction of the proposed 2m high Timber noise wall is standard and is considered business as usual.	O
Compliance with relevant safety standards and guidelines	Roading Gareth	Proposed Noise wall will be located at top of batter and away for the main alignment and therefore is not expected to have any impact on the operation and safety of SH16. Due to the set back the Noisewall it will also not impact visibility from the accessway to the shared path based on this there is no affect from the proposed noise wall on safety when compared to the option without the noise wall.	O
Public safety and security	Roading Gareth	No impact on public safety and security. Noise wall may provide limited minor security improvements for the property.	O
Consistency with NZ urban design protocol	Urban Design Emily	N/A to location	O
Utilisation of materials that reflect the character of the location	Urban Design Emily	Timber noise wall to reflect rural character of the surrounding landscape.	O
The extent to which the mitigation option promotes integration and establishes visual coherence and continuity in form, scale and appearance of structures and landscape proposals along the route	Visual and landscape Emily	Existing vegetation will be removed to allow for construction of the wall, although new vegetation is proposed in front of the wall which will mean the proposed structure will not likely be visible along the route when the vegetation establishes.	O
Road users' views to the surrounding landscape and key features/ locations in particular	Visual and landscape Emily	As above, it is unlikely that the wall will be visible from the road corridor beyond the proposed vegetation.	O
Maintenance or enhancement of visual amenity for surrounding residents	Visual and landscape Emily	A timber fence will change the outlook from the dwellings on the affected property. This will change from the existing vegetation lined boundary to a solid timber fence. This boundary creates a visually hard edge to the property in comparison to the existing situation	- -
	Workshop Comments	N/A – no workshop held for this PPF; yet discussion held between Project Manager and Design, Planning and Acoustic specialists.	
	Project team recommended option	The BPO is option 1 - a 2m high noise barrier, as it will have a significant positive effect given that it provides a 6db noise reduction and has a neutral effect from most disciplines' perspective and a moderately adverse visual and landscape effect compared to the existing situation. The noise wall will move this property from category B with no mitigation, to a category A.	

AREA W5: NZS 6806 - Assessment matrix

Assessment criteria	Discipline	Issues / Risks	Option 1 - 2m barrier
Value for money, including maintenance costs and consideration of benefit cost analysis	Acoustics		+
			BCR 1.25
Compliance with NZS 6806 noise criteria	Acoustics	Only 1 PPF in this cluster	+ + +
			Cat A
Achievement of the NZS 6806 structural mitigation performance standards	Acoustics		–
			1.6 dB reduction
Requirement for building-modification measures	Acoustics		+ + +
			No Cat C
Effect of changes to the do-nothing noise environment	Acoustics		o
			0.7 dB reduction
Potential effects on known heritage or cultural values	Heritage	none identified	o
Availability of sufficient land for construction and maintenance and the extent to which NZTA would need to acquire land, or interests in land	Property		–
			Likely requires land, if not then neutral score.
Practicality of the noise mitigation in terms of operations and maintenance requirements	Ops/Maintenance	Same comment as under E1 above.	o
Constructability/technical feasibility	Roading		o
			no surface mitigation
Compliance with relevant safety standards and guidelines	Roading		o
			no surface mitigation
Public safety and security	Roading		o
			no surface mitigation
Consistancy with NZ urban design protocol	Urban design	Minor change in context and character with change in boundary treatment	-
			2m barrier will have a small negative impact
Utilisation of materials that reflect the character of the location	Urban design	Change in existing character if existing boundary planting is removed. Opportunity to retain the existing planting to retain character	-
			small negative impact
The extent to which the mitigation option promotes integration and establishes visual coherence and continuity in form, scale and appearance of structures and landscape proposals along the route	Visual and landscape	Barriers will take away slightly from the existing rural environment. Not consistent with the existing surrounding environment	-
			small negative impact
Road users' views to the surrounding landscape and key features/ locations in particular	Visual and landscape	Hard edge to the road rather than vegetation boundary	-
			small negative impact
Maintenance or enhancement of visual amenity for surrounding residents	Visual and landscape	Residential dwelling will look at a barrier, however, it is not a high quality environment. Opportunities to retain planting or plant rearside of the wall.	-
			small negative impact

Assessment criteria	Discipline	Issues / Risks	Option 1 - 2m barrier
	Workshop Comments		340 and 344 SH16 Noise level is a Category B Noted there was an error on the 'Assessment tab' - a noise barrier is the only option at this location (not PA10). Option 1: A shared driveway is being proposed for these houses. This driveway and the shared path may affect the location of the noise barrier. We could put a barrier between the shared path and the new driveway. We can put a barrier on top of the proposed new retaining wall. There is less than one meter of space, so we would need to consider putting the noise barrier on the proposed retaining wall. 
	Workshop Actions		Siiri to remove PA 10 off the options - as the option is only the noise barrier. Emily to adjust her comments on this sheet – slight adverse impact from Urban Design and a L&V perspective. Stan to adjust his comments on this sheet - PA10 comments irrelevant.
	Project team recommended option		The recommended option is: Option 1 – 2m barrier (as this brings the dwelling into Cat A rather than Cat B, and mitigates fact that traffic acceleration away from the new RAB cannot be included in the noise model).

AREA W6: NZS 6806 - Assessment matrix

Assessment criteria	Discipline	Issues / Risks	Option 1 - PA10 30mm
Value for money, including maintenance costs and consideration of benefit cost analysis	Acoustics		+ + +
			BCR 5.26
Compliance with NZS 6806 noise criteria	Acoustics		+ + +
			All Cat A
Achievement of the NZS 6806 structural mitigation performance standards	Acoustics	using slightly better road surface, only PPF that requires mitigation is 2 storey	– –
			1.2 dB
Requirement for building-modification measures	Acoustics		+ + +
			No Cat C
Effect of changes to the do-nothing noise environment	Acoustics	all PPFs get reduced noise levels	o
			average 1 dB reduction (highest 3.5 dB reduction at ECEC)
Potential effects on known heritage or cultural values	Heritage	none identified	o
Availability of sufficient land for construction and maintenance and the extent to which NZTA would need to acquire land, or interests in land	Property		o
			No land required.
Practicality of the noise mitigation in terms of operations and maintenance requirements	Ops/Maintenance	Same comment as under E1 above.	o
Constructability/technical feasibility	Roading		– –
			Existing 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 standard PA10 will result in short surfacing life and high risk of pavement failure.
Compliance with relevant safety standards and guidelines	Roading		o
			neutral
Public safety and security	Roading		o
			neutral
Consistancy with NZ urban design protocol	Urban design	NA	o
			PA10 30mm
Utilisation of materials that reflect the character of the location	Urban design	NA	o
The extent to which the mitigation option promotes integration and establishes visual coherence and continuity in form, scale and appearance of structures and landscape proposals along the route	Visual and landscape	NA	o
			PA10 30mm
Road users' views to the surrounding landscape and key features/ locations in particular	Visual and landscape	NA	o
Maintenance or enhancement of visual amenity for surrounding residents	Visual and landscape	NA	o
	Workshop Comments		There are no acoustic barrier options as the only PPF that requires mitigation is 2 storey and barriers would not be effective in this location.
	Project team recommended option		The recommended option is: do not proceed with Option 1, as PA10 not feasible in this location, yet this section of the route will

Assessment criteria	Discipline	Issues / Risks	Option 1 - PA10 30mm
			have high strength OGPA (which may have noise mitigation qualities yet this is currently undocumented within the industry). Do minimum is the BPO.

AREA W7: NZS 6806 - Assessment matrix

Assessment criteria	Discipline	Issues / Risks	Option 1 - 2m barrier
Value for money, including maintenance costs and consideration of benefit cost analysis	Acoustics		+ + + BCR 1.79
Compliance with NZS 6806 noise criteria	Acoustics	Only 1 PPF in this cluster	+ + + Cat A
Achievement of the NZS 6806 structural mitigation performance standards	Acoustics	Fence for one PPF	+ + 4.7 dB
Requirement for building-modification measures	Acoustics		+ + + No Cat C
Effect of changes to the do-nothing noise environment	Acoustics		+ + 4 dB reduction
Potential effects on known heritage or cultural values	Heritage	none identified	o
Availability of sufficient land for construction and maintenance and the extent to which NZTA would need to acquire land, or interests in land	Property		– Likely requires land. If not, then neutral score.
Constructability/technical feasibility	Roading		o no surface mitigation
Compliance with relevant safety standards and guidelines	Roading		o no surface mitigation
Public safety and security	Roading		o no surface mitigation
Consistancy with NZ urban design protocol	Urban design	No change given existing 2m fence already in place	o
Utilisation of materials that reflect the character of the location	Urban design	Existing 2m fence already in place is a different material that may not connect with the existing fence and building typologies	–
The extent to which the mitigation option promotes integration and establishes visual coherence and continuity in form, scale and appearance of structures and landscape proposals along the route	Visual and landscape	No change to the existing character given existing 2m fence already in place	o 2m barrier - no change to the existing
Road users' views to the surrounding landscape and key features/ locations in particular	Visual and landscape	No change to the existing character given existing 2m fence already in place	o
Maintenance or enhancement of visual amenity for surrounding residents	Visual and landscape	No change to the existing character given existing 2m fence already in place	o
	Workshop Comments		The barrier is the best option as the curve would not allow changes to the road surfacing. Emily said we may need to consider a different fencing material to be consistent with the house and winery. There is an existing fence there, Siiri will confirm if the fence is a suitable material for noise mitigation. However, it is only 1.8m, may need a higher wall.
	Workshop Actions		Siiri to undertake site visit to assess fence material.
	Project team recommended option		The recommended option is: Option 1 – 2m barrier as 4 dB reduction achieved (as model doesn't allow for the existing 1.8m concrete fence). Provision of mitigation and the materials is likely to be subject to landowner feedback.

N

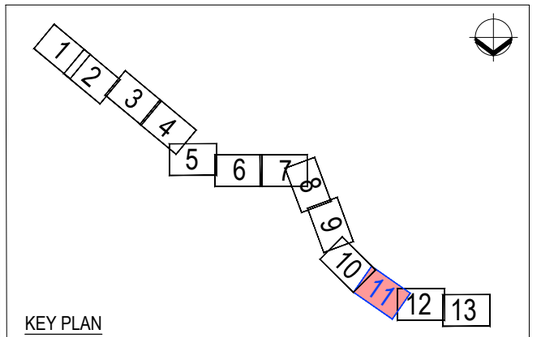
Appendix N – Localised Design Interface with Wetland Options

Drawing Plotted: 19 Jan 2022 2:07 PM

NOTES:

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

KEY PLAN



EXISTING WETLAND

NEW RETAINING WALL GRW8. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

NEW 2.5m WIDE FLUSH MEDIAN

MATCHLINE-REFER TO SHEET 10

13
CG-1308

40.83 m

128.43 sq m

CH193500

NEW TL-3 W-BEAM BARRIER SYSTEM

RECONSTRUCT EXISTING PROPERTY ACCESS

EXISTING POWER POLE

NEW CONVEYANCE AND DIVERSION CHANNEL. FOR DETAILS REFER TO STORMWATER DRAWINGS

NEW 3m SHARED PATH WITH 1m BERM EITHER SIDE

CH193600

EXISTING ENTRANCE TO SERVICE STATION NARROWED WITH CONTINUOUS RAISED SHARED PATH TO GIVE PRIORITY TO PEDESTRIANS OR CYCLISTS

522

BP SERVICE STATION

14
CG-1309

538

CH193700

550

TC 193794.336

CH193800

MATCHLINE-REFER TO SHEET 12

SH16

TO KUMEU

TO BRIGHAM CREEK

EXISTING LIGHTING COLUMN

NEW 3:1 EARTHWORKS

KUMEU VILLAGE REST HOME

20

OLD RAILWAY ROAD

43

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ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design			Approved For Construction*
Drawn			
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 Option #1 SUP South Side Existing

Discipline: CIVIL ENGINEERING

Drawing No.

Rev.

DO NOT SCALE

IF IN DOUBT ASK.

Document No. 3235084-CA-1201 TO 1213.DWG

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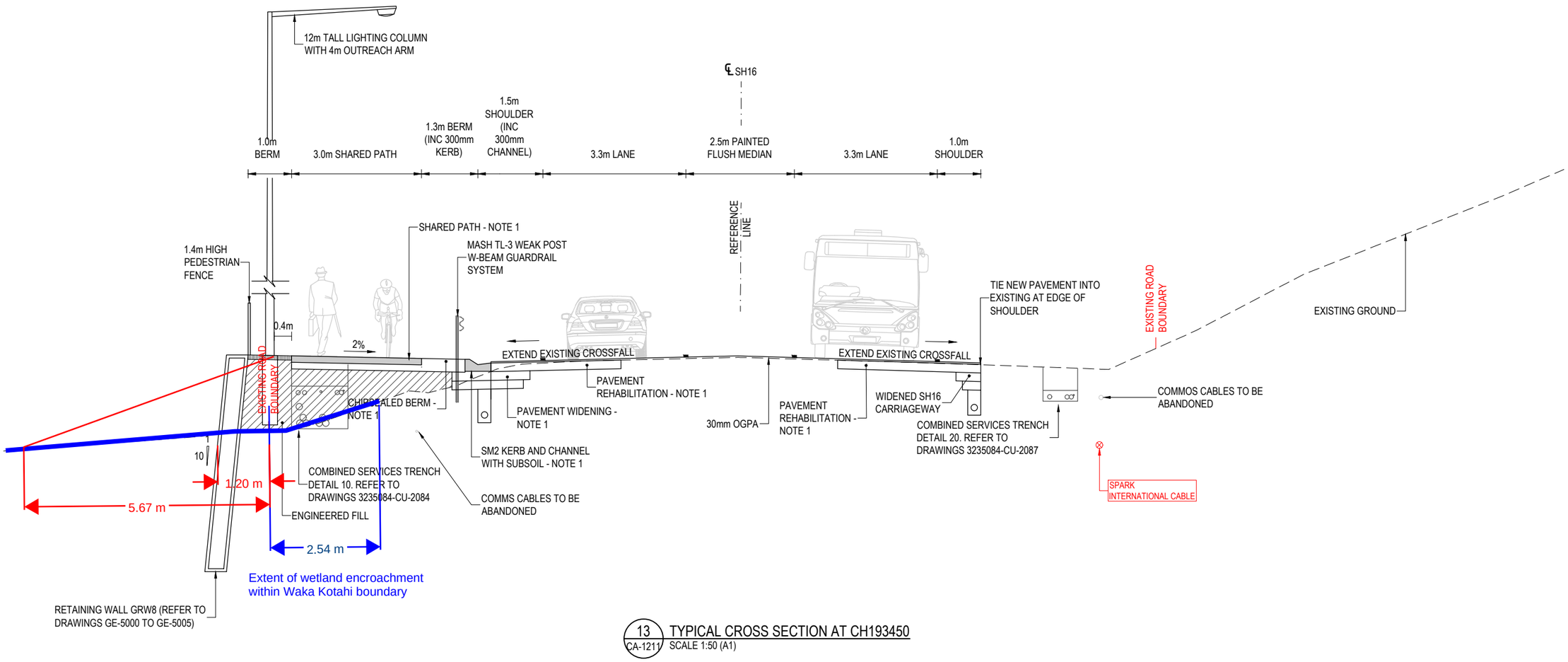

13 CA-1211 TYPICAL CROSS SECTION AT CH193450
SCALE 1:50 (A1)

NOTE 1: FOR ALL PAVEMENT CONSTRUCTION / REHABILITATION EXTENTS REFER TO PAVEMENT AND SURFACING PLANS 3235084-CP-3100 TO CP-3114. FOR

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

Original Scale (A1) 1:50
Reduced Scale (A3) 1:100

Design			Approved For Construction*
Drawn			
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: TYPICAL CROSS SECTIONS Option #1 SUP South Side Existing

Discipline: CIVIL ENGINEERING

Drawing No. | Rev.

ORIGINAL DRAWING IN COLOUR

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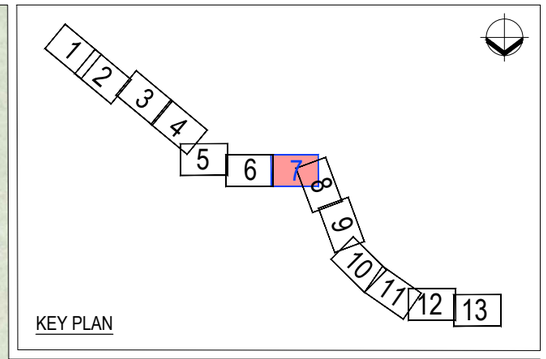
NOTES:

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



New SUP Crossing (Raised Table/Signalised)

TAUPAKI ROAD

EXTENT OF WORKS

455

466

454

CT 192073

192096

CH192180

TO BRIGHAM CREEK

CH192200

EXISTING MERGE TAPER TO BE MAINTAINED

NEW TREATMENT SWALE. FOR DETAILS REFER TO STORMWATER DRAWINGS

RECONSTRUCT EXISTING PROPERTY ACCESS

SH16

CH192300

TC 192

CH192400

NEW 2.5m WIDE FLUSH MEDIAN

TO KUMEU

EXISTING ROUNDABOUT TO REMAIN

EXISTING POWER POLE

MAINTAIN EXISTING PAVEMENT EDGE ON NORTHERN SIDE BETWEEN CH192220 AND CH192390

ALLELY ESTATE

393

KUMEU PRODUCE MARKET

New SUP Crossing (Raised Table)

EXISTING LIGHTING COLUMN

NEW 3:1 EARTHWORKS

New SUP requirements (3m wide, 1m berms)

407

MATCHLINE-REFER TO SHEET 6

OLD NORTH ROAD

MATCHLINE-REFER TO SHEET 8

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

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No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design			Approved For Construction*
Drawn			
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 Option #2A North Side SUP Existing

Discipline: CIVIL ENGINEERING

Drawing No.

