Appendix C8 Safety in Design Register

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PROJECT INFORMATION - Safety in Design Record - Simplified Procedure

Project Name	Ladies Mile - 80km/hr	***Project Number***	6-XT014.65	***Date***	
Client	Waka Kotahi NZ Transport Agency	***Project Stage***	Business Case		
Project Scope	New pedestrian underpass, upgraded intersection, shoulder widening and introduction of bus lanes	***Prepared By***	s 9(2)(a)	***Reviewed By***	s 9(2)(a)
Workshop Attendees	s 9(2)(a) (WSP), s 9(2)(a) (WSP)			***Reviewed Date***	4/09/2020

This document records the H&S hazards that could give rise to reasonably foreseeable risks to the health & safety of those interacting with the design option, or any part of it, as a work place during its lifecycle.

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HAZARDS ASSOCIATED WITH DESIGN ELEMENTS				RISK MATRIX			PROPOSED MITIGATION MEASURES	RISK MATRIX					RESIDUAL RISK	
Ref	Date	Hazard / Work Element	Issue	Consequence	Likelihood	RR	Proposed Mitigation Measures	C	L	RR	Status	Risk Owner	Residual Risk	Client / Asset Owner Acceptance / Comment
CONSTRUCTION														
C1	26/08/2020	Pedestrian Refuges	Construction in centre of road with live traffic and potential for injury with traffic	Major	Likely	High	Consider construction duration during concept/detailed design. Chose mateirals that reduce time workers exposed. Contractor to have temporary traffic control	Major	Rare	Low	Live	Designer/ Contractor	Worker Injury	
C2	18/08/2020	Public vs Plant	High risk construction work in public areas. Public (including Pedestrians, mobility users and people on bikes) will be moving around work areas and needing to access their homes. E.g. Footpath construction, property accesses, road.	Catastrophic	Likely	Critical	Construction methodologies to reduce impact and manage risk on site, temporary traffic management to separate work area from public. Communicate with public when works will be affecting access. Consider materials for quick construction and reduced inconvenience and alternative parking for homeowners	Catastrophic	Rare	Medium	Live	Designer/ Contractor	Public Injury	
C3	26/08/2020	Roundabout at Howards Drive	Existing traffic flows must be maintained during construction. This complex staging may present risk to the public or to works	Major	Possible	High	Designer to attempt to get levels close to existing to reduce complex staging. Contractor to manage site risks	Major	Unlikely	Medium	Live	Designer/ Contractor	Worker Injury	
C4	27/08/2020	Worker vs plant	Small working area expected, due to having to maintain traffic flows. More likely that worker will be hit by plant	Major	Likely	High	Contractor to plan works so that there is sufficient space. Exclusion zones to be established for high risk works	Major	Possible	High	Live	Contractor	Worker Injury	
C5	27/08/2020	Plant vs plant	Small working area expected, due to having to maintain traffic flows. More likely that plant will hit plant	Minor	Likely	Medium	Contractor to plan works so that there is sufficient space. Exclusion zones to be established for high risk works. TMPs where applicable.	Minor	Possible	Low	Live	Contractor	Worker Injury	
C6	27/08/2020	Noise	Prolonged and / or excessive construction noise could lead to hearing damage of workers	Moderate	Possible	Medium	Appropriate PPE to be worn.	Moderate	Rare	Low	Live	Contractor	Worker Injury	
C7	27/08/2020	Dust	Trenching and digging resulting in dust	Minor	Possible	Low	Ensure dust management protocols are developed and adhered to	Minor	Rare	Low	Live	Contractor	Worker Injury	
C8	27/08/2020	Contamination	Discovery of contamination during construction. Digging up old roads - asbestos pipe is likely to be found.	Moderate	Likely	High	Contractor to have appropriate procedure in place to handle contaminated material	Moderate	Rare	Low	Live	Contractor	Worker Injury	
C9	27/08/2020	Underpass at McDowell Drive	Working from heights - risk of falling person/material	Major	Possible	High	Designer to consider method of construction during detailed design and seek to minimise construction time at heights. Attempt to reduce depth of unerpass. Culvert should reduce construction time. Contractor to plans works safely and have exclusion zones where appropriate	Major	Unlikely	Medium	Live	Designer & Contractor	Worker Injury	
C10	27/08/2020	Temporary Works	Any temporary structure to be installed or constructed could fail and injure worker.	Major	Possible	High	Establish areas and structures for temporary works - to be signed off by certified engineer, if required. Temporary works design to be adhered to.	Major	Unlikely	Medium	Live	Designer & Contractor	Worker Injury	
C11	27/08/2020	Services	Excavation and Trenches - Safety of excavations for workers and the public - slips, trips and falls. Safety of excavating across live traffic lanes. Adequate protection of workers and the pubic from entering excavations	Catastrophic	Likely	Critical	Ensure Adequate protection of workers and the pubic from entering excavations. Temporary traffic management to be used if impacting traffic lane / footpath / accessway.	Catastrophic	Unlikely	High	Live	Contractor	Worker Injury	
C12	27/08/2020	Working with Concrete	Lime burns.	Moderate	Possible	Medium	Wear appropriate PPE that separates skin from concrete. Consider other materials during design	Moderate	Rare	Low		Designer & Contractor	Worker Injury	
C13	2/09/2020	Underground services	Service strike when excavating	Major	Likely	High	Indicate services while designing (beforeUdig). Contractor to undertake service locations prior to any excavation	Major	Possible	High	Live	Designer & Contractor	Service strike during construction	
C14	2/09/2020	Culverts	Excavation striking and damaging culverts	Minor	Possible	Low	Culverts marked on plan where possible, Contractor to locate prior to any excavation.	Minor	Unlikely	Low	Live	Designer & Contractor	Damaging culvert	
C15	2/09/2020	Overhead power lines / electrocution	Working in close proximity to power lines	Major	Possible	High	Mark power poles on plans. Controlled through Contractors methodology and H&S practices	Major	Unlikely	Medium	Live	Designer & Contractor	Electrocution	
C16	2/09/2020	Working in carriageway	Working near live traffic. Risk that workers are hit by traffic	Major	Possible	High	Maintain accesses where possible. TTM to provide safe working areas.	Major	Unlikely	Medium	Live	Contractor	Worker injury	
C17	2/09/2020	Manual handling, lifting/bending	Risk of injury during construction	Minor	Rare	Low	Contractor's methodology and H&S plan to provide safe work methods	Minor	Rare	Low	Live	Contractor	Worker injury	
C18	2/09/2020	Slips/trips/falls	Risk of slips/trips/falls	Minor	Rare	Low	Contractor's methodology and H&S plan to provide safe working environment.	Minor	Rare	Low	Live	Contractor	Worker injury	
C19	2/09/2020	Ice/snow freezing of surface	Risk of ice/snow if works are during winter season.	Minor	Unlikely	Low	Programme works to be outside of winter period.	Minor	Unlikely	Low	Live	Designer & Client	Adverse weather conditions	
C20	2/09/2020	Storage areas for plant and materials	Safe areas for storage during construction. Risk that positioning increases harm to public i.e.. Poor accessibility. Or that they are not fenced off appropriately	Minor	Rare	Low	Contractor to determine appropriate storage areas.	Minor	Rare	Low	Live	Client & Contractor	Storage areas	
C21	2/09/2020	Events - summer peak, tourism	Increase in traffic flows, traffic delays	Minor	Unlikely	Low	Programming, coordination with other contractors, advising client	Minor	Unlikely	Low	Live	Client & Contractor	Increased traffic flows	
OPERATION														
O1	2/09/2020	Crossing locations - Pedestrians	Pedestrians crossing multiple lanes of traffic and vehicle shadowing resulting in impact between pedestrian and vehicle. Eg. At Howards Drive	Catastrophic	Possible	High	There are currently refuge islands provided for at grade crossing locations. Designer to ensure that sight-lines are met for pedestrains and vehicles.	Catastrophic	Rare	Medium	Live	Designer	Public Injury	
O2	2/09/2020	Signs, Pedestrian fencing, Streetlight poles	Over-dimension loads for turning vehicles and along key route - exposing people to falling poles, electrical hazards, falling loads, falling signs	Major	Unlikely	Medium	Design infrastructure to be outside of the over-dimension load envelope. Design poles with socket bases so they can be removed or hinges so they can be folded down.	Major	Rare	Low	Live	Designer	Public Injury	
O3	27/08/2020	Visitors	New to the country and unfamiliar with the roads	Major	Possible	High	Appropriate signage to prevent wayfinding crashes and wrong direction crashes.	Major	Unlikely	Medium	Live	Designer	Public Injury	

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PROJECT INFORMATION - Safety in Design Record - Simplified Procedure

Project Name	Ladies Mile - 80km/hr	***Project Number***	6-XT014.65	***Date***	
Client	Waka Kotahi NZ Transport Agency	***Project Stage***	Business Case		
Project Scope	New pedestrian underpass, upgraded intersection, shoulder widening and introduction of bus lanes	***Prepared By***	s 9(2)(a)	***Reviewed By***	s 9(2)(a)
Workshop Attendees	s 9(2)(a) (WSP), s 9(2)(a) (WSP)			***Reviewed Date***	4/09/2020

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HAZARDS ASSOCIATED WITH DESIGN ELEMENTS				RISK MATRIX			PROPOSED MITIGATION MEASURES	RISK MATRIX					RESIDUAL RISK	
Ref	Date	Hazard / Work Element	Issue	Consequence	Likelihood	RR	Proposed Mitigation Measures	C	L	RR	Status	Risk Owner	Residual Risk	Client / Asset Owner Acceptance / Comment
O4	27/08/2020	Lighting	Appropriate lighting to ensure safety of vulnerable users at all hours. CPTED	Major	Possible	High	Design to appropriate standard considering CPTED	Major	Rare	Low	Live	Designer	Public Injury	
O5	27/08/2020	Intersections - operation	Unforeseen safety and operational issues leading to crashes and injuries	Moderate	Likely	High	Identify design solutions through external peer review/audit.	Moderate	Possible	Medium	Live	Designer	Public Injury	
O6	10/09/2020	Bus Lane	Inconsistent design - bus lane provided in between Stalker Rd roundabout, new Shotover River bridge and Howard Drive new roundabout. Not provided on the bridge or through the roundabouts. Speed limit is 80km/hr, risk of crash	Major	Possible	High	Designer to propose signage provided to warn other vehicles of merging traffic. Designer and client to chose bus stop locations at a distance from the merge so that buses have sufficient time to safely ahiceve 80km/hr before merging.	Major	Unlikely	Medium	Live	Designer & Client	Public Injury	
O7	27/08/2020	Cyclists	Risk of car hitting cyclist.	Catastrophic	Possible	High	Shoulder 1.5m wide throughout. No formal cycle lane. Consider signage to wanr vehicles of their presence.	Catastrophic	Unlikely	High	Live	Designer	Public Injury	
O8	2/09/2020	Speed	Risk that the straight alignment will encourage drivers to travel faster than the posted 80km/hr speed limit. This increases the risk for all crash types	Major	Possible	High	Consider traffic calming measures. No change to existing speed limit.	Major	Unlikely	Medium	Live	Designer & Client	Public Injury	
O9	2/09/2020	Vegetation	Vegetation impacting visibility, which is a risk to pedestrians crossing, vehicles pulling out of accessways or vehicles seeing around corners.	Major	Possible	High	Design trees to be appropriate distance away from edge line, chose planting that does not impact sight lines, careful consideration of placement around accessways and corners.	Major	Unlikely	Medium	Live	Designer	Public Injury	
MAINTENANCE														
M1	18/08/2020	Pedestrian refuges	Replacement of handrails that are often hit by vehicles in middle of constrained road corridor with busy traffic and potential for injury with traffic	Major	Possible	High	Socketed handrail foundations for quick replacement and limited time in centre of road with TTM to manage hazard	Major	Unlikely	Medium	Live	Designer & Client	Worker Injury	
M2	26/08/2020	Grass verges	Sections of grassed verges shown right next to edge line. Risk for maintenance team to work adjacent to live traffic.	Moderate	Unlikely	Low	Substitute for low maintenance alternative, or change design so that grass exists > 3m away from live traffic lane. OR have temporary traffic management In place during maintenance work near live traffic.	Moderate	Rare	Low	Live	Designer & Client	Worker Injury	
M3	2/09/2020	Vegetation	Vegetation impacting visibility	Catastrophic	Unlikely	High	Vegetation to be designed so that it is unlikely to impact visibility. All vegetation to be trimmed, as required	Catastrophic	Rare	Medium	Live	Designer & Client	Worker Injury	
M4	2/09/2020	Grass batters - noise mound	Noise mound at Howards Drive may be too steep to maintain.	Moderate	Possible	Medium	Consider accessibility and grade when designing the noise moud. Also aim to landscape using low maintenance plants, such as flax?	Moderate	Unlikely	Low	Live	Designer & Client	Worker Injury	
M5	2/09/2020	Area for maintenance vehicles to pull over	Safe parking areas for maintenance vehicles to carry out maintenance activities	Minor	Likely	Medium	Provide parking /pull over areas for maintenance vehicles - to be assessed at next design phase.	Minor	Likely	Medium	Live	Designer	Safe working area	
M6	2/09/2020	Snow clearing	Snow clearing on road and footpaths	Minor	Likely	Medium	Low probability of happening, so won't be addressed in design. Maintenance contractor to clear roads and footpaths, rather than windrowing it (which causes further issues, freezing, clogging drains, icy surfaces etc).	Minor	Possible	Low	Live	Client & Maintenance Contactor	Snow blocking the shared path	
M7	2/09/2020	Repair in unfavourable conditions	Repair of road and footpath will be difficult in rain/snow/ice	Minor	Likely	Medium	Temporary repair ASAP, full repair once weather conditions improve.	Minor	Possible	Low	Live	Maintenance Contactor	Personal injury	
M8	2/09/2020	No maintenance	Defects in the shared path surface	Minor	Likely	Medium	Designer to consider materials being specified and pavement design to address likelihood of defects forming. Client to check regular inspections are being completed	Minor	Possible	Low	Live	Designer & Client	Personal injury	
M9	2/09/2020	Public or workers distraction	Slips, trips, falls, injury, death	Catastrophic	Likely	Critical	Consider in the design what detour routes you are providing for pedestrians and cyclists around potential work sites or can you provide sufficient width along the corridor for users and workers to safely be alongside each other while maintenance is underway. Traffic Management Plan to be developed if applicable during maintenance works. Traffic management controls utilised through area affected by maintenance works.	Catastrophic	Unlikely	High	Live	Designer & Maintenance Contactor	Slips, trips, falls	
M10	2/09/2020	Traffic movement	Public (pedestrians, drivers or cyclists) or workers being struck by vehicle or plant machinery causing injury or death	Catastrophic	Likely	Critical	Traffic Management Plan. Traffic management controls utilised through area affected by construction.	Catastrophic	Unlikely	High	Live	Maintenance Contactor	Crashes	
M11	3/09/2020	Materials	Finished surface materials. E.g. Pavers/cobbles, street furniture, vegetation and other design elements having high maintenance requirements.	Major	Possible	High	Designers to consider maintenance when choosing design elements. Chose material which use have low maintenance requirements and are durable to reduce hazard to public and workers.	Major	Unlikely	Medium	Live	Maintenance Contactor	Crashes	
M12	3/09/2020	Busy Public Area	Maintenance crew working in and around a busy public area. Risk of injury to public by equipment.	Catastrophic	Possible	High	Traffic Management Plan. Traffic management controls utilised through area affected by construction, including pedestrian management. Plan works when public volumes are low.	Catastrophic	Unlikely	High	Live	Maintenance Contactor	Crashes	
M13	2/09/2020	Fall from heights	Maintenance of underrpass culvert, at road level (ie. Handrail). Risk that worker or tools may fall during maintenance inspection onto public below.	Catastrophic	Possible	High	Designers to consider maintenance regime and improve access/safety where possible. Traffic Management Plan. Traffic management controls utilised through area affected by maintenance works. All tools and workers to be attached to structure if working at heights. Maintenance contractor to have appropriate health and safety procedures and work methodology in place to protect their workers.	Catastrophic	Unlikely	High	Live	Designer & Maintenance Contactor	Worker Injury	
DECOMMISSIONING / DEMOLITION														

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D1	2/09/2020	Demolition of underpass	When underpass reaches the end of it's design life and must be remove / replaced. Risk of worker/public death from falling structure as it is removed.	Catastrophic	Possible	High	Designer should consider how the structure can be designed to demolish safely eg. Components that can be removed in their entirety, matierals that are not hazardous when demolished, how will services be attached. To be developed during detailed design phase. TTM to be in place during removal. Contractor to manage	Catastrophic	Unlikely	High	Live	Contractor	Worker Injury	
D2	2/09/2020	Area for renewals/maintenance vehicles to pull over	Safe parking areas for renewals / maintenance vehicles to carry out activities	Minor	Likely	Medium	Provide parking for maintenance / renewals vehicles - to be assessed at next design phase.	Minor	Likely	Medium	Live	Designer	Safe working area	
D3	3/09/2020	Materials	Finished surface materials. E.g. Pavers/cobbles, guardrail, fencing, signage, street furniture, vegetation and other design elements having high maintenance requirements, or will need to be removed and replaced.	Major	Possible	High	Designers to consider maintenance and renewals when choosing design elements. Chose material which use have low maintenance requirements and are durable to reduce hazard to public and workers.	Major	Unlikely	Medium	Live	Maintenance / Renewal Contactor	Crashes	
D4	3/09/2020	Busy Public Area	Demolition/Renewal Crew working in and around a busy public area. Risk of injury to public by equipment.	Catastrophic	Possible	High	Traffic Management Plan. Traffic management controls utilised through area affected by construction, including pedestrian management. Plan works when public volumes are low.	Catastrophic	Unlikely	High	Live	Maintenance / Renewal Contactor	Crashes	

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PROJECT INFORMATION - Safety in Design Record - Simplified Procedure

Project Name	Frankton - Bridge to Bridge - 60km/hr	***Project Number***	6-XT014.64		***Date***
Client	Waka Kotahi NZ Transport Agency	***Project Stage***	Business Case		
Project Scope	Combination of new and upgraded intersections, road, crossing locations, footpaths and shared paths	***Prepared By***	s 9(2)(a)	***Reviewed By***	s 9(2)(a)
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Ref	Date	Hazard / Work Element	Issue	Consequence	Likelihood	RR	Proposed Mitigation Measures	C	L	RR	Status	Risk Owner	Residual Risk	Client / Asset Owner Acceptance / Comment
CONSTRUCTION														
C1	26/08/2020	Raised tables & pedestrian refuges	Construction across entire road corridor (McBride St & Bus Hub) with traffic and potential for injury with traffic	Major	Likely	High	Consider construction duration during concept/detailed design. Chose AC over concrete to reduce time workers exposed for raised tables. Contractor to have temporary traffic control	Major	Rare	Low	Live	Designer/ Contractor	Worker Injury	
C2	18/08/2020	Public vs Plant	High risk construction work in public areas. Public (including Pedestrians, mobility users and people on bikes) will be moving around work areas and needing to access their homes, businesses, shops etc. E.g. Footpath construction, property accesses, road.	Catastrophic	Likely	Critical	Construction methodologies to reduce impact and manage risk on site, temporary traffic management to separate work area from public. Communicate with public when works will be affecting access/ Consider materials for quick construction and reduced inconvenience and alternative parking for homeowners	Catastrophic	Rare	Medium	Live	Designer/ Contractor	Public Injury	
C3	18/08/2020	Traffic Signals	Live Traffic - working with live traffic. Working where live traffic is under partial signal control. Working within an existing intersection or operating signals.	Catastrophic	Likely	Critical	Temporary traffic management to notify public. Plan works to be during off-peak i.e.. Nightworks	Catastrophic	Unlikely	High	Live	Contractor	Worker / Public Injury	
C4	27/08/2020	Traffic Signals	Electrical Hazards - Isolation of electrical hazards from workers and the public, earthing of equipment, connection to mains supply	Catastrophic	Likely	Critical	Ensure power it switched off until necessary to operated signals. Isolate public from work area and live electricity. Use certified electricians.	Catastrophic	Rare	Medium	Live	Contractor	Worker Injury	
C5	27/08/2020	Traffic Signals	Construction of detector loops - working in live traffic lanes. Noise and dust hazards when sawcutting. Pavement integrity, loop integrity.	Major	Likely	High	Temporary traffic management. Adequate noise and dust PPE. Quality Assurance	Major	Unlikely	Medium	Live	Contractor / Design	Worker Injury	
C6	26/08/2020	SH6/SH6a intersection	Existing traffic flows must be maintained during construction. This complex staging may present risk to the public or to works.	Major	Possible	High	Designer to consider construction staging and attempt to reduce risk. EG. Make levels similar to existing. Contractor to manage site risks. Majority can be built offline	Major	Unlikely	Medium	Live	Designer/ Contractor	Worker Injury	
C7	3/09/2020	Underpass at Hansen Rd	Risk of fall form heights during construction to lower pedestrian level and / or collapse of excavation (if culvert structure)	Major	Possible	High	Designer to Minimise level difference between underpass and guavabout, to reduce construction risk. Consider method of construction during detailed design and seek to minimise construction time at heights. Contractor to manage risk during construction to ensure safety of worker.	Major	Unlikely	Medium	Live	Designer/ Contractor	Worker Injury	
C8	3/09/2020	Wayfinding to access amenities	Risk that vehicles are confused trying to access shops as road layout changes throughout construction staging. Could cause a crash.	Major	Possible	High	Staging plans to be designed and approved by Design team. Contractor to communicate these to community early. To be monitored and additional signage to be erected, if required.	Major	Unlikely	Medium	Live	Designer/ Contractor	Public Injury	
C9	27/08/2020	Worker vs plant	Small working area expected, due to having to maintain traffic flows. More likely that worker will be hit by plant	Major	Likely	High	Contractor to plan works so that there is sufficient space. Exclusions zones to be established for high risk works	Major	Possible	High	Live	Contractor	Worker Injury	
C10	27/08/2020	Plant vs plant	Small working area expected, due to having to maintain traffic flows. More likely that plant will hit plant	Minor	Likely	Medium	Contractor to plan works so that there is sufficient space. Exclusions zones to be established for high risk works. VMPs where applicable.	Minor	Possible	Low	Live	Contractor	Worker Injury	
C11	27/08/2020	Noise	Prolonged and / or excessive construction noise could lead to hearing damage of workers	Moderate	Possible	Medium	Appropriate PPE to be worn.	Moderate	Rare	Low	Live	Contractor	Worker Injury	
C12	27/08/2020	Dust	Trenching and digging resulting in dust	Minor	Possible	Low	Ensure dust management protocols are developed and adhered to	Minor	Rare	Low	Live	Contractor	Worker Injury	
C13	27/08/2020	Contamination	Discovery of contamination during construction. Digging up old roads - asbestos pipe is likely to be found.	Moderate	Likely	High	Contractor to have appropriate procedure in place to handle contaminated material	Moderate	Rare	Low	Live	Contractor	Worker Injury	
C14	27/08/2020	Temporary Works	Any temporary structure to be installed or constructed could fail and injure worker.	Major	Possible	High	Establish areas and structures for temporary works - to be signed off by certified engineer, if required. Temporary works design to be adhered to.	Major	Unlikely	Medium	Live	Designer & Contractor	Worker / Public Injury	
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C18	2/09/2020	Culverts	Excavation striking and damaging culverts	Minor	Possible	Low	Culverts marked on plan where possible, Contractor to locate prior to any excavation.	Minor	Unlikely	Low	Live	Designer & Contractor	Damaging culvert	
C19	2/09/2020	Overhead power lines / electrocution	Working in close proximity to power lines	Major	Possible	High	Mark power poles on plans. Controlled through Contractors methodology and H&S practices	Major	Unlikely	Medium	Live	Designer & Contractor	Electrocution	
C20	2/09/2020	Working in carriageway	Working near live traffic. Risk that workers are hit by traffic	Major	Possible	High	Maintain accesses where possible. TTM to provide safe working areas.	Major	Unlikely	Medium	Live	Contractor	Worker injury	
C21	2/09/2020	Manual handling, lifting/bending	Risk of injury during construction	Minor	Rare	Low	Contractor's methodology and H&S plan to provide safe work methods	Minor	Rare	Low	Live	Contractor	Worker injury	
C22	2/09/2020	Slips/trips/falls	Risk of slips/trips/falls	Minor	Rare	Low	Contractor's methodology and H&S plan to provide safe working environment.	Minor	Rare	Low	Live	Contractor	Worker injury	
C23	2/09/2020	Ice/snow freezing of surface	Risk of ice/snow if works are during winter season.	Minor	Unlikely	Low	Programme works to be outside of winter period.	Minor	Rare	Low	Live	Designer & Client	Adverse weather conditions	

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Ref	Date	Hazard / Work Element	Issue	Consequence	Likelihood	RR	Proposed Mitigation Measures	C	L	RR	Status	Risk Owner	Residual Risk	Client / Asset Owner Acceptance / Comment
C24	2/09/2020	Storage areas for plant and materials	Safe areas for storage areas during construction. Risk that positioning increases harm to public i.e.. Poor accessibility. Or that they are not fenced off appropriately	Minor	Rare	Low	Contractor to determine appropriate storage areas.	Minor	Rare	Low	Live	Client & Contractor	Storage areas	
C25	2/09/2020	Events - summer peak, tourism	Increase in traffic flows, traffic delays	Minor	Unlikely	Low	Programming, coordination with other contractors, advising client	Minor	Rare	Low	Live	Client & Contractor	Increased traffic flows	
OPERATION														
O1	2/09/2020	Intersections - Pedestrians	Pedestrians crossing multiple lanes of traffic and vehicle shadowing resulting in impact between pedestrian and vehicle.	Catastrophic	Possible	High	Design traffic lights to give appropriate amount of time for all user types to cross safely i.e.. Mobility scooters, children, elderly etc. Refuge islands provided at most non-signalised crossing locations, otherwise a zebra raised table crossing. Consider adding more during detailed design. Ensure sight lines are met.	Catastrophic	Rare	Medium	Live	Designer	Public Injury	
O2	2/09/2020	Intersections - pedestrians	Speed limit is currently 60km/hr. Safe and survivable speed for pedestrian crash is 30km/hr	Catastrophic	Possible	High	Grade separation at Hansen Rd. Many signalised crossing locations provided. Raised tables used at zebra crossings to reduce speed - design these for 30km/hr	Catastrophic	Unlikely	High	Live	Designer & Client	Public Injury	
O3	27/08/2020	Cyclists	Inconsistent design. Some sections of road with cycle lane, some without. Eg. At Hawthorne Dr roundabout it terminates at the bus stop, no cycle lane provided down Kawarau Rd and cyclists to ride in bus lanes along SH6 heading north from SH6A. Cyclists are provided off road route through SH6/SH6A intersection. Speed limit is 60km/hr. Risk of crash.	Catastrophic	Possible	High	Kawarau Rd has shared path where there is no cycle lane on road. Signage & sharrows to direct cyclists through safest route and to warn vehicles of their presence. Designers to consider installing kerb/median to separate cyclists throguh SH6/SH6a intersection on road.	Catastrophic	Unlikely	High	Live	Designer	Public Injury	
O4	2/09/2020	Traffic Signals, Signs, Pedestrian fencing, Streetlight poles	Over-dimension loads for turning vehicles and along key route - exposing people to falling poles, electrical hazards, falling loads, falling signs	Major	Unlikely	Medium	Design infrastructure to be outside of the over-dimension load envelope. Design poles with socket bases so they can be removed or hinges so they can be folded down.	Major	Rare	Low	Live	Designer	Public Injury	
O5	2/09/2020	Traffic Signals	Signal poles within over-dimension load envelope	Major	Unlikely	Medium	Design signal poles to be outside of the over-dimension load envelope	Major	Rare	Low	Live	Designer	Public Injury	
O6	2/09/2020	Traffic Signals	Controller Location/ orientation/ maintenance access - safe access to controller, safe location, able to see signals to not affect operations when adjusting settings when signals are live	Major	Unlikely	Medium	Design maintenance access to be in a safe location	Major	Rare	Low	Live	Designer	Public Injury	
O7	2/09/2020	Traffic Signals	Luminaires, street lights - signals fault mode enabled, adequate illumination of traffic islands, pedestrian facilities and priority controlled components of intersections at night	Catastrophic	Unlikely	High	Design lighting so that if traffic signals stop working, users of the road can see the crossing adequately. Lighting needs to be designed so road users can see that there is an intersection ahead and they can see the traffic islands at night.	Catastrophic	Rare	Medium	Live	Designer	Public Injury	
O8	27/08/2020	Visitors	New to the country and unfamiliar with the roads	Major	Possible	High	Appropriate signage to prevent wayfinding crashes and wrong direction crashes.	Major	Unlikely	Medium	Live	Designer	Public Injury	
O9	27/08/2020	Lighting	Appropriate lighting to ensure safety of vulnerable users at all hours. CPTED	Major	Possible	High	Design to appropriate standard considering CPTED	Major	Rare	Low	Live	Designer	Public Injury	
O10	27/08/2020	Intersections - operation	Unforeseen safety and operational issues leading to crashes and injuries	Moderate	Likely	High	Identify design solutions through external peer review/audit.	Moderate	Possible	Medium	Live	Designer	Public Injury	
O11	2/09/2020	Wayfinding	Particularly around SH6/SH6A intersection. Risk of vehicle crash	Major	Possible	High	Signage & markings to give drivers plenty of warning, particularly into BP/businesss/cemetery. Road Safety Audit to be completed during Concept and Detailed Design phase to pick up any unforseen safety issues.	Major	Unlikely	Medium	Live	Designer	Public Injury	
O12	2/09/2020	Speed	Risk that the straight alignment will encourage drivers to travel faster than the posted 60km/hr speed limit. This increases the risk for all crash types	Major	Possible	High	Lanes currently ~3.5m wide, which should induce slower speeds. Consider additional Traffic calming measures.	Major	Unlikely	Medium	Live	Designer & Client	Public Injury	
O13	2/09/2020	Vegetation	Vegetation impacting visibility, which is a risk to pedestrians crossing, vehicles pulling out of accessways or vehicles seeing around corners.	Major	Possible	High	Design trees to be appropriate distance away from edge line, chose planting that does not impact sight lines, careful consideration of placement around accessways and corners.	Major	Unlikely	Medium	Live	Designer	Public Injury	
O14	2/09/2020	Cyclists using sharedpath	Cyclists using sharedpath may cause collisions with pedestrians	Major	Possible	High	Shared paths provided are at least 3m wide. Monitor post construction if additional signage required.	Major	Unlikely	Medium	Live	Designer & Client	Personal injury	
MAINTENANCE														
M1	18/08/2020	Pedestrian refuges	Replacement of handrails that are often hit by vehicles in middle of constrained road corridor with busy traffic and potential for injury with traffic	Major	Possible	High	Socketed handrail foundations for quick replacement and limited time in centre of road with TTM to manage hazard	Major	Unlikely	Medium	Live	Designer & Client	Worker Injury	
M2	27/08/2020	Traffic Signals	Controller Location - Risk to personnel if there is no safe access route to the controller, no safe and stable platform to work from. Controller location needs to be in a location the maintainer can see the signals to ensure worker can monitor effects of changes so no hazards are created. Worker at risk if they are not able to be seen by the public if working in path areas.	Major	Possible	High	Design safe accessibility to controller location	Major	Unlikely	Medium	Live	Designer	Worker Injury	
M3	27/08/2020	Traffic Signals	Pole Locations - Risk to personnel if there is not space to put up a ladder on any traffic island and create a safety zone. Risk if there is no stable platform to work on. Risk if there is no safe access route to all poles for vehicle/equipment/tools	Major	Possible	High	Design safe access to pole location. Consideration of traffic island sizes and materials for maintenance access.	Major	Unlikely	Medium	Live	Designer	Worker Injury	

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PROJECT INFORMATION - Safety in Design Record - Simplified Procedure

Project Name	Frankton - Bridge to Bridge - 60km/hr	***Project Number***	6-XT014.64		***Date***
Client	Waka Kotahi NZ Transport Agency	***Project Stage***	Business Case		
Project Scope	Combination of new and upgraded intersections, road, crossing locations, footpaths and shared paths	***Prepared By***	s 9(2)(a)	***Reviewed By***	s 9(2)(a)
Workshop Attendees	s 9(2)(a) (WSP), s 9(2)(a) (WSP)			***Reviewed Date***	4/09/2020

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HAZARDS ASSOCIATED WITH DESIGN ELEMENTS				RISK MATRIX			PROPOSED MITIGATION MEASURES	RISK MATRIX					RESIDUAL RISK	
Ref	Date	Hazard / Work Element	Issue	Consequence	Likelihood	RR	Proposed Mitigation Measures	C	L	RR	Status	Risk Owner	Residual Risk	Client / Asset Owner Acceptance / Comment
M4	26/08/2020	Grass verges	Sections of grassed verges shown right next to edge line. Risk for maintenance team to work adjacent to live traffic.	Moderate	Unlikely	Low	Substitute for low maintenance alternative, or change design so that grass exists > 3m away from live traffic lane. OR have temporary traffic management In place during maintenance work near live traffic.	Moderate	Rare	Low	Live	Designer & Client	Worker Injury	
M5	2/09/2020	Vegetation	Vegetation impacting visibility	Catastrophic	Unlikely	High	Vegetation to be designed so that it is unlikely to impact visibility. All vegetation to be trimmed, as required	Catastrophic	Rare	Medium	Live	Designer & Client	Worker Injury	
M6	2/09/2020	Area for maintenance vehicles to pull over	Safe parking areas for maintenance vehicles to carry out maintenance activities	Minor	Likely	Medium	Provide parking for maintenance vehicles - to be assessed at next design phase.	Minor	Likely	Medium	Live	Designer	Safe working area	
M7	2/09/2020	Snow clearing	Snow clearing on road and footpaths	Minor	Likely	Medium	Low probability of happening, so won't be addressed in design. Maintenance contractor to clear roads and footpaths, rather than windrowing it (which causes further issues, freezing, clogging drains, icy surfaces etc).	Minor	Possible	Low	Live	Client & Maintenance Contactor	Snow blocking the road or footpath	
M8	2/09/2020	Repair in unfavourable conditions	Repair of road and footpath will be difficult in rain/snow/ice	Minor	Likely	Medium	Temporary repair ASAP, full repair once weather conditions improve.	Minor	Possible	Low	Live	Maintenance Contactor	Personal injury	
M9	2/09/2020	No maintenance	Defects in the shared path surface	Minor	Likely	Medium	Designer to consider materials being specified and pavement design to address likelihood of defects forming. Client to check regular inspections are being completed	Minor	Possible	Low	Live	Designer & Client	Personal injury	
M10	2/09/2020	Public or workers distraction	Slips, trips, falls, injury, death	Catastrophic	Likely	Critical	Consider in the design what detour routes you are providing for pedestrians and cyclists around potential work sites or can you provide sufficient width along the corridor for users and workers to safely be alongside each other while maintenance is underway. Traffic Management Plan to be developed if applicable during maintenance works. Traffic management controls utilised through area affected by maintenance works.	Catastrophic	Unlikely	High	Live	Designer & Maintenance Contactor	Slips, trips, falls	
M11	2/09/2020	Traffic movement	Public (pedestrians, drivers or cyclists) or workers being struck by vehicle or plant machinery causing injury or death	Catastrophic	Likely	Critical	Traffic Management Plan. Traffic management controls utilised through area affected by construction.	Catastrophic	Unlikely	High	Live	Maintenance Contactor	Crashes	
M12	2/09/2020	Fall from heights	Maintenance of underpasspass bridge, over live traffic. Risk that worker or tools may fall during maintenance inspection	Catastrophic	Possible	High	Designers to consider maintenance regime and improve access/safety where possible. Traffic Management Plan. Traffic management controls utilised through area affected by maintenance works. All tools and workers to be attached to structure if working at heights. Maintenance contractor to have appropriate health and safety procedures and work methodology in place to protect their workers.	Catastrophic	Unlikely	High	Live	Designer & Maintenance Contactor	Worker Injury	
M13	3/09/2020	Materials	Finished surface materials. E.g. Pavers/cobbles, street furniture, vegetation and other design elements having high maintenance requirements.	Major	Possible	High	Designers to consider maintenance when choosing design elements. Chose material which use have low maintenance requirements and are durable to reduce hazard to public and workers.	Major	Unlikely	Medium	Live	Maintenance Contactor	Crashes	
M14	3/09/2020	Busy Public Area	Maintenance crew working in and around a busy public area. Risk of injury to public by equipment.	Catastrophic	Possible	High	Traffic Management Plan. Traffic management controls utilised through area affected by construction, including pedestrian management. Plan works when public volumes are low.	Catastrophic	Unlikely	High	Live	Maintenance Contactor	Crashes	
DECOMMISSIONING / DEMOLITION														
D1	2/09/2020	Demolition of underpasses	When underpass reaches the end of it's design life and must be remove / replace. Risk of worker/public death from falling structure as it is removed.	Catastrophic	Possible	High	Designer should consider how the structure can be designer to demolish safely eg. Components that can be removed in their entirety, matierals that are not hazardous when demolished, how will services be attached. To be developed during detailed design phase. TTM to be in place during removal. Contractor to manage	Catastrophic	Unlikely	High	Live	Contractor	Safe working area	
D2	2/09/2020	Area for renewals/maintenance vehicles to pull over	Safe parking areas for renewals / maintenance vehicles to carry out activities	Minor	Likely	Medium	Provide parking for maintenance / renewals vehicles - to be assessed at next design phase.	Minor	Likely	Medium	Live	Designer	Safe working area	
D3	3/09/2020	Materials	Finished surface materials. E.g. Pavers/cobbles, guardrail, fencing, signage, street furniture, vegetation and other design elements having high maintenance requirements, or will need to be removed and replaced.	Major	Possible	High	Designers to consider maintenance and renewals when choosing design elements. Chose material which use have low maintenance requirements and are durable to reduce hazard to public and workers.	Major	Unlikely	Medium	Live	Maintenance / Renewal Contactor	Crashes	
D4	3/09/2020	Busy Public Area	Demolition/Renewal Crew working in and around a busy public area. Risk of injury to public by equipment.	Catastrophic	Possible	High	Traffic Management Plan. Traffic management controls utilised through area affected by construction, including pedestrian management. Plan works when public volumes are low.	Catastrophic	Unlikely	High	Live	Maintenance / Renewal Contactor	Crashes	