Rev.

Document No. 3235084-CA-1201 TO 1213.DWG

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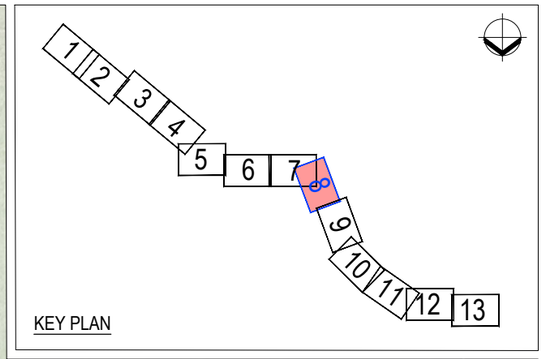
IF IN DOUBT ASK.

Drawing Plotted: 19 Jan 2022 2:08 PM

NOTES:

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



EXISTING WETLAND, APPROXIMATE MINIMUM DISTANCE TO THE PROPOSED RETAINING WALL IS 9.97m.

NEW RETAINING WALL SRW2. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

NEW TL-3 W-BEAM BARRIER SYSTEM

NEW RETENTION SWALE. FOR DETAILS REFER TO STORMWATER DRAWINGS

NEW 2.5m WIDE FLUSH MEDIAN

NEW TREATMENT SWALE. FOR DETAILS REFER TO STORMWATER DRAWINGS

RECONSTRUCT EXISTING PROPERTY ACCESS

RECONSTRUCT EXISTING PROPERTY ACCESS

RECONSTRUCT EXISTING PROPERTY ACCESS

EXISTING LIGHTING COLUMN

EXISTING POWER POLE

NEW RETAINING WALL GRW5. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

NEW RETENTION SWALE. FOR DETAILS REFER TO STORMWATER DRAWINGS

NEW RETENTION SWALE. FOR DETAILS REFER TO STORMWATER DRAWINGS

NEW CONVEYANCE AND DIVERSION CHANNEL. FOR DETAILS REFER TO STORMWATER DRAWINGS

RECONSTRUCT EXISTING PROPERTY ACCESS

NEW 3:1 EARTHWORKS

New SUP requirements (3m wide, 1m berms)

SH16

TO KUMEU

TO BRIGHAM CREEK

KUMEU PRODUCE MARKET

MATCHLINE-REFER TO SHEET 7

MATCHLINE-REFER TO SHEET 9

CH192500

CH192600

CH192700

CH192400

CH192300

CT 18260/875

11 CG-1307

9.97m

436

418

429

407

454

TC 192

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design			Approved For Construction*
Drawn			
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 Option #2A North Side SUP Existing

Discipline: CIVIL ENGINEERING

Drawing No.: Rev.:

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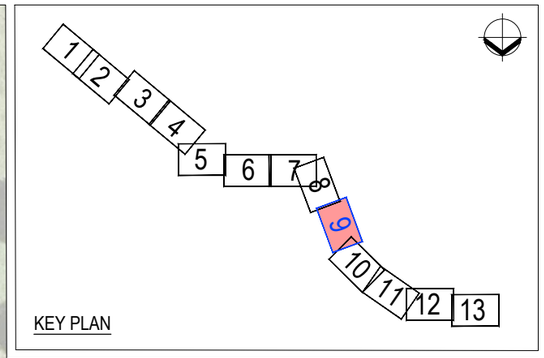
Document No. 3235084-CA-1201 TO 1213.DWG

Drawing Plotted: 19 Jan 2022 2:08 PM

NOTES:

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



NEW TL-3 W-BEAM BARRIER SYSTEM

NEW 2.5m WIDE FLUSH MEDIAN

12
CG-1307

NEW RETAINING WALL GRW6. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

PHIL GREIG STRAWBERRY GARDENS

CH192800

464

NEW RETAINING WALL GRW6. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

CH192900

RECONSTRUCT EXISTING PROPERTY ACCESS

NEW 3m SHARED PATH WITH 1m BERM EITHER SIDE

CH193000

472

RECONSTRUCT EXISTING PROPERTY ACCESS

MATCHLINE-REFER TO SHEET 10

SH16

TO BRIGHAM CREEK

TO KUMEU

NEW CONVEYANCE AND DIVERSION CHANNEL. FOR DETAILS REFER TO STORMWATER DRAWINGS

NEW RETAINING WALL GRW7. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

EXISTING POWER POLE

EXISTING LIGHTING COLUMN

RECONSTRUCT EXISTING PROPERTY ACCESS

New SUP requirements (3m wide, 1m berms)

RECONSTRUCT EXISTING PROPERTY ACCESS

NEW CONVEYANCE AND DIVERSION CHANNEL. FOR DETAILS REFER TO STORMWATER DRAWINGS

RECONSTRUCT EXISTING PROPERTY ACCESS

451

465

475

MATCHLINE-REFER TO SHEET 8

ORIGINAL DRAWING IN COLOUR

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No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design			Approved For Construction*
Drawn			
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 Option #2A North Side SUP Existing

Discipline: CIVIL ENGINEERING

Drawing No.

Rev.

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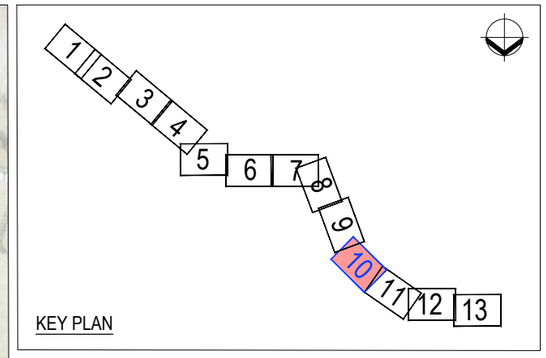
NOTES:

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



MATCHLINE REFER TO SHEET 9

RECONSTRUCT EXISTING PROPERTY ACCESS

NEW 2.5m WIDE FLUSH MEDIAN

CH193100

TO 193145.362

RECONSTRUCT EXISTING PROPERTY ACCESS

482

CH193200

CT 193271.4 m

CH193300

506

NEW RETAINING WALL GRW8. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

EXISTING WETLAND

MATCHLINE REFER TO SHEET 11

NEW TL-3 W-BEAM BARRIER SYSTEM

CH193400

RECONSTRUCT EXISTING PROPERTY ACCESS

SH16

TO BRIGHAM CREEK

TO KUMEU

NEW CONVEYANCE AND DIVERSION CHANNEL. FOR DETAILS REFER TO STORMWATER DRAWINGS

7.63 m

HEART AND SOUL EARLY LEARNING CENTRE

RECONSTRUCT EXISTING PROPERTY ACCESS

RECONSTRUCT EXISTING PROPERTY ACCESS

EXISTING POWER POLE

EXISTING LIGHTING COLUMN

NEW 3:1 EARTHWORKS

RECONSTRUCT EXISTING PROPERTY ACCESS

KUMEU VILLAGE REST HOME

507

New SUP requirements (3m wide, 1m berms)

New SUP requirements (3m wide, 1m berms)

491

505

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design			Approved For Construction*
Drawn			
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
Option #2A North Side SUP Existing

Discipline: CIVIL ENGINEERING

Drawing No. | Rev.

DO NOT SCALE

IF IN DOUBT ASK.

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Document No. 3235084-CA-1201 TO 1213.DWG

Drawing Plotted: 19 Jan 2022 2:07 PM

NOTES:

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

KEY PLAN

EXISTING WETLAND

NEW RETAINING WALL GRW8. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

NEW 2.5m WIDE FLUSH MEDIAN

MATCHLINE-REFER TO SHEET 10

NEW TL-3 W-BEAM BARRIER SYSTEM

RECONSTRUCT EXISTING PROPERTY ACCESS

EXISTING POWER POLE

NEW CONVEYANCE AND DIVERSION CHANNEL. FOR DETAILS REFER TO STORMWATER DRAWINGS

BP SERVICE STATION

MATCHLINE-REFER TO SHEET 12

SH16

TO BRIGHAM CREEK

TO KUMEU

EXISTING LIGHTING COLUMN

NEW 3:1 EARTHWORKS

New SUP Crossing (Raised Table)

New SUP requirements (3m wide, 1m berms)

KUMEU VILLAGE REST HOME

OLD RAILWAY ROAD

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design | Drawn | 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 Option #2A North Side SUP Existing

Discipline: CIVIL ENGINEERING

Drawing No. | Rev.

DO NOT SCALE

IF IN DOUBT ASK.

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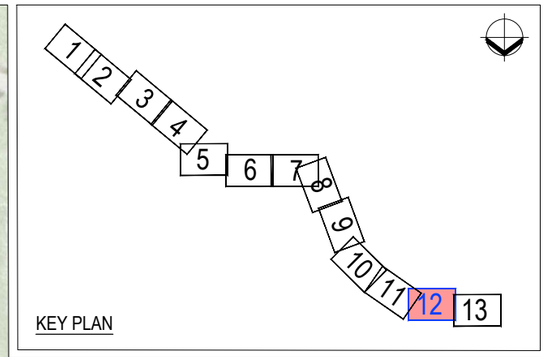
Document No. 3235084-CA-1201 TO 1213.DWG

Drawing Plotted: 19 Jan 2022 2:07 PM

NOTES:

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



TO BRIGHAM CREEK

KUMEU RIVER WINERY

MATCHLINE-REFER TO SHEET 11

CH193800

TO 193794.356

550

RECONSTRUCT EXISTING PROPERTY ACCESS

NEW RETENTION SWALE. FOR DETAILS REFER TO STORMWATER DRAWINGS

NEW 3m SHARED PATH WITH 1m BERM EITHER SIDE

5

3

CH193960

NEW 3:1 EARTHWORKS

NEW PEDESTRIAN FOOTBRIDGE ADJACENT TO KUMEU BRIDGE No.1 FOR DETAILS REFER TO STRUCTURAL DRAWINGS

CT 193989.486

CH194000

15
CG-1309

NEW RETAINING WALL GRW9. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

NEW TL-3 W-BEAM BARRIER SYSTEM

94/064.143

7

CH194100

SC 194144.14

TO KUMEU

SH16

16

Existing footpath to be upgraded to SUP requirements.

14

EXISTING KUMEU BRIDGE No.1 TO REMAIN

Existing SUP Bridge (upgrade/replace)

New SUP Crossing (Raised Table)

2-12

RIVERHEAD ROAD

New SUP requirements (3m wide, 1m berms)

Existing footpath to be upgraded to SUP requirements.

12

MATCHLINE-REFER TO SHEET 13

14

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design			Approved For Construction*
Drawn			
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 Option #2A North Side SUP Existing

Discipline: CIVIL ENGINEERING

Drawing No.

Rev.

Document No. 3235084-CA-1201 TO 1213.DWG

DO NOT SCALE

IF IN DOUBT ASK.

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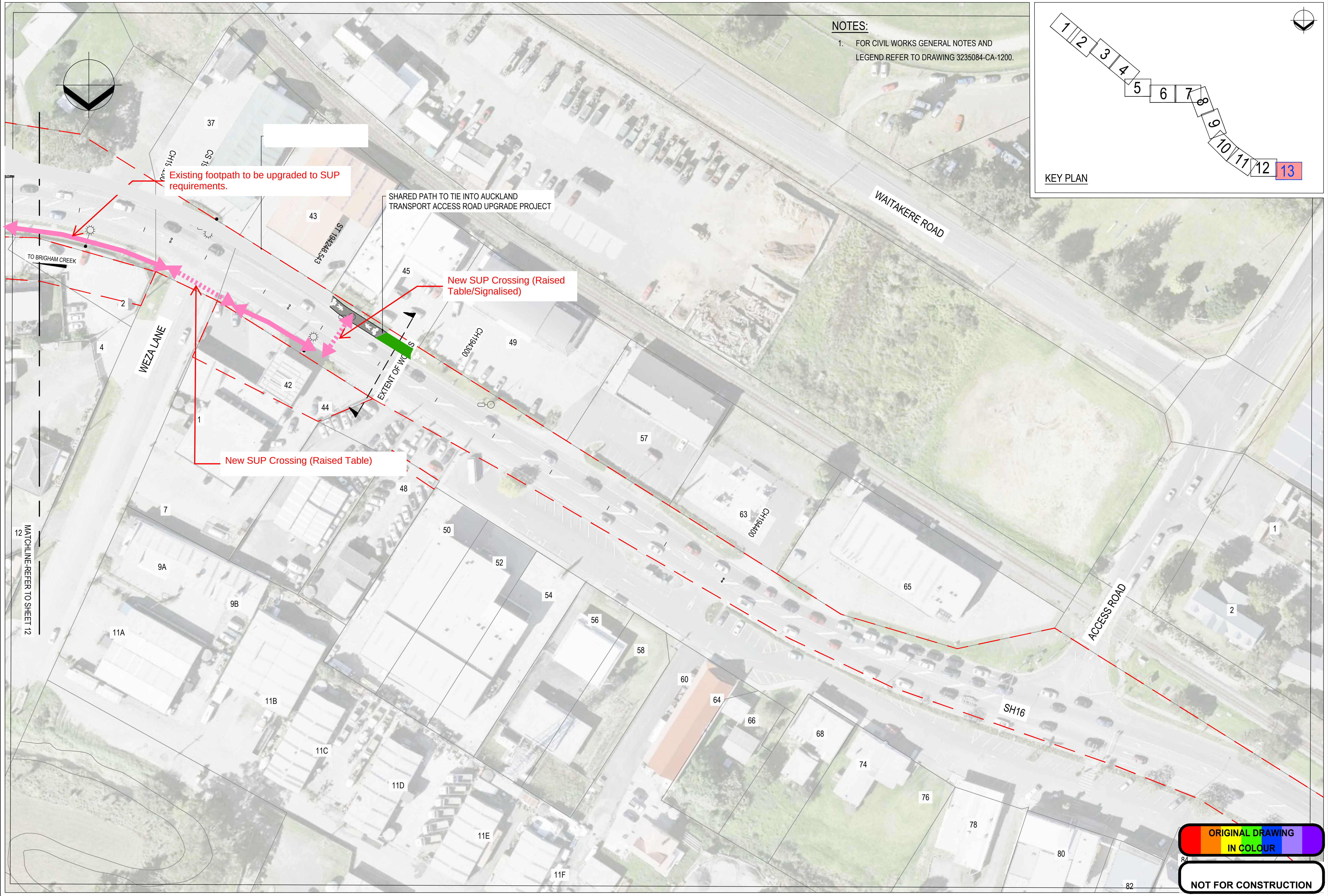
Drawing Plotted: 19 Jan 2022 2:07 PM



ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design / Drawn / 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 Option #2A North Side SUP Existing

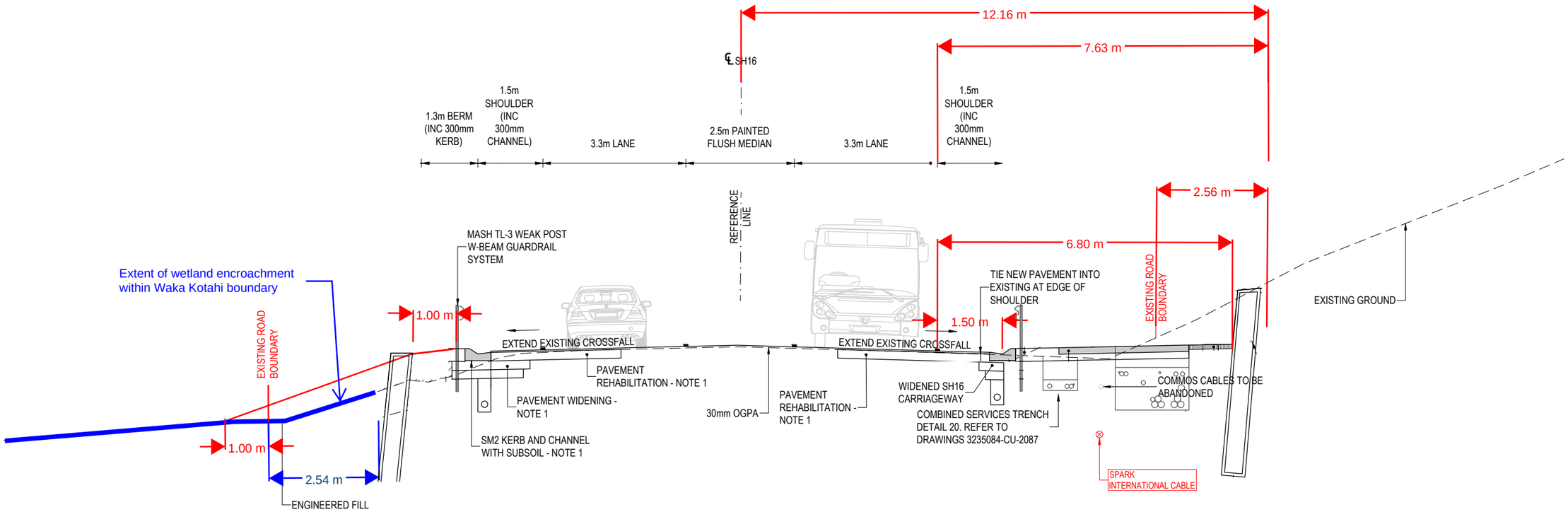
Discipline: CIVIL ENGINEERING

Drawing No. / Rev.

Document No. 3235084-CA-1201 TO 1213.DWG

DO NOT SCALE

IF IN DOUBT ASK.



13 CA-1211 TYPICAL CROSS SECTION AT CH193450
SCALE 1:50 (A1)

NOTE 1: FOR ALL PAVEMENT CONSTRUCTION / REHABILITATION EXTENTS REFER TO PAVEMENT AND SURFACING PLANS 3235084-CP-3100 TO CP-3114. FOR

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

Original Scale (A1) 1:50
Reduced Scale (A3) 1:100

Design			Approved For Construction*
Drawn			
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: TYPICAL CROSS SECTIONS Option #2A North Side SUP Existing

Discipline: CIVIL ENGINEERING
Drawing No.
Rev.