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PROJECT INFORMATION - Safety in Design Record - Simplified Procedure

Project Name	Queenstown Town Centre - SH6A & Town Centre	***Project Number***	6-XT014.50		***Date***
Client	Waka Kotahi NZ Transport Agency	***Project Stage***	Business Case		
Project Scope	Combination of new and upgraded intersections, road, crossing locations, footpaths, bus hub, bus lanes, to reduce congestion and improve amenity of the town centre	***Prepared By***	s 9(2)(a)	***Reviewed By***	s 9(2)(a)
Workshop Attendees	s 9(2)(a) (WSP), s 9(2)(a) (WSP)			***Reviewed Date***	4/09/2020

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HAZARDS ASSOCIATED WITH DESIGN ELEMENTS				RISK MATRIX			PROPOSED MITIGATION MEASURES	RISK MATRIX					RESIDUAL RISK	
Ref	Date	Hazard / Work Element	Issue	Consequence	Likelihood	RR	Proposed Mitigation Measures	C	L	RR	Status	Risk Owner	Residual Risk	Client / Asset Owner Acceptance / Comment
CONSTRUCTION														
C1	26/08/2020	Zebra crossings / Raised tables	Construction across entire road corridor (Athol & Camp St) with traffic and potential for injury with traffic	Major	Likely	High	Consider construction duration during concept/detailed design. Chose AC over concrete to reduce time workers exposed. Contractor to have temporary traffic control	Major	Rare	Low	Live	Designer/ Contractor	Worker Injury	
C2	18/08/2020	Public vs Plant	High risk construction work in public areas. Public (including Pedestrians, mobility users and people on bikes) will be moving around work areas and needing to access their homes, shops, restaurants, bars. Construction site at tourist destination. E.g. Footpath construction, property accesses, business accesses, business deliveries, road.	Catastrophic	Likely	Critical	Construction methodologies to reduce impact and manage risk on site, temporary traffic management to separate work area from public. Communicate with public & businesses when works will be affecting access. Consider materials for quick construction and reduced inconvenience and alternative parking for homeowners & businesses.	Catastrophic	Rare	Medium	Live	Designer/ Contractor	Public Injury	
C3	18/08/2020	Traffic Signals	Live Traffic - working with live traffic. Working where live traffic is under partial signal control. Working within an existing intersection or operating signals.	Catastrophic	Likely	Critical	Temporary traffic management to notify public. Plan works to be during off-peak i.e.. Nightworks	Catastrophic	Unlikely	High	Live	Contractor	Worker Injury	
C4	27/08/2020	Traffic Signals	Electrical Hazards - Isolation of electrical hazards from workers and the public, earthing of equipment, connection to mains supply	Catastrophic	Likely	Critical	Ensure power it switched off until necessary to operated signals. Isolate public from work area and live electricity. Use certified electricians.	Catastrophic	Rare	Medium	Live	Contractor	Worker Injury	
C5	27/08/2020	Traffic Signals	Construction of detector loops - working in live traffic lanes. Noise and dust hazards when sawcutting. Pavement integrity, loop integrity.	Major	Likely	High	Temporary traffic management. Adequate noise and dust PPE. Quality Assurance	Major	Unlikely	Medium	Live	Contractor / Design	Worker Injury	
C6	27/08/2020	Worker vs plant	Small working area expected, due to having to maintain traffic flows. More likely that worker will be hit by plant	Major	Likely	High	Contractor to plan works so that there is sufficient space. Exclusions zones to be established for high risk works	Major	Possible	High	Live	Contractor	Worker Injury	
C7	27/08/2020	Plant vs plant	Small working area expected, due to having to maintain traffic flows. More likely that plant will hit plant	Minor	Likely	Medium	Contractor to plan works so that there is sufficient space. Exclusions zones to be established for high risk works. VMPs where applicable.	Minor	Possible	Low	Live	Contractor	Worker Injury	
C8	27/08/2020	Excavation - Vibration / Slope Stability	Construction close to homes & businesses. Drilling/anchors to be installed. Risk that properties are de-stabilised and this causes harm to public.	Moderate	Possible	Medium	Designer: Geotech assessment of slope stability to inform design and construction methodology. Contractor: To follow methodology advised by designer	Moderate	Rare	Low	Live	Designer & Contractor	Collapse of slope, Injury	
C9	27/08/2020	Noise	Prolonged and / or excessive construction noise could lead to hearing damage of workers	Moderate	Possible	Medium	Appropriate PPE to be worn.	Moderate	Rare	Low	Live	Contractor	Worker Injury	
C10	27/08/2020	Dust	Trenching and digging resulting in dust	Minor	Possible	Low	Ensure dust management protocols are developed and adhered to	Minor	Rare	Low	Live	Contractor	Worker Injury	
C11	27/08/2020	Contamination	Discovery of contamination during construction. Digging up old roads - asbestos pipe is likely to be found.	Moderate	Likely	High	Contractor to have appropriate procedure in place to handle contaminated material	Moderate	Rare	Low	Live	Contractor	Worker Injury	
C12	27/08/2020	Temporary Works	Any temporary structure to be installed or constructed could fail and injure worker.	Major	Possible	High	Establish areas and structures for temporary works - to be signed off by certified engineer, if required. Temporary works design to be adhered to.	Major	Unlikely	Medium	Live	Designer & Contractor	Worker Injury	
C13	27/08/2020	Services	Excavation and Trenches - Safety of excavations for workers and the public - slips, trips and falls. Safety of excavating across live traffic lanes. Adequate protection of workers and the pubic from entering excavations	Catastrophic	Likely	Critical	Ensure Adequate protection of workers and the pubic from entering excavations. Temporary traffic management to be used if impacting traffic lane / footpath / accessway.	Catastrophic	Unlikely	High	Live	Contractor	Worker Injury	
C14	27/08/2020	Drowning	Working around waterways - risk of drowning e.g. Lake Wakatipu & Horne Creek or Bush Creek	Major	Possible	High	Contractor to manage work site so that it is fenced off / excluded from waterway. Structure design and how this affects the construction methodology.	Major	Unlikely	Medium		Designer & Contractor	Worker Injury	
C15	27/08/2020	Working with Concrete	Lime burns.	Moderate	Possible	Medium	Wear appropriate PPE that separates skin from concrete. Consider other materials during design	Moderate	Rare	Low		Designer & Contractor	Worker Injury	
C16	2/09/2020	Underground services	Service strike when excavating	Major	Likely	High	Indicate services while designing (beforeUdig). Contractor to undertake service locations prior to any excavation	Major	Possible	High	Live	Designer & Contractor	Service strike during construction	
C17	2/09/2020	Culverts	Excavation striking and damaging culverts	Minor	Possible	Low	Culverts marked on plan where possible, Contractor to locate prior to any excavation.	Minor	Unlikely	Low	Live	Designer & Contractor	Damaging culvert	
C18	2/09/2020	Overhead power lines / electrocution	Working in close proximity to power lines	Major	Possible	High	Mark power poles on plans. Controlled through Contractors methodology and H&S practices	Major	Unlikely	Medium	Live	Designer & Contractor	Electrocution	
C19	2/09/2020	Working in carriageway	Working near live traffic. Risk that workers are hit by traffic	Major	Possible	High	Maintain accesses where possible. TTM to provide safe working areas.	Major	Unlikely	Medium	Live	Contractor	Worker injury	
C20	2/09/2020	Manual handling, lifting/bending	Risk of injury during construction	Minor	Rare	Low	Contractor's methodology and H&S plan to provide safe work methods	Minor	Rare	Low	Live	Contractor	Worker injury	
C21	2/09/2020	Slips/trips/falls	Risk of slips/trips/falls	Minor	Rare	Low	Contractor's methodology and H&S plan to provide safe working environment.	Minor	Rare	Low	Live	Contractor	Worker injury	
C22	2/09/2020	Ice/snow freezing of surface	Risk of ice/snow if works are during winter season.	Minor	Unlikely	Low	Programme works to be outside of winter period.	Minor	Rare	Low	Live	Designer & Client	Adverse weather conditions	
C23	2/09/2020	Storage areas for plant and materials	Safe areas for storage areas during construction. Risk that positioning increases harm to public i.e.. Poor accessibility. Or that they are not fenced off appropriately	Minor	Rare	Low	Contractor to determine appropriate storage areas.	Minor	Rare	Low	Live	Client & Contractor	Storage areas	
C24	2/09/2020	Flooding	Flooding at Beach St / Marine Parade. (During high rainfall, lake levels can induce flooding through stormwater system)	Minor	Rare	Low	Designer: Stormwater requirements to be assessed during concept design Contractor: have appropriate mitigation/management plan in place	Minor	Rare	Low	Live	Designer & Client & Contractor	Flooding	

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PROJECT INFORMATION - Safety in Design Record - Simplified Procedure

Project Name	Queenstown Town Centre - SH6A & Town Centre	***Project Number***	6-XT014.50	***Date***	
Client	Waka Kotahi NZ Transport Agency	***Project Stage***	Business Case		
Project Scope	Combination of new and upgraded intersections, road, crossing locations, footpaths, bus hub, bus lanes, to reduce congestion and improve amenity of the town centre	***Prepared By***	s 9(2)(a)	***Reviewed By***	s 9(2)(a)
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Ref	Date	Hazard / Work Element	Issue	Consequence	Likelihood	RR	Proposed Mitigation Measures	C	L	RR	Status	Risk Owner	Residual Risk	Client / Asset Owner Acceptance / Comment
C25	2/09/2020	Events - summer peak, tourism	Increase in traffic flows, traffic delays	Minor	Unlikely	Low	Programming, coordination with other contractors, advising client	Minor	Rare	Low	Live	Client & Contractor	Increased traffic flows	
OPERATION														
O1	2/09/2020	Intersections - Pedestrians	Pedestrians crossing multiple lanes of traffic and vehicle shadowing resulting in impact between pedestrian and vehicle - particularly at bus hub on Stanley St.	Catastrophic	Possible	High	Design traffic lights to give appropriate amount of time for all user types to cross safely i.e.. Mobility scooters, children, elderly etc. Fyll pedestrian protection provided at all signalised intersections. Shared Use area through bus hub with speed limit at 30km/hr. Consider refuge islands	Catastrophic	Rare	Medium	Live	Designer	Public Injury	
O2	2/09/2020	Traffic Signals, Signs, Pedestrian fencing, Streetlight poles	Over-dimension loads for turning vehicles and along key route - exposing people to falling poles, electrical hazards, falling loads, falling signs	Major	Unlikely	Medium	Design infrastructure to be outside of the over-dimension load envelope. Design poles with socket bases so they can be removed or hinges so they can be folded down.	Major	Rare	Low	Live	Designer	Public Injury	
O3	2/09/2020	Traffic Signals	Signal poles within over-dimension load envelope	Major	Unlikely	Medium	Design signal poles to be outside of the over-dimension load envelope	Major	Rare	Low	Live	Designer	Public Injury	
O4	2/09/2020	Traffic Signals	Controller Location/ orientation/ maintenance access - safe access to controller, safe location, able to see signals to not affect operations when adjusting settings when signals are live	Major	Unlikely	Medium	Design maintenance access to be in a safe location	Major	Unlikely	Medium	Live	Designer	Public Injury	
O5	2/09/2020	Traffic Signals	Luminaires, street lights - signals fault mode enabled, adequate illumination of traffic islands, pedestrian facilities and priority controlled components of intersections at night	Catastrophic	Unlikely	High	Design lighting so that if traffic signals stop working, users of the road can see the crossing adequately. Lighting needs to be designed so road users can see that there is an intersection ahead and they can see the traffic islands at night.	Catastrophic	Rare	Medium	Live	Designer	Public Injury	
O6	27/08/2020	Visitors	New to the country and unfamiliar with the roads	Major	Possible	High	Appropriate signage to prevent wayfinding crashes and wrong direction crashes.	Major	Unlikely	Medium	Live	Designer	Public Injury	
O7	27/08/2020	Lighting	Appropriate lighting to ensure safety of vulnerable users at all hours. CPTED	Major	Possible	High	Design to appropriate standard considering CPTED	Major	Rare	Low	Live	Designer	Public Injury	
O8	27/08/2020	Intersections - operation	Unforeseen safety and operational issues leading to crashes and injuries	Moderate	Likely	High	Identify design solutions through external peer review/audit.	Moderate	Possible	Medium	Live	Designer	Public Injury	
O9	27/08/2020	Cyclists	No shoulder provided, and median only provided for some isolated sections. Risk of car hitting cyclist. Minimal cycle boxes provided throughout SH6A. Alternative cycle route provided through town centre via Camp St.	Catastrophic	Possible	High	Safer route provided through town. Narrow road corridor currently. Increase signage to show cyclists safest route through town	Catastrophic	Unlikely	High	Live	Designer	Public Injury	
O10	2/09/2020	Wayfinding - Vehicles	Particularly around Stanley / Shotover intersection, which is at the bus hub entrance. Cars may try to enter Stanley St. Risk of vehicle crash	Major	Possible	High	Signage & linemarking to give drivers plenty of warning. Road Safety Audit will also be completed during Concept and Detailed Design phase to pickup any unforseen safety issues.	Major	Unlikely	Medium	Live	Designer	Public Injury	
O11	2/09/2020	Intersections - pedestrians	Speed limit is currently 40km/hr. Safe and survivable speed for pedestrian crash is 30km/hr	Catastrophic	Possible	High	Consider raised tables at intersections, designed for 30km/hr	Catastrophic	Unlikely	High	Live	Designer & Client	Public Injury	
O12	2/09/2020	Speed	Risk that the straight alignment will encourage drivers to travel faster than the posted 40km/hr speed limit. This increases the risk for all crash types	Major	Possible	High	More constrained environment, less likely to speed. Consider traffic calming measures.	Major	Unlikely	Medium	Live	Designer & Client	Public Injury	
O13	2/09/2020	Vegetation	Vegetation impacting visibility, which is a risk to pedestrians crossing, vehicles pulling out of accessways or vehicles seeing around corners.	Major	Possible	High	Design trees to be appropriate distance away from edge line, chose planting that does not impact sight lines, careful consideration of placement around accessways and corners.	Major	Unlikely	Medium	Live	Designer	Public Injury	
O14	2/09/2020	Shared Zones	Risk that cars & pedestrians do not realise where shared zones begin and end. Risk that pedestrian is hit by car.	Catastrophic	Possible	High	Alternative pavement & signage used as a visual warning. Speed limit is 30km/hr through shared zones, which is safe and survivable for a pedestrian crash.	Catastrophic	Unlikely	High	Live	Designer	Public Injury	
O15	3/09/2020	Wayfinding - Cyclists	Risk that cyclists are not sure where they are / are not allowed	Major	Possible	High	Signage & line marking to give cyclists clear direction on correct way through town.	Major	Unlikely	Medium			Public Injury	
O16	2/09/2020	Cyclists using footpath	Cyclists using footpath may cause collisions with pedestrians	Major	Possible	High	Monitor post construction if additional signage required. Cycling on footpath may be made legal at some point - cater for this in the design.	Major	Unlikely	Medium	Live	Designer & Client	Personal injury	
O17	2/09/2020	Signage	Risk that people/vehicles hit signage	Major	Possible	High	Design to MOTSAM offsets and clearances.	Major	Unlikely	Medium	Live	Designer & Client	Personal injury	
MAINTENANCE														
M1	18/08/2020	Pedestrian refuges	Replacement of handrails that are often hit by vehicles in middle of constrained road corridor with busy traffic and potential for injury with traffic	Major	Possible	High	Socketed handrail foundations for quick replacement and limited time in centre of road with TTM to manage hazard	Major	Unlikely	Medium	Live	Designer & Client	Worker Injury	
M2	27/08/2020	Traffic Signals	Controller Location - Risk to personnel if there is no safe access route to the controller, no safe and stable platform to work from. Controller location needs to be in a location the maintainer can see the signals to ensure worker can monitor effects of changes so no hazards are created. Worker at risk if they are not able to be seen by the public if working in path areas.	Major	Possible	High	Design safe accessibility to controller location	Major	Unlikely	Medium	Live	Designer	Worker Injury	

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PROJECT INFORMATION - Safety in Design Record - Simplified Procedure

Project Name	Queenstown Town Centre - SH6A & Town Centre	***Project Number***	6-XT014.50	***Date***	
Client	Waka Kotahi NZ Transport Agency	***Project Stage***	Business Case		
Project Scope	Combination of new and upgraded intersections, road, crossing locations, footpaths, bus hub, bus lanes, to reduce congestion and improve amenity of the town centre	***Prepared By***	s 9(2)(a)	***Reviewed By***	s 9(2)(a)
Workshop Attendees	s 9(2)(a) (WSP), s 9(2)(a) (WSP)			***Reviewed Date***	4/09/2020

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HAZARDS ASSOCIATED WITH DESIGN ELEMENTS				RISK MATRIX			PROPOSED MITIGATION MEASURES	RISK MATRIX					RESIDUAL RISK	
Ref	Date	Hazard / Work Element	Issue	Consequence	Likelihood	RR	Proposed Mitigation Measures	C	L	RR	Status	Risk Owner	Residual Risk	Client / Asset Owner Acceptance / Comment
M3	27/08/2020	Traffic Signals	Pole Locations - Risk to personnel if there is not space to put up a ladder on any traffic island and create a safety zone. Risk if there is no stable platform to work on. Risk if there is no safe access route to all poles for vehicle/equipment/tools	Major	Possible	High	Design safe access to pole location. Consideration of traffic island sizes and materials for maintenance access.	Major	Unlikely	Medium	Live	Designer	Worker Injury	
M4	26/08/2020	Grass verges	Sections of grassed verges shown right next to edge line. Risk for maintenance team to work adjacent to live traffic.	Moderate	Unlikely	Low	Substitute for low maintenance alternative, or change design so that grass exists > 3m away from live traffic lane. OR have temporary traffic management In place during maintenance work near live traffic.	Moderate	Rare	Low	Live	Designer & Client	Worker Injury	
M5	2/09/2020	Vegetation	Vegetation impacting visibility	Catastrophic	Unlikely	High	Vegetation to be designed so that it is unlikely to impact visibility. All vegetation to be trimmed, as required	Catastrophic	Rare	Medium	Live	Designer & Client	Worker Injury	
M6	2/09/2020	Area for maintenance vehicles to pull over	Safe parking areas for maintenance vehicles to carry out maintenance activities	Minor	Likely	Medium	Provide parking for maintenance vehicles - to be assessed at next design phase.	Minor	Likely	Medium	Live	Designer	Safe working area	
M7	2/09/2020	Snow clearing	Snow clearing on road and footpaths	Minor	Likely	Medium	Low probability of happening, so won't be addressed in design. Maintenance contractor to clear roads and footpaths, rather than windrowing it (which causes further issues, freezing, clogging drains, icy surfaces etc).	Minor	Possible	Low	Live	Client & Maintenance Contactor	Snow blocking the shared path	
M8	2/09/2020	Repair in unfavourable conditions	Repair of road and footpath will be difficult in rain/snow/ice	Minor	Likely	Medium	Temporary repair ASAP, full repair once weather conditions improve.	Minor	Possible	Low	Live	Maintenance Contactor	Personal injury	
M9	2/09/2020	No maintenance	Defects in the shared path surface	Minor	Likely	Medium	Designer to consider materials being specified and pavement design to address likelihood of defects forming. Client to check regular inspections are being completed	Minor	Possible	Low	Live	Designer & Client	Personal injury	
M10	2/09/2020	Public or workers distraction	Slips, trips, falls, injury, death	Catastrophic	Likely	Critical	Consider in the design what detour routes you are providing for pedestrians and cyclists around potential work sites or can you provide sufficient width along the corridor for users and workers to safely be alongside each other while maintenance is underway Traffic Management Plan to be developed if applicable during maintenance works. Traffic management controls utilised through area affected by maintenance works.	Catastrophic	Unlikely	High	Live	Designer & Maintenance Contactor	Slips, trips, falls	
M11	2/09/2020	Traffic movement	Public (pedestrians, drivers or cyclists) or workers being struck by vehicle or plant machinery causing injury or death	Catastrophic	Likely	Critical	Traffic Management Plan. Traffic management controls utilised through area affected by construction.	Catastrophic	Unlikely	High	Live	Maintenance Contactor	Crashes	
M12	3/09/2020	Materials	Finished surface materials. E.g. Pavers/cobbles, street furniture, vegetation and other design elements having high maintenance requirements.	Major	Possible	High	Designers to consider maintenance when choosing design elements. Chose material which use have low maintenance requirements and are durable to reduce hazard to public and workers.	Major	Unlikely	Medium	Live	Maintenance Contactor	Crashes	
M13	3/09/2020	Busy Public Area	Maintenance crew working in and around a busy public area. Risk of injury to public by equipment.	Catastrophic	Possible	High	Traffic Management Plan. Traffic management controls utilised through area affected by construction, including pedestrian management. Plan works when public volumes are low.	Catastrophic	Unlikely	High	Live	Maintenance Contactor	Crashes	
DECOMMISSIONING / DEMOLITION														
D1	2/09/2020	Area for renewals/maintenance vehicles to pull over	Safe parking areas for renewals / maintenance vehicles to carry out activities	Minor	Likely	Medium	Provide parking for maintenance / renewals vehicles - to be assessed at next design phase.	Minor	Likely	Medium	Live	Designer	Safe working area	
D2	3/09/2020	Materials	Finished surface materials. E.g. Pavers/cobbles, guardrail, fencing, signage, street furniture, vegetation and other design elements having high maintenance requirements, or will need to be removed and replaced.	Major	Possible	High	Designers to consider maintenance and renewals when choosing design elements. Chose material which use have low maintenance requirements and are durable to reduce hazard to public and workers.	Major	Unlikely	Medium	Live	Maintenance / Renewal Contactor	Crashes	
D3	3/09/2020	Busy Public Area	Demolition/Renewal Crew working in and around a busy public area. Risk of injury to public by equipment.	Catastrophic	Possible	High	Traffic Management Plan. Traffic management controls utilised through area affected by construction, including pedestrian management. Plan works when public volumes are low.	Catastrophic	Unlikely	High	Live	Maintenance / Renewal Contactor	Crashes	

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PROJECT INFORMATION - Safety in Design Record - Simplified Procedure

Project Name	Queenstown Town Centre - Arterial Route	***Project Number***	6-XT014.50
Client	Waka Kotahi NZ Transport Agency	***Project Stage***	Business Case
Project Scope	Combination of new and upgraded intersections, road, crossing locations, footpaths to create a bypass from the town centre	***Prepared By***	s 9(2)(a)
Workshop Attendees	s 9(2)(a) (WSP), s 9(2)(a) (WSP)		

	Reviewed By	s 9(2)(a)
	Reviewed Date	4/09/2020

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HAZARDS ASSOCIATED WITH DESIGN ELEMENTS				RISK MATRIX			PROPOSED MITIGATION MEASURES	RISK MATRIX					RESIDUAL RISK	
Ref	Date	Hazard / Work Element	Issue	Consequence	Likelihood	RR	Proposed Mitigation Measures	C	L	RR	Status	Risk Owner	Residual Risk	Client / Asset Owner Acceptance / Comment
CONSTRUCTION														
C1	26/08/2020	Zebra crossings / Raised tables	Construction across entire road corridor (Man St & Thompson St) with traffic and potential for injury with traffic	Major	Likely	High	Consider construction duration during concept/detailed design. Chose AC over concrete to reduce time workers exposed. Contractor to have temporary traffic control	Major	Rare	Low	Live	Designer/ Contractor	Worker Injury	
C2	18/08/2020	Public vs Plant	High risk construction work in public areas. Public (including Pedestrians, mobility users and people on bikes) will be moving around work areas and needing to access their homes. E.g. Footpath construction, property accesses, road.	Catastrophic	Likely	Critical	Construction methodologies to reduce impact and manage risk on site, temporary traffic management to separate work area from public. Communicate with public when works will be affecting access/ Consider materials for quick construction and reduced inconvenience and alternative parking for homeowners	Catastrophic	Rare	Medium	Live	Designer/ Contractor	Public Injury	
C3	18/08/2020	Traffic Signals	Live Traffic - working with live traffic. Working where live traffic is under partial signal control. Working within an existing intersection or operating signals.	Catastrophic	Likely	Critical	Temporary traffic management to notify public. Plan works to be during off-peak i.e.. Nightworks	Catastrophic	Unlikely	High	Live	Contractor	Worker Injury	
C4	27/08/2020	Traffic Signals	Electrical Hazards - Isolation of electrical hazards from workers and the public, earthing of equipment, connection to mains supply	Catastrophic	Likely	Critical	Ensure power it switched off until necessary to operated signals. Isolate public from work area and live electricity. Use certified electricians.	Catastrophic	Rare	Medium	Live	Contractor	Worker Injury	
C5	27/08/2020	Traffic Signals	Construction of detector loops - working in live traffic lanes. Noise and dust hazards when sawcutting. Pavement integrity, loop integrity.	Major	Likely	High	Temporary traffic management. Adequate noise and dust PPE. Quality Assurance	Major	Unlikely	Medium	Live	Contractor / Design	Worker Injury	
C6	26/08/2020	Roundabout at Fernhill	Future levels are higher than existing levels. Existing traffic flows must be maintained during construction. This complex staging may present risk to the public or to works (e.g. Steep temp batters)	Major	Possible	High	Designer to attempt to get levels close to existing to reduce complex staging. Contractor to manage site risks	Major	Unlikely	Medium	Live	Designer/ Contractor	Worker Injury	
C7	26/08/2020	Trampers / Mountain bikers / Runners	Overpass to be constructed near Ben Lomond Track Trailhead. Trampers, runners, mountain bikers are less likely to stick to signed tracks.	Major	Possible	High	Contractors to appropriately fence off their hazardous equipment. Contractors to keep this user group in mind when planning works	Major	Rare	Low	Live	Contractor	Worker Injury	
C8	27/08/2020	Worker vs plant	Small working area expected, due to having to maintain traffic flows. More likely that worker will be hit by plant	Major	Likely	High	Contractor to plan works so that there is sufficient space. Exclusions zones to be established for high risk works	Major	Possible	High	Live	Contractor	Worker Injury	
C9	27/08/2020	Plant vs plant	Small working area expected, due to having to maintain traffic flows. More likely that plant will hit plant	Minor	Likely	Medium	Contractor to plan works so that there is sufficient space. Exclusions zones to be established for high risk works. VMPs where applicable.	Minor	Possible	Low	Live	Contractor	Worker Injury	
C10	27/08/2020	Excavation - Vibration / Slope Stability	Construction close to homes. Drilling/anchors to be installed. Risk that properties are de-stabilised and this causes harm to public.	Moderate	Possible	Medium	Designer: Geotech assessment of slope stability to inform design and construction methodology. Contractor: To follow methodology advised by designer	Moderate	Rare	Low	Live	Designer & Contractor	Collapse of slope, Injury	
C11	27/08/2020	Noise	Prolonged and / or excessive construction noise could lead to hearing damage of workers	Moderate	Possible	Medium	Appropriate PPE to be worn.	Moderate	Rare	Low	Live	Contractor	Worker Injury	
C12	27/08/2020	Dust	Trenching and digging resulting in dust	Minor	Possible	Low	Ensure dust management protocols are developed and adhered to	Minor	Rare	Low	Live	Contractor	Worker Injury	
C13	27/08/2020	Contamination	Discovery of contamination during construction. Digging up old roads - asbestos pipe is likely to be found.	Moderate	Likely	High	Contractor to have appropriate procedure in place to handle contaminated material	Moderate	Rare	Low	Live	Contractor	Worker Injury	
C14	27/08/2020	Overpass from Ballarat St	Working from heights - risk of falling person/material	Major	Possible	High	Designer to consider method of construction during detailed design and seek to minimise construction time at heights. Contractor to plans works safely and have exclusion zones where appropriate	Major	Unlikely	Medium	Live	Designer & Contractor	Worker Injury	
C15	27/08/2020	Temporary Works	Any temporary structure to be installed or constructed could fail and injure worker.	Major	Possible	High	Establish areas and structures for temporary works - to be signed off by certified engineer, if required. Temporary works design to be adhered to.	Major	Unlikely	Medium	Live	Designer & Contractor	Worker Injury	
C16	27/08/2020	Services	Excavation and Trenches - Safety of excavations for workers and the public - slips, trips and falls. Safety of excavating across live traffic lanes. Adequate protection of workers and the pubic from entering excavations	Catastrophic	Likely	Critical	Ensure Adequate protection of workers and the pubic from entering excavations. Temporary traffic management to be used if impacting traffic lane / footpath / accessway.	Catastrophic	Unlikely	High	Live	Contractor	Worker Injury	
C17	27/08/2020	Drowning	Working around waterways - risk of drowning e.g. Horne Creek & One Mile Creek	Major	Possible	High	Contractor to manage work site so that it is fenced off / excluded from waterway. Structure design and how this affects the construction methodology.	Major	Unlikely	Medium	Live	Designer & Contractor	Worker Injury	
C18	27/08/2020	Working with Concrete	Lime burns.	Moderate	Possible	Medium	Wear appropriate PPE that separates skin from concrete. Consider other materials during design	Moderate	Rare	Low	Live	Designer & Contractor	Worker Injury	
C19	2/09/2020	Underground services	Service strike when excavating	Major	Likely	High	Indicate services while designing (beforeUdig). Contractor to undertake service locations prior to any excavation	Major	Possible	High	Live	Designer & Contractor	Service strike during construction	
C20	2/09/2020	Culverts	Excavation striking and damaging culverts	Minor	Possible	Low	Culverts marked on plan where possible, Contractor to locate prior to any excavation.	Minor	Unlikely	Low	Live	Designer & Contractor	Damaging culvert	
C21	2/09/2020	Overhead power lines / electrocution	Working in close proximity to power lines	Major	Possible	High	Mark power poles on plans. Controlled through Contractors methodology and H&S practices	Major	Unlikely	Medium	Live	Designer & Contractor	Electrocution	
C22	2/09/2020	Working in carriageway	Working near live traffic. Risk that workers are hit by traffic	Major	Possible	High	Maintain accesses where possible. TTM to provide safe working areas.	Major	Unlikely	Medium	Live	Contractor	Worker injury	
C23	2/09/2020	Manual handling, lifting/bending	Risk of injury during construction	Minor	Rare	Low	Contractor's methodology and H&S plan to provide safe work methods	Minor	Rare	Low	Live	Contractor	Worker injury	

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PROJECT INFORMATION - Safety in Design Record - Simplified Procedure

Project Name	Queenstown Town Centre - Arterial Route	***Project Number***	6-XT014.50		***Date***
Client	Waka Kotahi NZ Transport Agency	***Project Stage***	Business Case		
Project Scope	Combination of new and upgraded intersections, road, crossing locations, footpaths to create a bypass from the town centre	***Prepared By***	s 9(2)(a)	***Reviewed By***	s 9(2)(a)
Workshop Attendees	s 9(2)(a) (WSP), s 9(2)(a) (WSP)			***Reviewed Date***	4/09/2020

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C24	2/09/2020	Slips/trips/falls	Risk of slips/trips/falls	Minor	Rare	Low	Contractor's methodology and H&S plan to provide safe working environment.	Minor	Rare	Low	Live	Contractor	Worker injury	
C25	2/09/2020	Ice/snow freezing of surface	Risk of ice/snow if works are during winter season.	Minor	Unlikely	Low	Programme works to be outside of winter period.	Minor	Rare	Low	Live	Designer & Client	Adverse weather conditions	
C26	2/09/2020	Storage areas for plant and materials	Safe areas for storage areas during construction. Risk that positioning increases harm to public i.e.. Poor accessibility. Or that they are not fenced off appropriately	Minor	Rare	Low	Contractor to determine appropriate storage areas.	Minor	Rare	Low	Live	Client & Contractor	Storage areas	
C27	2/09/2020	High bank/drop/retaining walls	Risk of fall from height during construction. E.g. Thompson St is approx. 3m above Brunswick with existing retaining wall supporting Thompson St, also between Beetham & Ballarat St.	Major	Unlikely	Medium	Designer to attempt to reduce height difference here. Otherwise, contractor to manage during construction.	Major	Rare	Low	Live	Designer & Contractor	Personal injury	
C28	2/09/2020	Flooding	Flooding at One Mile Creek/Fernhill roundabout	Minor	Rare	Low	Designer: Stormwater requirements to be assessed during concept design Contractor: have appropriate mitigation/management plan in place	Minor	Rare	Low	Live	Designer & Client & Contractor	Flooding	
C29	2/09/2020	Events - summer peak, tourism	Increase in traffic flows, traffic delays	Minor	Unlikely	Low	Programming, coordination with other contractors, advising client	Minor	Rare	Low	Live	Client & Contractor	Increased traffic flows	
OPERATION														
O1	2/09/2020	Intersections - Pedestrians	Pedestrians crossing multiple lanes of traffic resulting in impact between pedestrian and vehicle.	Catastrophic	Possible	High	Design traffic lights to give appropriate amount of time for all user types to cross safely i.e.. Mobility scooters, children, elderly etc. Full pedsetrian protection provided at all signalised intersections	Catastrophic	Rare	Medium	Live	Designer	Public Injury	
O2	2/09/2020	Accesses	Steepening of accesses and visibility of other users (peds/cyclists/vehicles) and impact between vehicle and other user (low speed exiting access)	Moderate	Possible	Medium	Speed is currently 40km/hr, vehicles likely to be travelling much slower than this when exiting driveway and approaching busy road, therefore Low risk. Max grades to be adhered to.	Moderate	Rare	Low	Live	Designer	Public Injury	
O3	2/09/2020	Traffic Signals, Signs, Pedestrian fencing, Streetlight poles	Over-dimension loads for turning vehicles and along key route - exposing people to falling poles, electrical hazards, falling loads, falling signs	Major	Unlikely	Medium	Design infrastructure to be outside of the over-dimension load envelope. Design poles with socket bases so they can be removed or hinges so they can be folded down.	Major	Rare	Low	Live	Designer	Public Injury	
O4	2/09/2020	Traffic Signals	Signal poles within over-dimension load envelope	Major	Unlikely	Medium	Design signal poles to be outside of the over-dimension load envelope	Major	Rare	Low	Live	Designer	Public Injury	
O5	2/09/2020	Traffic Signals	Controller Location/ orientation/ maintenance access - safe access to controller, safe location, able to see signals to not affect operations when adjusting settings when signals are live	Major	Unlikely	Medium	Design maintenance access to be in a safe location	Major	Rare	Low	Live	Designer	Public Injury	
O6	2/09/2020	Traffic Signals	Luminaires, street lights - signals fault mode enabled, adequate illumination of traffic islands, pedestrian facilities and priority controlled components of intersections at night	Catastrophic	Unlikely	High	Design lighting so that if traffic signals stop working, users of the road can see the crossing adequately. Lighting needs to be designed so road users can see that there is an intersection ahead and they can see the traffic islands at night.	Catastrophic	Rare	Medium	Live	Designer	Public Injury	
O7	27/08/2020	Rock Fall Risk	Rock fall risk at the Fernhill roundabout end. Could fall on to workers.	Major	Possible	High	Geotech assessment to be completed to advise slope stability and treatment. I.e.. Rock fall protection measures and maintenance checks.	Major	Rare	Low	Live	Designer	Public Injury	
O8	27/08/2020	Visitors	New to the country and unfamiliar with the roads	Major	Possible	High	Appropriate signage to prevent wayfinding crashes and wrong direction crashes.	Major	Unlikely	Medium	Live	Designer	Public Injury	
O9	27/08/2020	Lighting	Appropriate lighting to ensure safety of vulnerable users at all hours. CPTED	Major	Possible	High	Design to appropriate standard considering CPTED	Major	Rare	Low	Live	Designer	Public Injury	
O10	27/08/2020	Intersections - operation	Unforeseen safety and operational issues leading to crashes and injuries	Moderate	Likely	High	Identify design solutions through external peer review/audit.	Moderate	Possible	Medium	Live	Designer	Public Injury	
O11	27/08/2020	Cyclists	No shoulder provided, and median only provided for some isolated sections. Risk of car hitting cyclist. Minimal cycle boxes provided throughout arterial route.	Catastrophic	Possible	High	Safer route provided through town. Narrow road corridor currently. Increase signage to show cyclists safest route through town	Catastrophic	Unlikely	High	Live	Designer	Public Injury	
O12	2/09/2020	Distracted Driver	Along Thompson St with view over Lake Wakatipu there is a risk drivers will be distracted.	Major	Possible	High	Low risk, as low speed along Thompson, higher speed as they approach Fernhill roundabout. . Consider screening during concept/detailed design to restrict view for drivers.	Major	Unlikely	Medium	Live	Designer & Client	Public Injury	
O13	2/09/2020	Wayfinding	Particularly around Gorge/Shotover intersection, which has a raised median separating traffic flow where the arterial splits from SH6A. Risk of vehicle crash	Major	Possible	High	Re-consider whether raised median is appropriate Signage to give drivers plenty of warning Road Safety Audit to be completed during Concept and Detailed Design phase	Major	Unlikely	Medium	Live	Designer	Public Injury	
O14	2/09/2020	Intersections - pedestrians	Speed limit is currently 40km/hr. Safe and survivable speed for pedestrian crash is 30km/hr	Catastrophic	Possible	High	Consider raised tables at intersections, designed for 30km/hr	Catastrophic	Unlikely	High	Live	Designer & Client	Public Injury	
O15	2/09/2020	Speed	Risk that the straight alignment will encourage drivers to travel faster than the posted 40km/hr speed limit. This increases the risk for all crash types	Major	Possible	High	Traffic calming measures to be considered during next phase. Lanes are only 3.25m, to reduce speed. Wider line markings to give perception of narrow lanes.	Major	Unlikely	Medium	Live	Designer & Client	Public Injury	
O16	2/09/2020	Vegetation	Vegetation impacting visibility, which is a risk to pedestrians crossing, vehicles pulling out of accessways or vehicles seeing around corners.	Major	Possible	High	Design trees to be appropriate distance away from edge line, chose planting that does not impact sight lines, careful consideration of placement around accessways and corners.	Major	Unlikely	Medium	Live	Designer	Public Injury	
O17	2/09/2020	Cyclists using footpath	Cyclists using footpath may cause collisions with pedestrians.	Major	Possible	High	Monitor post construction if additional signage required. Wide shared paths have been designed to accommodation both peds and cyclists.	Major	Unlikely	Medium	Live	Designer & Client	Personal injury	

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PROJECT INFORMATION - Safety in Design Record - Simplified Procedure

Project Name	Queenstown Town Centre - Arterial Route	***Project Number***	6-XT014.50		***Date***
Client	Waka Kotahi NZ Transport Agency	***Project Stage***	Business Case		
Project Scope	Combination of new and upgraded intersections, road, crossing locations, footpaths to create a bypass from the town centre	***Prepared By***	s 9(2)(a)	***Reviewed By***	s 9(2)(a)
Workshop Attendees	s 9(2)(a) (WSP), s 9(2)(a) (WSP)			***Reviewed Date***	4/09/2020

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MAINTENANCE														
M1	18/08/2020	Pedestrian refuges	Replacement of handrails that are often hit by vehicles in middle of constrained road corridor with busy traffic and potential for injury with traffic	Major	Possible	High	Socketed handrail foundations for quick replacement and limited time in centre of road with TTM to manage hazard	Major	Unlikely	Medium	Live	Designer & Client	Worker Injury	
M2	27/08/2020	Traffic Signals	Controller Location - Risk to personnel if there is no safe access route to the controller, no safe and stable platform to work from. Controller location needs to be in a location the maintainer can see the signals to ensure worker can monitor effects of changes so no hazards are created. Worker at risk if they are not able to be seen by the public if working in path areas.	Major	Possible	High	Design safe accessibility to controller location	Major	Unlikely	Medium	Live	Designer	Worker Injury	
M3	27/08/2020	Traffic Signals	Pole Locations - Risk to personnel if there is not space to put up a ladder on any traffic island and create a safety zone. Risk if there is no stable platform to work on. Risk if there is no safe access route to all poles for vehicle/equipment/tools	Major	Possible	High	Design safe access to pole location. Consideration of traffic island sizes and materials for maintenance access.	Major	Unlikely	Medium	Live	Designer	Worker Injury	
M4	26/08/2020	Grass verges	Sections of grassed verges shown right next to edge line. Risk for maintenance team to work adjacent to live traffic and adjacent to the public.	Moderate	Unlikely	Low	Substitute for low maintenance alternative, or change design so that grass exists > 3m away from live traffic lane. OR have temporary traffic management in place during maintenance work near live traffic.	Moderate	Rare	Low	Live	Designer & Client	Worker Injury	
M5	2/09/2020	Vegetation	Vegetation impacting visibility	Catastrophic	Unlikely	High	Vegetation to be designed so that it is unlikely to impact visibility. All vegetation to be trimmed, as required	Catastrophic	Rare	Medium	Live	Designer & Client	Worker Injury	
M6	2/09/2020	Grass batters - Fernhill roundabout	Batters around the roundabout may be too steep to maintain, and the maintenance team needs to be able to access these safely	Moderate	Possible	Medium	Consider accessibility and grade when designing the roundabout. Also aim to landscape using low maintenance plants such as flax? This will be finalised during CD/DD, and may become a retaining wall.	Moderate	Unlikely	Low	Live	Designer & Client	Worker Injury	
M7	2/09/2020	Area for maintenance vehicles to pull over	Safe parking areas for maintenance vehicles to carry out maintenance activities	Minor	Likely	Medium	Provide parking for maintenance vehicles - to be assessed at next design phase.	Minor	Likely	Medium	Live	Designer	Safe working area	
M8	2/09/2020	Snow clearing	Snow clearing on road and footpaths	Moderate	Likely	High	Low probability of happening, so won't be addressed in design. Maintenance contractor to clear roads and footpaths, rather than windrowing it (which causes further issues, freezing, clogging drains, icy surfaces etc).	Minor	Possible	Low	Live	Client & Maintenance Contactor	Snow blocking the shared path	
M9	2/09/2020	Repair in unfavourable conditions	Repair of road and footpath will be difficult in rain/snow/ice	Minor	Likely	Medium	Temporary repair ASAP, full repair once weather conditions improve. Asphalt proposed, which is less susceptible to failure than chip seal.	Minor	Possible	Low	Live	Maintenance Contactor	Personal injury	
M10	2/09/2020	No maintenance	Defects in the shared path surface	Minor	Likely	Medium	Designer to consider materials being specified and pavement design to address likelihood of defects forming. Client to check regular inspections are being completed	Minor	Possible	Low	Live	Designer & Client	Personal injury	
M11	2/09/2020	Public or workers distraction	Slips, trips, falls, injury, death	Catastrophic	Likely	Critical	Consider in the design what detour routes you are providing for pedestrians and cyclists around potential work sites or can you provide sufficient width along the corridor for users and workers to safely be alongside each other while maintenance is underway. Traffic Management Plan to be developed if applicable during maintenance works. Traffic management controls utilised through area affected by maintenance works.	Catastrophic	Unlikely	High	Live	Designer & Maintenance Contactor	Slips, trips, falls	
M12	2/09/2020	Traffic movement	Public (pedestrians, drivers or cyclists) or workers being struck by vehicle or plant machinery causing injury or death	Catastrophic	Likely	Critical	Traffic Management Plan. Traffic management controls utilised through area affected by construction.	Catastrophic	Unlikely	High	Live	Maintenance Contactor	Crashes	
M13	2/09/2020	Fall from heights	Maintenance of overpass bridge, over live traffic. Risk that worker or tools may fall during maintenance inspection	Catastrophic	Possible	High	Designers to consider maintenance regime and improve access/safety where possible. Traffic Management Plan. Traffic management controls utilised through area affected by maintenance works. All tools and workers to be attached to structure if working at heights. Maintenance contractor to have appropriate health and safety procedures and work methodology in place to protect their workers.	Catastrophic	Unlikely	High	Live	Designer & Maintenance Contactor	Worker Injury	
M14	3/09/2020	Materials	Finished surface materials. E.g. Pavers/cobbles, street furniture, vegetation and other design elements having high maintenance requirements	Major	Possible	High	Designers to consider maintenance when choosing design elements. Chose material which use have low maintenance requirements and are durable to reduce hazard to public and workers.	Major	Unlikely	Medium	Live	Maintenance Contactor	Crashes	
M15	3/09/2020	Busy Public Area	Maintenance crew working in and around a busy public area. Risk of injury to public by equipment.	Catastrophic	Possible	High	Traffic Management Plan. Traffic management controls utilised through area affected by construction, including pedestrian management. Plan works when public volumes are low.	Catastrophic	Unlikely	High	Live	Maintenance Contactor	Crashes	
DECOMMISSIONING / DEMOLITION														
D1	2/09/2020	Demolition of overpass	When overpass reaches the end of it's design life and must be remove / replace. Risk of worker/public death from falling structure as it is removed.	Catastrophic	Possible	High	Designer should consider how the structure can be designer to demolish safely eg. Components that can be removed in their entirety, matierals that are not hazardous when demolished, how will services be attached. To be developed during detailed design phase. TTM to be in place during removal. Contractor to manage	Catastrophic	Unlikely	High	Live	Contractor	Worker Injury	

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PROJECT INFORMATION - Safety in Design Record - Simplified Procedure

Project Name	Queenstown Town Centre - Arterial Route	***Project Number***	6-XT014.50		***Date***
Client	Waka Kotahi NZ Transport Agency	***Project Stage***	Business Case		
Project Scope	Combination of new and upgraded intersections, road, crossing locations, footpaths to create a bypass from the town centre	***Prepared By***	s 9(2)(a)	***Reviewed By***	s 9(2)(a)
Workshop Attendees	s 9(2)(a) (WSP), s 9(2)(a) (WSP)			***Reviewed Date***	4/09/2020

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D2	2/09/2020	Area for renewals/maintenance vehicles to pull over	Safe parking areas for renewals / maintenance vehicles to carry out activities	Minor	Likely	Medium	Provide parking for maintenance / renewals vehicles - to be assessed at next design phase.	Minor	Likely	Medium	Live	Designer	Safe working area	
D3	3/09/2020	Materials	Finished surface materials. E.g. Pavers/cobbles, guardrail, fencing, signage, street furniture, vegetation and other design elements having high maintenance requirements, or will need to be removed and replaced.	Major	Possible	High	Designers to consider maintenance and renewals when choosing design elements. Chose material which use have low maintenance requirements and are durable to reduce hazard to public and workers.	Major	Unlikely	Medium	Live	Maintenance / Renewal Contactor	Crashes	
D4	3/09/2020	Busy Public Area	Demolition/Renewal Crew working in and around a busy public area. Risk of injury to public by equipment.	Catastrophic	Possible	High	Traffic Management Plan. Traffic management controls utilised through area affected by construction, including pedestrian management. Plan works when public volumes are low.	Catastrophic	Unlikely	High	Live	Maintenance / Renewal Contactor	Crashes	

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PROJECT INFORMATION - Safety in Design Record - Simplified Procedure

Project Name	Frankton to Queenstown (SH6A)	***Project Number***	6-XT014.40		***Date***
Client	Waka Kotahi NZ Transport Agency	***Project Stage***	Business Case		
Project Scope	A number of signalised intersections and pedestrian signals to provide safer access for pedestrians to public transport and side roads. Bus priority measure, mai	***Prepared By***	s 9(2)(a)	***Reviewed By***	s 9(2)(a)
Workshop Attendees	s 9(2)(a) (WSP) s 9(2)(a) (WSP)			***Reviewed Date***	4/09/2020

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CONSTRUCTION														
C1	18/08/2020	Pedestrian refuges	Construction in middle of constrained road corridor with busy traffic and potential for injury with traffic	Major	Likely	High	Cast in situ with TTM to manage hazard. Pre-cast likely to be a maintenance issue requiring attendance in busy corridor with same risks.	Major	Rare	Low	Live	Contractor	Worker Injury	
C2	18/08/2020	Accesses	Logistics during construction and use of access by property owners	Minor	Rare	Low	Consider materials for quick construction and reduced inconvenience and alternative parking for homeowners	Minor	Rare	Low	Live	Designer/ Contractor	Inconvenice for homeowners	
C3	18/08/2020	Public vs Plant	High risk construction work in public areas. Public (including Pedestrians, mobility users and people on bikes) will be moving around work areas and needing to access their homes & accommodation. E.g. Footpath construction, property accesses, road.	Catastrophic	Likely	Critical	Construction methodologies to reduce impact and manage risk on site, temporary traffic management to separate work area from public. Communicate with public when works will be affecting access/ Consider materials for quick construction and	Catastrophic	Rare	Medium	Live	Designer/ Contractor	Public Injury	
C4	18/08/2020	Traffic Signals	Live Traffic - working with live traffic. Working where live traffic is under partial signal control. Working within an existing intersection or operating signals	Catastrophic	Likely	Critical	Temporary traffic management to notify public. Plan works to be during off-peak i.e.. Nightworks	Catastrophic	Unlikely	High	Live	Contractor	Worker Injury	
C5	27/08/2020	Traffic Signals	Electrical Hazards - Isolation of electrical hazards from workers and the public, earthing of equipment, connection to mains supply	Catastrophic	Likely	Critical	Ensure power it switched off until necessary to operated signals. Isolate public from work area and live electricity. Use certified electricians.	Catastrophic	Rare	Medium	Live	Contractor	Worker Injury	
C6	27/08/2020	Traffic Signals	Construction of detector loops - working in live traffic lanes. Noise and dust hazards when sawcutting. Pavement integrity, loop integrity.	Major	Likely	High	Temporary traffic management. Adequate noise and dust PPE. Quality Assurance	Major	Unlikely	Medium	Live	Contractor / Design	Worker Injury	
C7	3/09/2020	Trampers / Mountain bikers / Runners	Trampers, runners, mountain bikers using Frankton Track will be trying to get to homes form the track and are less likely to stick to signed tracks	Major	Possible	High	Contractors to appropriately fence off their hazardous equipment. Contractors to keep this user group in mind when planning works	Major	Rare	Low	Live	Contractor	Public Injury	
C8	27/08/2020	Worker vs plant	Small working area expected, due to having to maintain traffic flows. More likely that worker will be hit by plant	Major	Likely	High	Contractor to plan works so that there is sufficient space. Exclusions zones to be established for high risk works	Major	Possible	High	Live	Contractor	Worker Injury	
C9	27/08/2020	Plant vs plant	Small working area expected, due to having to maintain traffic flows. More likely that plant will hit plant	Minor	Likely	Medium	Contractor to plan works so that there is sufficient space. Exclusions zones to be established for high risk works. VMPs where applicable.	Minor	Possible	Low	Live	Contractor	Worker Injury	
C10	27/08/2020	Excavation - Vibration / Slope Stability	Construction close to homes & businesses. Drilling/anchors to be installed. Risk that properties are de-stabilised and this causes harm to public	Moderate	Possible	Medium	Designer: Geotech assessment of slope stability to inform design and construction methodology. Contractor: To follow methodology advised by designer	Moderate	Rare	Low	Live	Designer & Contractor	Collapse of slope, Injury	
C11	27/08/2020	Noise	Prolonged and / or excessive construction noise could lead to hearing damage of workers	Moderate	Possible	Medium	Appropriate PPE to be worn.	Moderate	Rare	Low	Live	Contractor	Worker Injury	
C12	27/08/2020	Dust	Trenching and digging resulting in dust	Minor	Possible	Low	Ensure dust management protocols are developed and adhered to	Minor	Rare	Low	Live	Contractor	Worker Injury	
C13	27/08/2020	Contamination	Discovery of contamination during construction. Digging up old roads - asbestos pipe is likely to be found.	Moderate	Likely	High	Contractor to have appropriate procedure in place to handle contaminated material	Moderate	Rare	Low	Live	Contractor	Worker Injury	
C14	27/08/2020	Viewing platforms	Working from heights - risk of falling person/material	Major	Possible	High	Designer to consider method of construction during detailed design and seek to minimise construction time at heights. Contractor to plans works safely and have exclusion zones where appropriate	Major	Unlikely	Medium	Live	Designer & Contractor	Worker Injury	

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PROJECT INFORMATION - Safety in Design Record - Simplified Procedure

Project Name	Frankton to Queenstown (SH6A)	***Project Number***	6-XT014.40		***Date***
Client	Waka Kotahi NZ Transport Agency	***Project Stage***	Business Case		
Project Scope	A number of signalised intersections and pedestrian signals to provide safer access for pedestrians to public transport and side roads. Bus priority measure, mai	***Prepared By***	s 9(2)(a)	***Reviewed By***	s 9(2)(a)
Workshop Attendees	s 9(2)(a) (WSP) s 9(2)(a) (WSP)			***Reviewed Date***	4/09/2020

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C15	27/08/2020	Temporary Works	Any temporary structure to be installed or constructed could fail and injure worker.	Major	Possible	High	Establish areas and structures for temporary works - to be signed off by certified engineer, if required. Temporary works design to be adhered to.	Major	Unlikely	Medium	Live	Designer & Contractor	Worker Injury	
C16	27/08/2020	Services	Excavation and Trenches - Safety of excavations for workers and the public - slips, trips and falls. Safety of excavating across live traffic lanes. Adequate protection of workers and the pubic from entering excavations.	Catastrophic	Likely	Critical	Ensure Adequate protection of workers and the pubic from entering excavations. Temporary traffic management to be used if impacting traffic lane / footpath / accessway.	Catastrophic	Unlikely	High	Live	Contractor	Worker Injury	
C17	27/08/2020	Working with Concrete	Lime burns.	Moderate	Possible	Medium	Wear appropriate PPE that separates skin from concrete. Consider other materials during design	Moderate	Rare	Low		Designer & Contractor	Worker Injury	
C18	2/09/2020	Underground services	Service strike when excavating	Major	Likely	High	Indicate services while designing (beforeUdig). Contractor to undertake service locations prior to any excavation	Major	Possible	High	Live	Designer & Contractor	Service strike during construction	
C19	2/09/2020	Culverts	Excavation striking and damaging culverts	Minor	Possible	Low	Culverts marked on plan where possible, Contractor to locate prior to any excavation.	Minor	Unlikely	Low	Live	Designer & Contractor	Damaging culvert	
C20	2/09/2020	Overhead power lines / electrocution	Working in close proximity to power lines	Major	Possible	High	Mark power poles on plans. Controlled through Contractors methodology and H&S practices	Major	Unlikely	Medium	Live	Designer & Contractor	Electrocution	
C21	2/09/2020	Working in carriageway	Working near live traffic. Risk that workers are hit by traffic	Major	Possible	High	Maintain accesses where possible. TTM to provide safe working areas.	Major	Unlikely	Medium	Live	Contractor	Worker injury	
C22	2/09/2020	Manual handling, lifting/bending	Risk of injury during construction	Minor	Rare	Low	Contractor's methodology and H&S plan to provide safe work methods	Minor	Rare	Low	Live	Contractor	Worker injury	
C23	2/09/2020	Slips/trips/falls	Risk of slips/trips/falls	Minor	Rare	Low	Contractor's methodology and H&S plan to provide safe working environment.	Minor	Rare	Low	Live	Contractor	Worker injury	
C24	2/09/2020	Ice/snow freezing of surface	Risk of ice/snow if works are during winter season.	Minor	Unlikely	Low	Programme works to be outside of winter period.	Minor	Rare	Low	Live	Designer & Client	Adverse weather conditions	
C25	2/09/2020	Storage areas for plant and materials	Safe areas for storage areas during construction. Risk that positioning increases harm to public i.e.. Poor accessibility. Or that they are not fenced off appropriately	Minor	Rare	Low	Contractor to determine appropriate storage areas.	Minor	Rare	Low	Live	Client & Contractor	Storage areas	
C26	2/09/2020	High bank/drop/retaining walls	Risk of fall from height during construction. Steep bank in some sections towards the lake.	Major	Unlikely	Medium	Designer to attempt to reduce height difference. Otherwise, contractor to manage during construction.	Major	Rare	Low	Live	Designer & Contractor	Personal injury	
C27	2/09/2020	High traffic volumes	No feasible alternative route to divert traffic. Public are likely to feel disrupted and frustrated during construction. Risk that they adopt risky behaviour around work sites.	Moderate	Possible	Medium	Working during off-peak where possible to minimise disruption.	Moderate	Unlikely	Low	Live	Contractor	Personal injury	
C28	2/09/2020	Rock Fall	Cutting into northern hillside. Risk of slope failure during construction	Major	Possible	High	Geotech assessment to be completed. Construction team to follow advice.	Major	Unlikely	Medium	Live	Designer & Contractor	Personal injury	
C29	2/09/2020	Events - summer peak, tourism	Increase in traffic flows, traffic delays	Minor	Unlikely	Low	Programming, coordination with other contractors, advising client	Minor	Unlikely	Low	Live	Client & Contractor	Increased traffic flows	
OPERATION														
O1	2/09/2020	Intersections & Refuge Islands - Pedestrians	Pedestrians crossing multiple lanes of traffic and vehicle shadowing resulting in impact between pedestrian and vehicle.	Catastrophic	Possible	High	Design traffic lights to give appropriate amount of time for all user types to cross safely i.e.. Mobility scooters, children, elderly etc. Full pedestrian protection provided at all signalised intersections. Refuge islands are at non-signalised crossing locations. Ensure sightlines are met at all crossing locations	Catastrophic	Rare	Medium	Live	Designer	Public Injury	

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PROJECT INFORMATION - Safety in Design Record - Simplified Procedure

Project Name	Frankton to Queenstown (SH6A)	***Project Number***	6-XT014.40	***Date***
Client	Waka Kotahi NZ Transport Agency	***Project Stage***	Business Case	
Project Scope	A number of signalised intersections and pedestrian signals to provide safer access for pedestrians to public transport and side roads. Bus priority measure, mai	***Prepared By***	s 9(2)(a)	***Reviewed By*** s 9(2)(a)
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O2	2/09/2020	Intersections - pedestrians	Speed limit likely to reduce to 60km/hr. Road has been designed for 80km/hr. Safe and survivable speed for pedestrian crash is 30km/hr	Catastrophic	Possible	High	Signage to warn vehicles about pedestrian refuge crossings. Signalised crossings. Refuge islands provided at all non-signalised crossing locations, where there is low pedestrian demand.	Catastrophic	Unlikely	High	Live	Designer & Client	Public Injury	
O3	3/09/2020	Pedestrians - Crossing in between formal crossing locations	SH6A is lined with houses, apartments, and tourist accommodation. Pedestrians are likely to cross at their desire line, which may not be where a refuge island is. EG. Middleton Rd Bus stop, Bus stop to East of Suburb St & sections in between other bus stops.	Catastrophic	Possible	High	Refuge islands are provided every 200 - 400m . Longer distances where there are no houses. Median provided for majority of length. Signage to be installed to warn vehicle users of pedestrians. Narrow lanes, should reduce speed of vehicles. Designer to consider adding more refuge islands.	Catastrophic	Unlikely	High	Live	Designer & Client	Public Injury	
O4	2/09/2020	Accesses	Steepening of accesses and visibility of other users (peds/cyclists/vehicles) and impact between vehicle and other user (low speed exiting access)	Moderate	Possible	Medium	Design speed is currently 60km/hr, vehicles likely to be travelling much slower than this when exiting driveway and approaching busy road, therefore Low risk. Attempt to provide a car length at same grade as road at access point (i.e. from edge of carriageway). Sight lines to be assessed during detailed design.	Moderate	Rare	Low	Live	Designer	Public Injury	
O5	2/09/2020	Traffic Signals, Signs, Pedestrian fencing, Streetlight poles	Over-dimension loads for turning vehicles and along key route - exposing people to falling poles, electrical hazards, falling loads, falling signs	Major	Unlikely	Medium	Design infrastructure to be outside of the over-dimension load envelope. Design poles with socket bases so they can be removed or hinges so they can be folded down.	Major	Rare	Low	Live	Designer	Public Injury	
O6	2/09/2020	Traffic Signals	Signal poles within over-dimension load envelope	Major	Unlikely	Medium	Design signal poles to be outside of the over-dimension load envelope	Major	Rare	Low	Live	Designer	Public Injury	
O7	2/09/2020	Traffic Signals	Controller Location/ orientation/ maintenance access - safe access to controller, safe location, able to see signals to not affect operations when adjusting settings when signals are live	Major	Unlikely	Medium	Design maintenance access to be in a safe location	Major	Rare	Low	Live	Designer	Public Injury	
O8	2/09/2020	Traffic Signals	Luminaires, street lights - signals fault mode enabled, adequate illumination of traffic islands, pedestrian facilities and priority controlled components of intersections at night	Catastrophic	Unlikely	High	Design lighting so that if traffic signals stop working, users of the road can see the crossing adequately. Lighting needs to be designed so road users can see that there is an intersection ahead and they can see the traffic islands at night.	Catastrophic	Rare	Medium	Live	Designer	Public Injury	
O9	27/08/2020	Visitors	New to the country and unfamiliar with the roads	Major	Possible	High	Appropriate signage to prevent wayfinding crashes and wrong direction crashes.	Major	Unlikely	Medium	Live	Designer	Public Injury	
O10	27/08/2020	Lighting	Appropriate lighting to ensure safety of vulnerable users at all hours. CPTED	Major	Possible	High	Design to appropriate standard considering CPTED	Major	Rare	Low	Live	Designer	Public Injury	
O11	27/08/2020	Intersections - operation	Unforeseen safety and operational issues leading to crashes and injuries	Moderate	Likely	High	Identify design solutions through external peer review/audit.	Moderate	Possible	Medium	Live	Designer	Public Injury	
O12	27/08/2020	Cyclists	Inconsistent design throughout - cycle lane / 1.5m shoulder starts and stops on the northern side of the road, and no shoulder but shared path on southern side. Narrow lanes and bus routes. Risk of confusion with right of way and where	Catastrophic	Possible	High	Narrow road corridor currently. Increase signage and markings to show cyclists safest route through town. For shared path through accessways or side roads, designers to provide straighter alignment.	Catastrophic	Unlikely	High	Live	Designer	Public Injury	
O13	2/09/2020	Distracted Driver	Along SH6A with view over Lake Wakatipu there is a risk drivers will be distracted.	Major	Possible	High	Narrow lanes ~3.25m are traffic calming. Consider screening	Major	Unlikely	Medium	Live	Designer & Client	Public Injury	

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PROJECT INFORMATION - Safety in Design Record - Simplified Procedure

Project Name	Frankton to Queenstown (SH6A)	***Project Number***	6-XT014.40		***Date***
Client	Waka Kotahi NZ Transport Agency	***Project Stage***	Business Case		
Project Scope	A number of signalised intersections and pedestrian signals to provide safer access for pedestrians to public transport and side roads. Bus priority measure, mai	***Prepared By***	s 9(2)(a)	***Reviewed By***	s 9(2)(a)
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O14	2/09/2020	Speed	Risk that the straight alignment will encourage drivers to travel faster than the posted 60km/hr speed limit. This increases the risk for all crash types. People are likely to travel at 70km/hr as this is the current speed limit or 80km/hr as this is the design speed.	Major	Possible	High	Narrow lanes ~3.25m are traffic calming. Consider further traffic calming measures.	Major	Unlikely	Medium	Live	Designer & Client	Public Injury	
O15	2/09/2020	Vegetation	Vegetation impacting visibility, which is a risk to pedestrians crossing, vehicles pulling out of accessways or vehicles seeing around corners.	Major	Possible	High	Design trees to be appropriate distance away from edge line, chose planting that does not impact sight lines, careful consideration of placement around accessways and corners.	Major	Unlikely	Medium	Live	Designer	Public Injury	
O16	3/09/2020	Vehicles driving on shared path	3.0m width of shared path is wide enough for a vehicle to drive on the path	Major	Unlikely	Medium	Ensure correct signage and line marking present and visible. Monitor post construction, may need bollards at certain locations if this becomes an issue. Main road, so unlikely. Kerb to delineate. Consider safety barrier between road and path	Major	Rare	Low	Live	Designer & Maintenance Contractor	Personal injury	
O17	3/09/2020	Illegal parking	Tourists, taxis, coaches etc parking in access/bus tapers, blocking visibility from accesses and or/ blocking traffic lanes. Likely to occur around viewing platforms.	Major	Almost Certain	Critical	Line marking, signage to deter. Communicate with accommodation providers and coach/tourist operators. Illegal parking control to be delegated to council to enforce.	Major	Possible	High	Live	Designer, NOC & Client	Personal injury	
O18	3/09/2020	Priority of shared path	Shared path users may assume they have priority over vehicle traffic or vice versa which could lead to vehicle vs pedestrian/person on bike crashes	Major	Unlikely	Medium	Give way signage and line marking to be applied at intersections to warn shared path users that they must give way to vehicles. Social media posts to include operating rules when promoting project. Provide more priority to shared path users through accessways through use of pavement markings and signage.	Major	Rare	Low	Live	Designer & Client	Personal injury	
O19	3/09/2020	Scooters / Motorbikes on shared path	Scooters and / or motorbikes may try to use the shared path	Major	Unlikely	Medium	Appropriate signage and communications via social media, to be monitored. Post is delivered via scooter, they have special authority to drive on footpaths	Major	Rare	Low	Live	Designer & Client	Unsafe parking	
O20	3/09/2020	Use for art installations / graffiti	Someone may paint or graffiti shared path which may compromise skid resistance	Minor	Unlikely	Low	Consider graffiti-resistant coatings where it is likely to assist removal and adding art to discourage graffiti. Otherwise, Monitor and remove.	Minor	Rare	Low	Live	Client & Maintenance Contactor	Maintenance costs	
O21	3/09/2020	Traffic movement	Pedestrians, mobility users or people on bikes causing collisions	Major	Possible	High	Minimum width of 3.0m for shared path maintained. Monitor post construction if additional signage required.	Major	Unlikely	Medium	Live	Designer & Client	Personal injury	
MAINTENANCE														
M1	18/08/2020	Pedestrian refuges	Replacement of handrails that are often hit by vehicles in middle of constrained road corridor with busy traffic and potential for injury with traffic	Major	Possible	High	Socketed handrail foundations for quick replacement and limited time in centre of road with TTM to manage hazard	Major	Unlikely	Medium	Live	Designer & Client	Worker Injury	
M2	27/08/2020	Traffic Signals	Controller Location - Risk to personnel if there is no safe access route to the controller, no safe and stable platform to work from. Controller location needs to be in a location the maintainer can see the signals to ensure worker can monitor effects of changes so no hazards are created. Worker at risk if they are not able to be seen by the public if working in path	Major	Possible	High	Design safe accessibility to controller location	Major	Unlikely	Medium	Live	Designer	Worker Injury	

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Workshop Attendees	s 9(2)(a) (WSP) s 9(2)(a) (WSP)			***Reviewed Date***	4/09/2020

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Limitation on Safety in Design Information provided: *Only H&S hazards and risks which will or may result from the design have been identified and recorded. The hazards recorded are those that were identified at the date and associated with stage of the design.*

HAZARDS ASSOCIATED WITH DESIGN ELEMENTS				RISK MATRIX			PROPOSED MITIGATION MEASURES	RISK MATRIX					RESIDUAL RISK	
Ref	Date	Hazard / Work Element	Issue	Consequence	Likelihood	RR	Proposed Mitigation Measures	C	L	RR	Status	Risk Owner	Residual Risk	Client / Asset Owner Acceptance / Comment
M3	27/08/2020	Traffic Signals	Pole Locations - Risk to personnel if there is not space to put up a ladder on any traffic island and create a safety zone. Risk if there is no stable platform to work on. Risk if there is no safe access route to all poles for	Major	Possible	High	Design safe access to pole location. Consideration of traffic island sizes and materials for maintenance access.	Major	Unlikely	Medium	Live	Designer	Worker Injury	
M4	26/08/2020	Grass verges	Sections of grassed verges shown right next to edge line. Risk for maintenance team to work adjacent to live traffic.	Moderate	Unlikely	Low	Substitute for low maintenance alternative, or change design so that grass exists > 3m away from live traffic lane. OR have temporary traffic management In place during maintenance work near live traffic.	Moderate	Rare	Low	Live	Designer & Client	Worker Injury	
M5	2/09/2020	Vegetation	Vegetation impacting visibility	Catastrophic	Unlikely	High	Vegetation to be designed so that it is unlikely to impact visibility. All vegetation to be trimmed, as required	Catastrophic	Rare	Medium	Live	Designer & Client	Worker Injury	
M6	2/09/2020	Area for maintenance vehicles to pull over	Safe parking areas for maintenance vehicles to carry out maintenance activities	Minor	Likely	Medium	Provide parking for maintenance vehicles - to be assessed at next design phase.	Minor	Likely	Medium	Live	Designer	Safe working area	
M7	2/09/2020	Snow clearing	Snow clearing on road and footpaths	Minor	Likely	Medium	Low probability of happening, so won't be addressed in design. Maintenance contractor to clear roads and footpaths, rather than windrowing it (which causes further issues, freezing, clogging drains, icy surfaces etc).	Minor	Possible	Low	Live	Client & Maintenance Contactor	Snow blocking the shared path	
M8	2/09/2020	Repair in unfavourable conditions	Repair of road and footpath will be difficult in rain/snow/ice	Minor	Likely	Medium	Temporary repair ASAP, full repair once weather conditions improve.	Minor	Possible	Low	Live	Maintenance Contactor	Personal injury	
M9	2/09/2020	No maintenance	Defects in the shared path surface	Minor	Likely	Medium	Designer to consider materials being specified and pavement design to address likelihood of defects forming. Client to check regular inspections are being completed	Minor	Possible	Low	Live	Designer & Client	Personal injury	
M10	2/09/2020	Public or workers distraction	Slips, trips, falls, injury, death	Catastrophic	Likely	Critical	Consider in the design what detour routes you are providing for pedestrians and cyclists around potential work sites or can you provide sufficient width along the corridor for users and workers to safely be alongside each other while maintenance is underway. Traffic Management Plan to be developed if applicable during maintenance works. Traffic management controls utilised through area	Catastrophic	Unlikely	High	Live	Designer & Maintenance Contactor	Slips, trips, falls	
M11	2/09/2020	Traffic movement	Public (pedestrians, drivers or cyclists) or workers being struck by vehicle or plant machinery causing injury or death	Catastrophic	Likely	Critical	Traffic Management Plan. Traffic management controls utilised through area affected by construction.	Catastrophic	Unlikely	High	Live	Maintenance Contactor	Crashes	
M12	2/09/2020	Fall from heights	Maintenance of viewing platforms, over bank. Risk that worker or tools may fall during maintenance inspection	Major	Possible	High	Designers to consider maintenance regime and improve access/safety where possible. Traffic Management Plan. Traffic management controls utilised through area affected by maintenance works. All tools and workers to be attached to structure if working at heights. Maintenance contractor to have appropriate health and safety procedures and work methodology in place to protect their workers.	Major	Unlikely	Medium	Live	Designer & Maintenance Contactor	Worker Injury	
M13	3/09/2020	Materials	Finished surface materials. E.g. Pavers/cobbles, street furniture, vegetation and other design elements having high maintenance requirements.	Major	Possible	High	Designers to consider maintenance when choosing design elements. Chose material which use have low maintenance requirements and are durable to reduce hazard to public and workers.	Major	Unlikely	Medium	Live	Maintenance Contactor	Crashes	

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PROJECT INFORMATION - Safety in Design Record - Simplified Procedure

Project Name	Frankton to Queenstown (SH6A)	***Project Number***	6-XT014.40	***Date***
Client	Waka Kotahi NZ Transport Agency	***Project Stage***	Business Case	
Project Scope	A number of signalised intersections and pedestrian signals to provide safer access for pedestrians to public transport and side roads. Bus priority measure, mai	***Prepared By***	s 9(2)(a)	***Reviewed By*** s 9(2)(a)
Workshop Attendees	s 9(2)(a) (WSP) s 9(2)(a) (WSP)			***Reviewed Date*** 4/09/2020

This document records the H&S hazards that could give rise to reasonably foreseeable risks to the health & safety of those interacting with the design option, or any part of it, as a work place during its lifecycle.

Limitation on Safety in Design Information provided: *Only H&S hazards and risks which will or may result from the design have been identified and recorded. The hazards recorded are those that were identified at the date and associated with stage of the design.*

HAZARDS ASSOCIATED WITH DESIGN ELEMENTS				RISK MATRIX			PROPOSED MITIGATION MEASURES	RISK MATRIX					RESIDUAL RISK	
Ref	Date	Hazard / Work Element	Issue	Consequence	Likelihood	RR	Proposed Mitigation Measures	C	L	RR	Status	Risk Owner	Residual Risk	Client / Asset Owner Acceptance / Comment
M14	3/09/2020	Busy Public Area	Maintenance crew working in and around a busy public area. Risk of injury to public by equipment.	Catastrophic	Possible	High	Traffic Management Plan. Traffic management controls utilised through area affected by construction, including pedestrian management. Plan works when public volumes are low.	Catastrophic	Unlikely	High	Live	Maintenance Contactor	Crashes	
DECOMMISSIONING / DEMOLITION														
D1	2/09/2020	Demolition / Decommissioning of viewing platform	When viewing platform reaches the end of it's design life and must be remove / replace. Risk of worker/public death from falling structure as it is removed.	Catastrophic	Possible	High	Designer should consider how the structure can be designer to demolish safely eg. Components that can be removed in their entirety, matierals that are not hazardous when demolished, how will services be attached. To be developed during detailed design phase. TTM to be in place during removal. Contractor to manage	Catastrophic	Unlikely	High	Live	Contractor	Worker Injury	
D2	2/09/2020	Area for renewals/maintenance vehicles to pull over	Safe parking areas for renewals / maintenance vehicles to carry out activities	Minor	Likely	Medium	Provide parking for maintenance / renewals vehicles - to be assessed at next design phase	Minor	Likely	Medium	Live	Designer	Safe working area	
D3	3/09/2020	Materials	Finished surface materials. E.g. Pavers/cobbles, guardrail, fencing, signage, street furniture, vegetation and other design elements having high maintenance requirements, or will need to be removed and replaced.	Major	Possible	High	Designers to consider maintenance and renewals when choosing design elements. Chose material which use have low maintenance requirements and are durable to reduce hazard to public and workers.	Major	Unlikely	Medium	Live	Maintenance / Renewal Contactor	Crashes	
D4	3/09/2020	Busy Public Area	Demolition/Renewal Crew working in and around a busy public area. Risk of injury to public by equipment.	Catastrophic	Possible	High	Traffic Management Plan. Traffic management controls utilised through area affected by construction, including pedestrian management. Plan works when public volumes are low.	Catastrophic	Unlikely	High	Live	Maintenance / Renewal Contactor	Crashes	

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Business Group:	Transportation
Section:	
Location:	Queenstown
Project Name:	Queenstown Business Cases
Project Number:	6-XT014.00
Project Manager:	s 9(2)(a)
Date reviewed:	04/09/2020
Review team:	s 9(2)(a)
Project Overview:	

Risk Assessment Matrix

Consequence / Severity	Probability / Likelihood				
	Almost Certain	Likely	Possible	Unlikely	Rare
Catastrophic	Critical	Critical	High	High	Medium
Major	Critical	High	High	Medium	Low
Moderate	High	High	Medium	Low	Low
Minor	High	Medium	Low	Low	Low
Insignificant	Medium	Low	Low	Low	Low

Consequence / Severity

Consequence	Safety	Health	Environment	Program / Quality (meeting customer requirements)
Catastrophic	Death of member of the public. Multiple worker deaths.	Death of member of public. Multiple worker deaths e.g. asbestosis, cancers.	Extreme environmental incident, resulting in irreversible or long term or widespread harm.	Extreme product / service non- conformance resulting in catastrophic failure. Critical impact on customer business. Permanent stoppage.
Major	Single worker death. Multiple major injuries (worker or third party). Significant irreversible disability.	Single worker death. Life-shortening health effect. Health effect causing significant irreversible disability e.g. lung diseases.	Major environmental incident resulting in significant impact requiring management by external authorities and / or high level of resources for response and remedy. Environmental incident managed by external authorities e.g. contamination of potable water.	Major non-conformance or delay that adversely affects customer interests.
Moderate	Single major injury (worker or third party). Worker injury resulting in three days away from work.	Irreversible health effect e.g. loss of hearing, HAVS cases. Serious illness from which there is full recovery e.g. poisoning, legionnaires disease, MRSA.	Moderate environmental impact requiring management response to aid recovery. Reportable to authorities e.g. fuel tank spillage.	Partial delivery or delay to customer requirements.
Minor	Minor injury (worker or third party). Injuries resulting in one day away from work. Restricted work Medical treatment beyond first aid.	Reversible health effect, e.g. minor dermatitis, asthma, tinnitus. Minor illness, e.g. chronic poisoning. Restricted work. Medical treatment beyond first aid.	Local impact requiring management response, but from which there is natural recovery e.g. recovery of fly-tip waste, silt into spawning river.	Delayed or inconsistent delivery of customer requirements.
Insignificant	First aid case, with no lost time. Negligible safety impact.	Mild health effect for short period, with no lost time e.g. local skin irritation.	Minimal environmental impact e.g. minor oil drips.	Slight deviation from specification, of little customer concern.