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

DO NOT SCALE

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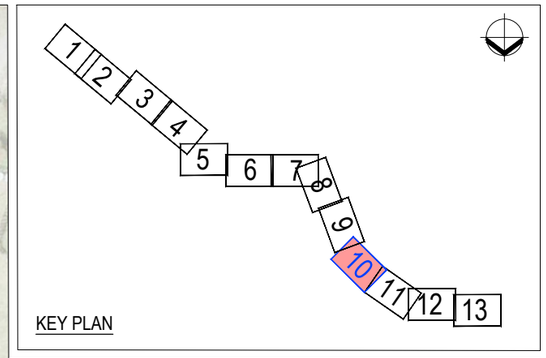
Drawing Plotted: 19 Jan 2022 2:08 PM

NOTES:

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



MATCHLINE REFER TO SHEET 9

RECONSTRUCT EXISTING PROPERTY ACCESS

New SUP requirements (3m wide, 1m berms)

NEW 2.5m WIDE FLUSH MEDIAN

CH193100

RECONSTRUCT EXISTING PROPERTY ACCESS

TO 193145.362

SUP Crossing (Raised Table/Signalised) to tie back into Southern side SUP alignment.

CH193200

CT 193271.4 m

CH193300

RECONSTRUCT EXISTING PROPERTY ACCESS

NEW TL-3 W-BEAM BARRIER SYSTEM

CH193400

NEW RETAINING WALL GRW8. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

EXISTING WETLAND

MATCHLINE REFER TO SHEET 11

506

TO BRIGHAM CREEK

SH16

TO KUMEU

NEW CONVEYANCE AND DIVERSION CHANNEL. FOR DETAILS REFER TO STORMWATER DRAWINGS

7.63 m

HEART AND SOUL EARLY LEARNING CENTRE

RECONSTRUCT EXISTING PROPERTY ACCESS

RECONSTRUCT EXISTING PROPERTY ACCESS

EXISTING POWER POLE

EXISTING LIGHTING COLUMN

NEW 3:1 EARTHWORKS

RECONSTRUCT EXISTING PROPERTY ACCESS

KUMEU VILLAGE REST HOME

507

New SUP requirements (3m wide, 1m berms)

491

505

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design | Drawn | 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
Option #2B North Side SUP Existing

Discipline: CIVIL ENGINEERING

Drawing No. | Rev.

Document No. 3235084-CA-1201 TO 1213.DWG

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IF IN DOUBT ASK.

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Drawing Plotted: 19 Jan 2022 2:07 PM

NOTES:

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

KEY PLAN

EXISTING WETLAND

NEW RETAINING WALL GRW8. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

NEW 2.5m WIDE FLUSH MEDIAN

MATCHLINE-REFER TO SHEET 10

NEW TL-3 W-BEAM BARRIER SYSTEM

RECONSTRUCT EXISTING PROPERTY ACCESS

EXISTING POWER POLE

NEW CONVEYANCE AND DIVERSION CHANNEL. FOR DETAILS REFER TO STORMWATER DRAWINGS

BP SERVICE STATION

New SUP requirements (3m wide, 1m berms)

MATCHLINE-REFER TO SHEET 12

SH16

7.60 m

3.50 m

2.50 m

TO BRIGHAM CREEK

EXISTING LIGHTING COLUMN

NEW 3:1 EARTHWORKS

TO KUMEU

New SUP Crossing (Raised Table)

SUP Crossing (Raised Table/Signalised) to tie back into Southern side SUP alignment.

New SUP requirements (3m wide, 1m berms)

KUMEU VILLAGE REST HOME

OLD RAILWAY ROAD

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design | Drawn | 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
Option #2B North Side SUP Existing

Discipline: CIVIL ENGINEERING

Drawing No. | Rev.

DO NOT SCALE

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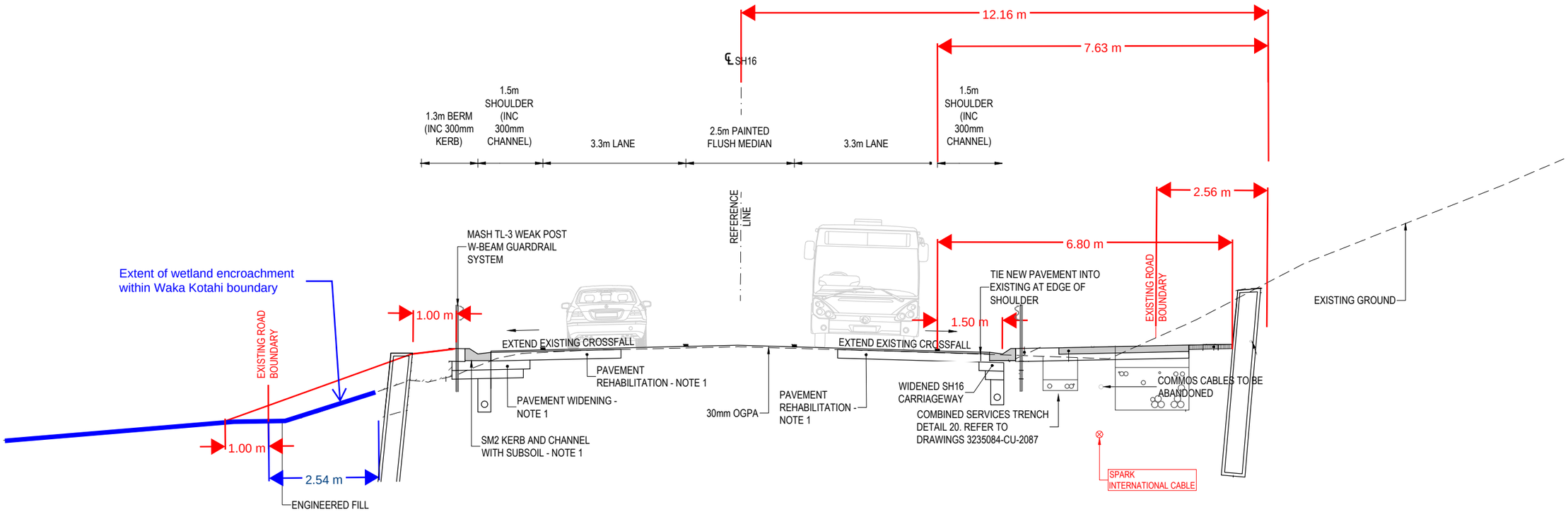
Document No. 3235084-CA-1201 TO 1213.DWG



13 CA-1211 TYPICAL CROSS SECTION AT CH193450
SCALE 1:50 (A1)

NOTE 1: FOR ALL PAVEMENT CONSTRUCTION / REHABILITATION EXTENTS REFER TO PAVEMENT AND SURFACING PLANS 3235084-CP-3100 TO CP-3114. FOR

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

Original Scale (A1) 1:50
Reduced Scale (A3) 1:100

Design			Approved For Construction*
Drawn			
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: TYPICAL CROSS SECTIONS Option #2B North Side SUP Existing

Discipline: CIVIL ENGINEERING
Drawing No.
Rev.

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

DO NOT SCALE

IF IN DOUBT ASK.

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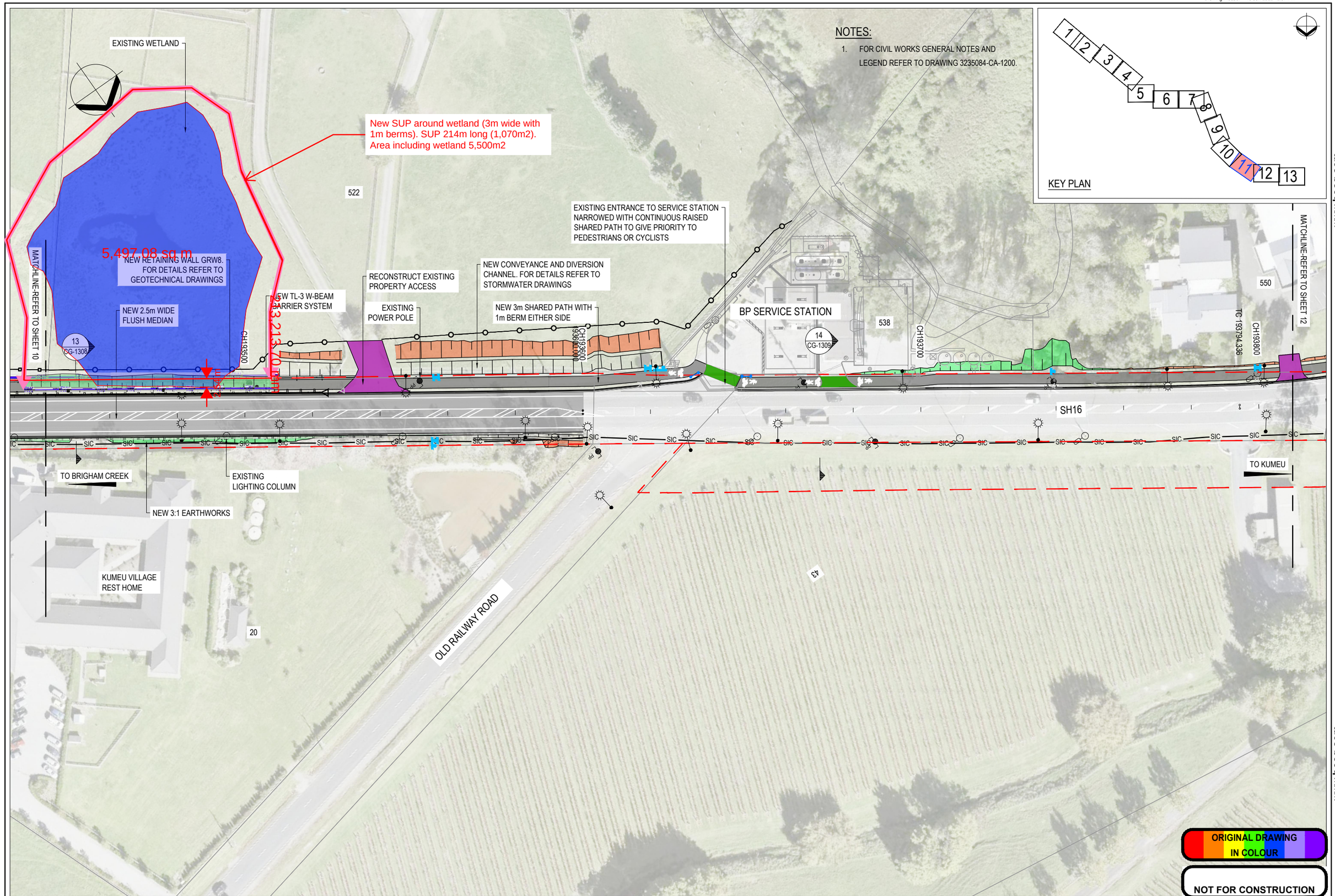
Drawing Plotted: 19 Jan 2022 2:07 PM



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NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design			Approved For Construction*
Drawn			
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 Option #3 SUP South Side Around Wetland

Discipline: CIVIL ENGINEERING

Drawing No.

Rev.

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Document No. 3235084-CA-1201 TO 1213.DWG

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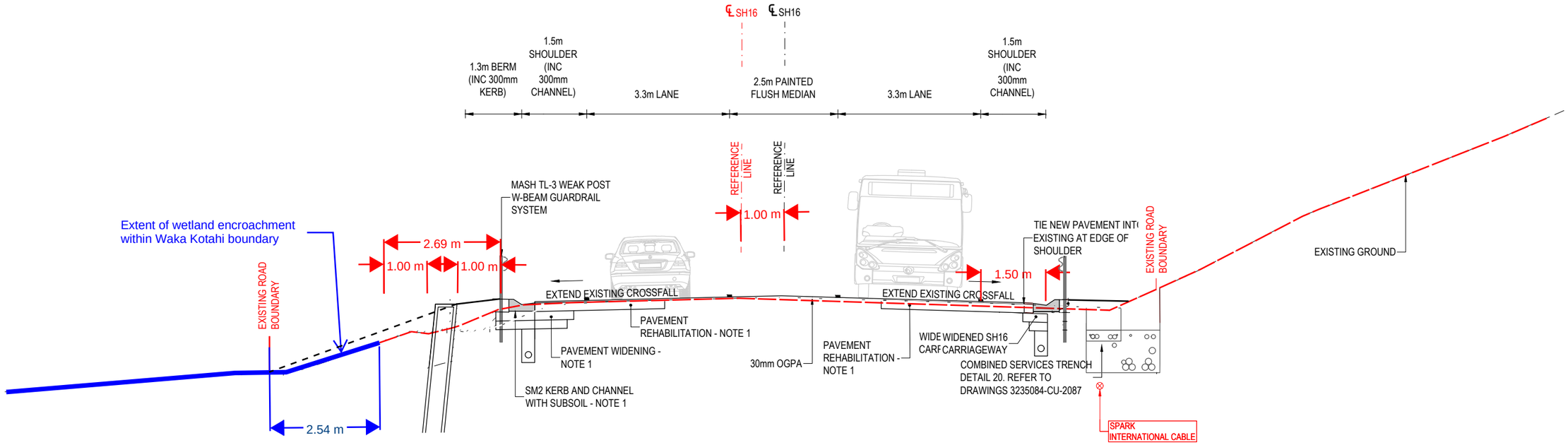

13 CA-1211 TYPICAL CROSS SECTION AT CH193450
SCALE 1:50 (A1)

NOTE 1: FOR ALL PAVEMENT CONSTRUCTION / REHABILITATION EXTENTS REFER TO PAVEMENT AND SURFACING PLANS 3235084-CP-3100 TO CP-3114. FOR

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

Original Scale (A1) 1:50
Reduced Scale (A3) 1:100

Design			Approved For Construction*
Drawn			
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: TYPICAL CROSS SECTIONS Option #3 SUP South Side Around Wetland

Discipline: CIVIL ENGINEERING

Drawing No.

Rev.

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

DO NOT SCALE

IF IN DOUBT ASK.

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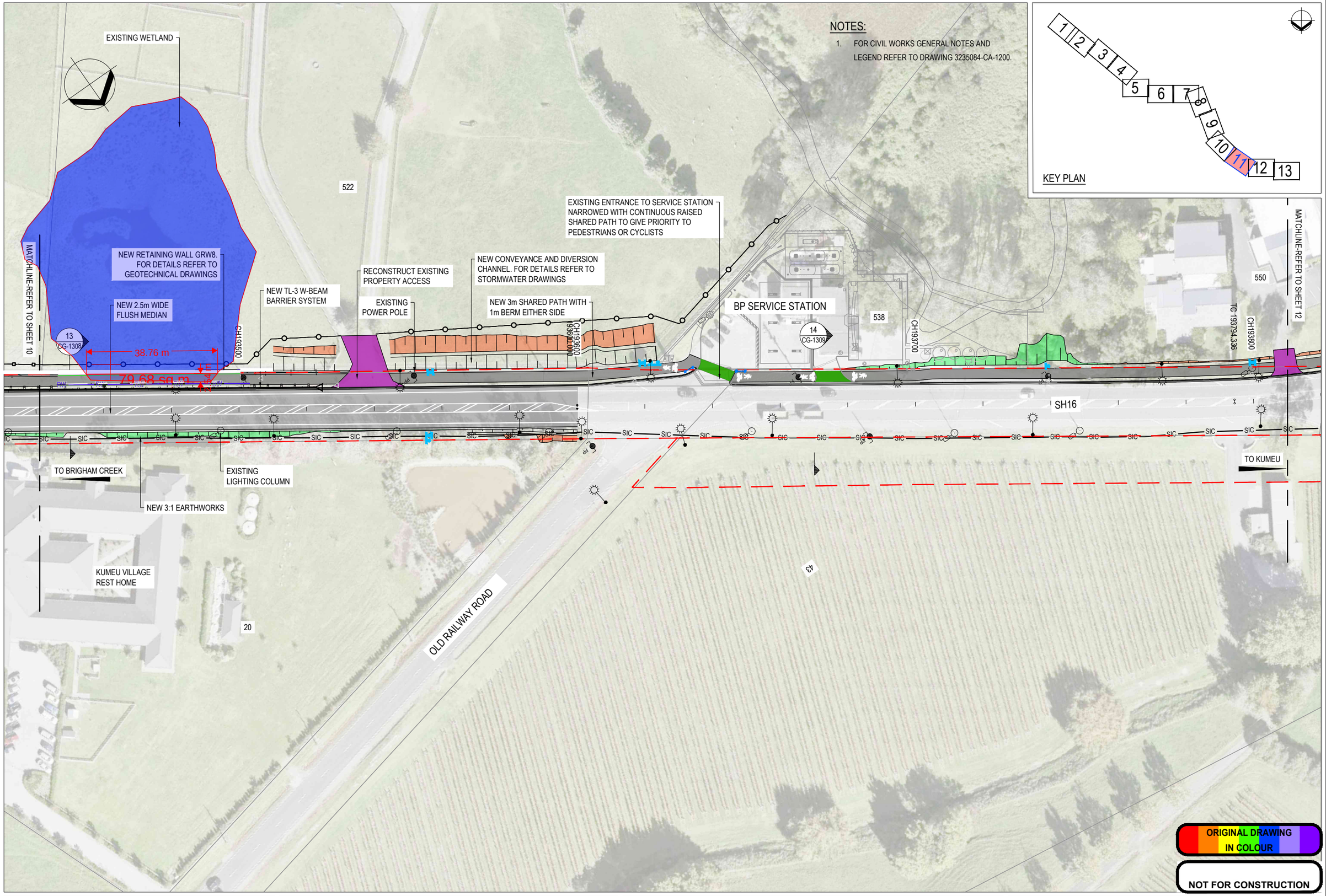
Document No. 3235084-CG-1301 TO 1309.DWG

Drawing Plotted: 19 Jan 2022 2:07 PM



No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design			Approved For Construction*
Drawn			
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 Option #4 SUP Bridge Existing

Discipline: CIVIL ENGINEERING

Drawing No.

Rev.

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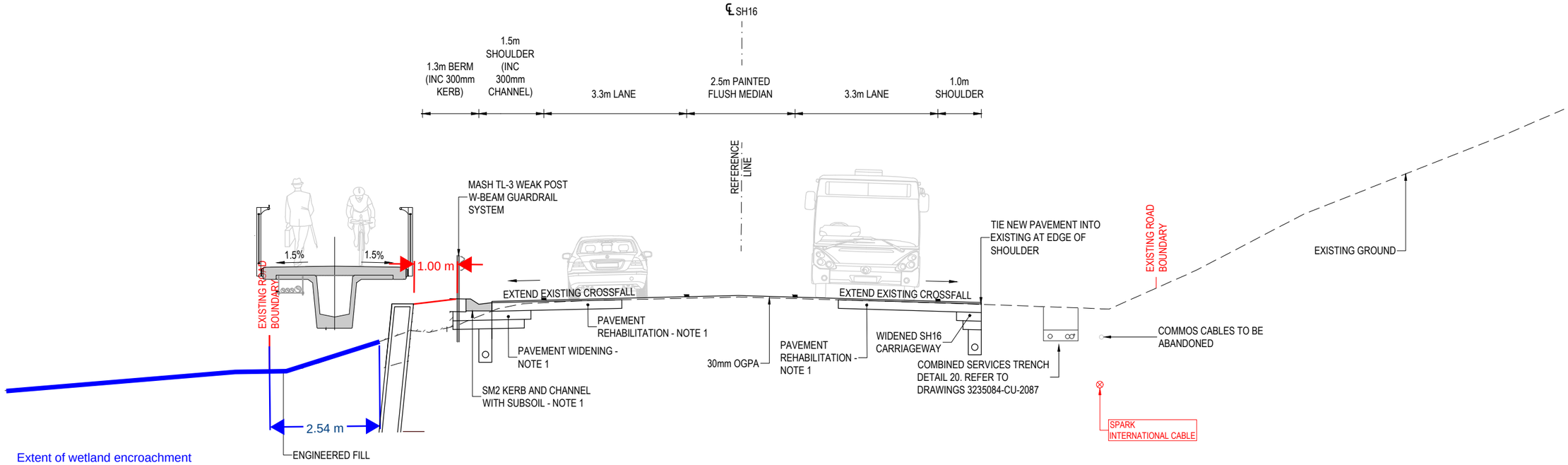
Document No. 3235084-CA-1201 TO 1213.DWG



13 CA-1211 TYPICAL CROSS SECTION AT CH193450
SCALE 1:50 (A1)

NOTE 1: FOR ALL PAVEMENT CONSTRUCTION / REHABILITATION EXTENTS REFER TO PAVEMENT AND SURFACING PLANS 3235084-CP-3100 TO CP-3114. FOR

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

Original Scale (A1) 1:50
Reduced Scale (A3) 1:100

Design			Approved For Construction*
Drawn			
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: TYPICAL CROSS SECTIONS Option #4 SUP Bridge Existing

Discipline: CIVIL ENGINEERING
Drawing No.
Rev.

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

DO NOT SCALE

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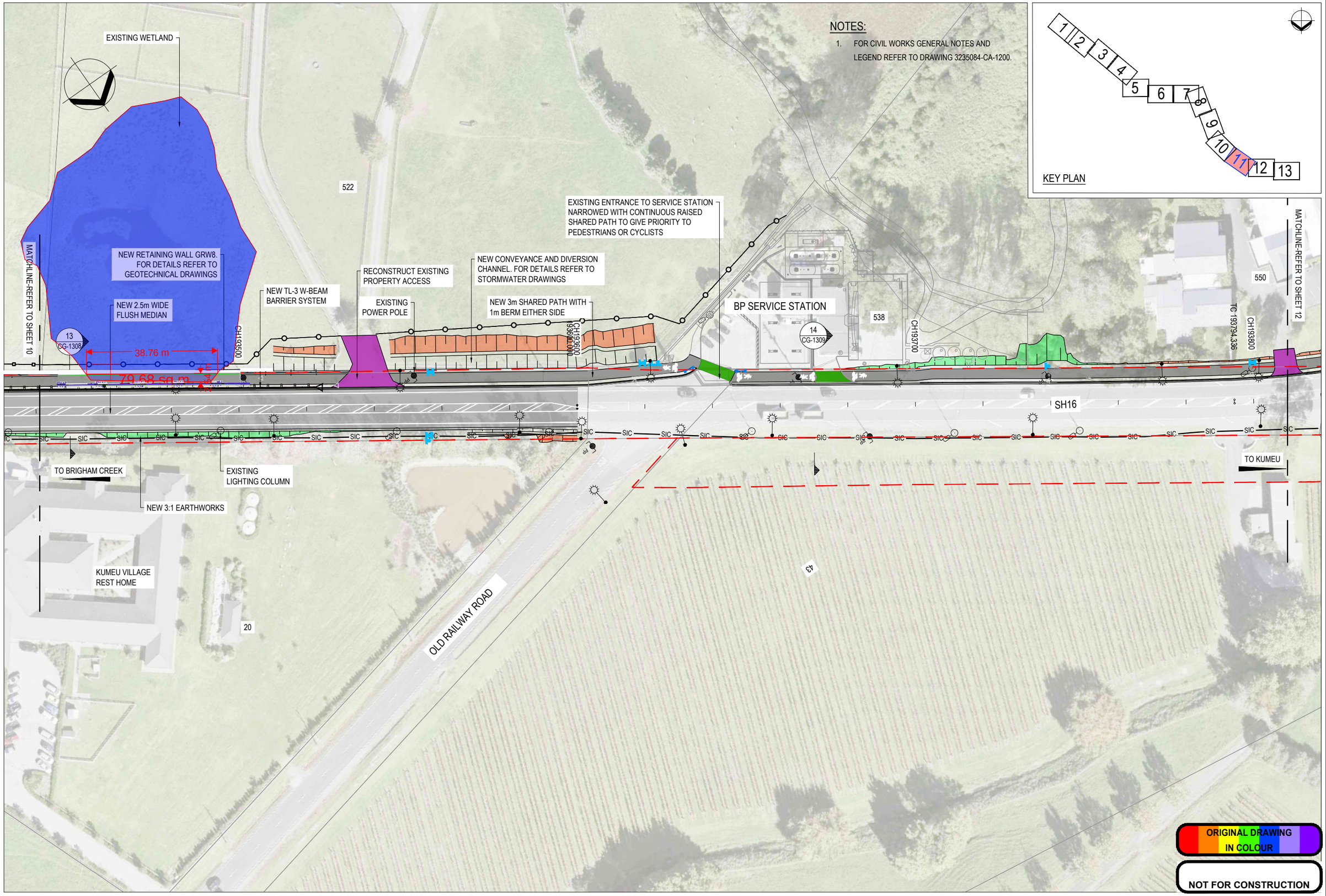
Document No. 3235084-CG-1301 TO 1309.DWG

Drawing Plotted: 19 Jan 2022 2:07 PM



No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design			Approved For Construction*
Drawn			
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 Option #5 SUP Boardwalk Existing

Discipline: CIVIL ENGINEERING

Drawing No.: | Rev.:

DO NOT SCALE

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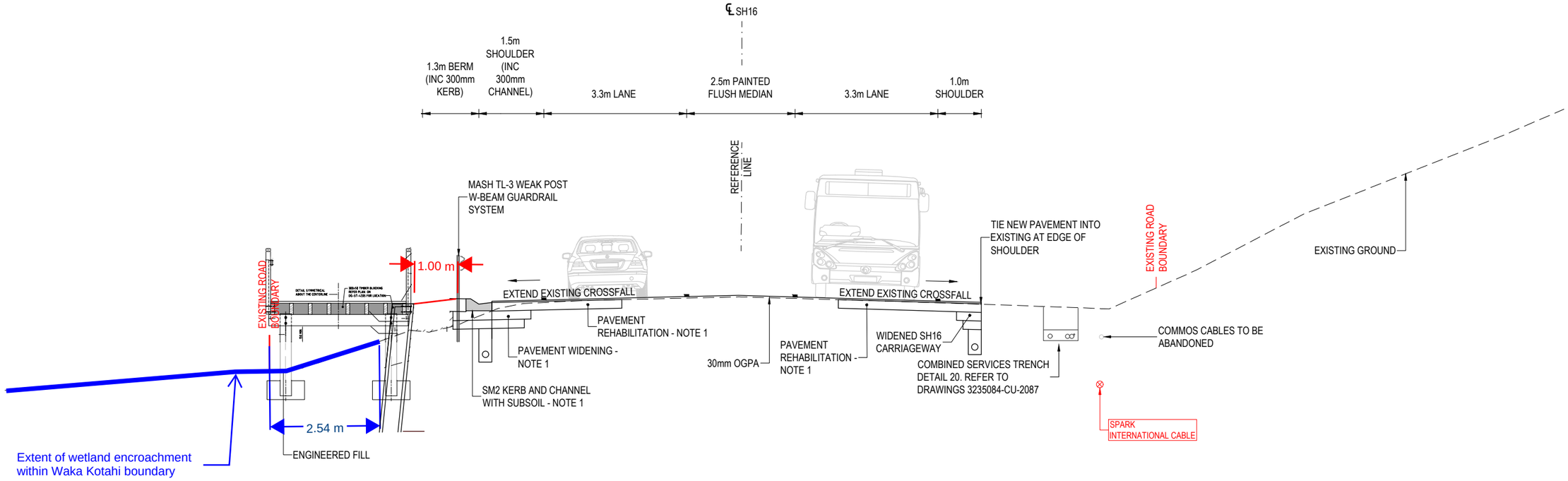
Document No. 3235084-CA-1201 TO 1213.DWG



13 CA-1211 TYPICAL CROSS SECTION AT CH193450
SCALE 1:50 (A1)

NOTE 1: FOR ALL PAVEMENT CONSTRUCTION / REHABILITATION EXTENTS REFER TO PAVEMENT AND SURFACING PLANS 3235084-CP-3100 TO CP-3114. FOR

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

Original Scale (A1) 1:50
Reduced Scale (A3) 1:100

Design			Approved For Construction*
Drawn			
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: TYPICAL CROSS SECTIONS Option #5 SUP Boardwalk Existing

Discipline: CIVIL ENGINEERING

Drawing No. | Rev.

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

DO NOT SCALE

IF IN DOUBT ASK.

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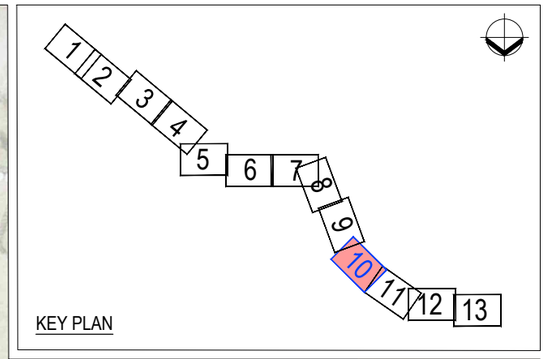
Document No. 3235084-CG-1301 TO 1309.DWG

Drawing Plotted: 19 Jan 2022 2:08 PM

NOTES:

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



KEY PLAN

MATCHLINE REFER TO SHEET 9

RECONSTRUCT EXISTING PROPERTY ACCESS

NEW 2.5m WIDE FLUSH MEDIAN

CH19310.00

TO 19315.362

Approximate tie-in location of realigned corridor

NEW 3m SHARED PATH WITH 1m BERM EITHER SIDE

CH1932

CT 19327.4

CH1933

482

506

EXISTING WETLAND

MATCHLINE REFER TO SHEET 11

NEW RETAINING WALL GRW8. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

NEW TL-3 W-BEAM BARRIER SYSTEM

CH19340

RECONSTRUCT EXISTING PROPERTY ACCESS

TO BRIGHAM CREEK

NEW CONVEYANCE AND DIVERSION CHANNEL. FOR DETAILS REFER TO STORMWATER DRAWINGS

HEART AND SOUL EARLY LEARNING CENTRE

RECONSTRUCT EXISTING PROPERTY ACCESS

RECONSTRUCT EXISTING PROPERTY ACCESS

EXISTING POWER POLE

EXISTING LIGHTING COLUMN

NEW 3:1 EARTHWORKS

RECONSTRUCT EXISTING PROPERTY ACCESS

KUMEU VILLAGE REST HOME

TO KUMEU

507

505

491

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design			Approved For Construction*
Drawn			
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 Option #6 SUP South Realigned

Discipline: CIVIL ENGINEERING

Drawing No.

Rev.

DO NOT SCALE

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Document No. 3235084-CA-1201 TO 1213.DWG

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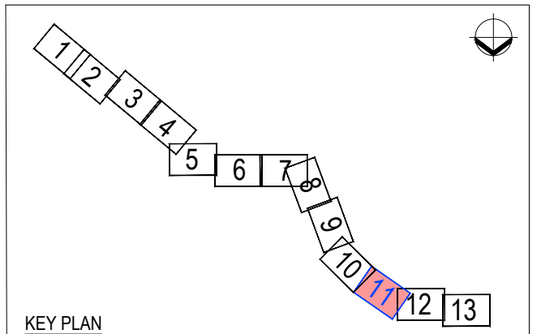
Drawing Plotted: 19 Jan 2022 2:07 PM

NOTES:

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

KEY PLAN



EXISTING WETLAND

NEW RETAINING WALL GRW8. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

NEW 2.5m WIDE FLUSH MEDIAN

MATCHLINE-REFER TO SHEET 10

13 CG-1308

CH193600

522

NEW TL-3 W-BEAM BARRIER SYSTEM

RECONSTRUCT EXISTING PROPERTY ACCESS

EXISTING POWER POLE

NEW CONVEYANCE AND DIVERSION CHANNEL. FOR DETAILS REFER TO STORMWATER DRAWINGS

NEW 3m SHARED PATH WITH 1m BERM EITHER SIDE

CH193600

EXISTING ENTRANCE TO SERVICE STATION NARROWED WITH CONTINUOUS RAISED SHARED PATH TO GIVE PRIORITY TO PEDESTRIANS OR CYCLISTS

BP SERVICE STATION

14 CG-1309

538

CH193700

550

TC 193794.336

CH193800

MATCHLINE-REFER TO SHEET 12

5.76 m

9.10 m

2.52 m

3.04 m

3.53 m

TO BRIGHAM CREEK

EXISTING LIGHTING COLUMN

NEW 3:1 EARTHWORKS

Approximate tie-in location of realigned corridor

TO KUMEU

KUMEU VILLAGE REST HOME

20

OLD RAILWAY ROAD

43

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ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design		Approved For Construction*
Drawn		
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 Option #6 SUP South Realigned

Discipline: CIVIL ENGINEERING

Drawing No.

Rev.

DO NOT SCALE

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Document No. 3235084-CA-1201 TO 1213.DWG

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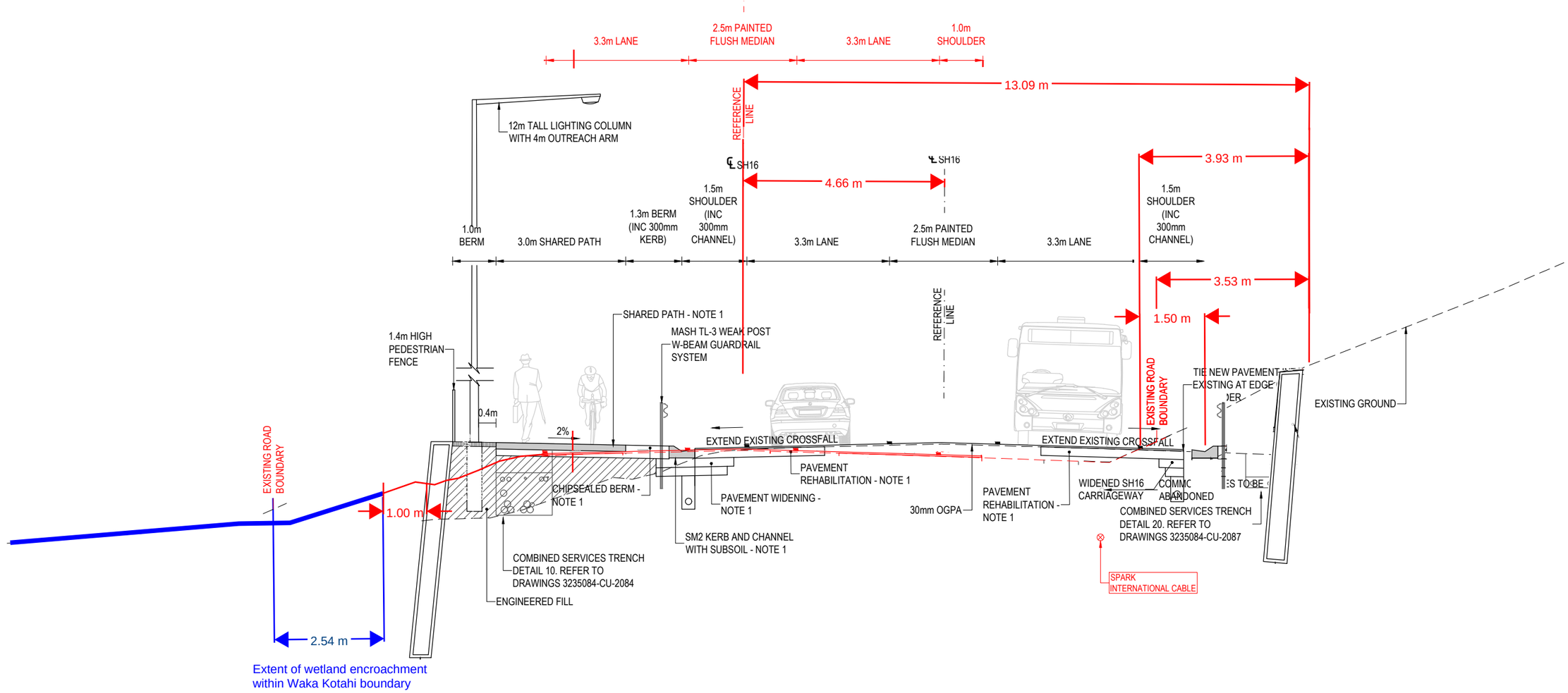

13 CA-1211 TYPICAL CROSS SECTION AT CH193450
SCALE 1:50 (A1)

NOTE 1: FOR ALL PAVEMENT CONSTRUCTION / REHABILITATION EXTENTS REFER TO PAVEMENT AND SURFACING PLANS 3235084-CP-3100 TO CP-3114. FOR

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

Original Scale (A1) 1:50
Reduced Scale (A3) 1:100

Design			Approved For Construction*
Drawn			
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: TYPICAL CROSS SECTIONS Option #6 SUP South Realigned

Discipline: CIVIL ENGINEERING

Drawing No.