Note: Consequence / Severity table extracted from WSP [Global] Standard 103 – Reporting Requirements: Appendix B – Scale of Severity.

Probability / Likelihood

Almost Certain	Likely	Possible	Unlikely	Rare
Several times a year	Once annually	Once every 2 to 5 years	Once every 5 to 10 years	Less than once every 10 years

Status
Active
Closed

Project Stage
Construction
Operations
Maintenance
Demolition

WSP Opus Critical Safety Risks	
Construction risks	Working at height
	Working around plant and machinery
	Working around electricity
	Working around trenching and excavations
	Working around cranes and lifting operations
	Working in confined spaces
	Managing Traffic
	Working in and around the rail corridor
	Working around or over water
People management	Driving at work
	Lone working
Occupational health	Working with asbestos
	Handling and storage of hazardous chemicals

Hierarchy of Control

Control	Ref.	Description
Eliminate	E	Remove the hazard or risk entirely.
Substitute	S	Minimise by substituting (wholly or partly) the hazard causing the risk, with something else that gives rise to a lesser risk. E.g. changing a highly hazardous chemical for a less hazardous one.
Isolate	I	Minimise by isolating the hazard to prevent any person coming into contact with it. An example is locking an electrical switchboard.
Engineering Controls	EC	Minimise by establishing engineering controls. Examples include any engineering solution that reduces a hazard (for example, noise, fumes) at the source such as welding fume extraction ventilation.
Administration Controls	AC	If a risk remains it must be minimised, so far as is reasonably practicable, by also implementing administrative controls. Examples include training, procedures, policies, signage and shift design that lessen the risk of a hazard. This includes job rotation, adjusting work schedules, and providing adequate staffing when the work output is increased.
PPE	P	If a risk remains, further minimise the risk through the provision and use of suitable personal protective equipment.
IF THE CONTROL MEASURE ELIMINATES THE HAZARD OR RISK, THEN THE HAZARD OR RISK SHOULD NO LONGER BE PRESENT		

Risk Ranking Requirements	
Critical	Operation at this level is not acceptable. Implement and/or review controls.
High	Only tolerated if examination proves that the hazard cannot be eliminated and is minimised as far as is reasonably practicable.
Medium	Only tolerated if examination proves that the hazard cannot be eliminated and is minimised as far as is reasonably practicable.
Low	Risk is acceptable. Review at next interval.

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Appendix C9 Safe Systems Assessment

Queenstown Town Centre

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SAFE SYSTEM ASSESSMENT

QUEENSTOWN TOWN CENTRE: SH6A AND ARTERIALS STAGE 1, 2 & 3

PREPARED FOR THE WAKA KOTAHI NZ TRANSPORT AGENCY

September 2020

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REVISION SCHEDULE

Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by
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1	18/11/20	Final	s 9(2)(a)	s 9(2)(a)	s 9(2)(a)	s 9(2)(a)

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Waka Kotahi NZ Transport Agency

Queenstown Town Centre SSBC

Safe System Assessment – Combined: SH6A upgrade and Arterials Stage 1, 2 & 3

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APPENDICES

Appendix A Safe System Assessment Matrix – Stage 1 Arterial Route

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EXECUTIVE SUMMARY

A full Safe System Assessment (SSA) has been conducted on the preliminary design for the SH6A upgrade and the Arterial Route from the Queenstown Town Centre Detailed Business Case (DBC). The existing preliminary design for these routes were assessed, and suggested improvements have been recommended. The SSA Matrix scores are shown in the table below.

Crash type/location	Safe System Score	
	Existing Design	Suggested Improvements
SH6A, South – North	218 / 704	156 / 704
SH6a, West – East	226 / 768	164 / 768
Arterial Route – Stage 1	216 / 576	152 / 576
Arterial Route – Stage 2	144 / 320	88 / 320
Arterial Route – Stage 3	288 / 704	192 / 704

The existing speed limit in the preliminary design is predominantly 40km/h throughout, except for isolated shared use areas, which are 30km/hr. This low speed creates a safe environment for vehicles to operate at and presents a low risk of death or serious injury for side impact and head-on vehicle crashes. As shown in in Figure 10 – 14 in the report, the crash types that are the main contributors to the overall score are pedestrians, cyclists and all intersections. If the improvements that have been suggested are adopted, these high scoring crash types can be reduced. In the current design, all signalised intersections have full protection for pedestrians and for right turns. The majority of the project scope has an operating speed which is greater than the 30km/h minimum impact speed for death or serious injury for pedestrians and cyclists. The improvements that have been suggested aim to reduce the risk for pedestrians and cyclists by either; reducing the operating speed of vehicles at high risk areas i.e. Intersections & crossings; or increase awareness of vulnerable users. The suggested improvements for all crash-types are:

- Raised safety platforms at intersections
- Ensure visibility is acceptable around bus hub. Consider kerb build outs, recessed bus parking.
- Consider limiting movements – LILO – at some intersections.
- Consider grade separation for pedestrian crossings
- Ensure width of median allows for full car width, where it is used as a RHT bay.
- Consider vehicle queueing lights at the Fernhill Roundabout
- Consider signalising non-signalised intersections
- Consider tree placement impact on sight distances during detailed design.
- Clear signage directing cyclists to most appropriate route through town
- Consider sharrows or markings to promote awareness of cyclists in the space.
- Provide crossing locations for pedestrians at narrow sections of road to reduce crossing distance.
- Improve skid resistance
- Part of maintenance programme – deicing agent applied
- Provide warning signage where there are steep downgrades

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1. Introduction to the Safe System

1.1 Safe System Pillars

The Safe System approach seeks to ensure that no road user is subjected to kinetic energy exchange in a crash that will result in death or serious injury. There is a shared responsibility for safe travel outcomes between system designers (road authorities, vehicle manufactures, road designers etc.) and road users. There are four Safe System pillars: safer vehicles, safer speeds, safer roads and safer road users. Post-crash response is another element that is often recognised as the fifth pillar. All parts of the system must be considered and strengthened so that road safety outcomes are maximised and to ensure that road users are adequately protected even if one part fails.

Safe System Assessment (SSA) is concerned mainly with the safer roads and safer speeds pillars. A SSA is used to examine road project proposals and aims to identify infrastructure and speed related factors that are likely to contribute to a higher risk of fatal and serious injury (FSI) crashes. It also seeks to identify design or scope changes that will improve the alignment of the project with Safe System principles.



Figure 1 - Safe System Pillars

1.2 Safe System Impact Speeds

The impact speed in a collision is a significant factor that affects the probability of a person being killed or seriously injured in a crash. Safe System impact speeds are speeds below which the chances of survival are high and the likelihood of serious injury is low.

Figure 2 is a guide to Safe System impact speeds for common crash types. It should be noted that the angle of impact of a collision is also a factor that affects the severity of a crash. As far as is practically possible, infrastructure should be designed, and travel speeds managed so that the impact speeds when a crash occurs are below the thresholds show in Figure 2.

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Figure 2 - Safe System Impact Speeds

2. Safe System Assessment Process

The Safe System Assessment process is based on Austroads Safe System Assessment Framework (Austroads 2016, Research Report AP-R509-16, Safe System Assessment Framework) and VicRoads Safe System Assessment Guidelines.

Steps in the process include:

- Deciding on the type of assessment (full or rapid)
- Selecting an appropriate team to conduct the assessment
- Understanding the project background, context and objectives
- Collation of information and data for both existing and future conditions
- Inspection of the site - the team has extensive knowledge of the site so a site visit wasn't needed.
- Conducting the assessment of existing conditions and each project design option using the SSA Matrix
- Consideration of the additional Safe System components; road users, vehicles and post-cash care
- Review of the SSA Matrix scores and development of suggested changes to improve alignment with Safe System principles
- Reporting
- Review of suggested design and scope changes
- Amendment of project scope and design to incorporate the accepted changes.

3. Assessment Details

3.1 Type of Assessment

This report is a Full SSA that has been conducted in accordance with VicRoads Safe System Assessment Guidelines and Austroads Safe System Assessment Framework (Austroads Research Report AP-R509-16).

The SSA has been undertaken to analyse the existing conditions and proposed works for Queenstown Town Centre looking in particular at the SH6A upgrade and Arterial Route. The project cost is above $5M, therefore, a Full SSA must be undertaken.

3.2 Assessment Team

The Safe Systems Assessment was conducted by:

- s 9(2)(a) (B.Eng) Work Group Manager – Transportation, WSP
- s 9(2)(a) (B.Eng) Transport Engineer, WSP
- s 9(2)(a) (B.Eng) Civil Engineer, WSP

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Independent Members who attended the workshop meeting:

- s 9(2)(a) (B.Eng), Work Group Manager - Transportation Safety, WSP
- s 9(2)(a) (B.Eng), Team Lead - Safety Engineers, NZTA
- s 9(2)(a) (MAppSc, BRS), Associate Director Transportation Planning & Digital Engineering, Abley

3.3 Meetings and Site Inspections

The SSA Project Team and Independent Members attended a MS Teams meeting on the 7 April 2020 to discuss changes to the Queenstown Town Centre network. Another meeting to discuss the arterial routes proposed was held on 6 July 2020 with Matthew, Holly and Esther.

No site visits were undertaken for this project. This project was undertaken during the Level-4 Nation Wide Lockdown for New Zealand's response to Covid-19. However, the team has been involved with the Frankton to Queenstown SSBC and Queenstown Town Centre DBC and are familiar with the road corridor to review existing conditions and advice on suggested improvements.

4. Project Description

4.1 Project Background

The project forms part of the combined Frankton to Queenstown SSBC and Queenstown Town Centre DBC. These business cases make recommendations for upgrading the transport network. Figure 3 shows the location and extent of the QTC DBC, shown by the shaded red area. The Arterial Route is shown by the blue solid line and the red solid line shows the SH6A upgrade extent covered in this SSA.



Figure 3: Project Scope of Queenstown Town Centre Demonstrated in Red

The key changes to Queenstown Town Centre include; upgrading the existing SH6A route through the town centre, which involves removing parking, introducing bus lanes and creating a public transport hub on Stanley St; and creating a new arterial route, which involves upgrading existing sections of road as well as creating new connections and will be constructed in three stages (refer to Figure 4 below):

- Stage 1: Melbourne St from Frankton/Melbourne intersection through to Henry/Gorge intersection
- Stage 2: Henry/Gorge intersection through to Camp St/Memorial St/Man St intersection
- Stage 3: Camp St/Memorial St/Man St intersection through to Fernhill Rd roundabout

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The projects are designed in conjunction to split the traffic between those users wanting to access the town centre, and those wanting to bypass the town centre, via the arterial route.

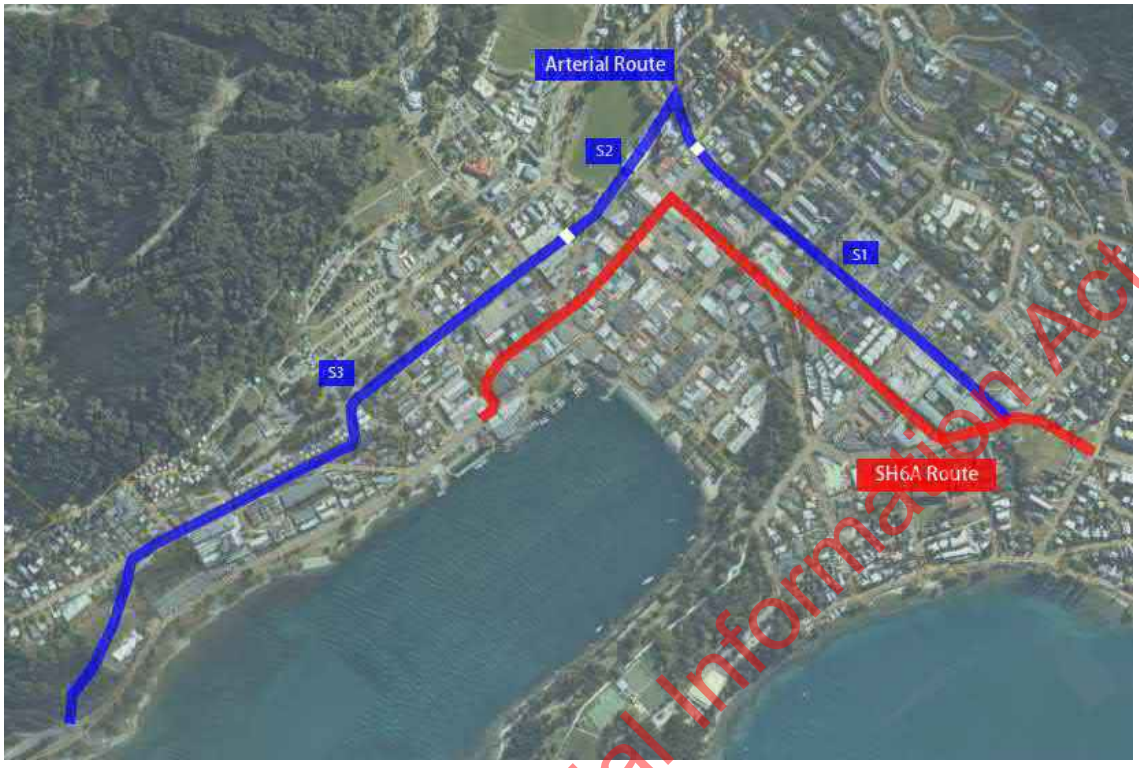


Figure 4: Queenstown Town Centre Arterial Route & SH6A upgrade

This assessment considers the entire SH6A upgrade, as well as the three stages of the Arterial Route ugrade.

4.2 Project Objectives

Three problem statements were developed to summarise issues on the Queenstown Town Centre corridor:

1. **Efficiency**. Unattractive PT/active travel options, coupled with growth in resident and visitor numbers, will lead to increasing congestion and parking demand. This further discourages people from visiting the Town Centre, has negative environmental effects and reduces Queenstown's liveability and visitor experience.

2. **Safety**. Roads performing both place and access functions introduce conflicts between vehicles and other modes, which increases the likeliness for injury and reduces the quality of the public realm.

3. **Amenity**. Severance created by high traffic volumes on SH6a together with the effect of drivers searching for parking is devaluing the pedestrian/cyclist experience, constraining the expansion of the town centre and limiting economic and placemaking opportunities.

To address the problems above, the following investment objectives were agreed with stakeholders:

1. Provide more efficient and reliable access for people and goods that:
    a. Sustainably manages growth
    b. Reduces reliance of private vehicle travel
    c. Enable enhanced land use
2. Is adaptable to change and disruption
3. Enhances the liveability and quality of the natural and built environment
4. Enhances safety with a goal of Vision Zero

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Error! Reference source not found. summarises the aim and background of the project.

Table 1: Project Summary - Queenstown Town Centre

Prompts	Comments
What is the reason for the project? Is there specific crash type risk? Is it addressing specific issues such as poor speed limit compliance, road access, congestion, future traffic growth, freight movement, amenity concerns from the community, maintenance/asset renewal, etc.	The arterials & SH6A upgrade project primarily seek to address accessibility, safety and amenity of the QTC road network. There are currently limited controlled crossings on the corridor, which limits access to public transport and active mode links along SH6A. There are also real and perceived pedestrian safety risks along the route, including wide intersection throats and narrow footpaths. It should be noted that there is no major crash history on SH6A, but there is a perceived risk that acts as a barrier to sustainable travel (several complaints from the public have been received by Aspiring Highways) and stakeholders identified Vision Zero as a desirable outcome. The existing posted speed limit throughout QTC is 50km/h. Arterial Route: The purpose is to provide a bypass route to avoid congestion in the town centre. An existing bypass route has been adopted by road users via Hallenstein St. This provides access from SH6A through to Gorge Rd, however it is windy, narrow, has parked cars lining it, narrow footpaths and no formal provision for cyclists. The proposed Arterial Route will provide a safer bypass from SH6A to Gorge Rd (Stage 1) as well as towards Fernhill/Glenorchy (Stage 2 & 3). The other comparable existing route to Stage 1 of the arterials is SH6A from Frankton Rd/Suburb St to Stanley St/Shotover St. SH6A route: Currently the route has multiple roundabouts and the route is lined with car parks. SH6A is the main route to the waterfront which is tourist destination. These factors all contribute to congestion. This project seeks to reduce congestion through removing parking, introducing bus lanes and introduce a dedicated down-town bus hub to encourage mode switch to public transport.

The objective of this Safe System Assessment is to identify the degree of the projects alignment with the Safe System objectives, and suggest solutions that could move the project closer towards alignment with Safe System objectives. The project team may then review the recommendations from the SSA and provide commentary around whether to accept recommendations or why they have not been adopted.

4.3 Existing Conditions and Context

Queenstown Town Centre (QTC) is a commercial, tourist and residential destination. Users must also travel through QTC to access Glenorchy from SH6A and Gorge Rd; or to access Frankton from Gorge Rd. There are many pedestrians and cyclists, with little provision for their safety due to recent rapid growth in the area, which is now being addressed through business cases.

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SH6A is the main route providing access to QTC, as well as through QTC, which runs along Frankton Rd, Stanley St & Shotover St. SH6A has a high AADT ranging from 18,000 – 19,000 AADT, and >100 pedestrians and cyclists. It is one-lane each way throughout. The section down Shotover St, which has roundabouts controlling movements and is lined with retail shops and parked cars either side contributing to congestion. The Stanley St section of SH6A has two signalised intersections. There is currently no formal arterial route. Some road users have adopted Hallenstein St, which connects Frankton Rd to Gorge Rd and bypasses the town centre traffic. Hallenstein St is a narrow, windy road with parked cars lining it, no provision for cyclists and little provision for pedestrians.

A range of upgrades considering the entire project scope of QTC business case were proposed during development. The main changes are upgrading SH6A to allow increased public transport use; pedestrianisation of the historic core of the town centre; and creating a new arterial route, which will be constructed in three stages. The preliminary design for SH6A and the Arterial Route are the focus for this SSA.

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Table 2: Existing Conditions and Context

Prompts	Comments
What is the function of the road? Consider location, roadside land use, area type, speed limit, intersection type, presence of parking, public transport services and vehicle flows. What traffic features exist nearby (e.g. upstream and downstream)? What alternative routes exist?	Arterial Route: Stage 1: Melbourne St & Henry St are single-lane each way, lined with parked cars, are residential and provide access to tourist accommodation. There is an existing missing link connecting Melbourne St to Henry St, from Beetham St to Ballarat St, which prevents Melbourne and Henry currently being used as an informal arterial route through town. AADTs' on Melbourne St and Henry St are 650 and 1000, respectively. Stage 2: Gorge Rd is a main road used to access the industrial section of town, Arthurs Point and Arrowtown. A new section of road will be constructed through the existing QLDC building and library, which is adjacent to a sports field and car park, to connect to Memorial St. Memorial St is currently a quiet single-lane road each way, used as an optional road to access the Gondola, cafes/restaurants/accommodation near the town centre. AADT on Gorge Rd is 10,000 and on Memorial St is 5100. Stage 3: Man St & Thompson St are currently both single lane each way, with some parallel parks provided lining the streets. The streets are used to access tourist accommodation, as well as residential accommodation. Mountain bikers use these streets to access the network of trails on Lomond Crescent. A series of give-way T-intersections control traffic flow. A new section of road will be required to connect Fernhill roundabout to Thompson St. AADTs' on Man St and Thompson St are 3000 and 1300, respectively. SH6A: As the only major link between Queenstown, Frankton and Glenorchy, SH6A is critical for the local economy. The only alternative routes are Gorge Road (via the one-way Edith Cavell Bridge) and Goldfield Heights/Hensman Road (narrow residential streets). As well as providing the only feasible route for public transport (2 routes, peak frequency of 15 minutes), emergency services and freight, the highway also facilitates access to many accommodation providers and residential areas. SH6A also currently provides access into as well as through the town centre. Traffic volumes on the highway increased by an average of 8%p.a. between 2012 and 2017 and reached 27,000vpd in 2019.

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Prompts	Comments
What is the speed environment? What is the current speed limit? Has it changed recently? Is it similar to other roads of this type? How does it compare to Safe System speeds? What is the acceptability of lowering the speed limit at this location?	Arterial Route & SH6A: The posted speed limit is 50km/h through the town centre currently. The speed environment generally matches the posted limit, though it conflicts with the road's access function and pedestrian crossing demand. During peak hours, traffic travels below the posted limit.
What road users are present? Consider the presence of elderly pedestrians, school children and cyclists. Also note what facilities are available to vulnerable road users (e.g. signalised crossings, bicycle lanes, school speed limits, etc.)	Arterial Route & SH6A: Vulnerable road users are rarely observed, though this is considered to be due to a car dominant design and a lack of active mode facilities. There are currently limited controlled crossings and only disjointed sections of cycle lane. Concentrations of pedestrians and cyclists mainly occur around bus stops and intersections on SH6A. However the limited number of controlled crossing points results in pedestrians crossing at their desire lines. Some cyclists have been observed on SH6A. It is expected that a latent demand for active modes would be unlocked with safer and more accessible infrastructure. There are also a high proportion of visiting drivers who are unfamiliar with NZ roads. While this does not directly translate into increased crash rates, there is an inherent increase in risk.
Vehicle composition using roadway What is the vehicle composition? Consider the presence of heavy vehicles (and what type), motorcyclists and other vehicles using the roadway.	A detailed breakdown of vehicle composition is not available. Length data collected from NZTA's TMS shows that approximately 9% of vehicles are over 5.5m long, an indication of the proportion of heavy vehicles. As the only appropriate route to Queenstown, all heavy vehicle traffic use SH6A, which is also designated an overdimension route.

4.4 Proposed Works

The recommended option for the Queenstown Town Centre business case is a strategic package of interventions designed to enable the public transport element of the preferred package, as well as improving access, active mode connectivity and safety. The business case has proposed a scheme design of upgrading SH6A through Queenstown Town Centre, combined with creating an Arterial route from SH6A in the north to bypass Queenstown Town Centre heading towards Glenorchy.

This report is assessing SH6A upgrades and the entire Arterial route, which consist of the following interventions:

- SH6A: South – North & East - West
  - Removing parked cars
  - Introducing dedicated bus lanes for sections
  - Introduction of central bus hub, with bus access only
  - Introduction of shared use zones
  - New and upgraded intersections
  - New and upgraded footpaths

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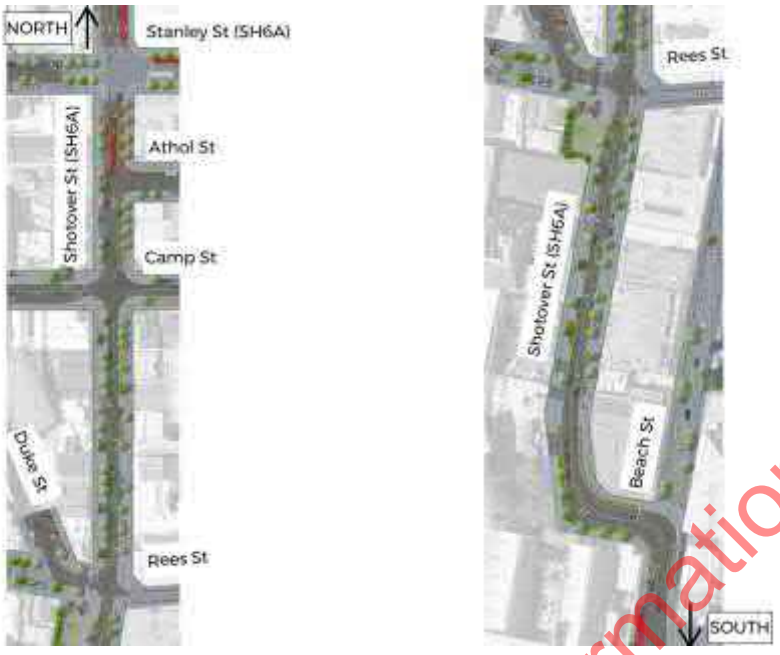


Figure 5: Render showing preliminary design of SH6A South - North



Figure 6: Render showing preliminary design of SH6A Wet - East

- Arterial Route: providing greater accessibility through QTC
  - Stage 1: Melbourne St from Frankton/Melbourne intersection through to Henry/Gorge intersection
    - New and upgraded intersections
    - New road connection from Henry St to Melbourne St
    - New and upgraded footpaths
  - Stage 2: Henry/Gorge intersection to Camp St intersection
    - New and upgraded intersections
    - New road connection from Gorge Rd to Memorial St
    - New and upgraded footpaths
  - Stage 3: Camp St intersection to Fernhill roundabout
    - New and upgraded intersections
    - New road connection from Thompson St to Fernhill roundabout
    - New and upgraded footpaths

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Figure 7: Render showing preliminary design of Arterials - Stage 1



Figure 8: Render showing preliminary design of Arterials - Stage 2

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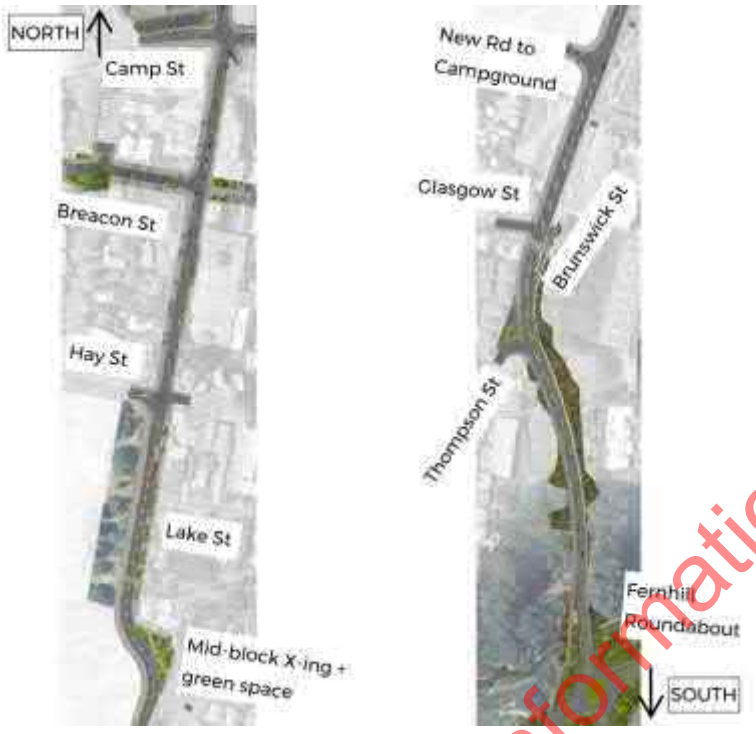


Figure 9: Render showing preliminary design of Arterials - Stage 3

5. Assessment of Project Design Options

5.1 Assessment Summary

In order to ensure that Safe System elements are considered, or to measure how well a given project (e.g. an intersection, road length, treatment type etc.) aligns with Safe System principals, a Safe System Matrix is used. The purpose of the Matrix is to use a risk assessment approach to assess different major crash types against the exposure of that risk, the likelihood of it occurring and the severity of the crash should it occur. These three attributes form the rows of the Matrix.

The rows of the Safe System Matrix show the crash types that represent the main crash and road user types that contribute to death and serious injury. Intersections and pedestrian amenities were separated into specific categories to help concentrate thinking on crash causes and solutions for each given arrangement and ensure vulnerable road users are directly considered. The SSA matrix has been broken up into sections shown in he Figures 5 - 9 above.

These have been adjusted from the standard 7-crash types to:

- SH6A South – North: 11-crash types
- SH6A West – East: 12-crash types
- Arterials:
  - Stage 1: 9-crash types
  - Stage 2: 5-crash types
  - Stage 3: 11-crash types

The Safe System Assessment Matrix scores for the current design conditions and the proposed opportunity changes to the design are shown in Table 3. The scores for each crash type for the current design conditions and proposed works are shown in **Error! Reference source not found.** 7. The detailed assessment o f the Matrix is presented in Appendix A - E.

The aim of the Safe System Matrix is to reduce the total score towards zero.

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Table 3: SAA Matrix Scores for the Project

Score					
Option	SH6A S - N	SH6A W - E	Arterials, S1	Arterials, S2	Arterials, S3
Current Design Conditions	218 / 704	226 / 768	216 / 576	144 / 320	288 / 704
With suggested Safe System Improvements	156 / 704	164 / 768	152 / 576	88 / 320	192 / 704

Refer to Appendices A - E for the full matrix for each section of the business case.

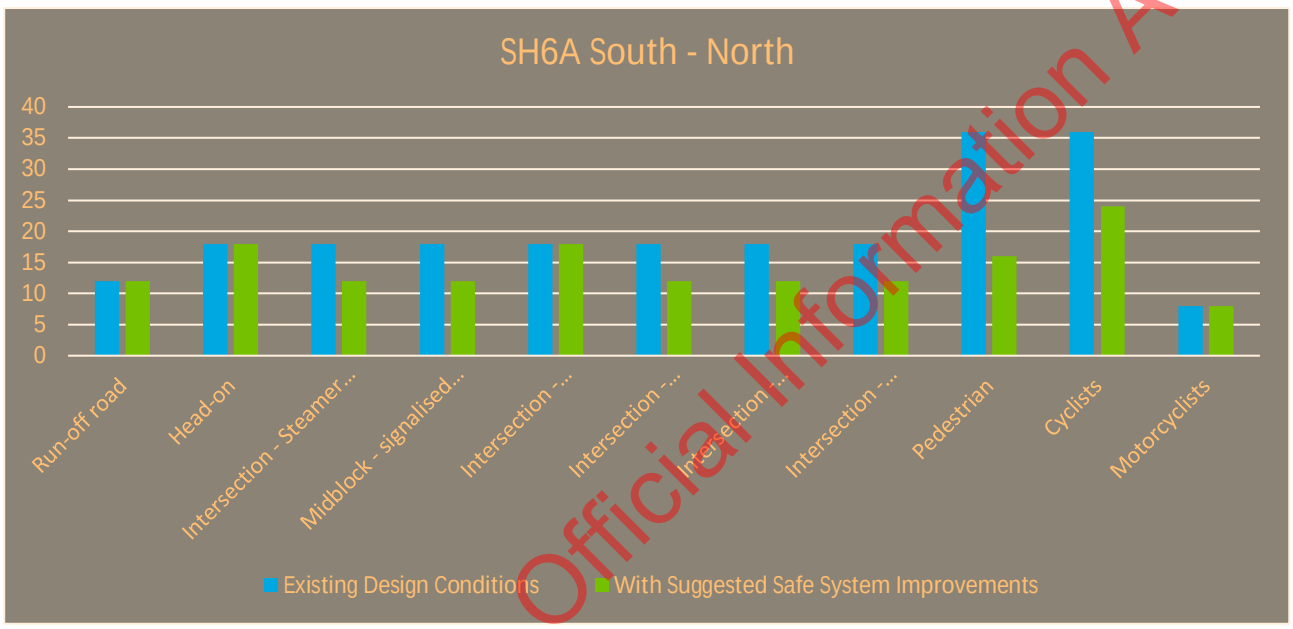


Figure 10: Safe System Scores for Crash Types – SH6A, South – North

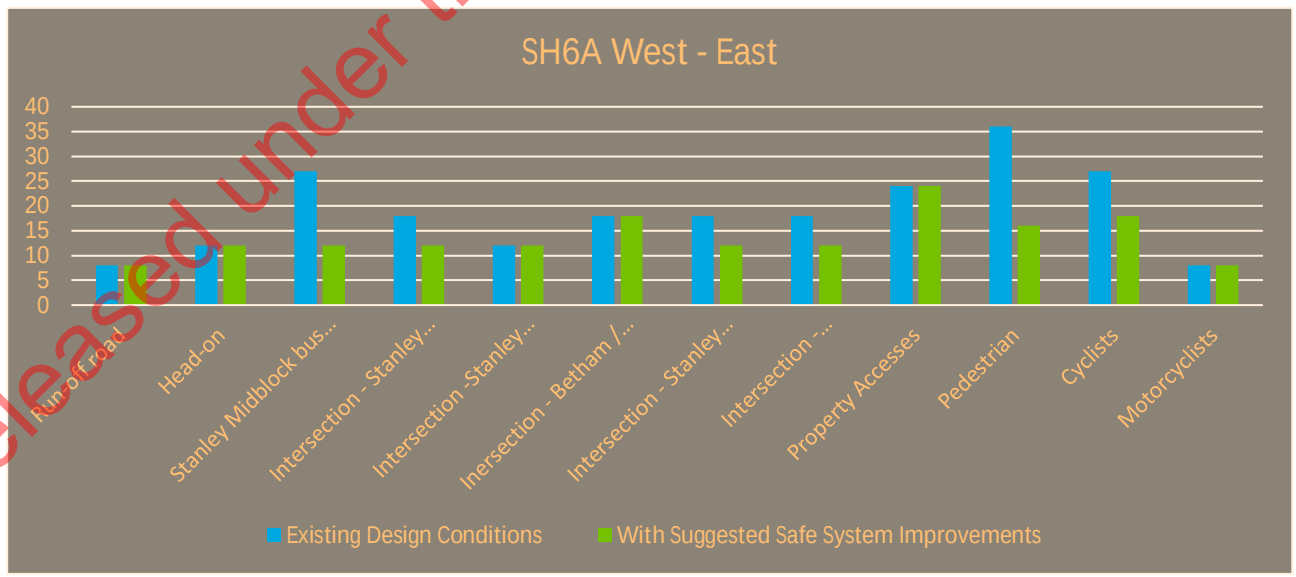


Figure 11: Safe System Scores for Crash Types – SH6A, West - East

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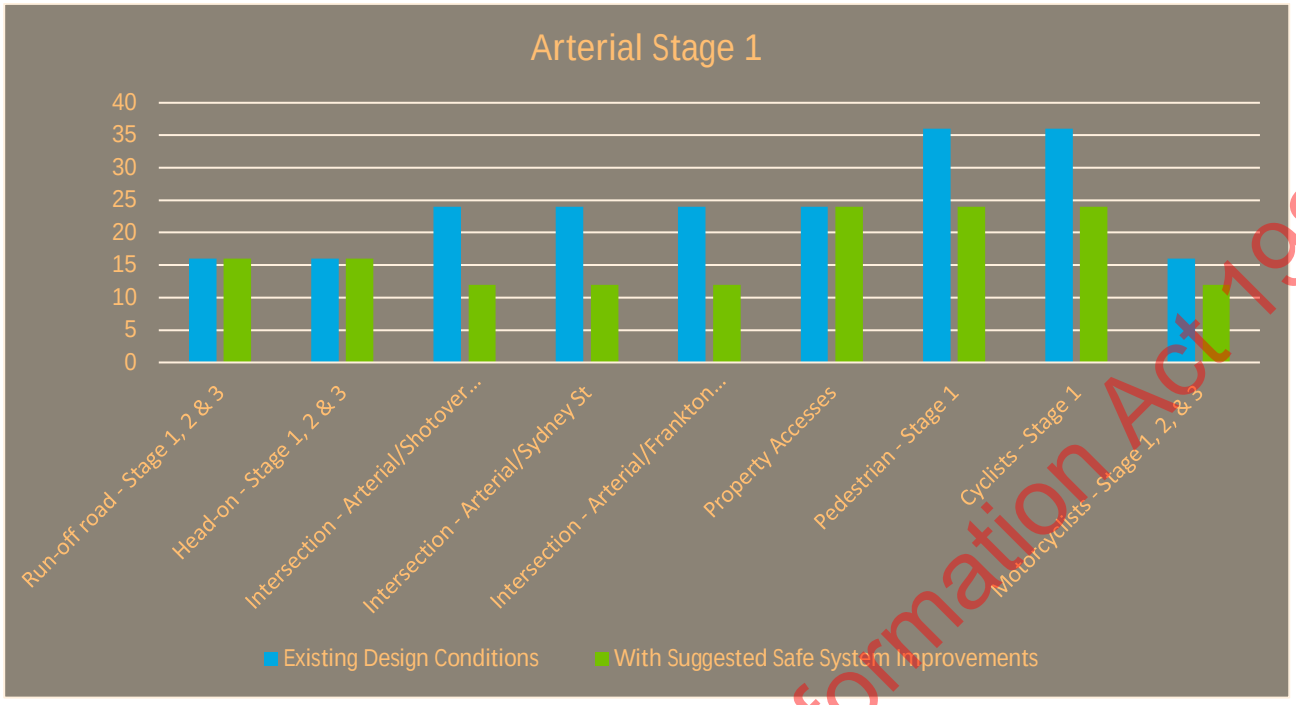