Rev.

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

DO NOT SCALE

IF IN DOUBT ASK.

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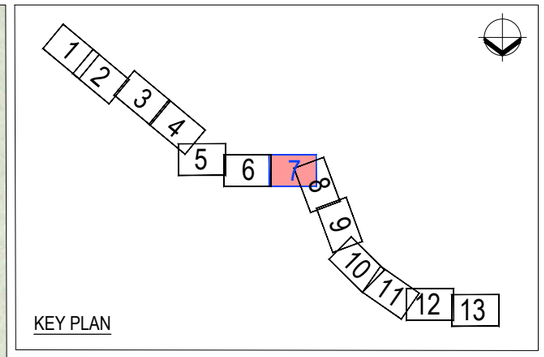
Document No. 3235084-CG-1301 TO 1309.DWG

Drawing Plotted: 19 Jan 2022 2:09 PM

NOTES:

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



New SUP Crossing (Raised Table/Signalised)

TAUPAKI ROAD

EXTENT OF WORKS

455

466

454

CT 192073 to

192096

TO BRIGHAM CREEK

CH192180

CH192200

EXISTING MERGE TAPER TO BE MAINTAINED

NEW TREATMENT SWALE. FOR DETAILS REFER TO STORMWATER DRAWINGS

RECONSTRUCT EXISTING PROPERTY ACCESS

CH192300

TC 192

CH192400

NEW 2.5m WIDE FLUSH MEDIAN

TO KUMEU

SH16

EXTENT OF WORKS

SIC

EXISTING ROUNDABOUT TO REMAIN

ALLELY ESTATE

393

EXISTING POWER POLE

EXISTING LIGHTING COLUMN

MAINTAIN EXISTING PAVEMENT EDGE ON NORTHERN SIDE BETWEEN CH192220 AND CH192390

KUMEU PRODUCE MARKET

NEW 3:1 EARTHWORKS

New SUP Crossing (Raised Table)

New SUP requirements (3m wide, 1m berms)

MATCHLINE-REFER TO SHEET 6

OLD NORTH ROAD

MATCHLINE-REFER TO SHEET 8

407

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

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No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design			Approved For Construction*
Drawn			
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 Option #7A North Side SUP Realigned

Discipline: CIVIL ENGINEERING

Drawing No.

Rev.

Document No. 3235084-CA-1201 TO 1213.DWG

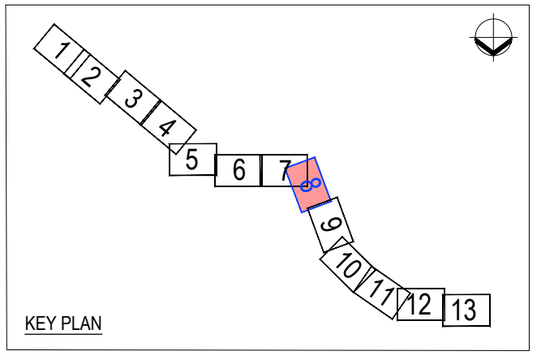
DO NOT SCALE

IF IN DOUBT ASK.

Drawing Plotted: 19 Jan 2022 2:08 PM

NOTES:

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



EXISTING WETLAND, APPROXIMATE MINIMUM DISTANCE TO THE PROPOSED RETAINING WALL IS 9.97m.

NEW RETAINING WALL SRW2. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

NEW TL-3 W-BEAM BARRIER SYSTEM

NEW RETENTION SWALE. FOR DETAILS REFER TO STORMWATER DRAWINGS

NEW 2.5m WIDE FLUSH MEDIAN

NEW TREATMENT SWALE. FOR DETAILS REFER TO STORMWATER DRAWINGS

RECONSTRUCT EXISTING PROPERTY ACCESS

RECONSTRUCT EXISTING PROPERTY ACCESS

RECONSTRUCT EXISTING PROPERTY ACCESS

EXISTING LIGHTING COLUMN

EXISTING POWER POLE

NEW RETAINING WALL GRW5. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

NEW RETENTION SWALE. FOR DETAILS REFER TO STORMWATER DRAWINGS

NEW RETENTION SWALE. FOR DETAILS REFER TO STORMWATER DRAWINGS

NEW CONVEYANCE AND DIVERSION CHANNEL. FOR DETAILS REFER TO STORMWATER DRAWINGS

RECONSTRUCT EXISTING PROPERTY ACCESS

NEW 3:1 EARTHWORKS

New SUP requirements (3m wide, 1m berms)

SH16

TO KUMEU

TO BRIGHAM CREEK

KUMEU PRODUCE MARKET

MATCHLINE-REFER TO SHEET 7

MATCHLINE-REFER TO SHEET 9

CH192500

CH192600

CH192700

CH192400

CH192300

CT 18260/875

11 CG-1307

9.97m

436

429

418

407

454

TC 192

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design			Approved For Construction*
Drawn			
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 Option #7A North Side SUP Realigned

Discipline: CIVIL ENGINEERING

Drawing No.: Rev.:

DO NOT SCALE

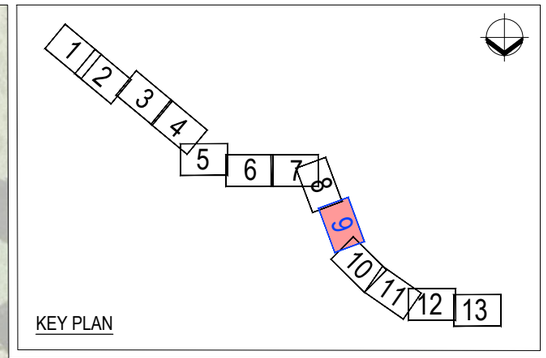
IF IN DOUBT ASK.

Document No. 3235084-CA-1201 TO 1213.DWG

Drawing Plotted: 19 Jan 2022 2:08 PM

NOTES:

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



NEW TL-3 W-BEAM BARRIER SYSTEM

NEW 2.5m WIDE FLUSH MEDIAN

12
CG-1307

NEW RETAINING WALL GRW6. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

PHIL GREIG STRAWBERRY GARDENS

CH192800

464

NEW RETAINING WALL GRW6. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

CH192900

RECONSTRUCT EXISTING PROPERTY ACCESS

NEW 3m SHARED PATH WITH 1m BERM EITHER SIDE

CH193000

RECONSTRUCT EXISTING PROPERTY ACCESS

472

MATCHLINE-REFER TO SHEET 10

SH16

60 km

TO BRIGHAM CREEK

60 km

TO KUMEU

NEW CONVEYANCE AND DIVERSION CHANNEL. FOR DETAILS REFER TO STORMWATER DRAWINGS

NEW RETAINING WALL GRW7. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

EXISTING POWER POLE

EXISTING LIGHTING COLUMN

RECONSTRUCT EXISTING PROPERTY ACCESS

New SUP requirements (3m wide, 1m berms)

RECONSTRUCT EXISTING PROPERTY ACCESS

NEW CONVEYANCE AND DIVERSION CHANNEL. FOR DETAILS REFER TO STORMWATER DRAWINGS

RECONSTRUCT EXISTING PROPERTY ACCESS

451

465

475

MATCHLINE-REFER TO SHEET 8

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design			Approved For Construction*
Drawn			
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 Option #7A North Side SUP Realigned

Discipline: CIVIL ENGINEERING

Drawing No.

Rev.

DO NOT SCALE

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Document No. 3235084-CA-1201 TO 1213.DWG

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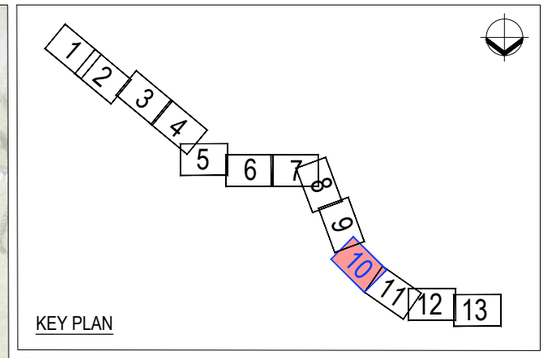

KEY PLAN

MATCHLINE: REFER TO SHEET 9

RECONSTRUCT EXISTING PROPERTY ACCESS

NEW 2.5m WIDE FLUSH MEDIAN

CH193100

TO 193145.362

RECONSTRUCT EXISTING PROPERTY ACCESS

482

CH193200

CT 193271.4 m

CH193300

506

NEW RETAINING WALL GRW8. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

EXISTING WETLAND

MATCHLINE: REFER TO SHEET 11

NEW TL-3 W-BEAM BARRIER SYSTEM

CH193400

RECONSTRUCT EXISTING PROPERTY ACCESS

SH16

TO BRIGHAM CREEK

TO KUMEU

NEW CONVEYANCE AND DIVERSION CHANNEL. FOR DETAILS REFER TO STORMWATER DRAWINGS

7.60 m

HEART AND SOUL EARLY LEARNING CENTRE

RECONSTRUCT EXISTING PROPERTY ACCESS

RECONSTRUCT EXISTING PROPERTY ACCESS

EXISTING POWER POLE

EXISTING LIGHTING COLUMN

NEW 3:1 EARTHWORKS

RECONSTRUCT EXISTING PROPERTY ACCESS

KUMEU VILLAGE REST HOME

507

New SUP requirements (3m wide, 1m berms)

New SUP requirements (3m wide, 1m berms)

491

505

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design			Approved For Construction*
Drawn			
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
Option #7A North Side SUP Realigned

Discipline: CIVIL ENGINEERING

Drawing No. | Rev.

DO NOT SCALE

IF IN DOUBT ASK.

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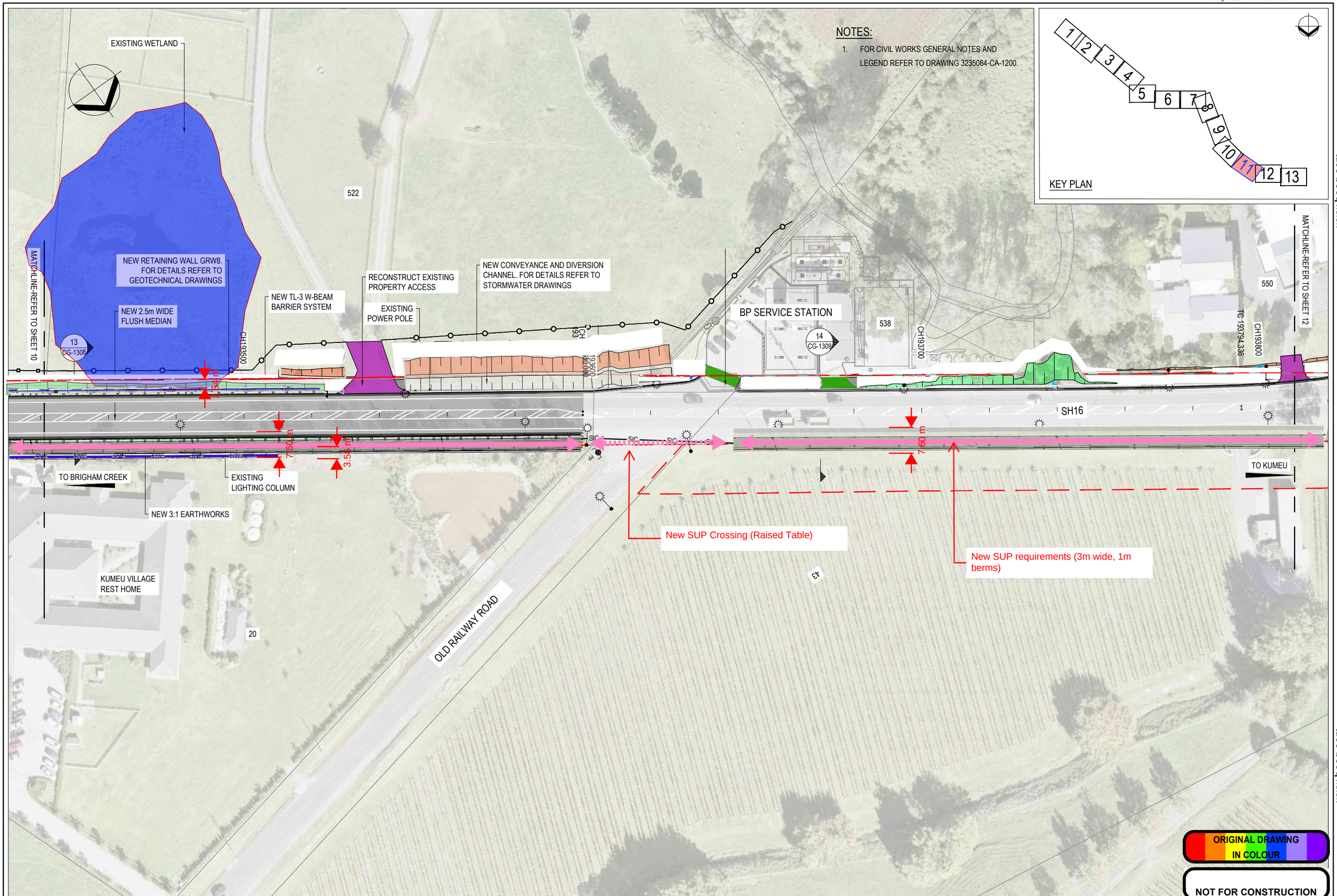
Drawing Plotted: 19 Jan 2022 2:07 PM



NOTES:

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

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No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design		Approved For Construction*
Drawn		
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
Option #7A North Side SUP Realigned

Discipline: CIVIL ENGINEERING

Drawing No.

Rev.

DO NOT SCALE

IF IN DOUBT ASK.

Document No. 3235084-CA-1201 TO 1213.DWG

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Drawing Plotted: 19 Jan 2022 2:07 PM

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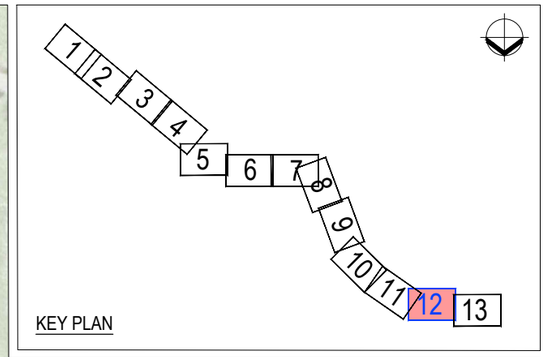
1. FOR CIVIL WORKS GENERAL NOTES AND LEGEND REFER TO DRAWING 3235084-CA-1200.



TO BRIGHAM CREEK

CH193800

CH193934.356

MATCHLINE-REFER TO SHEET 11

550

KUMEU RIVER WINERY

RECONSTRUCT EXISTING PROPERTY ACCESS

NEW RETENTION SWALE. FOR DETAILS REFER TO STORMWATER DRAWINGS

NEW 3m SHARED PATH WITH 1m BERM EITHER SIDE

5

3

CH193960

NEW 3:1 EARTHWORKS

NEW PEDESTRIAN FOOTBRIDGE ADJACENT TO KUMEU BRIDGE No.1 FOR DETAILS REFER TO STRUCTURAL DRAWINGS

CT 193989.486

CH194000

15
CG-1309

NEW RETAINING WALL GRW9. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

NEW TL-3 W-BEAM BARRIER SYSTEM

94/064.143

7

CH194100

SC 194144.14

TO KUMEU

SH16

16

Existing footpath to be upgraded to SUP requirements.

14

EXISTING KUMEU BRIDGE No.1 TO REMAIN

Existing SUP Bridge (upgrade/replace)

New SUP Crossing (Raised Table)

2-12

RIVERHEAD ROAD

New SUP requirements (3m wide, 1m berms)

Existing footpath to be upgraded to SUP requirements.

12

MATCHLINE-REFER TO SHEET 13

14

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design			Approved For Construction*
Drawn			
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 Option #7A North Side SUP Realigned

Discipline: CIVIL ENGINEERING

Drawing No.

Rev.

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Document No. 3235084-CA-1201 TO 1213.DWG

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Drawing Plotted: 19 Jan 2022 2:07 PM

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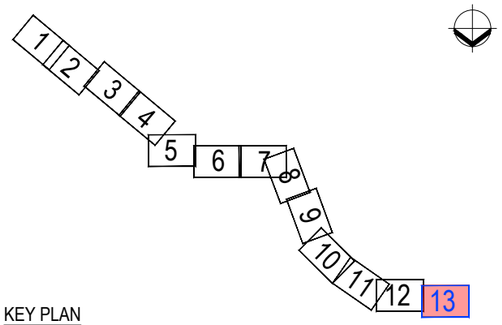
1. FOR CIVIL WORKS GENERAL NOTES AND LEGEND REFER TO DRAWING 3235084-CA-1200.