Figure 12: Safe System Scores for Crash Types – Arterial Route, Stage 1

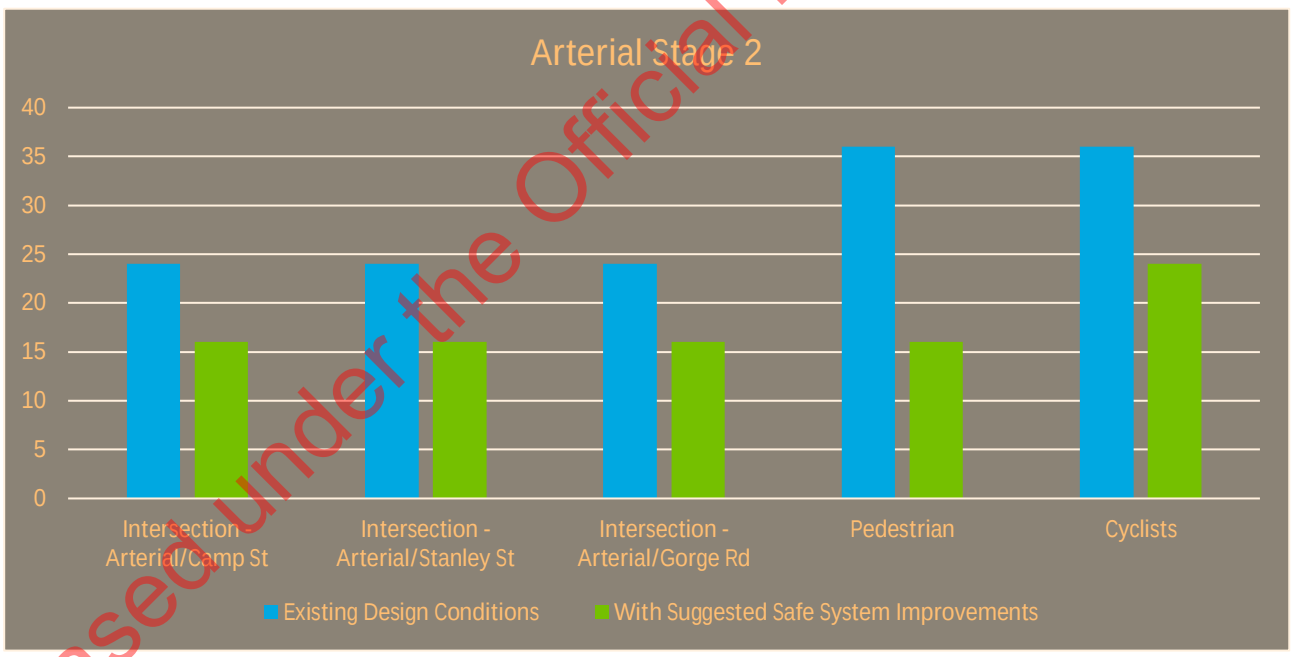


Figure 13: Safe System Scores for Crash Types – Arterial Route, Stage 2

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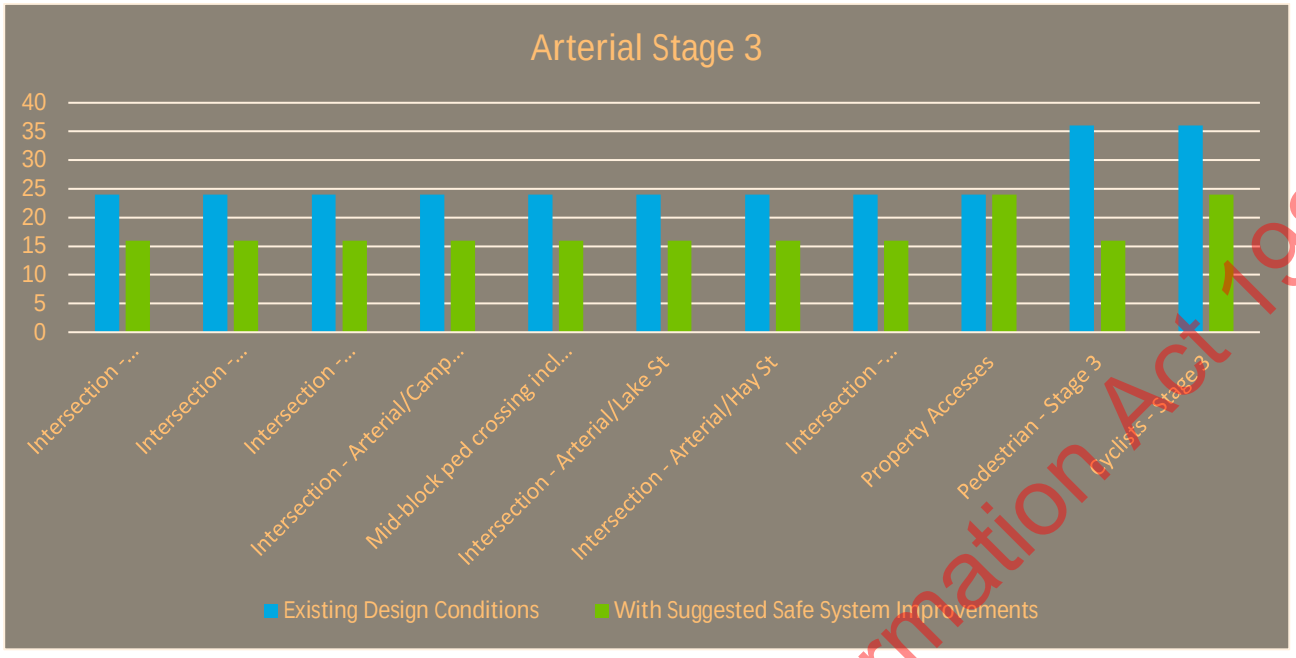


Figure 14: Safe System Scores for Crash Types – Arterial Route, Stage 3

5.1.1 Pedestrians & Cyclists

Throughout the entire project, SH6A as well as all stages of the Arterial Route, the crash types that have the highest perceived risk are Pedestrians & Cyclists, all scoring 36/64. The high AADT expected of > 100 pedestrians & cyclists resulted in a high exposure rating for these two groups.

- The design of the SH6A upgrade is mostly straight with a few curves in the horizontal alignment, and limited vertical curvature, resulting in good sight lines. There is no formal cycle-lane, and no shoulder. The current design has 3.5m wide footpaths on both sides of the road for most of the length. These widths reduce from Beetham St, heading East. Formal crossing points are provided at the intersections and a signalised mid-block crossing location where there is a greater distance between the intersections. This results in signalised crossing location provided approximately every 100m along the S-N stretch of SH6A. The distance is greater for the E-W section of SH6A, however SH6A from Shotover St to Ballarat St is a shared zone at the central bus hub. There is another shared use zone crossing Coronation Drive. These factors contribute to a likelihood rating of ¾.
- The design of the Arterial Route is mostly straight with a few curves in the horizontal alignment, and vertical curvature for Stage 1 & 3, resulting in moderate sight lines. There is no formal cycle-lane, and no shoulder, however there will be cycle boxes at each of the intersections to remind vehicles that cyclists may be present and provide cyclists a safe place to stop. The current design has approximately 3.5m wide footpaths on one side of the road for Stages 2 & 3, and both sides of the road for Stage 1. Formal crossings points are provided at the intersections, via an overpass from Ballarat St, and via two mid-block crossing locations on Stage 3. The distances between these crossings range from 130 to 600m apart, noting that the larger spacings are on Stage 3 where the demand is lower. These factors contribute to a likelihood rating of ¾.

Severity of a crash for pedestrians and cyclists is affected by speed. The proposed speed limit for both SH6A and the arterial route is 40km/hr, which is 10km/hr greater than the max speed for a pedestrian to survive from a crash.

Suggested safe system improvements in this report for pedestrians and cyclists seek to either reduce the likelihood or the severity. Likelihood and severity can be reduced by introducing raised tables, which are designed for a safe operating speed of 30km/hr, at every crossing location. Likelihood can also be reduced for cyclists by having signage to warn vehicles that cyclists may be present, or linemarking such as sharrows or cycle boxes. For pedestrians, grade separation could also be considered.

5.1.2 Intersections

All intersections similarly scored high, ranging from 18 - 36/64. Exposure for the arterial route intersections are greater, due to the high AADT expected of ~18,000 vehicles, compared to SH6A which has a lower

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exposure due to the expected AADT of ~5000. All signalised intersections have full protection for pedestrians and full protection for right turns.

- SH6A has 13 intersections. Factors that contributed to the likelihood of the crash included type of control, design of crossing, visibility, number of movements allowed and speed. The intersections consist of 4-way signalised, 3-way signalised, non-signalised T-intersections, and signalised pedestrian crossing points only. Visibility is generally good, except for Beach St and Rees St intersection. Most movements are allowed at each intersection. Wayfinding at intersections connecting into the bus hub is expected to increase likelihood of a crash. Speed is generally 40km/hr throughout, except for the shared use zones at the bus hub and across Coronation Drive, which will be posted 30km/hr. Intersections likelihood ranged from 2 – 3 / 4 depending on the combination of factors discussed here.
- The Arterial Route has 14 intersections. Factors that contributed to the likelihood of the crash included type of control, design of crossing, visibility, number of movements allowed and speed. The intersections consist of 3, 4 & 5-way signalised, non-signalised T-intersections, and non-signalised zebra crossings, which are raised tables. Visibility is good for Stage 1, and mostly good for Stage 2 & 3. Most movements are allowed at each intersection. Wayfinding at intersections on Gorge Rd / Shotover St / Turner St intersections is expected to increase likelihood of a crash. Speed is 40km/hr throughout. It is advised to ensure the design of the raised tables at the pedestrian crossings is for 30km/hr, which will improve safety for pedestrians and cyclists. Intersections likelihood ranged from 2 – ¾, depending on the combination of factors discussed here.

Severity is determined by impact angles and speed. At all intersections, for the SH6A and Arterial Route, excluding the pedestrian crossings, there is the potential for high impact angle crashes. The proposed speed limit of 40km/hr is lower than the max speed for drivers to survive high impact angle or head-on crashes, giving a lower severity score than the pedestrians and cyclist groups.

Suggested safe system improvements in this report for intersections seek to either reduce the likelihood or the severity. Likelihood and severity at intersections can be reduced by; introducing raised tables, which are designed for a safe operating speed of 30km/hr, at every crossing location; consider upgrading non-signalised intersections to signalised; ensure adequate wayfinding to minimise confusion and illegal manoeuvres; and design for site distances for vulnerable road users at bus hub and consider kerb build outs.

5.1.3 Property Accesses

Frequency of property accesses vary throughout the arterial route and the SH6A upgrade. Some sections with high frequency have a central median, which allows for right turns into and out of the accessways. Where a median is not provided at an accessway, it is recommended to either consider provision of a median, or banning right turns. Traffic calming measures could also reduce the likelihood of a crash. As the speed is already posted at 40km/hr, the risk is considered low.

5.1.4 Run-off Rd, Head-on, Motorcyclists

Proposed improvements for Motorcyclists are improved skid resistance and providing warning signs for steep downgrades. Proposed improvements for Run-off road crashes are improved skid resistance, de-icing agent applied during winter and traffic calming to achieve posted speed, particularly on steep grade sections. For both motorcyclists and run-off road crash types, these improvements do not mitigate or eliminate the associated risk, the scores remain the same. Recommendations made to Head-on crash types, included traffic calming and clear signage, but these did not lower the risk rating, which was already low.

Note that the vehicle volume numbers applied are projected forecasts from the business case, which consider the split between the SH6A route into town, and the arterial route to bypass the town centre.

Most crash types had opportunities to improve alignment with the Safe System, where the crash type saw a reduction in score with suggested improvements demonstrated in Figures 10 - 14.

With implementing the opportunities listed below, Pedestrian, Cyclists and most intersections were all able to be reduced in risk rating score, which are shown in Figures 10 – 14.

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- Raised safety platforms at intersections
- Ensure visibility is acceptable around bus hub. Consider kerb build outs, recessed bus parking.
- Consider limiting movements – LILO – at some intersections and property accesses.
- Consider grade separation for pedestrian crossings
- Ensure width of median allows for full car width, where it is used as a RHT bay.
- Consider vehicle queueing lights at the Fernhill Roundabout
- Consider signalising non-signalised intersections
- Consider tree placement impact on sight distances during detailed design.
- Clear signage directing cyclists to most appropriate route through town
- Consider sharrows or markings to promote awareness of cyclists in the space.
- Provide crossing locations for pedestrians at narrow sections of road to reduce crossing distance.
- Improve skid resistance
- Part of maintenance programme – deicing agent applied
- Provide warning signage where there are steep downgrades

It should be noted that the Arterial route through QTC has a speed limit of 40km/hr in the current design conditions. The SSA team decided that with the opportunities listed above and considering the design intent of the arterial route, it was not necessary to suggest lowering this design speed further.

6. Safe System Assessment Comments

As part of this SSA, consideration has been given to other components that comprise the Safe System i.e. road users, vehicles and post-crash care. Issues identified as relevant to this project are listed in Table 4.

Table 4: Other Safe System Components

Pillar	Prompts	Comments / Issues
Road user	Are road users likely to be alert and compliant? Are there factors that might influence this? What are the expected compliance and enforcement levels (alcohol / drugs, speed, road rules and driving hours)? What is the likelihood of driver fatigue? Can enforcement activities be conducted safely? Are there special road users (e.g. entertainment precincts, elderly, children, on-road activities, motorcyclist route), distraction by environmental factors (e.g. commerce, tourism) or risk-taking behaviours?	• Scenery distraction • High numbers of pedestrians • High proportion of visitor drivers • Fatigue • Impaired drivers (alcohol/drugs) • A challenge for police to enforce with limited places to pull people over. • Hotels and visitor accommodation – unfamiliar users with high pedestrian generation • Potential U-turn movements • PT and Tourism buses • Popular delivery route for mopeds/motorcyclists associated to food deliveries (Food on Q)
Vehicle	What level of alignment is there with the ideal of safer vehicles? Are there factors that may attract large numbers of unsafe vehicles? Is the percentage of heavy vehicles too high for the proposed / existing road design?	• Heavy vehicle use has been considered in the design as SH6A is the only appropriate route to Queenstown and is also the designated over dimension route. • Motorcycle volumes are expected to remain at <1%

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	Is this route used by recreational motorcyclists? Are there resources in the area to detect non-roadworthy, overloaded or unregistered vehicles and thus remove them from the network? Can enforcement activities be undertaken safely? Has vehicle breakdown been catered for? Has advanced vehicle features been catered for?	• Limited areas for pull-in areas for EBD vehicles along SH6A • To support emerging technologies such as Lane Departure Warning and Lane Keeping Assistance, standard road markings and signage must be used. These must be kept well maintained and replaced or reinstalled if worn out, including maintenance of vegetation to avoid obstruction or inconsistent signage.
Post-crash care	Are there issues that might influence safe and efficient post-crash care in the event of a severe injury (e.g. congestion, access, stopping space)? Do emergency and medical services operate as efficiently as possible? Are other road users and emergency response teams protected during a crash event? Are drivers provided the correct information to address travelling speeds on the approach and adjacent to the incident? Is there reliable information available via radio, VMS etc? Is there provision for e-safety (i.e. safety systems based on modern information and communication technologies, C-ITS)?	• None identified • Post–Crash response is expected to be good, however, emergency services could be delayed if road corridor is queued. Median along the Arterial Route allows emergency vehicle access. Additionally, alternative access for emergency services is now provided via Stanley and/or Hallenstein, so network resilience improved. • There is a police station and fire station in Queenstown Town, and Hospital in Frankton; all within proximity to the SH6A and Arterial Route road corridor. One-way exit has been provided from Coronation Drive to SH6A for the Police. • No specific features for crash warning in place, standard TTM procedures to be followed at this stage

7. Treatments to Further Improve Safe System Alignment

Table 5: Primary Treatments and Table 6 list treatments that will improve the Safe System alignment of the project.

Primary treatments are those measures that have the potential to eliminate or come close to eliminating the risk of fatal and serious injury (FSI) crashes.

Supporting treatments are effective in reducing the risk of FSI crashes but not to the extent of a primary treatment (i.e. there is a residual moderate or significant FSI crash risk). Implementation of a primary treatment should be given priority over a supporting treatment that may be targeting a similar crash risk.

It is recommended that proposed treatments below are reviewed along with the matrices in the appendices. The client is to decide which treatments are adopted, so that they may be implemented during detailed design phase.

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Table 5: Primary Treatments

Treatments for consideration	Project response
• Raised Safety Platforms (designed to 30km/hr operating speed) at every intersection	

Table 6: Supporting Treatments

Treatments for consideration	Project response
• Visibility for pedestrians around bus hub to be assessed. Consider kerb build out, recessed bus parking	
• Consider limiting movements at some intersection – LILO	
• Consider grade separation for pedestrian crossings	
• Ensure width of median allows for full car width, where it is used as a RHT bay.	
• Vehicle queueing lights at the Fernhill roundabout	
• Signalise non-signalised intersections	
• Tree placement impact on sight distances to be assess during detailed design.	
• Skid resistance	
• De-icing agent as part of maintenance scheme	
• Signage directing cyclists on best route through town centre	
• Increase linemarking for cyclists – sharrows and cycle boxes	
• Provide warning signage where there are steep downgrades	
• Provide crossing locations for pedestrians at narrow sections of road to reduce crossing distance.	

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8. Conclusions

The design proposal has a reasonable alignment with Safe System principles and offers an improvement over the existing conditions for most crash types identified. A number of features remain that have a less than desirable alignment with Safe System principals including run-off road crashes, pedestrian and cycle crashes. The project team is encouraged to consider the suggested improvements, which further improve the alignment with the Safe System principals, as detailed in the report.

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Appendices

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Appendix A Safe System Assessment Matrix – SH6A (South – North)

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	Run-off road	Head-on	Intersection - Steamer Wharf Shotover/Beach St	Midblock - signalised crossing - ALL	Intersection - Shotover/Brecon/Rees St	Intersection - Mann/Camp/Shotover	Intersection - Shotover/Athol St	Intersection - Stanley/Shotover	Pedestrian	Cyclists	Motorcyclists
Exposure Comments	SH6A 5-10,000 ADT	SH6A 5-10,000 ADT	Beach St - oneway, low volume, shared use SH6A 5-10,000 ADT Ped numbers >100 Cyclists >100	Ped > 100 SH6A 5-10,000 ADT	Ped > 100 SH6A 5-10,000 ADT Spread out intersection	Ped > 100 SH6A 5-10,000 ADT	Ped>100 SH6A 5-10,000 ADT Regional Bus Hub, coaches only	Ped > 100 SH6A 5-10,000 ADT Public bus connection	>100 Peds Designated footpath	>100 Cyclists No separation	37 ADT
Exposure Score	3	3	3	3	3	3	3	3	4	4	2
Likelihood Comments	Factors that increase the likelihood include: - Many trees lining the road - No shoulders - No barriers Factors that decrease the likelihood include: - Good sight lines - Low speed 40km/hr - Relatively straight alignment, excluding southern end at Beach St	Factors that increase the likelihood include: - No formal separation between opposite facing traffic - No RHT onto Stanley St for cars. Must be clearly sign posted. - No median Factors that decrease the likelihood include: - Low speed at 40km/hr - Relatively straight alignment, excluding southern end at Beach St	Factors that increase the likelihood include: - Poor sight lines - Priority controls - No cycle connection phases Factors that decrease the likelihood include: - Low speed at 40km/hr - Sufficient verge for cars to pull out from Beach St to merge onto SH6A - Signalised intersection, full predestrian protection and full protection for right turns.	Factors that increase the likelihood include: - - Factors that decrease the likelihood include: - Signalised control, full pedestrian protection - Low speed at 40km/hr - Good sight lines	Factors that increase the likelihood include: - Poor sight lines looking to, and coming from, Duke St - Factors that decrease the likelihood include: - Signalised intersection, full predestrian protection and full protection for right turns. - Limited turning movements as one way entry and exit - Only two right turn movements	Factors that increase the likelihood include: - All turn movements allowed - 4 way signalised intersection Factors that decrease the likelihood include: - Signalised intersection, full predestrian protection and full protection for right turns. - No turning lanes - Good sight lines - Short distances for pedestrians to cross	Factors that increase the likelihood include: - Wide mouth intersection, long crossing distance for peds - Dual lane approach through intersection - Confusion with lane marking - Not signalised - Wayfinding with bus lane and no RHT onto Stanley for other vehicles Factors that decrease the likelihood include: - Relatively good sight distance - Low speed at 40km/hr - Only one right turn movement	Factors that increase the likelihood include: - Offset centre lines - Wayfinding with bus lane and no RHT onto Stanley for other vehicles - 3-way intersection Factors that decrease the likelihood include: - Low speed at 40km/hr - Relatively good sight distance - Signalised - Barnes Dance	Factors that increase the likelihood include: - No pedestrian refuges - Factors that decrease the likelihood include: - Signalised crossing points at intersections & mid-block locations with full pedestrian protection - Good sight lines - Low speed 40km/hr - Suitably wide footpaths on both sides of the road	Factors that increase the likelihood include: - No shoulder - No linemarking or cycle boxes provided at intersections Factors that decrease the likelihood include: - Good sight lines, excluding corner at Beach St - Low speed 40km/hr - Likely to be more competent cyclists using this corridor. Alternative routes available that provide for all levels	Factors that increase the likelihood include: - No separate motorcyle lanes - Roadside hazards - parked cars, trees Factors that decrease the likelihood include: - Good sight lines, excluding corner at Beach St - Low speed 40km/hr - Urban environment - Fairly consistent design
Likelihood Score	2	3	3	2	3	3	3	3	3	3	2
Severity Comments	Factors that increase the severity include: - Parked cars - Bus stops - Accessways - Roadside hazards Factors that decrease the severity include: - 40km/hr Urban environment	Factors that increase the severity include: - - Factors that decrease the severity include: - 40km/hr Urban environment	Factors that increase the severity include: - - Factors that decrease the severity include: - 40km/hr Urban speed environment - Beach St is one-way. Exit controlled by signals.	Factors that increase the severity include: - - Factors that decrease the severity include: - 40km/hr Urban environment	Factors that increase the severity include: - High impact angle possible (T-bone crash) - Factors that decrease the severity include: - 40km/hr Urban speed environment - One-way through Duke / Rees St	Factors that increase the severity include: - High impact angle possible (T-bone crash) - Factors that decrease the severity include: - 40km/hr Urban environment	Factors that increase the severity include: - High impact angle possible (T-bone crash) - Factors that decrease the severity include: - 40km/hr Urban environment	Factors that increase the severity include: - High impact angle possible (T-bone crash) - Factors that decrease the severity include: - 40km/hr Urban environment	Factors that increase the severity include: - Speed is still 40km/hr. Safe and survivable speed for pedestrians is 30km/hr. - Factors that decrease the severity include: -	Factors that increase the severity include: - Speed is still 40km/hr. Safe and survivable speed for cyclists is 30km/hr. - Vehicle vs Cyclist crash still possible Factors that decrease the severity include: -	Factors that increase the severity include: - Speed is still 40km/hr. Safe and survivable speed for pedestrians is 30km/hr. - Factors that decrease the severity include: -
Severity Score	2	2	2	3	2	2	2	2	3	3	2
Product	12	18	18	18	18	18	18	18	36	36	8
Opportunities	- Traffic calming to achieve posted speed - Enure sight lines maintained when designing and maintaining landscaping - Surfacing with good skid resistance	- Traffic calming to achieve posted speed - Clear signage to prevent accident at Stanley/Shotover int.	- Raised table at intersection to reduce speeds - desgn for 30km/hr	- Rationalise and limit crossing places where demand allows - Raised table at intersection to reduce speeds - design for 30km/hr	- Raised table at intersection to reduce speeds - design for 30km/hr	- Raised table at intersection to reduce speeds - design for 30km/hr	- Reduce through lanes, remove turn lane - Raised table at intersection to reduce speeds - design for 30km/hr	- Raised table at intersection to reduce speeds - design for 30km/hr	- Raised platforms at intersection	- Clear Signage when use changes - Cycle boxes to be provided at intersections	- Provide improved skid resistance
Exposure	3	3	3	3	3	3	3	3	4	4	2
Likelihood	2	3	2	2	2	2	2	2	2	2	2
Severity	2	2	2	3	2	2	2	2	2	3	2
Product	12	18	12	12	18	12	12	12	16	24	8

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Appendix B Safe System Assessment Matrix – SH6A (West - East)

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	Run-off road	Head-on	Stanley Midblock bus crossing	Intersection - Stanley /Ballarat	Intersection -Stanley /Coronation Drive	Inersection - Betham / Stanley Street	Intersection - Stanley Sydney	Intersection - Stanley/Frankton/	Property Accesses	Pedestrian	Cyclists	Motorcyclists
Exposure Comments	Forecast ADT <5000 ADT	Forecast ADT <5000 ADT	Forecast ADT <5000 ADT Ped > 100 Public bus connectoin	Forecast ADT <5000 ADT Ped > 100	Forecast ADT <5000 ADT Ped > 100 Bus priority lane	Low volume side road 'Forecast ADT <5000 ADT	Ped > 100 'Forecast ADT <5000 ADT Public bus connection	Forecast ADT <5000 ADT Ped > 100	Assume volumes will be 18,000 ADT	>100 Peds Designated footpath	<100 Cyclists No separation	19 ADT
Exposure Score	2	2	3	3	3	3	3	3	4	4	3	2
Likelihood Comments	Factors that increase the likelihood include: - No shoulders - No barriers	Factors that increase the likelihood include: - Bus lanes & buses pulling out - Bus stops in traffic lane from Sydney St - Frankton Rd - Accessways requiring RHT, without median - No median for majority of length	Factors that increase the likelihood include: - Bus lanes create 4 lanes for peds to cross, without a median - Straight through approaches for buses	Factors that increase the likelihood include: - 3-way intersection - Bus lanes create 4 lanes for peds to cross, without a median - Bus priority lane WB starting - Wayfinding, cars may be unsure whether allowed to enter bus zone	Factors that increase the likelihood include: - 3-way intersection - Not signalised	Factors that increase the likelihood include: - 3-way intersection - Not signalised - All movements permitted	Factors that increase the likelihood include: - 4-way intersection	Factors that increase the likelihood include: - 3-way intersection - All movements permitted - Poor sight lines on the corner	Factors that increase the likelihood include: - Multiple property accessways throughout. - Limited flush median	Factors that increase the likelihood include: - No pedestrian refuges -	Factors that increase the likelihood include: - No shoulder - No linemarking or cycle boxes provided at intersections	Factors that increase the likelihood include: - No separate motorcyle lanes - Vaired sight lines - perhaps risk for motorcyclists from cars pulling out onto SH6A - Inconsistent design with changing bus lanes and cycle lanes throughout the length
	Factors that decrease the likelihood include: - Good sight lines - Low speed 40km/hr - Bus lanes for a section of road - Not many trees lining the road	Factors that decrease the likelihood include: - Low speed at 40km/hr	Factors that decrease the likelihood include: - Low speed at 40km/hr - Signalised crossing, full pedestrian protection/Barnes Dance with full protection for right turns	Factors that decrease the likelihood include: - 3-way intersection - Signalised crossing, full pedestrian protection/Barnes Dance with full protection for right turns	Factors that decrease the likelihood include: - Low speed, 30km/hr - Shared Use Zone - encourages safe driving around pedestrians and approaching - Coronation drive - one way for vehicles	Factors that decrease the likelihood include: - Good sight lines	Factors that decrease the likelihood include: - Signalised crossing, full pedestrian protection/Barnes Dance with full protection for right turns -	Factors that decrease the likelihood include: - Signalised crossing, full pedestrian protection/Barnes Dance with full protection for right turns	Factors that decrease the likelihood include: -	Factors that decrease the likelihood include: - Designated crossing points at intersections - Good sight lines - Low speed 40km/hr, in shared areas this drops to 30km/hr	Factors that decrease the likelihood include: - Varied sight lines - poor in some spots - Low speed 40km/hr - Likely to be more competent cyclists using this corridor. Alternative routes available that provide for all levels.	Factors that decrease the likelihood include: - Low speed 40km/hr - At signalised intersection, right turns protected.
Likelihood Score	2	3	3	3	2	3	3	3	3	3	3	2
Severity Comments	Factors that increase the severity include: - Roadside hazards	Factors that increase the severity include: - -	Factors that increase the severity include: - -	Factors that increase the severity include: - High impact angle possible (T-bone crash) -	Factors that increase the severity include: - High impact angle possible (T-bone crash) -	Factors that increase the severity include: - High impact angle possible (T-bone crash) -	Factors that increase the severity include: - High impact angle possible (T-bone crash) -	Factors that increase the severity include: - High impact angle possible (T-bone crash) -	Factors that increase the severity include: - -	Factors that increase the severity include: - Speed is still 40km/hr through majority of area. Safe and survivable speed for pedestrians is 30km/hr. -	Factors that increase the severity include: - Speed is still 40km/hr through majority of area. Safe and survivable speed for pedestrians is 30km/hr. - Vehicle vs cyclist crash still possible	Factors that increase the severity include: - Speed -
	Factors that decrease the severity include: - 40km/hr Urban speed environment	Factors that decrease the severity include: - 40km/hr Urban speed environment	Factors that decrease the severity include: - 40km/hr Urban speed environment - 30km/hr speed limit through shared zone	Factors that decrease the severity include: - 40km/hr Urban speed environment	Factors that decrease the severity include: - 40km/hr Urban speed environment - 30km/hr speed limit through shared zone	Factors that decrease the severity include: - 40km/hr Urban speed environment	Factors that decrease the severity include: - 40km/hr Urban speed environment	Factors that decrease the severity include: - 40km/hr Urban speed environment	Factors that decrease the severity include: - 40km/h Urban speed environment - Cars likely to be exiting slowly from driveway onto the main road.	Factors that decrease the severity include: -	Factors that decrease the severity include: -	Factors that decrease the severity include: -
Severity Score	2	2	3	2	2	2	2	2	2	3	3	2
Product	8	12	27	18	12	18	18	18	24	36	27	8
Opportunities	- Traffic calming to achieve posted speed - Enure sight lines maintained when designing and maintaining landscaping - Surfacing with good skid resistance	- Traffic calming to achieve posted speed	- Raised table at intersection to reduce speeds - design for 30km/hr - Ensure visibility for pedestrians around buses, consider kerb build outs, recessed bus parking	- Raised table at intersection to reduce speeds - design for 30km/hr - Clear signage and linemarking to communicate allowed movements - Limit turning movements, is there an option to make Ballarat north one way?	- Clear signage and change in pavement material to warn vehicles and pedestrians of each other	- Consider limiting movements - LILO	- Raised table at intersection to reduce speeds - design for 30km/hr - Rationalise intersection - can access be provided elsewhere via other intersections	- Raised table at intersection to reduce speeds - design for 30km/hr - Limit movement – LILO	- Traffic calming measures - Consider Banning RHT into properties where there is no flush median or provide median	- Raised platforms at intersection - designed for 30km/hr	- Signage indicating access to safer cyle routes through town	- Provide improved skid resistance
Exposure	2	2	3	3	3	3	3	3	4	4	3	2
Likelihood	2	3	2	2	2	3	2	2	3	2	2	2
Severity	2	2	2	2	2	2	2	2	2	2	3	2
Product	8	12	12	12	12	18	12	12	24	16	18	8

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Appendix C Safe System Assessment Matrix – Arterials, Stage 1

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	Run-off road - Stage 1, 2 & 3	Head-on - Stage 1, 2 & 3	Intersection - Arterial/Shotover St incl. Turner St	Intersection - Arterial/Sydney St	Intersection - Arterial/Frankton Rd/ Dublin	Property Accesses	Pedestrian - Stage 1	Cyclists - Stage 1	Motorcyclists - Stage 1, 2, & 3
Exposure Comments	Forecasted volumes expected 18,000vdp	Forecasted volumes expected 18,000vdp	Assume volumes will be 18,000 ADT	Assume volumes will be 18,000 ADT Peds>100	Assume volumes will be 18,000 ADT	Assume volumes will be 18,000 ADT	>100 Peds Designated footpath	>100 Cyclists >10,000 vpd No facilities for cyclists on arterial route	>100 ADT
Exposure Score	4	4	4	4	4	4	4	4	4
Likelihood Comments	Factors that increase the likelihood include: - No shoulders - No barriers - Winter conditions - Steep down grade on Stage 1 - Steep down grade on Stage 3 toward Fernhill roundabout - Out of context curves for Stage 2	Factors that increase the likelihood include: - Steep down grade on Stage 1 - Steep down grade on Stage 3 toward Fernhill roundabout - Out of context curves for Stage 2	Factors that increase the likelihood include: - Wayfinding with built up median will be a challenge for users - All movements allowed - Separated slip lane to access properties only allows for entry from Gorge Road approach. Could lead to confusion and illegal movements.	Factors that increase the likelihood include: - All movements - Depending on phasing, conflicting movements may be possible, particularly from north-east	Factors that increase the likelihood include: - Wayfinding turning onto Arterial and lane confusion may lead to poor manoeuvres - Left turn out only from arterial, Stanley St will remain accessible for all users. Left turn in from Frankton Road not possible. Wayfinding likely to be difficult leading to poor or illegal manoeuvres. - Pedestrian crossing not provided on Frankton Road from Suburb Street (demand likely to be low) - No cycle lane on arterial - No cycle facilities from Frankton Road to arterial at intersection	Factors that increase the likelihood include: - Multiple property accessways across footpath between Frankton Rd and Beetham St	Factors that increase the likelihood include: - Limited crossing places across arterial - Multiple property accessways across footpath between Frankton Road and Beetham St - No crossings provided but pedestrian access joining from Beetham and Mallaghan Streets	Factors that increase the likelihood include: - No shoulder - No allowance for cyclists - must share with vehicles. - Varied sight lines - poor in some spots - Steep downhill grade	Factors that increase the likelihood include: - No separate motorcycle lanes - Varied sight lines - Steep downgrades for Stage 1 & 3
	Factors that decrease the likelihood include: - Good sight lines - Low speed at 40km/hr - Straight alignment for Stage 1 & 3	Factors that decrease the likelihood include: - Median strip for majority of length - Low speed at 40km/hr - Straight alignment for Stage 1 & 3	Factors that decrease the likelihood include: - Signalised intersection, with protected right turns - 3 leg intersection - Signalised crossings for pedestrians with full protection, or Barnes Dance - Good visibility on approach	Factors that decrease the likelihood include: - Narrow approaches - Signalised crossings for pedestrians with full protection, or Barnes Dance - Signalised intersections, with protected right turns - Good visibility on approach	Factors that decrease the likelihood include: - Signalised crossings for pedestrians with full protection, or Barnes Dance - All legs signalised, with protected right turns	Factors that decrease the likelihood include: - Flush median for majority of length for vehicles to sit in to turn right into/out of the access.	Factors that decrease the likelihood include: - Designated crossing points at intersections - Overpass from Ballarat St - Good sight lines - Low speed 40km/hr - Suitably wide footpaths on both sides of road	Factors that decrease the likelihood include: - Low speed 40km/hr - Likely to be more competent cyclists using this corridor. Alternative routes available that provide for all levels	Factors that decrease the likelihood include: - Low speed 40km/hr - Consistent road corridor layout - Signalised intersections have protected right turns.
Likelihood Score	2	2	3	3	3	3	3	3	2
Severity Comments	Factors that increase the severity include: - Parked cars Stage 1 - Bus stops Stage 3 - Accessways Stage 3 - Roadside hazards	Factors that increase the severity include: - -	Factors that increase the severity include: - High impact angle crashes possible (T-bone crash) - Long crossing distance for pedestrians (3-4 lanes) with no refuge	Factors that increase the severity include: - Potential for higher approach speed, particularly from north-east - High impact angle crashes possible (T-bone crash)	Factors that increase the severity include: - Potential for higher approach speeds, particularly from Frankton Road south - High impact angle crashes possible (T-bone crash) but limited opportunity	Factors that increase the severity include: - -	Factors that increase the severity include: - Speed is still 40 km/h. Safe and survivable speed for pedestrian is 30 km/h -	Factors that increase the severity include: - Speed is still 40 km/h. Safe and survivable speed for pedestrian is 30 km/h - Downhill grade - Vehicle vs Cyclist crash possible	Factors that increase the severity include: - Speed is still 40 km/h. Safe and survivable speed for pedestrian is 30 km/h - Steep downgrade for Stage 1 & 3 - Vehicle vs motorcyclists crash possible
	Factors that decrease the severity include: - 40km/hr urban speed environment -	Factors that decrease the severity include: - 40km/hr urban speed environment -	Factors that decrease the severity include: - 40km/h Urban speed environment -	Factors that decrease the severity include: - 40km/h Urban speed environment -	Factors that decrease the severity include: - 40km/h Urban speed environment -	Factors that decrease the severity include: - 40km/h Urban speed environment - Cars likely to be exiting slowly from driveway onto the main road.	Factors that decrease the severity include: - -	Factors that decrease the severity include: - -	Factors that decrease the severity include: - -
Severity Score	2	2	2	2	2	2	3	3	2
Existing Design Conditions	16	16	24	24	24	24	36	36	16
Opportunities	- Surfacing with good skid resistance - Part of maintenance programme - de-icing agent applied - Traffic calming to achieve posted speed, particularly on steep grade sections	-Traffic Calming measures eg. Narrow lanes. 3.25m lanes currently in design. Could also do wider lanes, or planting.	- Raised table at intersection to reduce speeds, design for 30km/hr	- Raised table at intersection to reduce speeds, design for 30km/hr - Cater for on road cyclists at intersection and into arterial	- Raised table at intersection to reduce speeds, design for 30km/hr - Ensure adequate wayfinding to minimise confusion and illegal manoeuvres - Consider providing for more movement opportunities at intersection i.e. right out of arterial, left in from Frankton Road - Cater for on road cyclists at intersection and into arterial	- Traffic calming measures - Ban RHT into properties where there is no flush median (ie. Near intersections)	- Raised platforms at intersections & mid-block to manage speeds. - Provide crossings where pedestrians connect to arterial route or manage them to crossing points at intersections. - Consider grade separation for pedestrian crossings	- Clear Signage directing cyclists to most appropriate route through town. - Consider sharrows or markings to promote awareness of cyclists in the space. - Cyclist stop boxes at all intersections along arterial - Cater for on-road cyclists on arterial or ban them from the arterial (hard to do when accommodation and housing located on the arterial). - No filter turns to avoid vehicle conflicts.	- Raised table at intersections to reduce speeds - Ensure wayfinding to minimise confusion and illegal manoeuvres. - Provide improved skid resistance - Provide warning signage where there are steep downgrades
Exposure	4	4	4	4	4	4	4	4	3
Likelihood	2	2	3	3	3	3	3	2	2
Severity	2	2	1	1	1	2	2	3	2
With Suggested Safe System Impr	16	16	12	12	12	24	24	24	12