KEY PLAN



Existing footpath to be upgraded to SUP requirements.

SHARED PATH TO TIE INTO AUCKLAND TRANSPORT ACCESS ROAD UPGRADE PROJECT

New SUP Crossing (Raised Table/Signalised)

New SUP Crossing (Raised Table)

WAITAKERE ROAD

WEZA LANE

ACCESS ROAD

SH16

EXTENT OF WORKS

TO BRIGHAM CREEK

MATCHLINE-REFER TO SHEET 12

CH19420.543

CH19430

CH19440

CH19400

37 43 45 49 57 63 65 1 2 4 2 42 44 1 48 50 52 54 56 58 60 64 66 68 74 76 78 80 82 84 7 12 9A 9B 11A 11B 11C 11D 11E 11F

ORIGINAL DRAWING IN COLOUR

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No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

			Approved For Construction*
Design			
Drawn			
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
Option #7A North Side SUP Realigned

Discipline: CIVIL ENGINEERING

Drawing No. | Rev.

DO NOT SCALE

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Document No. 3235084-CA-1201 TO 1213.DWG

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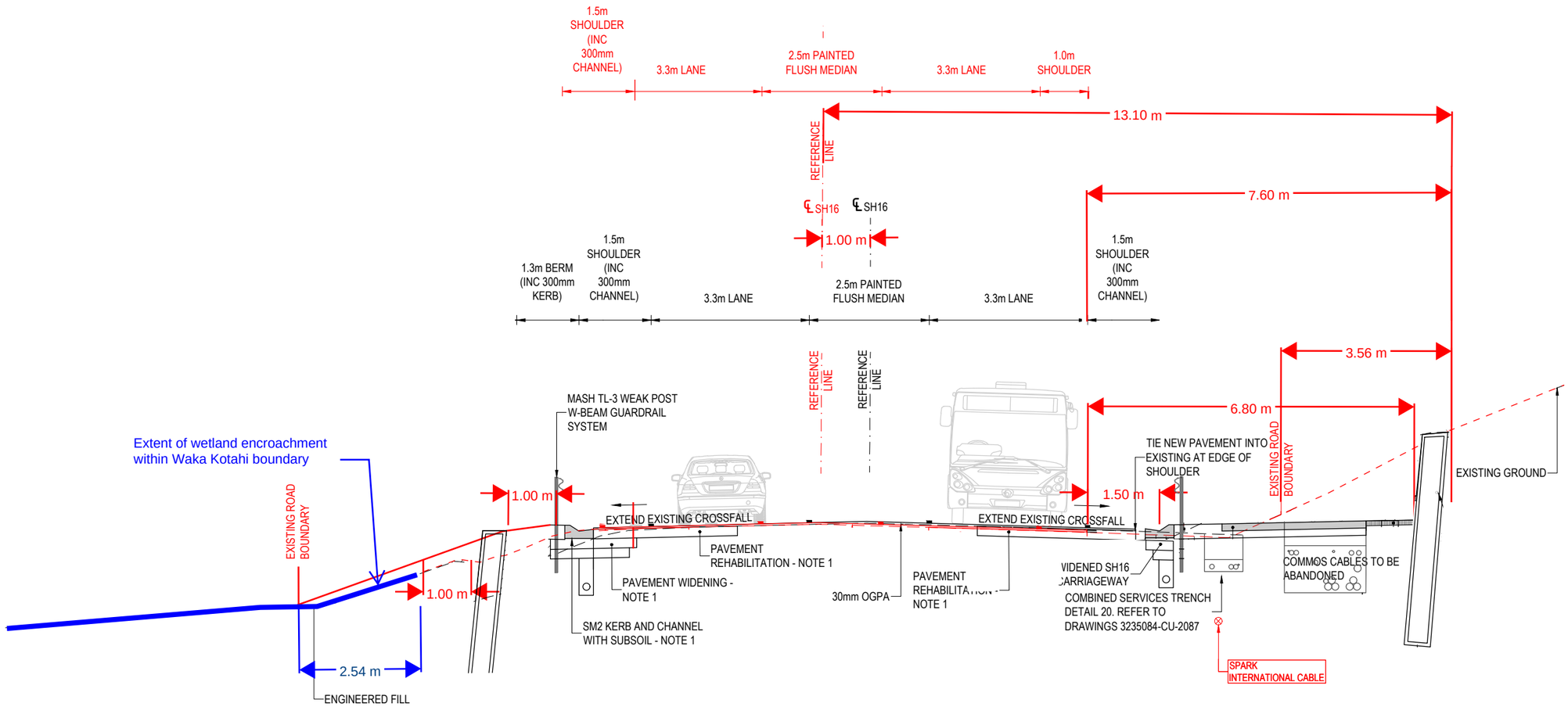

13 CA-1211 TYPICAL CROSS SECTION AT CH193450
SCALE 1:50 (A1)

NOTE 1: FOR ALL PAVEMENT CONSTRUCTION / REHABILITATION EXTENTS REFER TO PAVEMENT AND SURFACING PLANS 3235084-CP-3100 TO CP-3114. FOR

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

Original Scale (A1) 1:50
Reduced Scale (A3) 1:100

Design			Approved For Construction*
Drawn			
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: TYPICAL CROSS SECTIONS Option #7A North Side SUP Realigned

Discipline: CIVIL ENGINEERING

Drawing No. | Rev.

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

DO NOT SCALE

IF IN DOUBT ASK.

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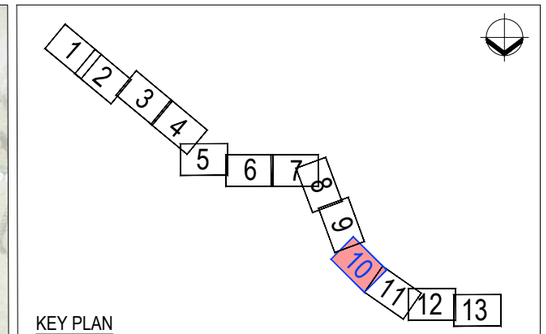
Document No. 3235084-CG-1301 TO 1309.DWG

Drawing Plotted: 19 Jan 2022 2:08 PM

NOTES:

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

KEY PLAN



MATCHLINE: REFER TO SHEET 9

RECONSTRUCT EXISTING PROPERTY ACCESS

New SUP requirements (3m wide, 1m berms)

NEW 2.5m WIDE FLUSH MEDIAN

CH193100

RECONSTRUCT EXISTING PROPERTY ACCESS

TO 193145.362

SUP Crossing (Raised Table/Signalised) to tie back into Southern side SUP alignment.

CH193200

CT 193271.4 m

CH193300

RECONSTRUCT EXISTING PROPERTY ACCESS

NEW TL-3 W-BEAM BARRIER SYSTEM

CH193400

NEW RETAINING WALL GRW8. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

EXISTING WETLAND

MATCHLINE: REFER TO SHEET 11

506

TO BRIGHAM CREEK

NEW CONVEYANCE AND DIVERSION CHANNEL. FOR DETAILS REFER TO STORMWATER DRAWINGS

SH16

TO KUMEU

7.60 m

HEART AND SOUL EARLY LEARNING CENTRE

RECONSTRUCT EXISTING PROPERTY ACCESS

RECONSTRUCT EXISTING PROPERTY ACCESS

RECONSTRUCT EXISTING PROPERTY ACCESS

EXISTING POWER POLE

EXISTING LIGHTING COLUMN

NEW 3:1 EARTHWORKS

KUMEU VILLAGE REST HOME

507

New SUP requirements (3m wide, 1m berms)

491

505

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design			Approved For Construction*
Drawn			
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
Option #7B North Side SUP Realigned

Discipline: CIVIL ENGINEERING

Drawing No. | Rev.

Document No. 3235084-CA-1201 TO 1213.DWG

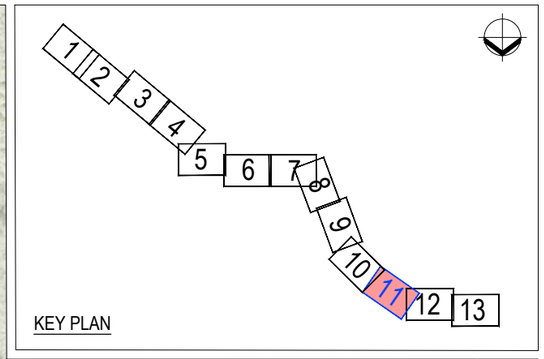
DO NOT SCALE

IF IN DOUBT ASK.

Drawing Plotted: 19 Jan 2022 2:07 PM

NOTES:

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



EXISTING WETLAND

NEW RETAINING WALL GRW8. FOR DETAILS REFER TO GEOTECHNICAL DRAWINGS

NEW 2.5m WIDE FLUSH MEDIAN

MATCHLINE-REFER TO SHEET 10

13 CG-1308

CH193500

NEW TL-3 W-BEAM BARRIER SYSTEM

RECONSTRUCT EXISTING PROPERTY ACCESS

EXISTING POWER POLE

NEW CONVEYANCE AND DIVERSION CHANNEL. FOR DETAILS REFER TO STORMWATER DRAWINGS

CH193600

522

BP SERVICE STATION

14 CG-1309

538

CH193700

New SUP requirements (3m wide, 1m berms)

50

TC 193794.336

CH193800

MATCHLINE-REFER TO SHEET 12

SH16

7.60 m

3.58 m

7.60 m

SIC

TO BRIGHAM CREEK

EXISTING LIGHTING COLUMN

NEW 3:1 EARTHWORKS

TO KUMEU

New SUP Crossing (Raised Table)

SUP Crossing (Raised Table/Signalised) to tie back into Southern side SUP alignment.

New SUP requirements (3m wide, 1m berms)

43

KUMEU VILLAGE REST HOME

20

OLD RAILWAY ROAD

ORIGINAL DRAWING IN COLOUR

NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

Original Scale (A1) 1:500

Reduced Scale (A3) 1:1000

Design | Drawn | 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
Option #7B North Side SUP Realigned

Discipline: CIVIL ENGINEERING

Drawing No. | Rev.

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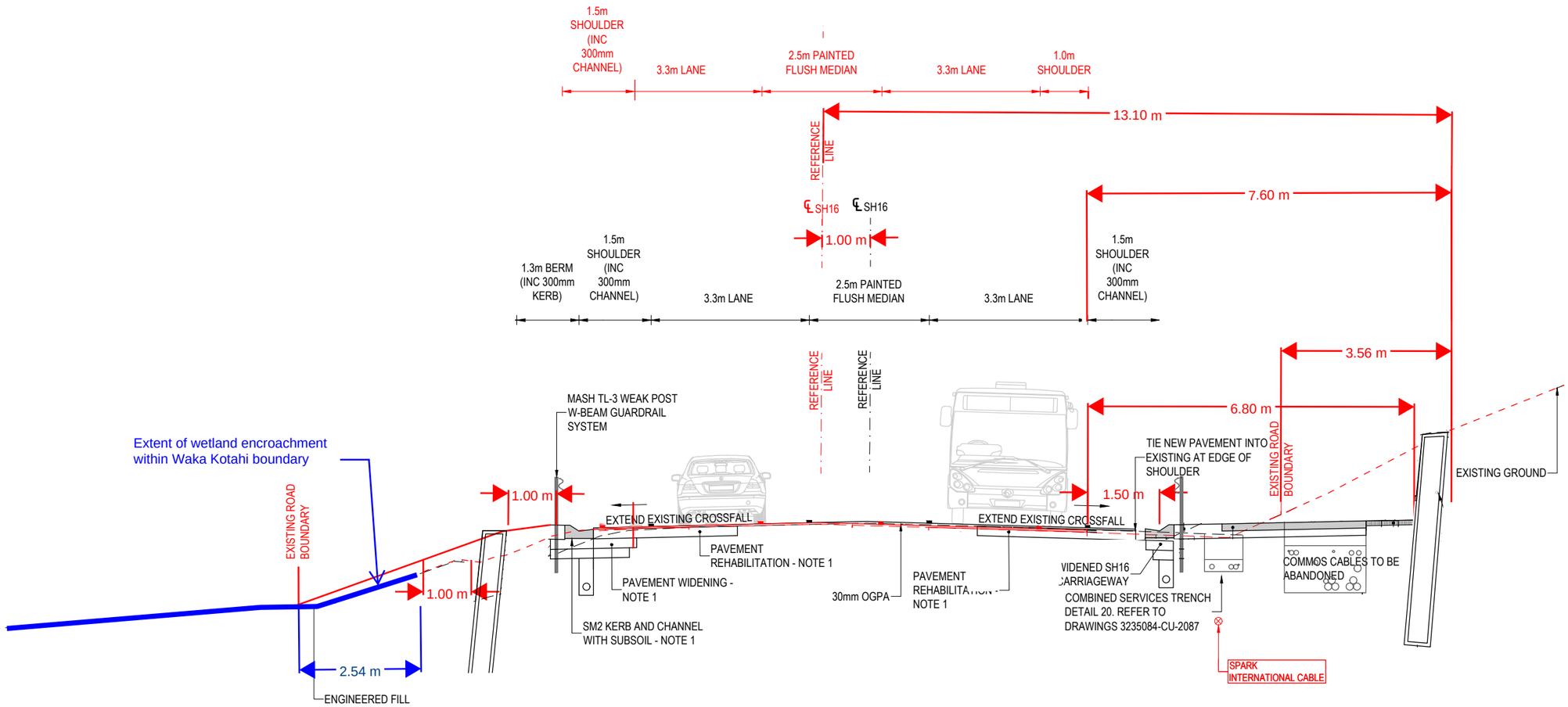

13 CA-1211 TYPICAL CROSS SECTION AT CH193450
SCALE 1:50 (A1)

NOTE 1: FOR ALL PAVEMENT CONSTRUCTION / REHABILITATION EXTENTS REFER TO PAVEMENT AND SURFACING PLANS 3235084-CP-3100 TO CP-3114. FOR

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

Original Scale (A1) 1:50
Reduced Scale (A3) 1:100

Design			Approved For Construction*
Drawn			
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: TYPICAL CROSS SECTIONS Option #7B North Side SUP Realigned

Discipline: CIVIL ENGINEERING

Drawing No. | Rev.

ORIGINAL DRAWING IN COLOUR

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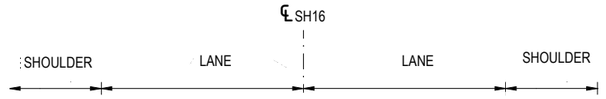
Document No. 3235084-CG-1301 TO 1309.DWG

Drawing Plotted: 18 Jan 2022 5:05 PM



REFERENCE LINE

Extent of wetland encroachment within Waka Kotahi boundary

EXISTING ROAD BOUNDARY

2.54 m

EXISTING GROUND

SPARK INTERNATIONAL CABLE

13 CA-1211 TYPICAL CROSS SECTION AT CH193450
SCALE 1:50 (A1)

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

Original Scale (A1) 1:50
Reduced Scale (A3) 1:100

Design			Approved For Construction*
Drawn			
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: TYPICAL CROSS SECTIONS Current Arrangement

Discipline: CIVIL ENGINEERING

Drawing No.

Rev.

DO NOT SCALE

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O

Appendix O – Localised Design Interface with Wetland Options Assessment

Localised Option Assessment for Project design interface with a Wetland

A localised options assessment was undertaken to assess nine different design options at the interface of a wetland at 522 SH16. It is noted that the wetland delineation extent is different when considered under the RMA and NPS FM definitions where the delineation under the latter is slightly less along the northern edge of the wetland. A total of nine design options were developed for this Localised Option Assessment as outlined below. The details of the various design options are outlined in Appendix N – Wetlands Options.

- **Option 1** – SUP South side existing alignment (i.e. per the early draft detailed design)
- **Option 2a** – North side SUP (long) existing alignment
- **Option 2b** – North side SUP (short) existing alignment
- **Option 3** – SUP South side around wetland
- **Option 4** – SUP Bridge existing alignment
- **Option 5** – SUP Boardwalk existing alignment
- **Option 6** – SUP South Realigned alignment
- **Options 7a** – North side SUP (long) realigned alignment
- **Option 7b** – North side SUP (short) realigned alignment

The table below details the MCA scoring and commentary for the Design Interface with a Wetland Assessment. Workshops analysis notes and identification of the preferred option is found below the table.

Multi-Criteria Analysis Table– Project design interface with wetland at 522 SH16

CRITERIA	OPTION 1	OPTION 2A	OPTION 2B	OPTION 3	OPTION 4	OPTION 5	OPTION 6	OPTION 7A	OPTION 7B	OPTION ASSESSMENT COMMENTARY (TO PROVIDE RATIONALE FOR INDIVIDUAL OPTION SCORES AND ANY COMPARATIVE ANALYSIS)
Project Objective: Safety	+2	+1	+1	+1	+2	+2	+2	+1	+1	*Consider safety for different types of transport users. Gainers/losers in terms of safety. Impacts on personal safety/security. Impact on fatal and serious incidents. Does this option comply with the safe system approach?:* Shared use paths (sups) improve safety of pedestrians and cyclists by separating them from live traffic lanes. Therefore, SUP will provide safety benefits to SUP users. Crossing points and intersections that intersects the SUP exposes SUP users to traffic and increases safety risks to the users. Existing eastbound lane has 6 crossing points (2x SH16, Weza Lane, Riverhead Road, Old Railway Road, Old North Road). Existing westbound lane has 1 crossing point at Taupaki Road roundabout.