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Appendix D Safe System Assessment Matrix – Arterials, Stage 2

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	Intersection - Arterial/Camp St	Intersection - Arterial/Stanley St	Intersection - Arterial/Gorge Rd	Pedestrian	Cyclists
Exposure Comments	Forecasted volumes expected >10,000vdp Peds>100	Forecasted volumes expected >10,000vdp Peds>100	Forecasted volumes expected >10,000vdp Peds>100	>100 Peds Designated footpath	>100 Cyclists No separation
Exposure Score	4	4	4	4	4
Likelihood Comments	Factors that increase the likelihood include: - 5-way intersection - Wayfinding - confusion with accessing Duke St - Curved geometry through intersection	Factors that increase the likelihood include: - No ped crossing facilities - Non-signalised - Turning lane commencing north of Stanley intersection. Queueing may develop across Stanley	Factors that increase the likelihood include: - Skewed angle of intersection may reduce visibility - Wayfinding prior to Turner St may be a challenge for some users with short distance between intersections allowing lane changes. - All movements allowed	Factors that increase the likelihood include: - Spaced out crossings (though more closely spaced where more densely populated area of town) - Limited crossing places across arterial: ranging from 60m to 200m spacing between crossing locations - Some property accessways across footpath between Shotover & Memorial St - No formal crossing at Stanley St, which leads to bus hub	Factors that increase the likelihood include: - No shoulder - No allowance for cyclists - must share with vehicles - Varied sight lines - poor in some spots
	Factors that decrease the likelihood include: - Barnes Dance - enables Duke St crossing - Signalised intersection, with protected right turns	Factors that decrease the likelihood include: -	Factors that decrease the likelihood include: - Signalised intersection, with protected right turns - 3 leg intersection - Signalised crossings for pedestrians, with full protection	Factors that decrease the likelihood include: - Designated crossing points at intersections, with full pedestrian protection or Barnes Dance - Good sight lines - Low speed 40km/hr - Suitably wide footpaths on both sides of road	Factors that decrease the likelihood include: - Low speed 40km/hr - Likely to be more competent cyclists using this corridor. Alternative routes available that provide for all levels.
Likelihood Score	3	3	3	3	3
Severity Comments	Factors that increase the severity include: - High impact angle crashes possible (T-bone crash)	Factors that increase the severity include: - High impact angle crashes possible (T-bone crash)	Factors that increase the severity include: - High impact angle crashes possible (T-bone crash) - Long crossing distance for pedestrians (3-4 lanes) with no refuge	Factors that increase the severity include: - Speed is still 40 km/h. Safe and survivable speed for pedestrian is 30 km/h	Factors that increase the severity include: - Speed is still 40km/hr. Safe and survivable speed for cyclists is 30km/hr - Vehicle vs Cyclist crash possible
	Factors that decrease the severity include: - 40km/hr Urban speed environment -	Factors that decrease the severity include: - 40km/hr Urban speed environment -	Factors that decrease the severity include: - 40km/hr Urban speed environment -	Factors that decrease the severity include: - -	Factors that decrease the severity include: - -
Severity Score	2	2	2	3	3
Product	24	24	24	36	36
Opportunities	- Clear signage and linemarking - Raised table at intersection to reduce speeds	- Ensure median allows for one car width for RHT into Stanley St - Signalise - Raised table at intersection to reduce speeds	- Raised table at intersection to reduce speeds - Pedestrian protection (full or partial) on phases or Barnes dance - Phasing to limit opportunity for vehicle conflicts	- Raised platforms at intersections - Provide crossings where pedestrians connect to arterial route - Consider grade separation for pedestrian crossings	- Clear Signage directing cyclists to most appropriate route through town. - Consider sharrows or markings to promote awareness of cyclists in the space. - Cyclist stop boxes at all intersections along arterial - Cater for on-road cyclists on arterial or ban them from the arterial (hard to do when accommodation and housing located on the arterial).
Exposure	4	4	4	4	4
Likelihood	2	2	2	2	2
Severity	2	2	2	2	3
Product	16	16	16	16	24

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Appendix E Safe System Assessment Matrix – Arterials, Stage 3

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	Intersection - Arterial/Fernhill roundabout	Intersection - Arterial/Thomspon	Intersection - Arterial/Glasgow incl. raised ped crossing & Brunswick exit	Intersection - Arterial/Camp ground new rd	Mid-block ped crossing incl green space on corner	Intersection - Arterial/Lake St	Intersection - Arterial/Hay St	Intersection - Arterial/Brecon St	Property Accesses	Pedestrian - Stage 3	Cyclists - Stage 3
Exposure Comments	Forecasted volumes expected >10,000vdp	Forecasted volumes expected >10,000vdp	Forecasted volumes expected >10,000vdp Peds>100	Forecasted volumes expected >10,000vdp	Forecasted volumes expected >10,000vdp Peds>100	Forecasted volumes expected >10,000vdp	Forecasted volumes expected >10,000vdp Peds>100	Forecasted volumes expected >10,000vdp Peds>100	Assume volumes will be 18,000 ADT	>100 Peds Designated footpath	>100 Cyclists >10,000 vpd No facilities for cyclists on arterial route
Exposure Score	4	4	4	4	4	4	4	4	4	4	4
Likelihood Comments	Factors that increase the likelihood include: - Vertical alignment could reduce sight distance - Curved approaches could reduce sight distance - Non-signalised intersection - Steep downhill approaching the roundabout from the arterial	Factors that increase the likelihood include: - Non-signalised intersection - Vertical alignment could reduce sight distances	Factors that increase the likelihood include: - Non-signalised intersection - RHT from Glasgow - High volumes of cyclists accessing MTB tracks up Glasgow St	Factors that increase the likelihood include: - Non-signalised intersection - Straight section of road may encourage speeding	Factors that increase the likelihood include: - Non-signalised intersection - Driveway on the corner - Poor sightlines	Factors that increase the likelihood include: - Non-signalised intersection - Bus stop may block view of vehicles exiting Lake St - Trees may reduce sight distance of those existing Lake St	Factors that increase the likelihood include: - 4-way intersection - Skewed alignment	Factors that increase the likelihood include: - Only crossing for pedestrians on 2 out of 3 crossings (people may want to cross at desire line).	Factors that increase the likelihood include: - Multiple property accessways north and south of Breacon St intersections. Some around Glasgow St too. - No flush median around Breacon St intersection	Factors that increase the likelihood include: - Limited crossing places across arterial - Multiple property accessways across footpath between Gorge Rd & Hay St - Multiple side street crossings uncrontrolled.	Factors that increase the likelihood include: - No shoulder - No allowance for cyclists - must share with vehicles. - Varied sight lines - poor in some spots - Steep downhill grade toward Fernhill roundabout
	Factors that decrease the likelihood include: - Minimum sight lines met at detailed design	Factors that decrease the likelihood include: - Horizontal sight distances look to be met	Factors that decrease the likelihood include: - Ped crossing creating gaps in traffic for vehicles entering arterial turning left	Factors that decrease the likelihood include: - Good sight lines with straight approaches - No ped crossing facility - Footpath only on one side of the road	Factors that decrease the likelihood include: - Signage and markings approaching crossing. - Median strip at driveway access	Factors that decrease the likelihood include: - Short distance between intersection, so speed likely to be low - Median strip at Lake St providing RHT bay into Lake St from Arterial Rd	Factors that decrease the likelihood include: - Signalised intersection, with full protection for pedestrians/Barnes Dance and full protection for right turns	Factors that decrease the likelihood include: - Signalised intersection, with full protection for pedestrians and full protection for right turns - High volumes of pedestrians and cyclists accessing the Gondola from town	Factors that decrease the likelihood include: - Flush median for majority of length south of Breacon St, for vehicles to sit in to turn right into/out of the access. - RHT bay provided into hotel block just south of Breacon St.	Factors that decrease the likelihood include: - Designated crossing points at signalised intersections with full pedestrian protection or Barnes Dance - Good sight lines - Low speed 40km/hr - Suitably wide footpaths on one side of road of the road for majority of length, which restricts the amount of crossing points	Factors that decrease the likelihood include: - Low speed 40km/hr - Likely to be more competent cyclists using this corridor. Alternative routes available that provide for all levels - Cycle boxes provided at intersections
Likelihood Score	3	3	3	3	3	3	3	3	3	3	3
Severity Comments	Factors that increase the severity include: - Impact angles - side impact possible -	Factors that increase the severity include: - Impact angles - side impact possible -	Factors that increase the severity include: - Impact angles - side impact possible -	Factors that increase the severity include: - Impact angles - side impact possible -	Factors that increase the severity include: - Impact angles - side impact possible - Peds through driveway access	Factors that increase the severity include: - Impact angles - side impact possible -	Factors that increase the severity include: - Impact angles - side impact possible -	Factors that increase the severity include: - Impact angles - side impact possible -	Factors that increase the severity include: - -	Factors that increase the severity include: - Speed is still 40 km/h. Safe and survivable speed for pedestrian is 30 km/h -	Factors that increase the severity include: - Speed - Downhill grade toward Fernhill roundabout - Vehicle vs Cyclist crash possible
	Factors that decrease the severity include: - 40km/hr Urban speed environment -	Factors that decrease the severity include: - 40km/hr Urban speed environment -	Factors that decrease the severity include: - 40km/hr Urban speed environment - Lower speed induced by raised table -	Factors that decrease the severity include: - 40km/hr Urban speed environment -	Factors that decrease the severity include: - 40km/hr Urban speed environment - Lower speed induced by raised table -	Factors that decrease the severity include: - 40km/hr Urban speed environment -	Factors that decrease the severity include: - 40km/hr Urban speed environment -	Factors that decrease the severity include: - 40km/hr Urban speed environment -	Factors that decrease the severity include: - 40km/h Urban speed environment - Cars likely to be exiting slowly from driveway onto the main road.	Factors that decrease the severity include: -	Factors that decrease the severity include: -
Severity Score	2	2	2	2	2	2	2	2	2	3	3
Existing Design Conditions	24	24	24	24	24	24	24	24	24	36	36
Opportunities	- Signalise - Vehicle queueing warning lights	- Signalise	- Design the raised table operating speed to be 30km/hr to improve safety for pedestrians & cyclists - Signalise - Signage warning vehicles about cyclists	- Signalise	- Ensure that median allows for one car width for driveway access RHT - Design the raised table operating speed to be 30km/hr to improve safety for pedestrians & cyclists	- Signalise - Consider shifting bus stop to improve sight distance for those existing Lake St. - Consider tree placement impact on sight distances during detailed design	- Raised table at intersection to reduce speeds	- Raised table at intersection to reduce speeds	- Traffic calming measures - Ban RHT into properties where there is no flush median or RHT bay (ie. Near Breacon St intersection\)	- Raised platforms at intersections - Provide crossings where pedestrians connect to arterial route - Consider grade separation for pedestrian crossings - At side street crossings - provide drop kerb where side street narrows to reduce distance crossed by pedestrians	- Clear Signage directing cyclists to most appropriate route through town. - Consider sharrows or markings to promote awareness of cyclists in the space. - Cyclist stop boxes at all intersections along arterial - Cater for on-road cyclists on arterial or ban them from the arterial (hard to do when accommodation and housing located on the arterial).
Exposure	4	4	4	4	4	4	4	4	4	4	4
Likelihood	2	2	2	2	2	2	2	2	3	2	2
Severity	2	2	2	2	2	2	2	2	2	2	3
With Suggested Safe System Impr	16	16	16	16	16	16	16	16	24	16	24

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SAFE SYSTEM ASSESSMENT
FRANKTON TO QUEENSTOWN: SH6A

PREPARED FOR THE WAKA KOTAHI NZ TRANSPORT AGENCY

September 2020

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REVISION SCHEDULE

Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by
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Waka Kotahi NZ Transport Agency

Queenstown Town Centre SSBC

Safe System Assessment – Queenstown to Frankton SH6A

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APPENDICES

Appendix A Safe System Assessment Matrix – Queenstown to Frankton SH6A

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Executive Summary

A full Safe System Assessment (SSA) has been conducted on the preliminary design conditions (Development Plans) for SH6A – Queenstown to Frankton Part B of the combined Frankton to Queenstown Single Stage Business Case (SSBC) and Queenstown Town Centre Detailed Business Case (DBC) with Safe System principals. The Safe System Matrix score for Existing Design Conditions is 348/704, with lower scores being better.

This Safe System has also evaluated design proposals which incorporated primary treatments and secondary treatments that could be implemented into the project to further align SH6A with Safe Systems. The Safe System Matrix score for Suggested Safe System Improvements is 154/704, producing an outcome further towards zero and better aligned with Safe System Principals.

The SSA Matrix scores are shown in the table below.

Option	Score
Existing Design Conditions	348/ 704
With suggested Safe System Improvements	154 / 704

The crash types that have the highest perceived risk and are the main contributors to the existing preliminary design conditions score are:

- Signalised Intersections – 48/64
- Pedestrian Refuge Crossings – 48/64
- On-Road Cycle Lanes – 36/64

However, all crash types had opportunities to improve alignment with Safe Systems where each of the 11-crash types saw a reduction in score with suggested improvements. If suggested Safe System Improvements were implemented, the residual crash-types with highest perceived risk are:

- On-road cyclists – 24/64
- Run-off road crashes – 24/64

A number of ideas for consideration are presented in this Safe System Assessment that bring the project closer 'Towards Zero', including the following primary and supporting treatments:

- Measures to reduce speeds through controlled intersections to 50km/h or below such as raised platforms
- Increased separation between opposing traffic flows which could be increase median width or flexible barriers
- Reduce pedestrian crossing points to 30km/h or less, or provide separated facilities such as an underpass
- Installing raised treatments for active travel priority at all shared path access crossings and unsignalised side roads
- Installing continuous flexible barriers sufficiently offset from face of kerb to reduce the severity of run-off-road crashes
- Lower permanent speed of 60km/h for SH6A
- Provide high skid resistance pavement at high risk locations
- Continuous lighting throughout corridor, with minimum lighting requirements met at all pedestrian crossing locations
- Redirect access ways to local roads, or combined, shared service lanes
- Provide separated cycle facilities at shared on-road areas such as bus stops
- Implement cobbled pedestrian crossing points if separated facility cannot be achieved

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1. Introduction to the Safe System

1.1 Safe System Pillars

The Safe System approach seeks to ensure that no road user is subjected to kinetic energy exchange in a crash that will result in death or serious injury. There is a shared responsibility for safe travel outcomes between system designers (road authorities, vehicle manufactures, road designers etc.) and road users. There are four Safe System pillars: safer vehicles, safer speeds, safer roads and safer road users. Post-crash response is another element that is often recognised as the fifth pillar. All parts of the system must be considered and strengthened so that road safety outcomes are maximised and to ensure that road users are adequately protected even if one part fails.

Safe System Assessment (SSA) is concerned mainly with the safer roads and safer speeds pillars. A SSA is used to examine road project proposals and aims to identify infrastructure and speed related factors that are likely to contribute to a higher risk of fatal and serious injury (FSI) crashes. It also seeks to identify design or scope changes that will improve the alignment of the project with Safe System principles.



Figure 1 - Safe System Pillars

1.2 Safe System Impact Speeds

The impact speed in a collision is a significant factor that affects the probability of a person being killed or seriously injured in a crash. Safe System impact speeds are speeds below which the chances of survival are high and the likelihood of serious injury is low.

Figure 2 is a guide to Safe System impact speeds for common crash types. It should be noted that the angle of impact of a collision is also a factor that affects the severity of a crash. As far as is practically possible, infrastructure should be designed, and travel speeds managed so that the impact speeds when a crash occurs are below the thresholds show in Figure 2.

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Figure 2 - Safe System Impact Speeds

2. Safe System Assessment Process

The Safe System Assessment process is based on Austroads Safe System Assessment Framework (Austroads 2016, Research Report AP-R509-16, Safe System Assessment Framework) and VicRoads Safe System Assessment Guidelines.

Steps in the process include:

- Deciding on the type of assessment (full or rapid)
- Selecting an appropriate team to conduct the assessment
- Understanding the project background, context and objectives
- Collation of information and data for both existing and future conditions
- Inspection of the site
- Conducting the assessment of existing conditions and each project design option using the SSA Matrix
- Consideration of the additional Safe System components; road users, vehicles and post-cash care
- Review of the SSA Matrix scores and development of suggested changes to improve alignment with Safe System principles
- Reporting
- Review of suggested design and scope changes
- Amendment of project scope and design to incorporate the accepted changes.

3. Assessment Details

3.1 Type of Assessment

This is a Full SSA that has been conducted in accordance with VicRoads Safe System Assessment Guidelines and Austroads Safe System Assessment Framework (Austroads Research Report AP-R509-16).

The SSA has been undertaken to analyse the existing conditions and proposed works for SH6/SH6A from Part B of the combined Frankton to Queenstown Single Stage Business Case (SSBC) and Queenstown Town Centre Detailed Business Case (DBC). The project cost is above $5M, therefore, a Full SSA must be undertaken.

This report only reflects the project progress up to Workshop No.4 (22 February) and Development Plans.

3.2 Assessment Team

The Safe Systems Assessment was conducted by:

- s 9(2)(a) (B.Eng) Work Group Manager – Transportation, WSP
- s 9(2)(a) (B.Eng) Transport Engineer, WSP
- s 9(2)(a) (B.Eng), Work Group Manager - Transportation Safety, WSP

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- s 9(2)(a) Team Lead - Safety Engineers, NZTA

s 9(2)(a) and s 9(2)(a) are part of the Business Case Team, while s 9(2)(a) and s 9(2)(a) are Independent Members who attended the workshop meeting.

3.3 Meetings and Site Inspections

The SSA Project Team and Independent Members attended a MS Teams meeting on the 7 April 2020.

No site visits were undertaken for this project. This project was undertaken during the Level-4 Nation Wide Lockdown for New Zealand's response to Covid-19. However, members of the SSA are familiar with sites and locations and used Google Street View in lieu of lockdown.

4. Project Description

4.1 Project Background

This assessment focusses on proposed improvements to State Highway 6A between the SH6/SH6A intersection (BP roundabout) and the SH6A/Suburb Street intersection. The project forms part of the combined Frankton to Queenstown SSBC and Queenstown Town Centre DBC. These business cases make recommendations for upgrading the transport network. Figure 3 shows the locations of the FTQ & QTC DBC with the extents of this project shown in yellow.



Figure 3: Project Scope of SH6A from Frankton to Queenstown Demonstrated in Yellow

4.2 Project Objectives

Four problem statements were developed to summarise issues on the Frankton to Queenstown corridor:

1. **Efficiency**. Rapid growth, the high relative attractiveness of car travel over other modes and a lack of alternative routes are leading to increasing traffic volumes along SH6A. This is causing more congestion, longer / more unreliable travel times and rat-running, which limits opportunities for future tourism growth and reduces the liveability of Queenstown.

2. **Resilience**. SH6A provides the only direct transport link between Queenstown and Frankton but is subject to landslides and is constrained in width. This means that the road is susceptible to delays

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caused by minor planned or unplanned disruptions, which creates severance between the two centres and makes access to essential services (i.e. emergency services and the airport) vulnerable.

3. **Safety**. High traffic volumes limit opportunities to safely cross or turn onto SH6A, increasing frustration for all road users and limiting access to PT/active travel modes. This raises the likelihood of injury or death, causes community severance and reduces the LOS for all road users.

4. **Amenity**. High traffic volumes, limited connections to active travel routes and unattractive adjacent land use means that SH6A is not presenting as a high-quality gateway into Queenstown. This does not align with the community's aspiration for high levels of amenity and an enhanced place value for Queenstown.

To address the problems above, the following investment objectives were agreed with stakeholders:

1. Provide more efficient and reliable access for people and goods that:
    a. Sustainably manages growth
    b. Reduces reliance of private vehicle travel
    c. Enable enhanced land use
2. Is adaptable to change and disruption
3. Enhances the liveability and quality of the natural and built environment
4. Enhances safety with a goal of Vision Zero

Error! Reference source not found. summarises the aim and background of the project.

Table 1: Project Summary

Prompts	Comments
What is the reason for the project? Is there specific crash type risk? Is it addressing specific issues such as poor speed limit compliance, road access, congestion, future traffic growth, freight movement, amenity concerns from the community, maintenance/asset renewal, etc.	The project primarily seeks to address road access and active mode safety issues on SH6A. Increasing traffic volumes are reducing gaps in traffic, making access to side roads and land use difficult, and drivers are taking increased risks to make right turns. The posted speed limit is 70km/h, which results in higher severity crashes. There are currently no controlled crossings on the corridor, which limits access to public transport and active mode links along SH6A and the Frankton track. There are also real and perceived pedestrian safety risks along the route, including wide intersection throats and narrow footpaths. It should be noted that there is no major crash history on SH6A, but there is a perceived risk that acts as a barrier to sustainable travel (several complaints from the public have been received by Aspiring Highways) and stakeholders identified Vision Zero as a desirable outcome.

The objective of this Safe System Assessment is to identify the degree of the projects alignment with the Safe System objectives and suggest solutions that could move the project closer towards alignment with Safe System objectives. The project team may then review the recommendations from the SSA and provide commentary around whether to accept recommendations or why they have not been adopted.

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4.3 Existing Conditions and Context

Queenstown Town Centre is a commercial, tourist and residential destination where SH6A is the main route providing access to QTC, as well as through to travel to residential areas on route to Glenorchy. With Frankton being a developing commercial and shopping area, this is also increasing traffic on SH6A in both travel directions. SH6A as a high AADT >25,000 vpd and >100 pedestrians and cyclists. It is one-lane each way throughout. Active travel users have little provision for their safety due to recent rapid growth in the area, which is now being addressed through business cases.

Error! Reference source not found. provides a more detailed summary of existing conditions on SH6A from Queenstown to Frankton.

Table 2: Existing Conditions and Context

Prompts	Comments
What is the function of the road? Consider location, roadside land use, area type, speed limit, intersection type, presence of parking, public transport services and vehicle flows. What traffic features exist nearby (e.g. upstream and downstream)? What alternative routes exist?	As the only major link between Queenstown and Frankton, SH6A is critical for the local economy. The only alternative routes are Gorge Road (via the one-way Edith Cavell Bridge) and Goldfield Heights/Hensman Road (narrow residential streets). As well as providing the only feasible route for public transport (2 routes, peak frequency of 15 minutes), emergency services and freight, the highway also facilitates access to many accommodation providers and residential areas. Traffic volumes on the highway increased by an average of 8%p.a. between 2012 and 2017 and reached 27,000vpd in 2019.
What is the speed environment? What is the current speed limit? Has it changed recently? Is it similar to other roads of this type? How does it compare to Safe System speeds? What is the acceptability of lowering the speed limit at this location?	The posted speed limit is 70km/h for the majority of its length. A typical cross section of the highway includes 3.5m lanes separated by a 2.5m painted median, with a narrow footpath on the lakeside. The speed environment generally matches the posted limit, though it conflicts with the road's access function and pedestrian crossing demand. During peak hours, traffic travels below the posted limit.
What road users are present? Consider the presence of elderly pedestrians, school children and cyclists. Also note what facilities are available to vulnerable road users (e.g. signalised crossings, bicycle lanes, school speed limits, etc.)	Vulnerable road users are rarely observed, though this is considered to be due to a car dominant design and a lack of active mode facilities. There are currently no controlled crossings and only disjointed sections of cycle lane. Concentrations of pedestrians and cyclists mainly occur around bus stops. The Frankton Track is well used by pedestrians and cyclists, though it can only be accessed at certain points. Some cyclists have been observed on SH6A. It is expected that a latent demand for active modes would be unlocked with safer and more accessible infrastructure. There are also a high proportion of visiting drivers who are unfamiliar with NZ roads. While this does not directly translate into increased crash rates, there is an inherent increase in risk.
Vehicle composition using roadway **What is the vehicle composition? Consider the presence of heavy vehicles (and what type),**	A detailed breakdown of vehicle composition is not available. Length data collected from NZTA's TMS shows that approximately 9% of vehicles are

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motorcyclists and other vehicles using the roadway.	over 5.5m long, an indication of the proportion of heavy vehicles. As the only appropriate route to Queenstown, all heavy vehicle traffic uses SH6A, which is also designated an overdimension route.

4.4 Proposed Works – Current Design Conditions

The recommended option for the Frankton to Queenstown corridor is a strategic package of interventions designed to enable the public transport element of the preferred package, as well as improving access, active mode connectivity and safety. The business case has proposed a scheme design consisting of the following interventions:

- Intersection upgrades
- New and upgraded bus stops
- New bus lanes
- Shared path and cycle lane along SH6A
- New and upgraded active mode crossings

Figure 4 shows the emerging preferred option for SH6A.

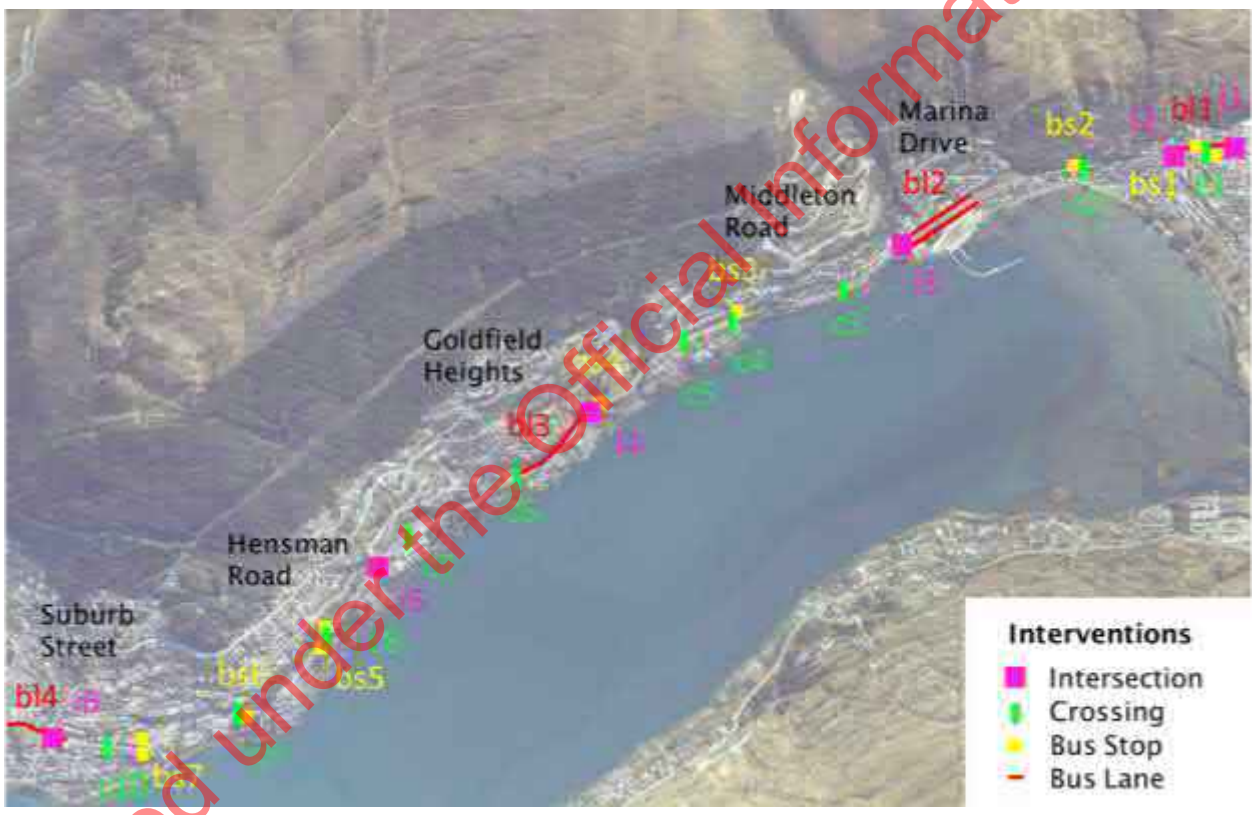


Figure 4: Frankton to Queenstown Emerging Preferred Option

4.4.1 Intersections

Signal control will provide more reliable access to residential areas and accommodation providers, as well as safer crossing opportunities for active mode users. More detail on individual intersection improvements is provided in Table 3.

Table 3: Proposed Intersection Upgrades

Location	Upgrade	Purpose
i1. McBride Street	Signalise existing intersection	The proposed SH6/SH6A intersection upgrade and Old Frankton traffic calming measures would restrict access around Frankton Village. Signalising McBride Street is required to retain reasonable access, particularly for fuel tankers servicing the Mobil station. Full protection would also be provided for pedestrians crossing SH6A and McBride Street.

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Location	Upgrade	Purpose
i2. Yewlett Crescent	Ban right turn out	Minimising opposing movements at the intersection improves efficiency on the highway. Controlled right turn provided at McBride signals instead.
i3. Frankton Marina* Marine Drive intersection to be constructed separately	New signalised intersection	The 190-berth marina and supporting commercial development requires signal control for functional access. Separating traffic movements across two Marina accesses* improves intersection performance, enabling consistent demand through all intersections along the corridor.
i4. Goldfield Heights	Signalise existing intersection	Along with Hensman Road, Goldfield Heights provides access to all land use above SH6A before the town centre and is the only alternative route. A 900-house subdivision is also proposed to be at least partially accessed by the road. Anticipated future demands will require signal control to maintain functionality on the highway. Signalisation will also provide connectivity for active mode users and create gaps for buses to pull out of adjacent stops.
i5. Hensman Road	Signalise existing intersection	Similar to Goldfield Heights, as one of two accesses to the alternative route is required signalisation to prevent rat running. Will also provide active mode access to the Andrews Road bus stop.

4.4.2 Bus Stops

In order to achieve mode shift targets, the public transport catchment needs to be as big as possible. New bus stop locations have been selected to maximise the change opportunity in areas earmarked for development, without compromising the efficiency of the service with excessive stopping. Some existing stops have been identified for upgrades to provide room to accelerate and provide capacity for public and private services. Proposed bus stop improvements are detailed in Table 4.

Table 4: Proposed Bus Stop Upgrades

Location	Upgrade	Purpose
bs1. Yewlett Crescent	New eastbound and westbound stops	Passengers in old Frankton (Lake Ave, Stewart Street, Frankton campground) currently have a 700m walk on a gradient to access the nearest bus stop. Additional stops at Yewlett Crescent improve public transport accessibility for approximately 100 houses (2013 census).
bs2. Frankton Hill	Re-utilise existing stop	ORC removed the stop from service due to low demand. A new subdivision is currently proposed for 970-994 Frankton Road, which may justify reintroducing the adjacent stop.
bs3. Middleton Road	New eastbound stop	There are 200 dwellings proposed to be built above Middleton Road, some of which would be more than 1km from the nearest bus stop. A new bus stop at this location is likely to have a good catchment.
bs4. Goldfield Heights	Extend eastbound stop	The eastbound stop currently services two major hotels, the Sherwood and the Holiday Inn, which generate high demand for ski field buses during winter. Extending the stop will enable retention of the important ski bus service while improving reliability for the public service. The longer stop may also assist buses accelerating to pull out. An additional westbound stop could be provided at 595 Frankton Road if the site is developed as a hotel.
bs5. 293 Frankton Road	New eastbound and westbound stops	A hotel is proposed below the highway that would be 500m from the nearest bus stop. Additional stops at this location may also service the Villa del Lago accommodation.
bs6. Oaks Club Resort	New eastbound double stop	Passengers from two major hotels, Villa del Lago and Oaks Club Resort, currently have to walk up to 500m to catch an eastbound bus at the Pounamu Apartments. Adding a bus stop at this location would serve a large catchment.
bs7. Pounamu Apartments	Extend eastbound stop and add new westbound stop	This is one of the busiest stops for commercial operators, who frequently obstruct public services. Extending the bus bay would increase capacity, reducing delays and improving reliability. The longer stop may also assist buses accelerating to pull out. An additional westbound stop would improve access for residents and accommodation on the lakeside.

4.4.3 Bus Lanes

Sections of SH6A have been identified where physical bus priority can be provided with minimal widening, complementing the Virtual Priority option without significant additional cost. Proposed bus lanes mainly

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provide priority on approach to signals, where buses will be able to jump queues. A summary of proposed bus lanes is provided in Table 5.

Table 5: Proposed Bus Lane Upgrades

Location	Upgrade	Purpose
bl1. Towne Place to McBridge Street	Eastbound bus lane	Provide priority for buses on approach to SH6/SH6A intersection, where queues are expected to be significant.
bl2. Perkins Road to 90m east of Marina Drive	Eastbound and westbound bus lane	Provide priority through busy Marina intersection and between bus stops at Perkins Road and Marina Drive, utilising flat land and redundant flush median (no side roads) to build bus lanes at minimal cost.
bl3. Larch Hill place to Goldfield Heights	Eastbound bus lane	Provide priority through busy Goldfield Heights intersection, utilising redundant flush median (no side roads) to build bus lanes at minimal cost.
bl4. East of Suburb Street to Dublin Street	Westbound bus lane	Provide priority for buses on approach to Dublin Street, where queues are expected to be significant.
Coronation Drive (town centre)	Westbound bus lane	Provide priority for buses on approach to Stanley Street, where queues are expected to be significant.
Beetham Street to east of Sydney Street (town centre)	Eastbound bus lane	Provide priority for buses exiting the town centre, up the gradient on Stanley Street.

4.4.4 Active Modes

A 1.5m-wide on-road cycle lane in the eastbound direction and a 4.0m-wide shared path in the westbound direction are proposed to provide continuous and safe access for cyclists and pedestrians along SH6A. **Error! Reference source not found.** shows how the cycle lane will interact with bus lanes and b us stops in a typical cross section (due to width constraints cyclists will share the lane with buses in places – shared lanes will be no wider than 3.2m to encourage travel in single file, except at bus stops where cyclists can pass).

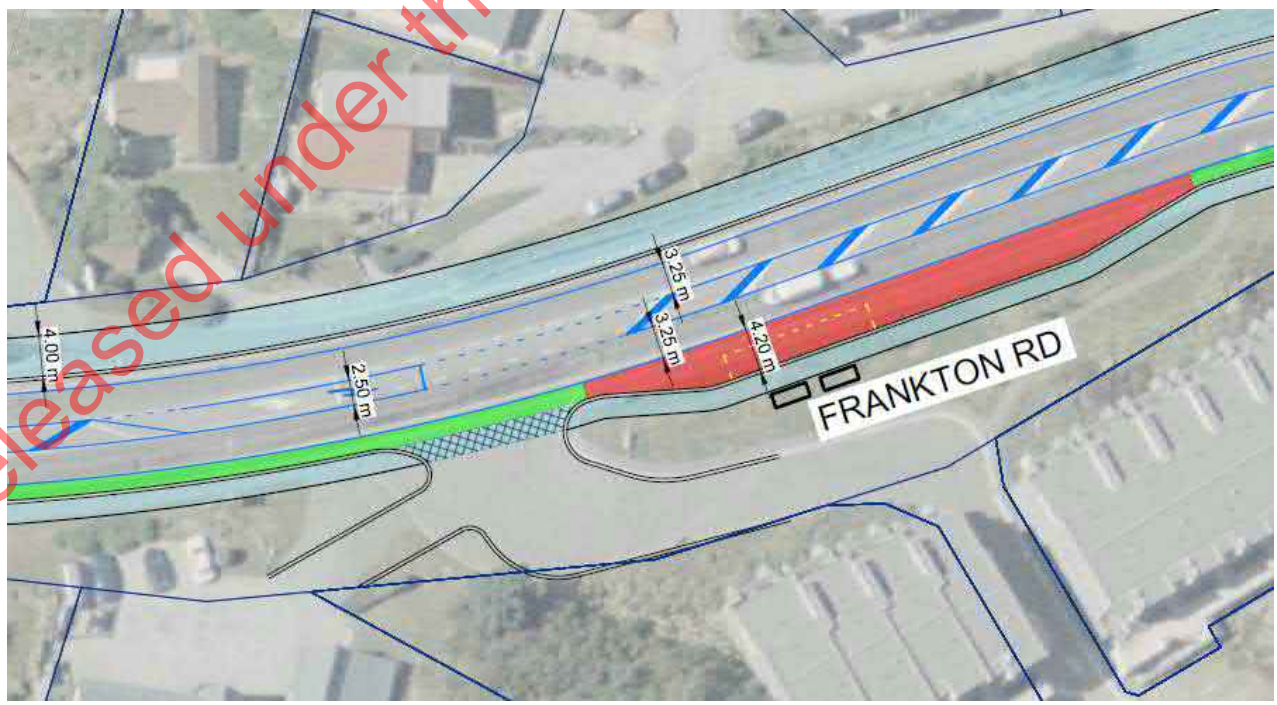


Figure 5: Proposed Typical Cross Section Cycle Lane and Bus Lane

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Active modes are a key enabler of achieving mode shift targets, both as a realistic transport option themselves and by providing safe and convenient first mile/last mile access to public transport. **Error! R eference source not found.** summarises proposed crossing upgrades for SH6A. These improvements are in addition to pedestrian signal facilities at main intersections.

Table 6: Proposed Active Mode Upgrades

Location	Upgrade	Purpose
c1. Between Yewlett Crescent and McBride Street	New refuge island	Provide safe crossing for access to new bus stop pair via footpath on southern side. We note that proposed pedestrian refuges are implemented where there is a low pedestrian demand, and signals at higher pedestrian demand locations.
c2. 983 Frankton Road	New refuge island	Given the increase in bus patronage expected, the Frankton Hill bus stop is anticipated to be reintroduced. Safe crossing should then be provided to the footpath on the southern side.
c3. 748 Frankton Road	New refuge island	Provide safe access to footpath on southern side for houses 748-790 Frankton Road.
c4. Middleton Road	New raised crossing on side road	Connect new footpaths either side of Middleton Road providing safe access to new bus stop.
c5. Potters Hill Drive	New signalised crossing	Provide safe access between existing bus stop pair and create "dummy" gaps in traffic for buses to pull out.
c6. Larch Hill Place	New signalised crossing	Provide safe access to footpath on southern side, connect to new bus stop and create "dummy" gaps in traffic for buses to pull out.
c7. Rees Hotel	New refuge island	Provide safe access to Andrews Road bus stop and new footpath on northern side.
c8. Between Hensman Road and Villa del Lago	New refuge island	Provide safe crossing for access to new bus stop pair servicing new hotel (if built).
c9. Oaks Club Shores	New signalised crossing	Provide safe crossing for access between existing and new bus stop and create "dummy" gaps in traffic for buses to pull out.
c10. 101 Frankton Road	New refuge island	Cater for increasing crossing demand on section with 650m between existing refuges.

5. Assessment of Project Design Options

5.1 Assessment Summary

In order to ensure that Safe System elements are considered, or to measure how well a given project (e.g. an intersection, road length, treatment type etc.) aligns with Safe System principals, a Safe System Matrix is used. The purpose of the Matrix is to use a risk assessment approach to assess different major crash types against the exposure of that risk, the likelihood of it occurring and the severity of the crash should it occur. These three attributes form the rows of the Matrix.

The columns of the Safe System Matrix show the crash types that represent the main crash and road user types that contribute to death and serious injury. Intersections and pedestrian amenities were separated into specific categories to help concentrate thinking on crash causes and solutions for each given arrangement and ensure vulnerable road users are directly considered. This saw the standard 7-crash types in a SSA Matrix expand to 11-crash types.

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The Safe System Assessment Matrix scores for the existing design conditions and suggested safe system improvements are shown in Table 7. The scores for each crash type for the existing conditions and proposed works are shown in Figure 6. The detailed assessment of the Matrix is presented in Appendix A.

The aim of the Safe System Matrix is to reduce the total score towards zero.

Table 7: SAA Matrix Scores for the Project

Option	Score
Existing Design Conditions	348 / 704
With suggested Safe System Improvements	154 / 704

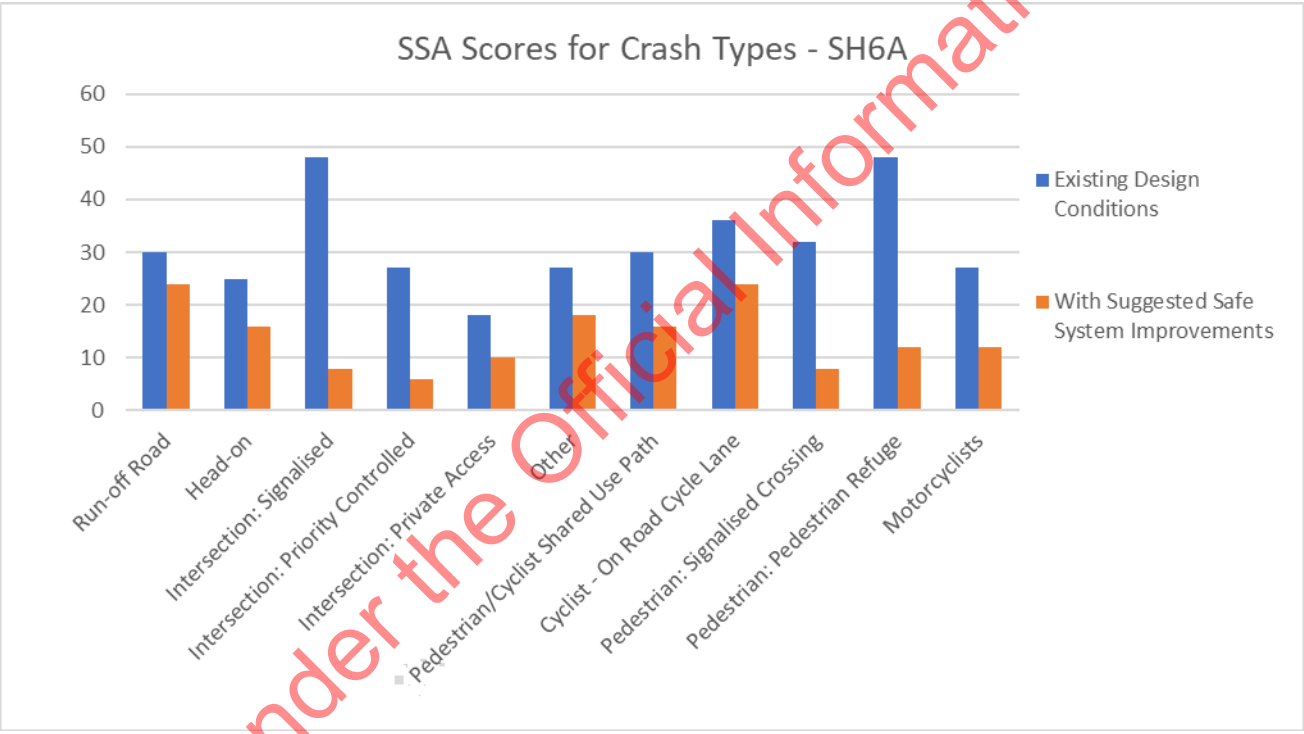


Figure 6: SSA Scores for Crash Types

The crash types that have the highest perceived risk and are the main contributors to the Existing Design Conditions Score are:

- Signalised Intersections – 48/64
- Pedestrian Refuge Crossings – 48/64
- On-Road Cycle Lanes – 36/64

However, all crash types had opportunities to improve alignment with Safe Systems where each of the 11-crash types saw a reduction in score with suggested improvements. If all suggested Safe System Improvements were implemented, the residual crash-types with highest perceived risk are:

- On-road cyclists – 24/64
- Run-off road crashes – 24/64

Recommended treatments to improve alignment with Safe Systems are detailed in Section 7.

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6. Safe System Assessment Comments

As part of this SSA, consideration has been given to other components that comprise the Safe System i.e. road users, vehicles and post-crash care. Issues identified as relevant to this project are listed in Table 8.

Table 8: Other Safe System Components

Pillar	Prompts	Comments / Issues
Road user	Are road users likely to be alert and compliant? Are there factors that might influence this? What are the expected compliance and enforcement levels (alcohol / drugs, speed, road rules and driving hours)? What is the likelihood of driver fatigue? Can enforcement activities be conducted safely? Are there special road users (e.g. entertainment precincts, elderly, children, on-road activities, motorcyclist route), distraction by environmental factors (e.g. commerce, tourism) or risk-taking behaviours?	• Scenery distraction • High proportion of visitor drivers • Fatigue • Impaired drivers (alcohol/drugs) • A challenge for police to enforce with limited places to pull people over. • Check point opportunity between Z station and Perkins Road. Potential opportunity to enhance facility • Hotels and visitor accommodation – unfamiliar users with high pedestrian generation • Potential U-turn movements • PT and Tourism buses • Popular delivery route for mopeds/motorcyclists associated to food deliveries (Food on Q)
Vehicle	What level of alignment is there with the ideal of safer vehicles? Are there factors that may attract large numbers of unsafe vehicles? Is the percentage of heavy vehicles too high for the proposed / existing road design? Is this route used by recreational motorcyclists? Are there resources in the area to detect non-roadworthy, overloaded or unregistered vehicles and thus remove them from the network? Can enforcement activities be undertaken safely? Has vehicle breakdown been catered for? Has advanced vehicle features been catered for?	• Heavy vehicle use has been considered in the design as SH6A is the only appropriate route to Queenstown and is also the designated over dimension route. • Motorcycle volumes are expected to remain at <0.1% • Limited areas for pull-in areas for EBD vehicles along SH6A • To support emerging technologies such as Lane Departure Warning and Lane Keeping Assistance, standard road markings and signage must be used. These must be kept well maintained and replaced or reinstalled if worn out, including maintenance of vegetation to avoid obstruction or inconsistent signage.
Post-crash care	Are there issues that might influence safe and efficient post-crash care in the event of a severe injury (e.g. congestion, access, stopping space)? Do emergency and medical services operate as efficiently as possible? Are other road users and emergency response teams protected during a crash event? Are drivers provided the correct information to address travelling	• None identified Ability to provide contraflow post-crash event in most locations which avoids increase wait time or introduce lengthy detours on roads with lower classification. There is a police station and fire station in Queenstown Town, and Hospital in Frankton; all within proximity to the road SH6A road corridor

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	speeds on the approach and adjacent to the incident? Is there reliable information available via radio, VMS etc? Is there provision for e-safety (i.e. safety systems based on modern information and communication technologies, C-ITS)?	• No specific features for crash warning in place, standard TTM procedures to be followed at this stage

7. Treatments to Further Improve Safe System Alignment

Table 9 and Table 10 list treatments that will improve the Safe System alignment of the project.

Primary treatments are those measures that have the potential to eliminate or come close to eliminating the risk of fatal and serious injury (FSI) crashes.

Supporting treatments are effective in reducing the risk of FSI crashes but not to the extent of a primary treatment (i.e. there is a residual moderate or significant FSI crash risk). Implementation of a primary treatment should be given priority over a supporting treatment that may be targeting a similar crash risk.

Table 9: Primary Treatments

Treatments for Consideration	Project Response
Measures to reduce speeds through signalised intersections to 50 km/h or below. This may involve the use of raised platforms or roundabouts and could also be achieved through enforced speed limit reductions.	
While conflicting with the function of the State Highway, to achieve primary Safe System for pedestrians crossing the highway, speeds would need to be reduced to 30km/h at all crossing points. Alternatively, a separated facility would be required (i.e. an underpass or overpass)	
Installing raised treatments and bicycle/pedestrian priority when the shared path crosses unsignalised side roads at all locations.	
Installing continuous flexible median barriers to prevent head-on crashes at locations possible. However, this would hinder contraflow for emergency services post-accidents (already noted in Matrix)	
Installing continuous flexible barriers sufficiently offset from face of kerb to reduce the severity of run-off-road crashes	

Table 10: Supporting Treatments

Treatments for consideration	Project Response
Reduce speed limit to 60km/h which will lower severity of crashes (all types).	

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Providing high skid resistance pavement at high risk locations i.e. intersection approaches	
Ensuring that intersections and approaches are lit to an appropriate standard. Consider providing continuous lighting along the length of the project.	
Redirect accessways to local roads or combined shared points via service lanes	
Providing separated cycle facilities at shared on-road areas, for example a dashed white line through bus bays to indicate where cyclists should be within the lane	
Provide delineation at accessways highlighting priority of SUP users across accessways	
Implement cobbled pedestrian crossing points (with lighting) to increase delineation and driver awareness if a separated facility cannot be provided	

Table 11: Other Considerations

Treatments for Consideration	Project Response
Installing red light and speed cameras at signalised intersections	

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8. Conclusions

The SSA identified that the crash types with the highest perceived risk existing design conditions are signalised intersections, pedestrian refuge crossings and on-road cycling lanes. The risk identified that the current speed environment of 70km/h increases crash severity and crash likelihood where the SSA team believe that this can be improved.

The SSA team believe that the treatment preference includes a permanent speed reduction of SH6A to 60km/h which will lower the severity of all crash types.

To further reduce intersection speeds to 50km/h or below includes the implementation of raised tables or enforced speed limits which offers the best alignment with Safe System principals. Pedestrian refuge islands would ideally see speed reductions to 30km/h or less, achieved by raised table crossings. However, significant speed reductions can conflict with the function of a State Highway where alignment with safe system treatments is not always best for efficiency or objectives to reduce congestion. Alternatives were given to increase pedestrian safety such as pedestrian underpasses or cobbled crossing points with minimum lighting standards achieved.

A number of features remain that have a less than desirable alignment with Safe System principals including run-off road crashes and on-road cycle lanes crashes which are vulnerable in terms of road user safety.

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Appendices

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Appendix A Safe System Assessment Matrix – Queenstown to Frankton SH6A

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	Run-off road	Head-on	Intersection - Signalised	Intersection – Priority controlled	Intersection – private access	Other	Pedestrian/Cyclist Shared Use Path	Cyclist - On road cycle lane	Pedestrian - signalised crossing	Pedestrian - pedestrian refuge	Motorcyclists	
Exposure Comments:	· AADT 25,000 Currently, no capacity increase under project · Length 6km	· AADT 25,000 Currently, no capacity increase under project · Length 6km	· AADT 25,000 · High volume intersections · Key intersections	· AADT 25,000 · Medium to low volume intersections · Medium priority intersections	· AADT 1,000-5,000 · Private accessways or multiple accessways · Low volume but many access points along project length · No priority control	· AADT 25,000 · U-turn crash	· >100/day · Will increase under proposal	· >100/day · Will increase under proposal	· >100/day · Will increase under proposal	· >100/day · Will increase under proposal	· 90 motorcyclists/day	
Exposure Score:	4	4	4	3	2	3	4	4	4	4.0	3	
Likelihood Comments:	***Factors that increase the likelihood include:*** · Undulating and curved terrain · 70km/hr speed · Distraction with scenery	***Factors that increase the likelihood include:*** · Undulating and curved terrain · 70km/hr speed · Undivided Road	***Factors that increase the likelihood include:*** · higher urban speed environment · lower reaction speeds · reasonably spaced intersections	***Factors that increase the likelihood include:*** · only priority control, no controlled movements · Limited sight distance due to horizonal and vertical curvature · Visibility obstructed by adjacent bus stops	***Factors that increase the likelihood include:*** · No priority control · Limited sight distance due to horizonal and vertical curvature on many sites · Visibility obstructed by adjacent bus stops, fences and hedges etc · Shared use path across accessways	***Factors that increase the likelihood include:*** · Traffic volumes and few turning opportunities · Higher number of visitors and visitor accommodation along SH6a. New users. Lost visitors doing U-turns.	***Factors that increase the likelihood include:*** · Crossing at grade with multiple accessways and intersections · Varying changes in level at access points · Confusion over priority at side roads · uncontrolled speeds on SUP and cyclist and ped interaction	***Factors that increase the likelihood include:*** · Sharing facilities with bus lanes, potential for buses to stop throughfare for cyclists. · No separated facilities at intersections. Cyclists have to "adopt the lane" · High adjacent vehicle speeds · potential congestion for cycle lane during peak times leading to overtaking in lane	***Factors that increase the likelihood include:***	***Factors that increase the likelihood include:*** · No priority control	***Factors that increase the likelihood include:*** · Same as for ROR, head on and intersection type crashes · High operating speed	
	Factors that decrease the likelihood include: · Central median · Peri-urban · Streetlighting · Localised widening e.g. Bus lanes	***Factors that decrease the likelihood include:*** · Flush median · Urban environment	***Factors that decrease the likelihood include:*** · signalised control · separation of phases · protected right turns · mostly full ped protection	***Factors that decrease the likelihood include:*** · right turn bays for majority · ped/cycle crash interaction on side road only	***Factors that decrease the likelihood include:*** · Flush median · Generally used by more familiar users	***Factors that decrease the likelihood include:*** · Signalising intersections will create more gaps · Lower speeds · U-turns available at intersections? · using side roads for U-turns	***Factors that decrease the likelihood include:*** · 4m width allows for shared bi-directional movement	***Factors that decrease the likelihood include:*** · Priority at private accessways	***Factors that decrease the likelihood include:*** · Priority control for peds	***Factors that decrease the likelihood include:***	***Factors that decrease the likelihood include:*** · Flush median provides some separation, shoulder on Frankton bound lane	
Likelihood Score:	3	2.5	3	3	3	3	3	3	2	3	3	
Severity Comments:	***Factors that increase the likelihood include:*** · Unprotected drop offs · Embankment/retaining structures	***Factors that increase the likelihood include:*** · 70km/hr speed	***Factors that increase the likelihood include:*** · High impact angles, right turn against · Pedestrians crossing at grade · Impact speed for red-light running · User conflicts in phasing.	***Factors that increase the likelihood include:*** · high impact angles, right turn against · pedestrians crossing at grade · high impact speed with through vehicles · No pedestrian or cyclists priority, no protection	***Factors that increase the likelihood include:*** · High impact angles, right turn against · Pedestrians crossing at grade · High impact speed · No pedestrian or cyclists priority, no protection	***Factors that increase the likelihood include:*** · High through speeds	***Factors that increase the likelihood include:*** · Potential for high speed cycle movements on SUP	***Factors that increase the likelihood include:*** · High adjacent vehicle speeds · Potentially high cycle speeds on road · No priority at intersections	***Factors that increase the likelihood include:*** · At grade · High impact speeds	***Factors that increase the likelihood include:*** · At grade · High impact speeds · No priority control for peds	***Factors that increase the likelihood include:*** · High operating speed	
	Factors that decrease the likelihood include: · Sections of safety barrier · Few roadside hazards · Lower speed environment	***Factors that decrease the likelihood include:***	***Factors that decrease the likelihood include:***	***Factors that decrease the likelihood include:*** · only T intersections · speeds reduced by turning movements	***Factors that decrease the likelihood include:*** · Pedestrians and cyclists on shared path have priority at accessway but poorly understood by road users	***Factors that decrease the likelihood include:*** · Shallower impact angles for mid block U-turn crash	***Factors that decrease the likelihood include:*** · Low speed vehicle crashes	***Factors that decrease the likelihood include:*** · Sufficient width cycle lane. Sufficient width for buses and cycles to share.	***Factors that decrease the likelihood include:***	***Factors that decrease the likelihood include:***	***Factors that decrease the likelihood include:*** · Hazard free shoulders	
Severity Score:	3	3	4	3	3	3	3	3	4	4.0	3	
Product (multiply scores above for crash type)	**30**	**25**	**48**	**27**	**18**	**27**	**30**	**36**	**32**	**48**	**27**	**348**
Opportunities	· Reduce speed to 60km/h which will lower severity · Complete protection of drop offs · Relocate barrier to be sufficiently offset from face of kerb · Reduced Severity score 2	· Reduce speed to 60km/h which will lower severity · Opportunity to physically divide carriageway in sections with limited access. However doesn't provide access for emergency services · Reduced Severity score 2	· Reduce approach speeds through speed limits · Raised table platforms (approach or through intersection) to reduce speeds through intersections and control impact speeds to <30km/h where peds/cyclists, (50km/h for vehicle collisions) · Reduced severity score 1 and likelihood to 2	· Reduce approach speeds through speed limits · Raised table platforms (approach or through intersection) to reduce speeds through intersections and control impact speeds to <30km/h where peds/cyclists, (50km/h for vehicle collisions) · Reduced severity score 1 and likelihood to 2	· Redirect accessways to local roads or combine to shared points via service lanes · LILO only · Raise or highlight SUP across accessway · Managing speeds on shared path · New developments may remove or combine access point	· Reduce approach speeds through speed limits · Provide opportunity for U-turns at intersections, specifically signalised controlled intersections · Reduces likelihood score	· Limit speeds on shared use path (through legislation or threshold treatments) · Provide delineation at accessways highlighting priority of SUP users across accessways · Reduced likelihood and severity score	· Reduced speed limits of passing vehicles · Provide cycle lanes with advance stop boxes at intersections · Provide separated facilities at bus stops and bus lanes · These reduce the likelihood score	· reduce approach speeds through speed limits · raised table platforms (approach or through crossing) to reduce speeds through intersections and control impact speeds to <30km/h where peds/cyclists, · Grade separation Reduced severity score 1	· reduce approach speeds through speed limits The intersections and pedestrians crosing will be signalised. · approach platforms <30km/h where peds/cyclists · grade separation · Remove crossing · Toward safe system principles could be implented using a staged approach	· Under run protection on safety barriers · Reduce speeds · Reduce speeds at intersections	
Exposure Score:	4	4	4	3	2.5	3	4	4	4	4.0	3	
Likelihood Score:	3	2	2	2	2	2	2	2	2	3	2	
Severity Score:	2	2	1	1	2	3	2	3	1	1.0	2	
Product	**24**	**16**	**8**	**6**	**10**	**18**	**16**	**24**	**8**	**12**	**12**	**154**

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SAFE SYSTEM ASSESSMENT
FRANKTON & LADIES MILE

PREPARED FOR THE WAKA KOTAHI NZ TRANSPORT AGENCY

October 2020

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REVISION SCHEDULE

Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
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Waka Kotahi NZ Transport Agency

Safe System Assessment – Frankton & Ladies Mile SSBC

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APPENDICES

Appendix A Safe System Assessment Matrix – Frankton: Kawarau Rd

Appendix B Safe System Assessment Matrix – Frankton: Frankton-Ladies Mile Hwy

Appendix C Safe System Assessment Matrix – Ladies Mile: Frankton-Ladies Mile Hwy

Appendix D Drawings *Note: These drawings were the most up to version at the time of completing this assessment*

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EXECUTIVE SUMMARY

A full Safe System Assessment (SSA) has been conducted on the preliminary design for the Frankton and Ladies Mile Detailed Business Case. The existing preliminary design for these routes were assessed, and suggested improvements have been recommended. The SSA Matrix scores are shown in the table below.

Crash type/location	Safe System Score	
	Existing Design	Suggested Improvements
Frankton	684 / 1216	600 / 1216
Ladies Mile	244 / 448	188 / 448

Frankton: SH6 from Kawarau Bridge to Shotover Bridge

The existing speed limit in the preliminary design is 60km/h, except for an isolated shared use area near Gray Street, which is 30km/h. This moderate speed presents a low risk of death or serious injury for head on crashes only. Side impact, pedestrian and cyclist crashes have a high risk of death or serious injury.

Ladies Mile: SH6 from Shotover River Bridge to McDowell Drive

The existing speed limit in the preliminary design is 80km/h. This high speed presents a high risk of death or serious injury for all crash types.

As shown in in Figure 4 - 6 in the report, the crash types for both Frankton and Ladies Mile that are the main contributors to the overall score are pedestrians, cyclists and all intersections. If the improvements that have been suggested are adopted, some of these high scoring crash types can be reduced. In the current design, all signalised intersections have full protection for pedestrians and for right turns.

The improvements that have been suggested aim to reduce the risk for all crash types by either; reducing the operating speed of vehicles; increasing the awareness of vulnerable users; introducing signals for pedestrians. The suggested improvements for all crash types are:

- Raised safety platforms at all zebra crossings, to be designed for 30km/h.
- Install signalised pedestrian crossings at signalised roundabouts.
- Additional refuges to be used when pedestrians crossing 2 lanes or more, non-signalised.
- Consider sight lines when maintaining and designing vegetation.
- Ensure adequate wayfinding.
- Cater for on-road cyclists, including additional linemarking.
- Improve access though roundabouts for cyclists.
- Consider banning RHT into driveway, where conflict with intersection.
- Consider further grade separation for pedestrians.
- Traffic calming measures.
- Improve skid resistance.
- Part of maintenance programme – deicing agent applied.
- Provide warning signage where there are steep downgrades.

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1. Introduction to the Safe System

1.1 Safe System Pillars

The Safe System approach seeks to ensure that no road user is subjected to kinetic energy exchange in a crash that will result in death or serious injury. There is a shared responsibility for safe travel outcomes between system designers (road authorities, vehicle manufactures, road designers etc.) and road users. There are four Safe System pillars: safer vehicles, safer speeds, safer roads and safer road users. Post-crash response is another element that is often recognised as the fifth pillar. All parts of the system must be considered and strengthened so that road safety outcomes are maximised and to ensure that road users are adequately protected even if one part fails.

Safe System Assessment (SSA) is concerned mainly with the safer roads and safer speeds pillars. A SSA is used to examine road project proposals and aims to identify infrastructure and speed related factors that are likely to contribute to a higher risk of fatal and serious injury (FSI) crashes. It also seeks to identify design or scope changes that will improve the alignment of the project with Safe System principles.



Figure 1 - Safe System Pillars

1.2 Safe System Impact Speeds

The impact speed in a collision is a significant factor that affects the probability of a person being killed or seriously injured in a crash. Safe System impact speeds are speeds below which the chances of survival are high and the likelihood of serious injury is low.

Figure 2 is a guide to Safe System impact speeds for common crash types. It should be noted that the angle of impact of a collision is also a factor that affects the severity of a crash. As far as is practically possible, infrastructure should be designed, and travel speeds managed so that the impact speeds when a crash occurs are below the thresholds show in Figure 2.

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CRASH TYPE	IMPACT SPEED
 Head on with another vehicle	70 km/h
 Side impact	50 km/h
 Side impact with tree	30 km/h
 Pedestrian & cyclists	30 km/h

Figure 2 - Safe System Impact Speeds

2. Safe System Assessment Process

The Safe System Assessment process is based on Austroads Safe System Assessment Framework (Austroads 2016, Research Report AP-R509-16, *Safe System Assessment Framework*) and VicRoads *Safe System Assessment Guidelines*.

Steps in the process include:

- Deciding on the type of assessment (full or rapid)
- Selecting an appropriate team to conduct the assessment
- Understanding the project background, context and objectives
- Collation of information and data for both existing and future conditions
- Inspection of the site - the team has extensive knowledge of the site so a site visit wasn't needed.
- Conducting the assessment of existing conditions and each project design option using the SSA Matrix
- Consideration of the additional Safe System components; road users, vehicles and post-cash care
- Review of the SSA Matrix scores and development of suggested changes to improve alignment with Safe System principles
- Reporting
- Review of suggested design and scope changes
- Amendment of project scope and design to incorporate the accepted changes.

3. Assessment Details

3.1 Type of Assessment

This report is a Full SSA that has been conducted in accordance with VicRoads Safe System Assessment Guidelines and Austroads Safe System Assessment Framework (Austroads Research Report AP-R509-16).

The SSA has been undertaken to analyse the existing conditions and proposed works for Queenstown Town Centre looking in particular at the SH6A upgrade and Arterial Route. The project cost is above $5M, therefore, a Full SSA must be undertaken.

3.2 Assessment Team

The Safe Systems Assessment was conducted by:

- s 9(2)(a) (B.Eng) Work Group Manager – Transportation, WSP
- s 9(2)(a) (B.Eng) Transport Engineer, WSP
- s 9(2)(a) (B.Eng) Civil Engineer, WSP

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Independent Members who attended the workshop meeting:

- s 9(2)(a) (B.Eng), Work Group Manager - Transportation Safety, WSP
- s 9(2)(a) (B.Eng), Team Lead - Safety Engineers, NZTA
- s 9(2)(a) (MAppSc, BRS), Associate Director Transportation Planning & Digital Engineering, Abley

3.3 Meetings and Site Inspections

The SSA Project Team and Independent Members attended a MS Teams meeting on the 7 April 2020 to discuss changes to the Queenstown Town Centre network. Reece and Esther met to discuss Frankton and Ladies Mile multiple times during September 2020.

No site visits were undertaken for this project. This project was undertaken during the Level-4 Nation Wide Lockdown for New Zealand's response to Covid-19. However, the team has been involved with the Frankton SSBC and Ladies Mile DBC and are familiar with the road corridor to review existing conditions and advice on suggested improvements.

4. Project Description

4.1 Project Background

Frankton and Ladies Mile projects are two of the four live business cases in the Queenstown area making recommendations for upgrading the transport network. Figure 3 shows the location and extent of the these business cases. Frankton is shown in pink and the Ladies Mile is shown in blue.



Figure 3: Project Scope of Queenstown Town Centre Demonstrated in Red

Both Frankton and Ladies Mile projects involve upgrading the existing SH6.

The key changes to Frankton consist of introducing a bus lane, upgrading the existing bus hub, introducing a shared user space, upgrading and installing new intersections, upgrading cycling facilities including a shared path and installation of an underpass.

The key changes to Ladies Mile include introducing a bus lane, upgrading Howards Dr intersection and installation of an underpass.

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4.2 Project Objectives

Three problem statements were developed to summarise issues on the Frankton to Queenstown, Frankton and Ladies Mile business cases:

1. **Efficiency**. Rapid growth, the high relative attractiveness of car travel over other modes and a lack of alternative routes are leading to increasing traffic volumes along SH6a. This is causing more congestion, longer/more unreliable travel times and rat-running, which limits opportunities for future tourism growth and reduces the liveability of Queenstown.

2. **Resilience**. SH6a provides the only direct transport link between Queenstown and Frankton but is subject to landslides and is constrained in width. This means that the road is susceptible to delays caused by minor planned or unplanned disruptions, which creates severance between the two centres and makes access to essential services (i.e. emergency services and the airport) vulnerable.

3. **Safety**. High traffic volumes limit opportunities to safely cross or turn onto SH6a, increasing frustration for all road users and limiting access to PT/active travel modes. This raises the likelihood of injury or death, causes community severance and reduces the LOS for all road users.

4. **Amenity**. High traffic volumes, limited connections to active travel routes and unattractive adjacent land use means that SH6a is not presenting as a high-quality gateway into Queenstown. This does not align with the community's aspiration for high levels of amenity and an enhanced place value for Queenstown.

To address the problems above, the following investment objectives were agreed with stakeholders:

1. Provide more efficient and reliable access for people and goods that:
    a. Sustainably manages growth
    b. Reduces reliance of private vehicle travel
    c. Enable enhanced land use
2. Is adaptable to change and disruption
3. Enhances the liveability and quality of the natural and built environment
4. Enhances safety with a goal of Vision Zero

Table 1: Project Summary - Queenstown Town Centre

Prompts	Comments
What is the reason for the project? Is there specific crash type risk? Is it addressing specific issues such as poor speed limit compliance, road access, congestion, future traffic growth, freight movement, amenity concerns from the community, maintenance/asset renewal, etc.	Frankton and Ladies Mile SH6 upgrades primarily seek to address accessibility, safety and amenity of the QTC road network. There are currently limited controlled crossings on the corridor, which limits access to public transport and active mode links along SH6A. There are also real and perceived safety risks along the route, including narrow footpaths, minimal road cyclist provision and narrow shoulders. It should be noted that there is no major crash history on SH6A, but there is a perceived risk that acts as a barrier to sustainable travel (several complaints from the public have been received

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	by Aspiring Highways) and stakeholders identified Vision Zero as a desirable outcome. Congestion levels are particularly high between Lucas Pl and SH6/SH6a intersection, which links the airport to Queenstown. The existing posted speed limit throughout the Frankton section of SH6 ranges from 70km/h along Kawarau Rd, to 50km/h at the SH6a intersection and increases to 80km/h between Hansen Rd and Grant Rd. The existing posted speed limit throughout Ladies Mile is 80km/h.

The objective of this Safe System Assessment is to identify the degree of the projects alignment with the Safe System objectives and suggest solutions that could move the project closer towards alignment with Safe System objectives. The project team may then review the recommendations from the SSA and provide commentary around whether to accept recommendations or why they have not been adopted.

4.3 Existing Conditions and Context

Frankton is a commercial, tourist and residential destination. As the Queenstown airport is in Frankton, located off Lucas Place, all visitors arriving by plane must travel through Frankton via SH6. Ladies Mile, which also forms SH6, links Wanaka and Cromwell to Queenstown, as well as destinations further south.

Frankton

Kawarau Rd (i.e. SH6), Frankton, is a busy two-lane road with an existing speed limit of 70km/h. It connects the Kawarau Bridge to the SH6/SH6a intersection. AADT range from 11,000 south of the Lucas Place (i.e. Airport access), to 19,000 north of Lucas Place. It provides access between Jacks Point & Hanleys Farm subdivisions, Remarkables ski field, Remarkables Park shopping centre, the airport, Queenstown, Five Mile, and other residential subdivisions in the Queenstown area. Kawarau Rd provides this link through a residential area but has minimal accessways directly off the highway. There is an existing bus hub near the SH6/SH6a intersection. The SH6/SH6a intersection is currently a non-signalised roundabout, which causes significant congestion during peak periods. A narrow footpath is provided on at least one side of the road for the majority of Kawarau Rd, however it is inconsistent. 3-signalised crossings locations are currently provided over a length of 1200m.

Frankton-Ladies Mile Highway (i.e. SH6), Frankton, is a busy two-lane road with an existing speed limit of 50km/h closer to the SH6/SH6a intersection, which increases to 80km/h between Hansen Rd and Grant Rd. The width of the carriageway increases by one lane each way from Grant Rd heading north-east. AADT is 26,000. A footpath is provided set back from the highway to the south, which links the Five Mile shopping district to Kawarau Rd. A detour must be taken around the Golf Course by pedestrians to access the bus hub on Kawarau Rd.

SH6 throughout Frankton has no formal provision for cyclists – they must use the shoulders, which have varying widths throughout. There are no stopping lines for the majority of the existing project length.

The main changes proposed in the preliminary design for Frankton are upgrading the existing bus hub, upgrading intersections – in particular the congested SH6/SH6a roundabout, introduction of bus lanes, improvements for pedestrian and cyclists.

Ladies Mile

Frankton-Ladies Mile Highway (i.e. SH6), Ladies Mile, is a busy two-lane road with an existing speed limit of 80km/h. AADT changes from 17,000 east of Stalker Rd to 24,000 west of Stalker Rd. The project scope of SH6 is the main highway leading into Queenstown. There is one T-intersection and one roundabout which connect Lake Hayes and Lower Shotover subdivisions, respectively. There are a few property accessways directly off the highway. Currently there is no formal provision for cyclists on the road, however there is an existing shoulder, which varies in width. Off-road trails provide safer access for cyclists toward Frankton and Queenstown, but do not fall within the scope of this project. A footpath is provided from Howards Drive to Stalker Rd, which is set back from the highway. At the Stalker Rd intersection pedestrian refuges are provided to connect Spence Rd. No crossings are provided at Howards Drive T-intersection.

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The main changes proposed in the preliminary design for Ladies Mile are introduction of bus lanes, upgrading a T-intersection to a roundabout and provision of an underpass.

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Table 2: Existing Conditions and Context

Prompts	Comments
What is the function of the road? Consider location, roadside land use, area type, speed limit, intersection type, presence of parking, public transport services and vehicle flows. What traffic features exist nearby (e.g. upstream and downstream)? What alternative routes exist?	Frankton, Kawarau Rd: Kawarau Rd is a busy road that provides access between subdivisions, the airport, Remarkables ski field, Remarkables Park shopping centre, Queenstown and Five Mile. There is limited parking and limited property accessways, despite the road going through a residential area. There is an existing bus hub near the SH6/SH6a intersection, and a narrow footpath provided for the length of the road with a few signalised crossing points. There is no cycling provision. Vehicles wanting to access Queenstown or northern subdivisions along SH6 can take back streets such as McBride Street or via Lucas & Hawthorne Drive. However, no alternative route is available for people accessing the airport. Frankton, Frankton-Ladies Mile Hwy: Frankton-Ladies Mile Highway, through Frankton, provides access from Wanaka and Glenorchy to Queenstown and Frankton, including residential subdivisions in between. Queenstown Events Centre, Five Mile and an industrial area on Glenda Drive are accessible via SH6. Currently all intersections are non-signalised roundabout or T-intersections. Congestion backs up SH6 from the SH6/SH6a roundabout in the west and Shotover River Bridge to the east during peak hours. No parking is allowed for the entire length. A footpath is provided set back from the highway to the south, which links the Five Mile shopping district to Kawarau Rd. A detour must be taken around the Golf Course by pedestrians to access the bus hub on Kawarau Rd. No viable alternative road exists. Ladies Mile, Frankton-Ladies Mile Hwy: Frankton-Ladies Mile Highway, throughout Ladies Mile, performs a similar function to the highway through Frankton i.e. Provides access from Wanaka and Glenorchy to Queenstown and Frankton. Ladies Mile has two subdivisions, Lake Hayes and Lower Shotover, which can only be accessed via SH6. SH6 is the most common route connecting these subdivisions to Queenstown. Residents could take a longer route via Lower Shotover Rd and through Arthurs Point via Malaghans Rd and Gorge Rd. As many residents may work in either Five Mile or the industrial area on Glenda Drive, SH6 is the only route to work. There is no pedestrian provision and no on road cyclists provision. There are alternative off-road trails that cyclists may take to access Frankton and Queenstown, though these are indirect.

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Prompts	Comments
What is the speed environment? What is the current speed limit? Has it changed recently? Is it similar to other roads of this type? How does it compare to Safe System speeds? What is the acceptability of lowering the speed limit at this location?	Frankton, Kawarau Rd: 70km/h from Kawarau Bridge until SH6/SH6a intersection, where it drops to 50km/h. Frankton, Frankton-Ladies Mile Hwy: 50km/h at the SH6/SH6a intersection which increases to 80km/h between Hansen Rd and Grant Rd. Ladies Mile, Frankton-Ladies Mile Hwy: 80km/h. For all areas the speed environment generally matches the posted speed limit. During peak hours traffic will travel below the posted speed limit.
What road users are present? Consider the presence of elderly pedestrians, school children and cyclists. Also note what facilities are available to vulnerable road users (e.g. signalised crossings, bicycle lanes, school speed limits, etc.)	There are two primary schools and one high school in Frankton. There are also multiple schools in Queenstown, which is a 20minute bike ride away. Two rest homes are also in Frankton. This creates an environment with a high volume of children, cyclists and elderly throughout the area. A few signalised crossing locations are provided along Kawarau Rd. No signalised crossings are provided along Ladies-Mile Highway. A narrow footpath is provided along the length of Kawarau Rd, as well as Ladies-Mile Highway. No cycle lanes are provided on road, however there are cycle trails linking Frankton to Queenstown along the lakefront. Vulnerable road users are rarely observed along the Ladies Mile section of SH6. This is due to the high speed limit, and lack of provision.
Vehicle composition using roadway What is the vehicle composition? Consider the presence of heavy vehicles (and what type), motorcyclists and other vehicles using the roadway.	A detailed breakdown of vehicle composition is not available. Mobile Roads data gives a range of 4.2 – 5% heavies across SH6 in Frankton and Ladies Mile.