Criteria	Option 1	Option 2A	Option 2B	Option 3	Option 4	Option 5	Option 6	Option 7A	Option 7B	Option assessment commentary (to provide rationale for individual option scores and any comparative analysis)
										Option 1, 4, 5, and 6 3m wide SUP (1m berms) is proposed on Southern side of existing SH16 alignment. The SUP intersects a main road at Taupaki Road. These options provide safety improvements such as flush median, shoulder widening and side barrier installation. **Options 2a and 7a** SUP is proposed on the northern side of existing SH16 alignment. Long length of SUP (2.190km) on northern side which then crosses SH16 to the SUP on the Southern side at Taupaki RAB and Kumeu Township. The SUP intersects 6 roads at 2xSH16, Weza Lane, Riverhead Road, Old Railway Road, Old North Road. These options provide safety improvements (i.e. Flush Median, shoulder widening and side barrier installation). Side barriers protects road users from steep banks. **Options 2b and 7b** SUP located on northern side of existing SH16 alignment. Short length of SUP (540m) on northern side which then crosses SH16 to the SUP on the Southern side. SUP users have to cross the busy highway, exposing them to the heavy traffic on SH 16. The SUP intersects 6 roads at 2x SH16, Weza Lane, Riverhead Road, Old Railway Road, Old North Road. These options provide safety improvements such as flush median, shoulder widening and side barrier installation. **Option 3** This option is similar to Option 1. However, the SUP goes around the wetland. Alignment would not meet desired lines for SUP users and is a significant detour (of approximately 140-150m) which has the potential to create unsafe user behaviour (i.e. taking short cuts). To score a large positive impact would need a SUP on both sides of the corridor, yet that was discounted at corridor wide assessment of walking and cycling facilities.
Project Objective: Transport Efficiency	+3	+1	+1	+2	+3	+3	+3	+1	+1	*Effects on travel volumes, journey times or reliability of journey times. Gainers and losers – impacts on users and operators of different transport modes:* All options have limited impact on the main alignment of SH16 except as noted below. As such the Transport Efficiency is largely based on the active

Criteria	Option 1	Option 2A	Option 2B	Option 3	Option 4	Option 5	Option 6	Option 7A	Option 7B	Option Assessment Commentary (to provide rationale for individual option scores and any comparative analysis)
										mode users and any impact, they may have on the SH16 main alignment users. **Option 1:** SUP connects to southern side links and provides greatest efficiency for SUP users. SUP has no impact on main alignment users. **Option 2A:** SUP on Northern side requires crossing to get to southern side SUP links. Reduced efficiency for SUP users. SUP also has a limited impact on the main alignment users with crossing of side road and main alignment crossing at Kumeu. **Option 2B:** SUP on Northern side requires crossing to get to southern side SUP links. Reduced efficiency for SUP users. SUP also has an impact on the main alignment users with crossing of side road and 2 additional main alignment crossings. **Option 3:** SUP connects to southern side links and provides reasonable efficiency for SUP users however not additional length around wetland. SUP has no impact on main alignment users. **Option 4:** SUP connects to southern side links and provides greatest efficiency for SUP users. SUP has no impact on main alignment users. **Option 5:** SUP connects to southern side links and provides greatest efficiency for SUP users. SUP has no impact on main alignment users. **Option 6:** SUP connects to southern side links and provides greatest efficiency for SUP users. SUP has no impact on main alignment users. **Option 7A:** SUP on Northern side requires crossing to get to southern side SUP links. Reduced efficiency for SUP users. SUP also has a limited impact on the main alignment users with crossing of side road and main alignment crossing at Kumeu.

Criteria	Option 1	Option 2A	Option 2B	Option 3	Option 4	Option 5	Option 6	Option 7A	Option 7B	Option Assessment Commentary (to provide rationale for individual option scores and any comparative analysis)
										Option 7B: SUP on Northern side requires crossing to get to southern side SUP links. Reduced efficiency for SUP users. SUP also has an impact on the main alignment users with crossing of side road and 2 additional main alignment crossings.
Project Objective: **Supports Modal Shift**	+3	+2	+2	+2	+3	+3	+3	+2	+2	*Fit with wider government policy including national transport targets. The extent to which the option will achieve the Project objective relating to provision for active mode of travel between Brigham Creek and Kumeū on SH16 corridor (including a safe, efficient walking and cycling facility):* There is currently no provision for pedestrians and cyclists along the SH16 corridor within Section D. The provision of a SUP will therefore be a significant improvement on the existing environment in terms of providing infrastructure for multiple modes of travel (and contributing to achieving GPS-LT 2021 priority of providing better travel choices), which has the potential to encourage modal shift (from vehicles to more active modes of transport). All options would have a moderate to large positive impact over the long term. Yet the SUP options with less direct routes/those with multiple crossing points could potentially be a deterrent for active mode users (i.e. not as attractive), so have not scored as well as the more direct routes.
Technical SUP Design solution **Gareth**	0	-2	-1	0	-1	0	-1	-2	-1	*The degree of design complexity and any engineering design constraints:* **Option1:** Option 1 is considered relatively straight forward from a design perspective. It is noted that maintaining the existing SH16 alignment with widening as required reduces the pavement design requirements and generally maintains the existing northern berm arrangements in the vicinity of the wetland. The design of the shared path on the Southern side of the SH16 alignment is consistent with the Options assessment revisit and is the preferred alignment in terms of reducing crossing and conflicts with the SUP and

Criteria	Option 1	Option 2A	Option 2B	Option 3	Option 4	Option 5	Option 6	Option 7A	Option 7B	Option Assessment Commentary (to provide rationale for individual option scores and any comparative analysis)
										resulting design complexity associated with this. Engineered fill is provided for Construction of the Shared path and is retained with a low level timber retaining wall which reduces the encroachment into the wetland however is more complicated than a fill batter. The Retaining wall does however require edge barrier protection which again is considered a standard design element. The combined services trench (CST) is to be constructed under the SUP on the Southern side which reduces CST crossing and associated design complexity. The SUP extends into the identified wetland flood area and will reduce available storage from the existing arrangement. However standard stormwater design solutions can be implemented to mitigate this impact. It is noted that the deign encroaches further into the wetland than the existing arrangement for this solution. **Option2A:** Option 2A is considered more, complex than Option 1 from a design perspective. It is noted that maintaining the existing SH16 alignment with widening as required reduces the pavement design requirements. It is noted that design works to both the Northern and Southern berm are required as part of this option. The design of the shared path is on the Northern side of the SH16 alignment which is not consistent with the Options assessment revisit and was not the preferred alignment in terms of reducing crossing and conflicts with the SUP. This will introduce additional design complexity in terms of additional crossings of side roads and the main SH16 alignment. In this option the SUP extends on the northern side of the SH16 alignment for a significant length and there will be interfaces with existing land use

Criteria	Option 1	Option 2A	Option 2B	Option 3	Option 4	Option 5	Option 6	Option 7A	Option 7B	Option Assessment Commentary (to provide rationale for individual option scores and any comparative analysis)
										along this length. It is noted that the current designation boundary is reduced on the northern side when compared to the Southern side and as such there will be increased accommodation works and impact which will require design input. The SUP will require a combination of Cut and Fill for Construction and will require retaining in a number of locations including reducing encroachment into the wetland. The retaining of the cut batter on the northern side of the alignment adjacent to the wetland will have some increased design complexity due to the presence of the Kumeu Village Rest Home. Retaining walls will require edge barrier protection which is considered a standard design element. The combined services trench (CST) would likely be required to be constructed on the Northern side under the SUP this introduces additional crossing points for the CST and associated design complexity as well as interaction with the SIC cable. There is limited impact to the identified wetland flood area from this option and standard stormwater design solutions can be implemented to mitigate any impact. The SUP on the Northern side will require additional stormwater design than would be expected for the southern side as the catchment generally lows towards the SH16 alignment. It is noted that the design will not encroach into the wetland as part of the permanent footprint. **Option2B:** Option 2B is considered more, complex than Option 1 from a design perspective however due to the reduced length of northern SUP less complex than Option 2A. It is noted that maintaining the existing SH16 alignment with widening as required reduces the pavement design requirements. It is noted that design works to both the Northern and Southern berm are required as part of this option.

Criteria	Option 1	Option 2A	Option 2B	Option 3	Option 4	Option 5	Option 6	Option 7A	Option 7B	Option Assessment Commentary (to provide rationale for individual option scores and any comparative analysis)
										The design of the shared path is on the Northern side of the SH16 alignment which is not consistent with the Options assessment revisit and was not the preferred alignment in terms of reducing crossing and conflicts with the SUP. This will introduce additional design complexity in terms of additional crossings of the main SH16 alignment and a side road. In this option the SUP extends on the northern side of the SH16 alignment for a short length and there will be interfaces with existing land use along this length (shorter than 2A). It is noted that the current designation boundary is reduced on the northern side when compared to the Southern side and as such there will be increased accommodation works and impact which will require design input. The SUP will require a combination of Cut and Fill for Construction and will require retaining in a number of locations including reducing encroachment into the wetland. The retaining of the cut batter on the northern side of the alignment adjacent to the wetland will have some increased design complexity due to the presence of the Kumeu Village Rest Home. Retaining walls will require edge barrier protection which is considered a standard design element. The combined services trench (CST) would likely be required to be constructed on the Northern side under the SUP over a shorter length than 2A introducing additional crossing points for the CST and associated design complexity including the SIC cable. Alternatively the CST could be aligned under the southern pavement locally around the wetland. There is limited impact to the identified wetland flood area from this option and standard stormwater design solutions can be implemented to mitigate any impact. The SUP on the Northern side over the shorter length is expected to require limited additional stormwater design than would be expected for the southern side It is noted that the design will not encroach into the wetland as part of the permanent footprint.

Criteria	Option 1	Option 2A	Option 2B	Option 3	Option 4	Option 5	Option 6	Option 7A	Option 7B	Option Assessment Commentary (to provide rationale for individual option scores and any comparative analysis)
										Option 3: Option 3 is considered relatively standard from a design perspective. It is noted that altering the existing SH16 alignment north with required widening will require additional pavement design. The SUP would be maintained on the Southern side but would extend around the wetland. This would likely be achieved with standard engineered fill. Allowance for catchment inflows and outflows would need to be made and would likely be in the form of culverts or low level boardwalks at a number of locations around the wetland. There may be some impact to the to the identified wetland flood area from this option and standard stormwater design solutions can be implemented to mitigate any impact. The combined services trench (CST) would likely be required to be constructed on the Northern side of the alignment and would interact with the SIC cable. The CST could alternatively be aligned under the southern pavement locally around the wetland and then under the southern side SUP. Significant private land requirement however limited to *one property so limited design complexity. It is noted that the design will not encroach into the wetland as part of the permanent footprint. **Option 4:** Option 4 has significant design complexity associated with the design of the bridge structure and retaining. It is noted that maintaining the existing SH16 alignment with widening as required reduces the pavement design requirements and generally maintains the existing northern berm arrangements in the vicinity of the wetland.

Criteria	Option 1	Option 2A	Option 2B	Option 3	Option 4	Option 5	Option 6	Option 7A	Option 7B	Option Assessment Commentary (to provide rationale for individual option scores and any comparative analysis)
										The design of the shared path on the Southern side of the SH16 alignment is consistent with the Options assessment revisit and is the preferred alignment in terms of reducing crossing and conflicts with the SUP and resulting design complexity associated with this. The required bridge does provided significant although limited design complexity. The combined services trench (CST) would likely be required to be constructed on the Northern side of the alignment and would interact with the SIC cable. The CST could alternatively be aligned under the southern pavement locally around the wetland and then under the southern side SUP. Limited impact on Stormwater including flood area can be addressed through standard SW design. It is noted that the design has a permanent encroachment into the wetland. **Option 5:** Option 5 has some limited design complexity associated with the design of the boardwalk structure and retaining. It is noted that maintaining the existing SH16 alignment with widening as required reduces the pavement design requirements and generally maintains the existing northern berm arrangements in the vicinity of the wetland. The design of the shared path on the Southern side of the SH16 alignment is consistent with the Options assessment revisit and is the preferred alignment in terms of reducing crossing and conflicts with the SUP and resulting design complexity associated with this. The required boardwalk does provide some limited design complexity. The combined services trench (CST) would likely be required to be constructed on the Northern side of the alignment and would interact with

Criteria	Option 1	Option 2A	Option 2B	Option 3	Option 4	Option 5	Option 6	Option 7A	Option 7B	Option Assessment Commentary (to provide rationale for individual option scores and any comparative analysis)
										the SIC cable. The CST could alternatively be aligned under the southern pavement locally around the wetland and then under the southern side SUP. Limited impact on Stormwater including flood area can be addressed through standard SW design. It is noted that the design has a permanent encroachment into the wetland. **Option 6:** Option 6 is considered relatively straight forward from a design perspective and is very similar to option 1 with additional pavement and northern berm works. It is noted that altering the existing SH16 alignment north with required widening will require additional significant additional pavement design as well as retaining to the northern berm and associated edge barrier. The design of the shared path on the Southern side of the SH16 alignment is consistent with the Options assessment revisit and is the preferred alignment in terms of reducing crossing and conflicts with the SUP and resulting design complexity associated with this. Engineered fill is provided for Construction of the Shared path and is retained with a low level timber retaining wall which eliminates encroachment into the wetland. The Retaining wall does however require edge barrier protection which is considered a standard design element. The retaining of the cut batter on the northern side of the alignment adjacent to the wetland will have some increased design complexity due to the presence of the Kumeū Village Rest Home. Retaining walls will require edge barrier protection which is considered a standard design element. The widening into the northern berm is very similar in extent to Options 2 A & B and 7 A & B.

Criteria	Option 1	Option 2A	Option 2B	Option 3	Option 4	Option 5	Option 6	Option 7A	Option 7B	Option Assessment Commentary (to provide rationale for individual option scores and any comparative analysis)
										The combined services trench (CST) is to be constructed under the SUP on the Southern side which reduces CST crossing and associated design complexity. The SUP will have a limited impact on the wetland flood area and will reduce available storage from the existing arrangement. However standard stormwater design solutions can be implemented to mitigate this impact. It is noted that the design will not encroach into the wetland as part of the permanent footprint. **Option7A:** Option 7A is considered more, complex than option 2A and 6 from a design perspective. It is noted that altering the existing SH16 alignment north with required widening will require additional pavement design. The design of the shared path is on the Northern side of the SH16 alignment which is not consistent with the Options assessment revisit and was not the preferred alignment in terms of reducing crossing and conflicts with the SUP. This will introduce additional design complexity in terms of additional crossings of side roads and the main SH16 alignment. In this option the SUP extends on the northern side of the SH16 alignment for a significant length and there will be interfaces with existing land use along this length. It is noted that the current designation boundary is reduced on the northern side when compared to the Southern side and as such there will be increased accommodation works and impact which will require design input. The SUP will require a combination of Cut and Fill for Construction and will require retaining in a number of locations including reducing encroachment into the wetland. The retaining of the cut batter on the northern side of the alignment adjacent to the wetland will have some increased design complexity due to the presence of the Kumeu Village Rest

Criteria	Option 1	Option 2A	Option 2B	Option 3	Option 4	Option 5	Option 6	Option 7A	Option 7B	Option Assessment Commentary (to provide rationale for individual option scores and any comparative analysis)
										Home. Retaining walls will require edge barrier protection which is considered a standard design element. The combined services trench (CST) would likely be required to be constructed on the Northern side under the SUP this introduces additional crossing points for the CST and associated design complexity as well as interaction with the SIC cable. There is expected to be no impact to the identified wetland flood area from this option and standard stormwater design solutions can be implemented to mitigate any impact. The Sup on the Northern side will require additional stormwater design than would be expected for the southern side as the catchment generally flows towards the SH16 alignment. It is noted that the design will not encroach into the wetland as part of the permanent footprint. **Option7B:** Option 7B is considered more, complex than option 7B, 1 and 6 from a design perspective however due to the reduced length of northern SUP less complex than option 7A. It is noted that altering the existing SH16 alignment north with required widening will require additional pavement design. The design of the shared path is on the Northern side of the SH16 alignment which is not consistent with the Options assessment revisit and was not the preferred alignment in terms of reducing crossing and conflicts with the SUP. This will introduce additional design complexity in terms of additional crossings of the main SH16 alignment and a side road. In this option the SUP extends on the northern side of the SH16 alignment for a short length and there will be interfaces with existing land use along this length (shorter than 7A). It is noted that the current designation boundary is reduced on the northern side when compared to the Southern

Criteria	Option 1	Option 2A	Option 2B	Option 3	Option 4	Option 5	Option 6	Option 7A	Option 7B	Option Assessment Commentary (to provide rationale for individual option scores and any comparative analysis)
										side and as such there will be increased accommodation works and impact which will require design input. The SUP will require a combination of Cut and Fill for Construction and will require retaining in a number of locations including reducing encroachment into the wetland. The retaining of the cut batter on the northern side of the alignment adjacent to the wetland will have some increased design complexity due to the presence of the Kumeu Village Rest Home. Retaining walls will require edge barrier protection which is considered a standard design element. The combined services trench (CST) would likely be required to be constructed on the Northern side under the SUP over a shorter length than 7A introducing additional crossing points for the CST and associated design complexity including SIC cable. Alternatively the CST could be aligned under the southern side pavement locally around the wetland. There is limited impact to the identified wetland flood area from this option and standard stormwater design solutions can be implemented to mitigate any impact. The Sup on the Northern side over the shorter length is expected to require limited additional stormwater design than would be expected for the southern side It is noted that the design will not encroach into the wetland as part of the permanent footprint.
Constructability	-1	-1	-1	-1	-2	-1	-2	-2	-2	*The degree of construction complexity and any construction constraints:* Assessment of options is against the existing environment with no construction activity occurring. Construction activities for any option will have a negative impact (so starting point was -1). All options are readily constructable, yet there is a slight difference between degree of complexity.

CRITERIA	OPTION 1	OPTION 2A	OPTION 2B	OPTION 3	OPTION 4	OPTION 5	OPTION 6	OPTION 7A	OPTION 7B	OPTION ASSESSMENT COMMENTARY (TO PROVIDE RATIONALE FOR INDIVIDUAL OPTION SCORES AND ANY COMPARATIVE ANALYSIS)
										Option1: Additional complexity is limited to construction of a retaining wall. **Option2A:** Additional complexity is limited to construction of two retaining walls and additional utility crossings of SH16. **Option2B:** Additional complexity is limited to construction of two retaining walls, additional utility crossings of SH16 and proximity of SIC. **Option 3:** Additional complexity is limited to construction of a retaining wall, combination of at grade (concrete) and boardwalk path, additional earthworks and proximity of SIC. **Option 4:** Additional complexity is limited to construction of a retaining wall, a bridge (two spans) and proximity of SIC. **Option 5:** Additional complexity is limited to construction of a retaining wall, piers, a boardwalk and proximity of SIC. More labour intensive, similar to Option 3 **Option 6:** Additional complexity is limited to construction of two retaining walls, additional roadworks and TTM. **Option 7A:** Additional complexity is limited to construction of two retaining walls, additional utility crossings of SH16, proximity to SIC, additional roadworks and TTM. **Option7B:** Additional complexity is limited to construction of two retaining walls, additional utility crossings of SH16, proximity to SIC, additional roadworks and TTM.There is a slight difference between 2a/2b and 7a/7b (with b's being more complex than a's), yet not enough to differentiate between scores.
Property **Don**	-1	-2	-1	-2	-1	-1	-1	-2	-1	*The degree of complexity or level of risk associated with formal legal access for the construction, operation and maintenance of the shared use path, including potential impact on business operations:* The slight negative scores of -1 reflect the relatively minor complexity/risk for land access for those scored options. For the moderate negative scores, the complexity/risk in a property sense is greater because of the impacts, i.e. greater land requirements. In the case of options 2a, 3, and 7a, it reflects the more substantial impact on the adjacent rest home which may result in additional business loss.

Sensitivity: General

Criteria	Option 1	Option 2a	Option 2b	Option 3	Option 4	Option 5	Option 6	Option 7a	Option 7b	Option assessment commentary (to provide rationale for individual option scores and any comparative analysis)
										Whilst Option 6 has scored slight negative impact on property, it is of a lesser extent than Options 2b and 7b which also scored slight negative impact on property.
Wetland effects	-2	0	0	-2	-1	-1	0	0	0	*The degree of potential effect on the wetland (current ecological value):* Current ecological value of wetland is Low. For all options, Assumption stock exclusion is undertaken by landowner (in accordance with NES regulations) regardless of who owner is / Waka Kotahi project implementation. **Option 1:** this option results in the permanent loss of natural wetland. It will result in a detectable change that will like require offsetting or compensating. It will result in the marginal reduction in the ecological function of the wetland with the loss of exotic wetland vegetation. Without offsetting the effects would score a -2 however with offsetting a 0 or +1 is easily achievable. **Option 2a & b:** No detectable change the ecological function on the natural wetland from an ecological perspective there is no change 0 **Option 3:** There is potential that the cycleway around the wetland may create a impermeable barrier around the wetlands hydrological source and result in the drainage of the wetland. In essence the wetland potential will be surround by an impermeable barrier. Additional increase in potential edge effects **Option 4:** Marginal adverse change to the wetland, while it will not result in the total loss of wetland, it will result in the shading of any wetland vegetation. This may result in vegetation loss to the wetland. There is a question around the maintenance requirement and the potential for continued vegetation disturbance. Without offsetting the effects would score a -1 however with offsetting a 0 or +1 is easily achievable. **Option 5:** Marginal adverse change to the wetland, while it will not result in the total loss of wetland, it will result in the shading of any wetland vegetation. This may result in vegetation loss to the wetland. There is a question around the maintenance requirement and the potential for continued vegetation disturbance. Without offsetting the effects would score a -1 however with offsetting a 0 or +1 is easily achievable

Criteria	Option 1	Option 2A	Option 2B	Option 3	Option 4	Option 5	Option 6	Option 7A	Option 7B	Option assessment commentary (to provide rationale for individual option scores and any comparative analysis)
										Option 6: No detectable change the ecological function on the natural wetland from an ecological perspective there is no change 0 **Option 7a & b:** No detectable change the ecological function on the natural wetland from an ecological perspective there is no change 0
Ecological effects (Freshwater excluding wetlands)	-1	-1	-1	-1	-1	-1	-1	-1	-1	*The degree of potential ecological effects (freshwater excluding wetlands) and the ability avoid, remedy or mitigate effects:* The below assessment is undertaken on the understanding that there are no distinctively different freshwater ecological values between the upstream and downstream reach on either side of SH16. This understanding is based on the finding within the Watercourse Classification Assessment and draft Ecological Impact Assessment. **Option 1:** This option does not result in any freshwater effects that would be considered beyond any alignment that requires road widening to fit the additional shared pathway within. The assessment is therefore considered slightly negative as there will be low level effects on the streams that cross SH16 due to the extension of culverts. **Option 2a & b:** This option does not result in any freshwater effects that would be considered beyond any alignment that requires road widening to fit the additional shared pathway within. The assessment is therefore considered slightly negative as there will be low level effects on the streams that cross SH16 due to the extension of culverts. **Option 3:** This option does not result in any freshwater effects that would be considered beyond any alignment that requires road widening to fit the additional shared pathway within. The assessment is therefore considered slightly negative as there will be low level effects on the streams that cross SH16 due to the extension of culverts. **Option 4:** This option does not result in any freshwater effects that would be considered beyond any alignment that requires road widening to fit the additional shared pathway within. The assessment is therefore considered slightly negative as there will be low level effects on the streams that cross SH16 due to the extension of culverts.

Criteria	Option 1	Option 2A	Option 2B	Option 3	Option 4	Option 5	Option 6	Option 7A	Option 7B	Option assessment commentary (to provide rationale for individual option scores and any comparative analysis)
										Option 5: This option does not result in any freshwater effects that would be considered beyond any alignment that requires road widening to fit the additional shared pathway within. The assessment is therefore considered slightly negative as there will be low level effects on the streams that cross SH16 due to the extension of culverts. **Option 6:** This option does not result in any freshwater effects that would be considered beyond any alignment that requires road widening to fit the additional shared pathway within. The assessment is therefore considered slightly negative as there will be low level effects on the streams that cross SH16 due to the extension of culverts. **Option 7a & b:** This option does not result in any freshwater effects that would be considered beyond any alignment that requires road widening to fit the additional shared pathway within. The assessment is therefore considered slightly negative as there will be low level effects on the streams that cross SH16 due to the extension of culverts.
Ecological effects (terrestrial)	-1	-1	-1	-1	-1	-1	-1	-1	-1	*The degree of potential ecological effects (terrestrial) and the ability avoid, remedy or mitigate effects:* The below assessment is undertaken on the understanding that there are no distinctively different terrestrial ecological features between either side of SH16 as documented within ecological assessment. It is further assessed with the understanding that the protected vegetation is based on vegetation within the AUP Chapter 26 Infrastructure Table E26.3.3.1. **Option 1:** This option does result in any terrestrial effects that would be considered beyond any alignment that requires road widening to fit the additional shared pathway within. The proposal is likely to result in the removal vegetation within the riparian yards and depending on the results of the arborist survey the removal large trees which may provide potential bat habitat, however all terrestrial vegetation and the habitat it provides for native fauna is generally considered low, with this considered the assessment of effect is considered low

Criteria	Option 1	Option 2a	Option 2b	Option 3	Option 4	Option 5	Option 6	Option 7a	Option 7b	Option assessment commentary (to provide rationale for individual option scores and any comparative analysis)
										Option 2a & b: This option does result in any terrestrial effects that would be considered beyond any alignment that requires road widening to fit the additional shared pathway within. The proposal is likely to result in the removal vegetation within the riparian yards and depending on the results of the arborist survey the removal large trees which may provide potential bat habitat, however all terrestrial vegetation and the habitat it provides for native fauna is generally considered low, with this considered the assessment of effect is considered low **Option 3:** This option does result in any terrestrial effects that would be considered beyond any alignment that requires road widening to fit the additional shared pathway within. The proposal is likely to result in the removal vegetation within the riparian yards and depending on the results of the arborist survey the removal large trees which may provide potential bat habitat, however all terrestrial vegetation and the habitat it provides for native fauna is generally considered low, with this considered the assessment of effect is considered low **Option 4:** This option does result in any terrestrial effects that would be considered beyond any alignment that requires road widening to fit the additional shared pathway within. The assessment is therefore considered neutral. **Option 5:** This option does result in any terrestrial effects that would be considered beyond any alignment that requires road widening to fit the additional shared pathway within. The proposal is likely to result in the removal vegetation within the riparian yards and depending on the results of the arborist survey the removal large trees which may provide potential bat habitat, however all terrestrial vegetation and the habitat it provides for native fauna is generally considered low, with this considered the assessment of effect is considered low **Option 6:** This option does result in any terrestrial effects that would be considered beyond any alignment that requires road widening to fit the additional shared pathway within. The proposal is likely to result in the removal vegetation within the riparian yards and depending on the results of the arborist survey the removal large trees which may provide potential bat habitat, however all terrestrial vegetation and the habitat it provides for native fauna is generally considered low, with this considered the assessment of effect is considered low

Criteria	Option 1	Option 2A	Option 2B	Option 3	Option 4	Option 5	Option 6	Option 7A	Option 7B	Option assessment commentary (to provide rationale for individual option scores and any comparative analysis)
										Option 7a & b: This option does result in any terrestrial effects that would be considered beyond any alignment that requires road widening to fit the additional shared pathway within. The proposal is likely to result in the removal vegetation within the riparian yards and depending on the results of the arborist survey the removal large trees which may provide potential bat habitat, however all terrestrial vegetation and the habitat it provides for native fauna is generally considered low, with this considered the assessment of effect is considered low
Cultural effects										*Potential impact of the option on; Waahi Tohu, Maori Archaeology, Whenua, Hau Takiwa, Moana, Wai Maaori, Rerenga Rauropi:* No input received from Mana Whenua prior to or the week following the MCA Workshop.
Social effects	+1	+2	+3	+1	+1	+1	+1	+2	+3	*The degree of potential effect on social infrastructure and community facilities:* Note – early engagement with the Rest Home co-owner/General Manager has informed this assessment **Option 1:** does not provide access for residents and staff at the rest home to access the shared path. Residents will still be cut off from accessing the Town Centre and surrounding amenities (e.g. BP), staff will need continue to make unsafe movements to cross the road and walk into town (although noting a median barrier will be in place). This immediate impact is balanced with the wider community benefit for providing shared path facility and continuing this on Northern Side, resulting in +1 scoring. **Option 2A:** This option will have both positive and negative impacts for the Rest Home but on balance is a +2 score as the long term benefits to the residents and staff will likely outweigh the negatives. Residents would be able to use a safe and accessible shared path facility to walk into the Town Centre. Currently they are not able to do this at all. And staff make unsafe crossing movements to cross SH16. It is noted the rest home requested information on safety barriers between the traffic and shared path. Noted this will result in permanent acquisition of rest home. At this stage I'm aware that bringing the road closer to the facility (shared path) will not be a significant impact, residents like the noise/hustle and bustle. Opportunity to design outlook to provide positive amenity whilst still giving residents a good view of

Criteria	Option 1	Option 2A	Option 2B	Option 3	Option 4	Option 5	Option 6	Option 7A	Option 7B	Option Assessment Commentary (to provide rationale for individual option scores and any comparative analysis)
										people coming and going. The accessway is used, but isn't the primary access to the site. Detailed design will need to be done to ensure that septic tank access, fire fighting/refuse management etc can occur elsewhere in the building and not conflict with staff/resident/carparking at the rear of the building. This option also potentially impacts the ECE – Hearts and Minds Childcare Centre and Kumeu Produce Market. The works will temporarily impact the ECE due to construction of the shared path and bring the shared path close to their building and changing their fence line. They also may have a narrower accessway as a result. But overall positive impact due to safer pathway close to their facility. The Kumeu Produce Market will have some impact on their accessway but it is assumed the building is retained and access can also be maintained (the wider community will benefit from a safe path closet to this facility to access it). Wider community impact – this option provides for continuity of the shared path on the northern side. Key thing will be considering where necessary crossing points, or not precluding these to be added in the future as community facilities change/are added along the corridor. **Option 2B:** This option similar to Option 2A, with added benefit of crossing to BP side to access facilities there safely so local benefits. Wider community – less continuity of the shared path but can be mitigated by clear signage etc. This option crosses over before it potentially impacts ECE, and has benefit of also being closer to that facility so that parents/staff can access. **Option 3:** Similar to Option 1 but with less benefits to wider community in terms of useability of the shared path **Option 4:** Similar to Options 1 and 3 **Option 5:** Similar to Options 1, 3 and 4 NOTE - if Options 2a, 2b, 7a or 7b is shortlisted or preferred, the design team will need to feed into the assessment in terms of feasibility of various design solutions to the issues noted above, as that would inform decision making. **Option 6:** Similar to Options 1,3, 4 and 5 but includes more permanent impacts on rest home without the benefit of the shared path directly accessible to staff and residents. Score could be lowered with provision for a crossing point over to shared path or an additional footpath opposite Kumeu

Criteria	Option 1	Option 2A	Option 2B	Option 3	Option 4	Option 5	Option 6	Option 7A	Option 7B	Option assessment commentary (to provide rationale for individual option scores and any comparative analysis)
										River Winery to connect with the existing foot path near Riverhead Road. On balance the score is a +1 as still provides a wider community benefit **Option 7A:** Similar to Option 2A **Option 7B:** Similar to Option 7A but added benefit of residents/staff able to cross the road to access the BP
Landscape and Visual effects **(CPTED and Urban Design included)**	-1	-2	-1	-1	-2	-1	-2	-2	-1	*The degree of potential landscape and visual effects, including CPTED (safety and security) considerations:* **The existing landscape along the SH16 corridor is a modified rural environment. While the predominant land use to the south of the alignment is rural pastureland there are existing examples of structures including retaining walls and timber fences along the corridor. The options described below will not significantly impact on the landscape or visual effect of the corridor. However, the options have been scored negative based on zero being no change to the existing environment.** **Option 1** has a very slight negative effect to the landscape and visual effect due to the low retaining wall. These effects are easily mitigated through planting. **Options 2a** and **7a** present longer lengths of retaining walls associated with the South side (long) alignment which have moderate negative landscape and visual effects. The retaining walls are exposed to all users along the SH16 corridor. These retaining walls are unable to be mitigated due to height and proximity to the shared path. **Options 2b** and **7b** present shorter lengths of retaining walls associated with the South side (short) alignment which will have slight negative landscape and visual effects. These retaining walls are unable to be mitigated due to height and proximity to the shared path. **Option 3** presents a pathway around wetland which does not require any structures. Given the construction of a concrete path within an open pasture/ wetland environment there will be a very slight negative effect. However, there is an opportunity to expand the designation to allow space to integrate mitigation planting along the pathway to remove any visual effects caused. This option presents a potential CPTED issue due to the distance of the path from the road and no surveillance from passing vehicles.

CRITERIA	OPTION 1	OPTION 2A	OPTION 2B	OPTION 3	OPTION 4	OPTION 5	OPTION 6	OPTION 7A	OPTION 7B	OPTION ASSESSMENT COMMENTARY (TO PROVIDE RATIONALE FOR INDIVIDUAL OPTION SCORES AND ANY COMPARATIVE ANALYSIS)
										A pathway around the wetland will complement the wetland environment and creates an opportunity for enhancing experience for path users (i.e. Information boards, Mana Whenua input to path design). **Option 4** presents a bridge option which has a moderate negative landscape and visual impact. Given the surrounding rural pastureland and wetland area the bridge will be prominent and will be out of character with the site. The size and prominence of the structure will reduce opportunities for landscape and visual mitigation. **Option 5**'s boardwalk structure will present a very slight negative landscape and visual effect. However, the construction will have less of an impact on the landscape and any negative visual impacts can be easily mitigated through planting. This option complements the existing character of the site and will create a separated environment for pedestrians and cyclists. A boardwalk creates an opportunity for enhancing experience for path users (ie. Information boards, Mana Whenua input to boardwalk design). **Option 6** shows a realignment of the SH16 road corridor to minimise impact on the wetland. While the wetland will not be impacted, similar to Options 2 and 7 visual impacts of additional retaining walls result in a moderate negative effect for landscape and visual character for users travelling along the SH16 corridor
Operations and maintenance	-1	-1	-1	-2	-2	-2	-1	-1	-1	*The degree of complexity or level of risk associated with safe access for the purposes of operation and maintenance of the state highway including shared use path:* There are currently no structures within this area of Section D of the corridor. All options result in additional pavement and structures compared to existing environment so starting point (all options) is a slight adverse impact due to additional Operation and Maintenance requirements. All options with at-grade SUP, street lights and retaining wall (Options 1, 2a, 2b, 6, 7a, 7b) would be -1 and are equivalent in impact on existing maintenance. Option 6 is -1 as considered similar to option 2b. The increased complexity of the design and the resulting assets (structures) and future required structural inspections are main reason for the -2 moderate adverse impact for **Options 3, 4, 5**.

CRITERIA	OPTION 1	OPTION 2A	OPTION 2B	OPTION 3	OPTION 4	OPTION 5	OPTION 6	OPTION 7A	OPTION 7B	OPTION ASSESSMENT COMMENTARY (TO PROVIDE RATIONALE FOR INDIVIDUAL OPTION SCORES AND ANY COMPARATIVE ANALYSIS)
										This is because Option 3 (around outer edge of boardwalk) may be partial at-grade, and partial low-level boardwalk, so may have O&M requirement to replace boardwalk timber slats. Option 4 (bridge) and Option 5 (boardwalk) result in new structures that would require greater maintenance.