4.4 Proposed Works

The recommended option for the Frankton and Ladies Mile business cases is a strategic package of interventions designed to enable the public transport element of the preferred package, as well as improving access, active mode connectivity and safety. The preliminary design consists of upgrades to the existing highway.

This report is assessing SH6 upgrades to Frankton and Ladies Mile, which is consist of the following interventions:

- Frankton: Kawarau Road & Frankton-Ladies Mile Highway
  - Introducing dedicated bus lanes for sections
  - Introduction of cycle lanes for sections
  - Upgrade of existing bus hub, with provision for other coaches
  - Introduction of a shared use zone
  - Additional crossing facilities

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  - Upgraded intersections
  - New and upgraded footpaths, including shared paths
  - Provision of an underpass

- Ladies Mile: Frankton-Ladies Mile Highway
  - Introducing a dedicated bus lane for sections
  - Upgrading existing intersections
  - Provision of an underpass

Refer to Appendix D for these two projects.

5. Assessment of Project Design Options

5.1 Assessment Summary

In order to ensure that Safe System elements are considered, or to measure how well a given project (e.g. an intersection, road length, treatment type etc.) aligns with Safe System principals, a Safe System Matrix is used. The purpose of the Matrix is to use a risk assessment approach to assess different major crash types against the exposure of that risk, the likelihood of it occurring and the severity of the crash should it occur. These three attributes form the rows of the Matrix.

The rows of the Safe System Matrix show the crash types that represent the main crash and road user types that contribute to death and serious injury. Intersections and pedestrian amenities were separated into specific categories to help concentrate thinking on crash causes and solutions for each given arrangement and ensure vulnerable road users are directly considered. The SSA matrix has been broken up into the sections listed below.

These have been adjusted from the standard 7-crash types to:

- Frankton, Kawarau Rd: 13-crash types
- Frankton, Frankton-Ladies Mile Hwy: 6-crash types
- Ladies Mile, Frankton-Ladies Mile Hwy: 7-crash types

The Safe System Assessment Matrix scores for the current design conditions and the proposed opportunity changes to the design are shown in Table 3. The scores for each crash type for the current design conditions and proposed works are shown in Figures 4 - 6. The detailed assessment of the Matrix is presented in Appendix A – C.

The aim of the Safe System Matrix is to reduce the total score towards zero.

Table 3: SAA Matrix Scores for the Project

	Score		
Option	Frankton: Kawarau Rd	Frankton: Frankton-Ladies Mile Hwy	Ladies Mile: Frankton-Ladies Mile Hwy
Current Design Conditions	444 / 832	240 / 384	244 / 448
With suggested Safe System Improvements	416 / 832	184 / 384	188 / 448

Refer to Appendices A - E for the full matrix for each section of the business case.

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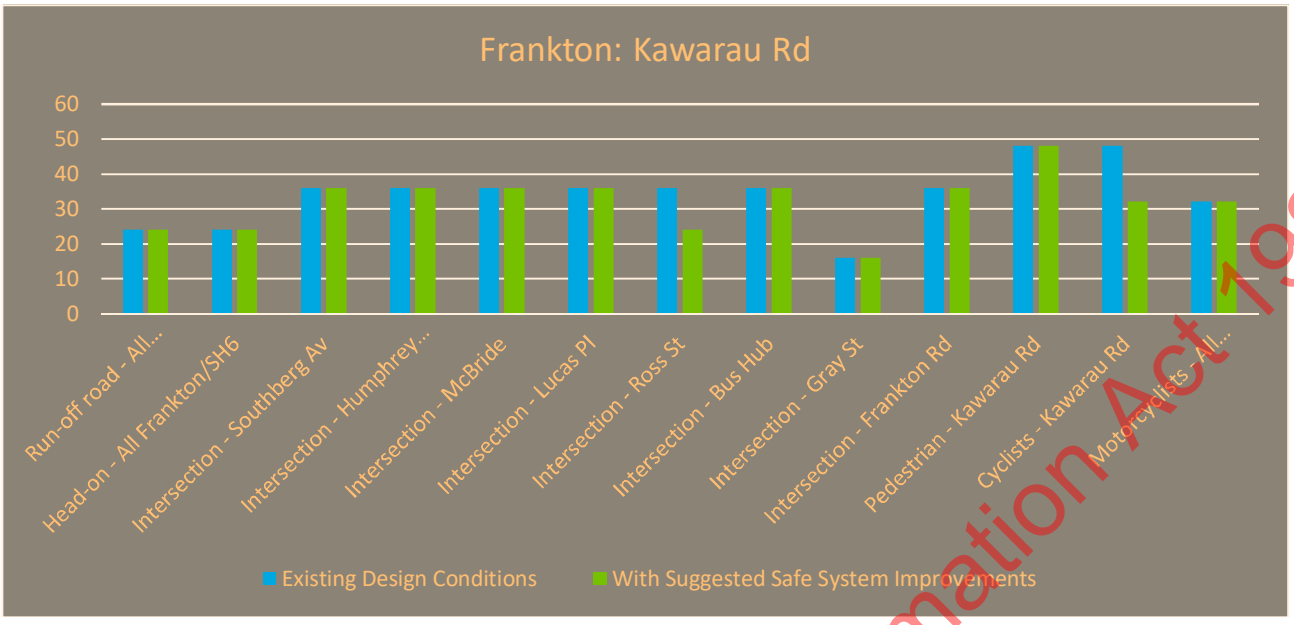


Figure 4: Safe System Scores for Crash Types – Frankton: Kawarau Rd

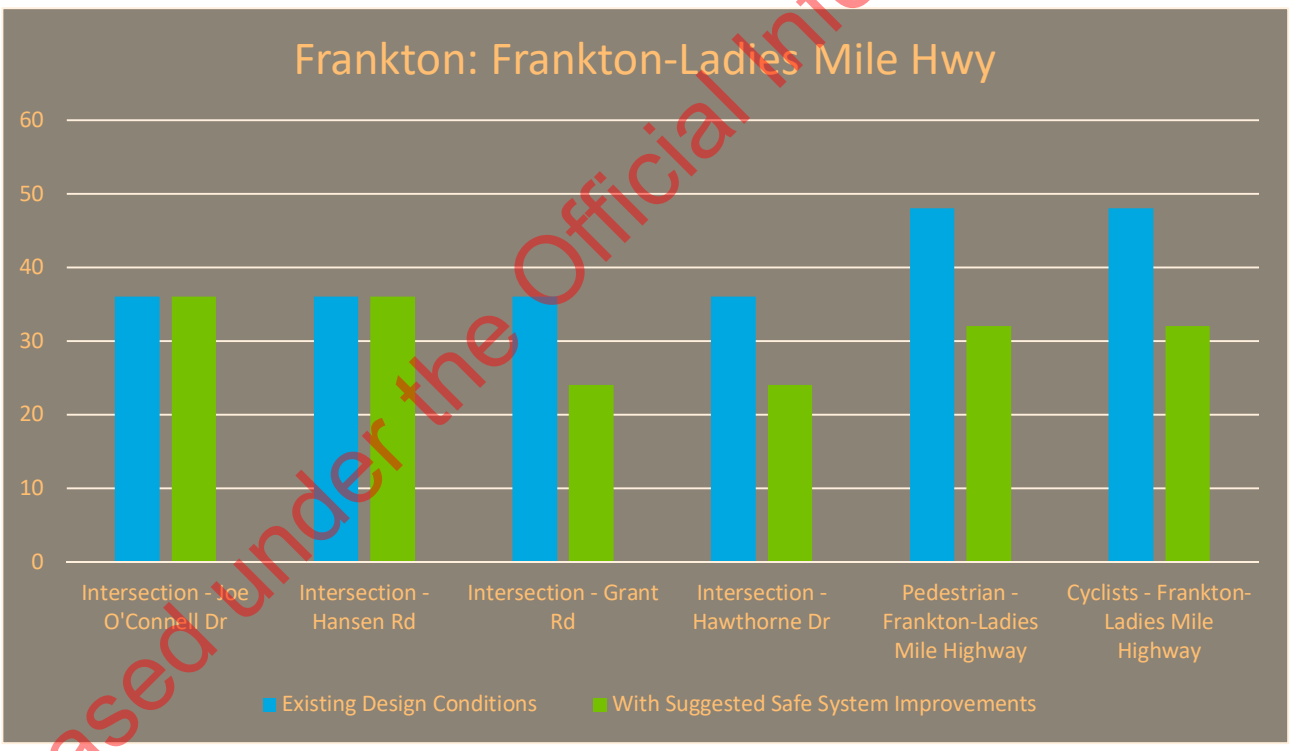


Figure 5: Safe System Scores for Crash Types – Frankton: Frankton-Ladies Mile Hwy

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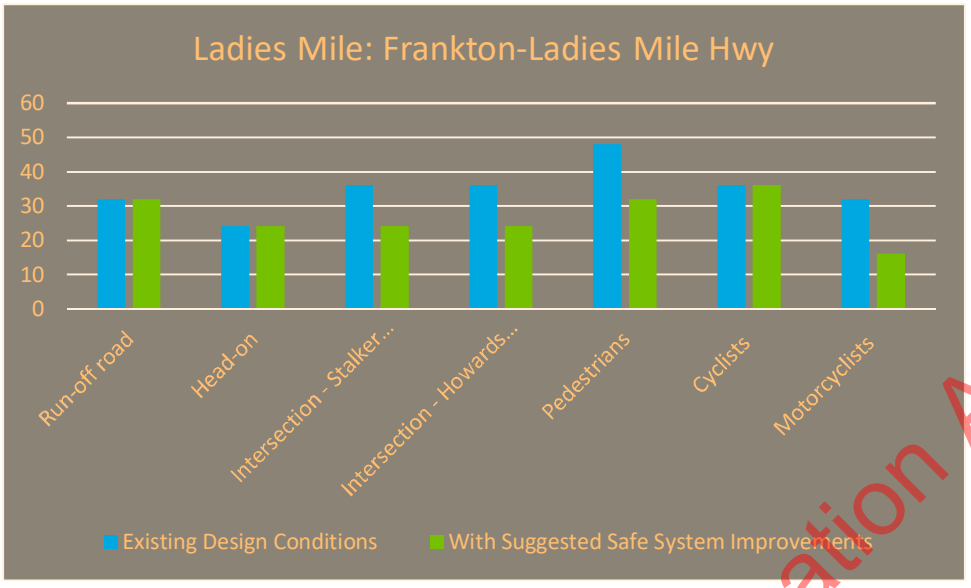


Figure 6: Safe System Scores for Crash Types – Ladies Mile: Frankton-Ladies Mile Hwy

5.1.1 Pedestrians & Cyclists

Throughout the Frankton and Ladies Mile project, the crash types that have the highest perceived risk are Pedestrians & Cyclists, which scores range from 36 – 48 / 64. This high AADT expected of > 100 pedestrians & cyclists resulted in a high exposure rating for these two groups.

- **Frankton**: The current design of Kawarau Rd through Frankton is mostly straight, with a slight horizontal curve at Lucas Place and a vertical curve heading north from the Kawarau River. Frankton-Ladies Mile is also relatively straight with minimal vertical curvature. This results in good sightlines throughout. Along Kawarau Rd a cycle lane is provided for a short section around Humphrey St. Once this terminates, cyclists are given provision off-road via a shared path. A cycle lane is provided from the SH6/SH6a intersection heading east along Frankton-Ladies Mile Hwy for both EB and WB directions. Footpath provision is upgraded along the Kawarau Rd length. Shared paths are provided on both sides of the road for the length of the project. Crossing at side roads are via a pedestrian or signalised crossing. All crossings across Kawarau Rd are signalised, with full pedestrian protection. Pedestrian facilities are provided along both sides of Frankton-Ladies Mile Hwy from SH6/SH6a to just past Hansen Rd, where they are provided on the south side of the highway only. At SH6/SH6a intersection and Joe O-Connell Drive intersection, pedestrians have a signalised crossing. Although Grant Rd and Hawthorne Drive roundabouts are signalised for vehicles, neither are signalised for pedestrians however, pedestrian refuge islands are provided. An underpass is provided at the new Hansen Rd access. These factors discussed contribute to a likelihood rating for both pedestrians & cyclists of 3/4 for Kawarau Rd and Frankton-Ladies Mile Hwy.
- **Ladies Mile**: The current design of Frankton-Ladies Mile Hwy matches the existing grade of the road, which is mostly straight with a vertical and horizontal curvature between Stalker Rd and the Shotover River. This results in good sight lines throughout. No cyclists provision throughout because the intention is to encourage cyclists to use the off-road trails, which are a far safer alternative to the 80km/h highway. However, a 1.5m shoulder has been provided for road cyclists that will not use the trails. Pedestrian provision is inconsistent, and only provided where demand requires it. This includes around Howards Drive, which connects Lower Shotover and Lake Hayes in the south to a future subdivision (part of the Ladies Mile Masterplan) on the northern side of the highway. This non-signalised roundabout provides pedestrian refuges on all four legs. Another example is the underpass at McDowell Drive, which provides access from the Lake Hayes subdivision to Lake Hayes walking tracks. These factors contribute to a likelihood rating for both pedestrians & cyclists of ¾ for Ladies Mile.

Severity of a crash for pedestrians and cyclists is affected by speed. The maximum speed that a pedestrian is likely to survive when involved in a crash is 30km/h. As the speed limits are all greater than this, except for an isolated shared use area at Gray St, pedestrians & cyclists have a severity rating of 4/4 for all sections of the project.

Suggested safe system improvements in this report for pedestrians and cyclists seek to either reduce the likelihood or the severity. Likelihood and severity can be reduced by introducing raised tables on the side

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roads where there are currently zebra crossings designed, which are designed for a safe operating speed of 30km/h. Likelihood can also be reduced for cyclists by having signage to warn vehicles that cyclists may be present, signalise crossings, linemarking such as sharrows or cycle boxes and providing consistent on-road cycling provision for the length of Kawarau Rd. For pedestrians, additional grade separation or additional refuges at multi-lane crossings could also be considered.

5.1.2 Intersections

All intersections similarly scored high, ranging from 16 - 36/64. Exposure for all intersections in Frankton and Ladies Mile are 4/4 because of the high AADT expected of ~26,000 vehicles. All signalised intersections have full protection for pedestrians and full protection for right turns.

- **Frankton** has 12 intersections. Factors that contributed to the likelihood of the crash included type of control, design of crossing, visibility, number of movements allowed and speed. The intersections consist of 4-way signalised, 3-way signalised, non-signalised T-intersections, signalised roundabouts, the bus hub, and signalised pedestrian crossing points only. Visibility is generally good, except for exiting from Southberg Avenue. Most movements are allowed at each intersection. Wayfinding at intersection connecting into the bus hub and SH6/SH6a intersection is expected to increase the likelihood of a crash. The speed limit is 60km/h throughout. Intersections likelihood ranged from 2 – ¾, depending on the combination of factors discussed here.
- **Ladies Mile** has two intersections; Stalker Road, which is remaining as is, and Howards Dr, which is getting upgraded to a roundabout. Factors that contributed to the likelihood of the crash included type of control, design of crossing, visibility, number of movements allowed and speed. Both intersections are non-signalised roundabouts, where all movements are allowed. The speed limit throughout Ladies Mile is 80km/h. These factors contributed towards a likelihood rating of ¾ for both intersections.

Severity is determined by impact angles and speed. At most intersections, for Frankton and Ladies Mile, excluding the pedestrian crossings locations, there is the potential for high impact angle crashes. The signalised roundabouts reduce the impact angles through design. Ladies mile has a speed limit of 80km/h, at which all crash types are likely to cause death or serious injury. Frankton has a speed limit of 60km/h, except for the shared use zone at Gray St, where the speed is 30km/h. The safe system impact speeds given in Section 1.2 of this report have been used to identify the severity score. This results in the score ranging from 2 – ¾.

Suggested safe system improvements in this report for intersections seek to either reduce the likelihood or the severity. Likelihood and severity at intersections can be reduced by; introducing raised tables at zebra crossings on side roads, which are designed for a safe operating speed of 30km/h; ensure adequate wayfinding to minimise confusion and illegal manoeuvres; improving site lines through trimming vegetation; limiting movements to reduce conflicts, specifically at property accessways; cater for on-road cyclists on throughout Kawarau Rd; and introduce signals at roundabouts for pedestrians to cross. For most intersections, these improvements were not able to reduce the likelihood or severity by significant degree enough to change the rating score. Nonetheless, they should be considered.

5.1.3 Run-off Rd, Head-on, Motorcyclists

Proposed improvements for Motorcyclists are improved skid resistance and providing warning signs for steep downgrades. Proposed improvements for Run-off road crashes are improved skid resistance, de-icing agent applied during winter and traffic calming to achieve posted speed, particularly on steep grade sections. For both motorcyclists and run-off road crash types, these improvements do not mitigate or eliminate the associated risk, the scores remain the same. Recommendations made to Head-on crash types, included traffic calming and clear signage, but these did not lower the risk rating, which was already low.

Note that the vehicle volume numbers applied are based on current numbers, as the flow of existing traffic should not change.

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Most crash types had opportunities to improve alignment with the Safe System, where the crash type saw a reduction in score with suggested improvements demonstrated in Figures 4 - 6. See below list identifying opportunities:

- Raised safety platforms at all zebra crossings, to be designed for 30km/h.
- Install signalised pedestrian crossings at signalised roundabouts.
- Additional refuges to be used when pedestrians crossing 2 lanes or more, non-signalised.
- Consider sight lines when maintaining and designing vegetation.
- Ensure adequate wayfinding.
- Cater for on-road cyclists, including additional linemarking.
- Improve access though roundabouts for cyclists.
- Consider banning RHT into driveway, where conflict with intersection.
- Consider further grade separation for pedestrians.
- Traffic calming measures.
- Improve skid resistance.
- Part of maintenance programme – deicing agent applied.
- Provide warning signage where there are steep downgrades.

It should be noted that the SSA team decided that the proposed speed limits were acceptable considering the design intent and current use of SH6.

6. Safe System Assessment Comments

As part of this SSA, consideration has been given to other components that comprise the Safe System i.e. road users, vehicles and post-crash care. Issues identified as relevant to this project are listed in Table 4.

Table 4: Other Safe System Components

Pillar	Prompts	Comments / Issues
Road user	Are road users likely to be alert and compliant? Are there factors that might influence this? What are the expected compliance and enforcement levels (alcohol / drugs, speed, road rules and driving hours)? What is the likelihood of driver fatigue? Can enforcement activities be conducted safely? Are there special road users (e.g. entertainment precincts, elderly, children, on-road activities, motorcyclist route), distraction by environmental factors (e.g. commerce, tourism) or risk-taking behaviours?	• Scenery distraction • High numbers of pedestrians • High proportion of visitor drivers • Fatigue • Impaired drivers (alcohol/drugs) • A challenge for police to enforce with limited places to pull people over. • Hotels and visitor accommodation – unfamiliar users with high pedestrian generation • Potential U-turn movements • PT and Tourism buses • Schools nearby. • Airport off Lucas Pl – peaks likely to be generated from flight times, which could encourage risk taking behaviour.
Vehicle	What level of alignment is there with the ideal of safer vehicles? Are there factors that may attract large numbers of unsafe vehicles? Is the percentage of heavy vehicles too high for the proposed / existing road design?	• Heavy vehicle use has been considered in the design as SH6 and SH6a is the only appropriate route to Queenstown and is also the designated over dimension route.

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	Is this route used by recreational motorcyclists? Are there resources in the area to detect non-roadworthy, overloaded or unregistered vehicles and thus remove them from the network? Can enforcement activities be undertaken safely? Has vehicle breakdown been catered for? Has advanced vehicle features been catered for?	• Motorcycle volumes are expected to remain at <1% • Limited areas for pull-in areas for EBD vehicles along SH6A • To support emerging technologies such as Lane Departure Warning and Lane Keeping Assistance, standard road markings and signage must be used. These must be kept well maintained and replaced or reinstalled if worn out, including maintenance of vegetation to avoid obstruction or inconsistent signage.
Post-crash care	Are there issues that might influence safe and efficient post-crash care in the event of a severe injury (e.g. congestion, access, stopping space)? Do emergency and medical services operate as efficiently as possible? Are other road users and emergency response teams protected during a crash event? Are drivers provided the correct information to address travelling speeds on the approach and adjacent to the incident? Is there reliable information available via radio, VMS etc? Is there provision for e-safety (i.e. safety systems based on modern information and communication technologies, C-ITS)?	• None identified • Post–Crash response is expected to be good, however, emergency services could be delayed if road corridor is queued. Bus Lane allows emergency vehicle access. • There is a police station and fire station in Queenstown Town, and Hospital in Frankton; all within proximity to the SH6 road corridor. One-way exit has been provided from Coronation Drive to SH6A for the Police. • No specific features for crash warning in place, standard TTM procedures to be followed at this stage

7. Treatments to Further Improve Safe System Alignment

Table 5: Primary Treatments and Table 6 list treatments that will improve the Safe System alignment of the project.

Primary treatments are those measures that have the potential to eliminate or come close to eliminating the risk of fatal and serious injury (FSI) crashes.

Supporting treatments are effective in reducing the risk of FSI crashes but not to the extent of a primary treatment (i.e. there is a residual moderate or significant FSI crash risk). Implementation of a primary treatment should be given priority over a supporting treatment that may be targeting a similar crash risk.

It is recommended that proposed treatments below are reviewed along with the matrices in the appendices. The client is to decide which treatments are adopted, so that they may be implemented during detailed design phase.

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Table 5: Primary Treatments

Treatments for consideration	Project response
• Raised Safety Platforms (designed to 30km/h operating speed) only one side streets where zebra crossing is currently given in the design.	

Table 6: Supporting Treatments

Treatments for consideration	Project response
• Install signalised pedestrian crossings at signalised roundabouts.	
• Additional refuges to be used when pedestrians crossing 2 lanes or more, non-signalised.	
• Consider sight lines when maintaining and designing vegetation.	
• Ensure adequate wayfinding.	
• Cater for on-road cyclists, including additional linemarking.	
• Improve access though roundabouts for cyclists.	
• Consider banning RHT into driveway, where conflict with intersection.	
• Consider further grade separation for pedestrians.	
• Traffic calming measures.	
• Improve skid resistance.	
• Part of maintenance programme – deicing agent applied.	
• Provide warning signage where there are steep downgrades.	

8. Conclusions

The design proposal has a reasonable alignment with Safe System principles and offers an improvement over the existing conditions for most crash types identified. A number of features remain that have a less

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than desirable alignment with Safe System principals including run-off road crashes, pedestrian and cycle crashes. The project team is encouraged to consider the suggested improvements, which further improve the alignment with the Safe System principals, as detailed in the report.

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Appendices

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Appendix A Safe System Assessment Matrix – Frankton: Kawarau Rd

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	Run-off road - All Frankton/SH6	Head-on - All Frankton/SH6	Intersection - Southberg Av	Intersection - Humphrey St incl properties	Intersection - McBride	Intersection - Lucas Pl	Intersection - Ross St	Intersection - Bus Hub	Intersection - Gray St	Intersection - Frankton Rd	Pedestrian - Kawarau Rd	Cyclists - Kawarau Rd	Motorcyclists - All Frankton/SH6
Exposure Comments	Forecasted volumes expected 26,000vdp	Forecasted volumes expected 26,000vdp	Forecasted volumes expected 26,000vdp	Forecasted volumes expected 26,000vdp	Forecasted volumes expected 26,000vdp	Forecasted volumes expected 26,000vdp	Forecasted volumes expected 26,000vdp	Forecasted volumes expected 26,000vdp	Forecasted volumes expected 26,000vdp	Forecasted volumes expected 26,000vdp	>100 Peds Designated footpath	>100 Cyclists >10,000 vpd No facilities for cyclists on arterial route	>100 ADT
Exposure Score	4	4	4	4	4	4	4	4	4	4	4	4	4
Likelihood Comments	***Factors that increase the likelihood include:*** - Variable shoulders - No barriers - Winter conditions - Slightly skewed alignment - Speed at 60km/hr ***Factors that decrease the likelihood include:*** - Good sight lines, except for southern approach to Southberg Av - Limited vertical curvature - Minimal roadside hazards	***Factors that increase the likelihood include:*** - Slightly skewed alignment - Speed at 60km/hr - ***Factors that decrease the likelihood include:*** - Median strip for some sections - Limited vertical curvature - Good sight lines, except for southern approach to Southberg Av - Narrow lanes at 3 - 3.5m wide as a traffic calming measure	***Factors that increase the likelihood include:*** - Non-signalised 3-leg intersection - Limited sight distance for RHT out of Southberg Ave - 60km/hr speed limit ***Factors that decrease the likelihood include:*** - Median strip provided for vehicles turning right into and out of Southberg Ave - Low volume road, servicing ~ 10 residential homes	***Factors that increase the likelihood include:*** - Limited visibility coming from Humphrey St - 60km/hr speed limit - Property accesses - Conflict with intersection RHT into/out fof 44A Kawarau Rd. ***Factors that decrease the likelihood include:*** - Signalised 3-way intersection, fully protected pedestrians and right hand turns - Good visibility on approach on Kawarau Rd - Lights at intersection provide safe exit from accessways - Medan strip provides refuge for vehiclepulling into one accesswayy	***Factors that increase the likelihood include:*** - Non-signalised intersection, 3-way intersection - 60km/hr speed limit ***Factors that decrease the likelihood include:*** - Raised table for footpath crossing - Good visibility	***Factors that increase the likelihood include:*** - Wayfinding turning onto SH6 from Ross St through bus lane may lead to poor manoeuvres - No cycle lane on Kawarau Rd - No cycle facilities at intersection ***Factors that decrease the likelihood include:*** - Signalised 3-way intersection, with full protection for pedestrians and right hand turns - Kerb build outs to direct traffic flow and provide refuge for pedestrians - Shared paths provided for peds and cyclists	***Factors that increase the likelihood include:*** - Non-signalised intersection, 3-way intersection - 60km/hr speed limit ***Factors that decrease the likelihood include:*** - Raised table for footpath crossing - Good visibility	***Factors that increase the likelihood include:*** - Wayfinding for vehicles dropping/picking up to/from bus hub - No cycle lane on Kawarau Rd - No cycle facilities at intersection - Parking provided on Kawarau Rd - Bus stops pulling into / out of traffic lane ***Factors that decrease the likelihood include:*** - Signalised crossings, full protection for pedestrians and right turns. - Plenty of shared path area for pedestrians and cyclists - Plenty of parking provided for buses and other coaches	***Factors that increase the likelihood include:*** - Wayfinding LHT only out onto Kawarau Rd may confuse drivers ***Factors that decrease the likelihood include:*** - Shared Zone, 30km/hr speed limit - Signalised exit onto Kawarau Rd, fully protected by the signalised pedestrian crossings at the western end of the bus hub - Cyclists route provided running down Grey St through shared zone.	***Factors that increase the likelihood include:*** - Wayfinding turning onto Arterial and lane confusion may lead to poor manoeuvres, particulary into/out of BP - No cycle lane or provision on Kawarau Rd - ***Factors that decrease the likelihood include:*** - Signalised crossings for pedestrians with full protection, or Barnes Dance. - All legs signalised, with protected right turns and full pedestrian protection - Cycle lane provided on Fishtrot/Ladies Mile Rd through intersection. Kerb to delineate between cycle lane and traffic.	***Factors that increase the likelihood include:*** - 60km/hr speed limit - ***Factors that decrease the likelihood include:*** - Suitably wide footpaths on both sides of road - Signalised crossing points at intersections, full pedestrian protection - Mostly good sight lines - Zebra crossings provided - Shared space provided, with 30km/hr posted speed limit.	***Factors that increase the likelihood include:*** - Variable provision for cyclists. - Limited cycle lane - 60km/hr speed limit ***Factors that decrease the likelihood include:*** - Likely to be more competent cyclists using this corridor. Alternative routes available that provide for all levels - Shared path provided to give off-road access to cyclists - Full protection for pedestrians and right turns at intersections.	***Factors that increase the likelihood include:*** - No separate motorcycle lanes - 60km/hr speed limit - Variable shoulders - No barriers - Winter conditions - Slightly skewed alignment ***Factors that decrease the likelihood include:*** - Relatively Consistent road corridor layout - Signalised intersections have protected right turns.
Likelihood Score	2	3	3	3	3	3	3	3	2	3	3	3	2
Severity Comments	***Factors that increase the severity include:*** - 60km/hr speed limit - No barriers ***Factors that decrease the severity include:*** - -	***Factors that increase the severity include:*** - 60km/hr speed limit - ***Factors that decrease the severity include:*** - -	***Factors that increase the severity include:*** - High impact angle crashes possible (T-bone crash) - 60km/hr speed limit ***Factors that decrease the severity include:*** - -	***Factors that increase the severity include:*** - High impact angle crashes possible (T-bone crash) - 60km/hr speed limit ***Factors that decrease the severity include:*** - -	***Factors that increase the severity include:*** - High impact angle crashes possible (T-bone crash) - 60km/hr speed limit ***Factors that decrease the severity include:*** - -	***Factors that increase the severity include:*** - Potential for higher approach speeds, particularly from Frankton Road south - High impact angle crashes possible (T-bone crash) but limited opportunity - 60km/hr speed limit ***Factors that decrease the severity include:*** - -	***Factors that increase the severity include:*** - High impact angle crashes possible (T-bone crash) - 60km/hr speed limit ***Factors that decrease the severity include:*** - -	***Factors that increase the severity include:*** - High impact angle crashes possible (T-bone crash) but limited opportunity - 60km/hr speed limit ***Factors that decrease the severity include:*** - -	***Factors that increase the severity include:*** - High impact angle crashes possible (T-bone crash) but limited opportunity ***Factors that decrease the severity include:*** - 30km/h Urban speed environment	***Factors that increase the severity include:*** - 60km/hr speed limit - High impact angle crashes possible (T-bone crash) but limited opportunity ***Factors that decrease the severity include:*** - -	***Factors that increase the severity include:*** - Speed is 60 km/h. Safe and survivable speed for pedestrian is 30 km/h - ***Factors that decrease the severity include:*** - -	***Factors that increase the severity include:*** - Speed is 60 km/h. Safe and survivable speed for pedestrian is 30 km/h - Downhill grade - Vehicle vs Cyclist crash possible ***Factors that decrease the severity include:*** - -	***Factors that increase the severity include:*** - Speed is 60 km/h. Safe and survivable speed for pedestrian is 30 km/h - Vehicle vs motorcyclists crash possible ***Factors that decrease the severity include:*** - -
Severity Score	3	2	3	3	3	3	3	3	2	3	4	4	4
Existing Design Conditions	24	24	36	36	36	36	36	36	16	36	48	48	32
Opportunities	- Surfacing with good skid resistance - Part of maintenance programme - de-icing agent applied - Traffic calming to achieve posted speed, particularly on steep grade sections - Consider Barriers	- Consider further Traffic Calming measures	- Trim vegetation close to Kawarau Bridge to gain minimum sight distance for vehicles turning out of Southberg Ave (140lm for 60km/hr speed limit)	- Consider sight lines when landscaping. Potentially trim 20 Humphrey St trees to improve visibility. - Consider banning RHT into 44A Kawarau Rd	- Raised table at footpath crossing to be designed for 30km/hr	- Ensure adequate wayfinding to minimise confusion and illegal manoeuvres - Cater for on road cyclists at intersection and through SH6 eg. Cycle boxes at intersection	- Consider alternative linemarking/provision for LHT from Ross St to Kawarau Rd - Raised table at footpath crossing to be designed for 30km/hr	- Raised table zebra crossing to reduce speeds, design for 30km/hr - Ensure adequate wayfinding to minimise confusion and illegal manoeuvres - Signage clearly showing where vehicles may drive. - Consider providing for more movement opportunities at intersection i.e.. right out of arterial/left in from Frankton Road - Cater for on road cyclists at intersection and into arterial	- Ensure adequate wayfinding to minimise confusion and illegal manoeuvres	- Ensure adequate wayfinding to minimise confusion and illegal manoeuvres - Cater for on road cyclists through intersection coming from Kawarau Rd ie. Cycle boxes.	- Raised platforms at zebra crossings. - Consider grade separation for pedestrian crossings	- Clear Signage/Linemarking directing cyclists to most appropriate route through area. - Consider sharrows or markings to promote awareness of cyclists in the space. - Cyclist stop boxes at all intersections along Kawarau. - Cater for on-road cyclists on Kawarau Rd	- Ensure wayfinding to minimise confusion and illegal manoeuvres. - Provide improved skid resistance - Provide warning signage where there are steep downgrades
Exposure	4	4	4	4	4	4	4	4	4	4	4	4	4
Likelihood	2	3	3	3	3	3	3	3	2	3	3	2	2
Severity	3	2	3	3	3	2	3	2	2	3	4	4	4
With Suggested Safe System Impr	24	24	36	36	36	36	24	36	16	36	48	32	32

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Appendix B Safe System Assessment Matrix – Frankton: Frankton-Ladies Mile Hwy

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	Intersection - Joe O'Connell Dr	Intersection - Hansen Rd	Intersection - Grant Rd	Intersection - Hawthorne Dr	Pedestrian - Frankton-Ladies Mile Highway	Cyclists - Frankton-Ladies Mile Highway
Exposure Comments	Forecasted volumes expected 26,000vdp	Forecasted volumes expected 26,000vdp	Forecasted volumes expected 26,000vdp	Forecasted volumes expected 26,000vdp	>100 Peds Designated footpath	>100 Cyclists No separation
Exposure Score	**4**	**4**	**4**	**4**	**4**	**4**
Likelihood Comments	***Factors that increase the likelihood include:*** - 3-way intersection - 60km/hr speeds limit	***Factors that increase the likelihood include:*** - 3-way intersection. - No ped crossing facilities - Non-signalised - Turning lane commencing north of Stanley intersection. Queueing may develop across Stanley	***Factors that increase the likelihood include:*** - Skewed angle of intersection may reduce visibility - Risk that vehicles may queue across through lanes - Long crossing distance for pedestrians (3 lanes) with no refuge - No signals for pedestrians to cross	***Factors that increase the likelihood include:*** - Skewed angle of intersection may reduce visibility - Risk that vehicles may queue across through lanes - Long crossing distance for pedestrians (3 lanes) with no refuge - No signals for pedestrians to cross	***Factors that increase the likelihood include:*** - 60km/hr speed limit. Safe and survivable speed is 30km/hr for pedestrians. - At roundabouts, pedetrians crossing 3 lanes of traffic for some legs	***Factors that increase the likelihood include:*** - 60km/hr speed limit. Safe and survivable speed is 30km/hr for pedestrians. - Good sight lines - Risk that cyclists will not use off-road crossing facility provided at roundabouts as they are in-direct.
	Factors that decrease the likelihood include: - Signalised intersection, with protected right turns and protection for pedestrians - Good sight lines - Cycle boxes provided	***Factors that decrease the likelihood include:*** - Underpass for pedestrians to cross SH6 - Signalised intersection,with full pedestrian and right turn protection. - Cycle boxes provided	***Factors that decrease the likelihood include:*** - Signalised roundabout, with protected right turns - 3 leg intersection	***Factors that decrease the likelihood include:*** - Signalised roundabout, with protected right turns - 3 leg intersection	***Factors that decrease the likelihood include:*** - Footpath provided for length of SH6 - Designated crossing points at intersections, with full pedestrian protection - Pedestrian refuges provided at roundabout crossings - Good sight lines - Underpass provided at Hansen Rd	***Factors that decrease the likelihood include:*** - Cycle lane provided for length of SH6, excluding roundabouts, where alternative off road facility is provided. - Likely to be more competent cyclists using this corridor. Alternative routes available that provide for all levels.
Likelihood Score	**3**	**3**	**3**	**3**	**3**	**3**
Severity Comments	***Factors that increase the severity include:*** - High impact angle crashes possible (T-bone crash) - 60km/hr speed limit	***Factors that increase the severity include:*** - High impact angle crashes possible (T-bone crash) - 60km/hr speed limit	***Factors that increase the severity include:*** - 60km/hr speed limit	***Factors that increase the severity include:*** - High impact angle crashes possible (T-bone crash) - 60km/hr speed limit	***Factors that increase the severity include:*** - Speed is still 60 km/h. Safe and survivable speed for pedestrian is 30 km/h	***Factors that increase the severity include:*** - Speed is still 60km/hr. Safe and survivable speed for cyclists is 30km/hr - Vehicle vs Cyclist crash possible
	Factors that decrease the severity include: - -	***Factors that decrease the severity include:*** - -	***Factors that decrease the severity include:*** - Impact angles reduced due to design of the roundabout	***Factors that decrease the severity include:*** - Impact angles reduced due to design of the roundabout -	***Factors that decrease the severity include:*** - -	***Factors that decrease the severity include:*** - -
Severity Score	**3**	**3**	**3**	**3**	**4**	**4**
Product	**36**	**36**	**36**	**36**	**48**	**48**
Opportunities	- Clear signage and linemarking	'- Phasing to limit opportunity for vehicle conflicts	- Phasing to limit opportunity for vehicle conflicts - Consider installing signals for pedestrians to cross	- Phasing to limit opportunity for vehicle conflicts - Consider installing signals for pedestrians to cross	- Consider further grade separation for pedestrian crossings - Consider additional refuges at roundaobuts where pedestrians are crossing 3 lanes	- At roundabouts where cyclists are guided off road, provide a more direct crossing route to encourage use.
Exposure	**4**	**4**	**4**	**4**	**4**	**4**
Likelihood	**3**	**3**	**3**	**3**	**2**	**2**
Severity	**3**	**3**	**2**	**2**	**4**	**4**
Product	**36**	**36**	**24**	**24**	**32**	**32**

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Appendix C Safe System Assessment Matrix – Ladies Mile: Frankton-Ladies Mile Hwy

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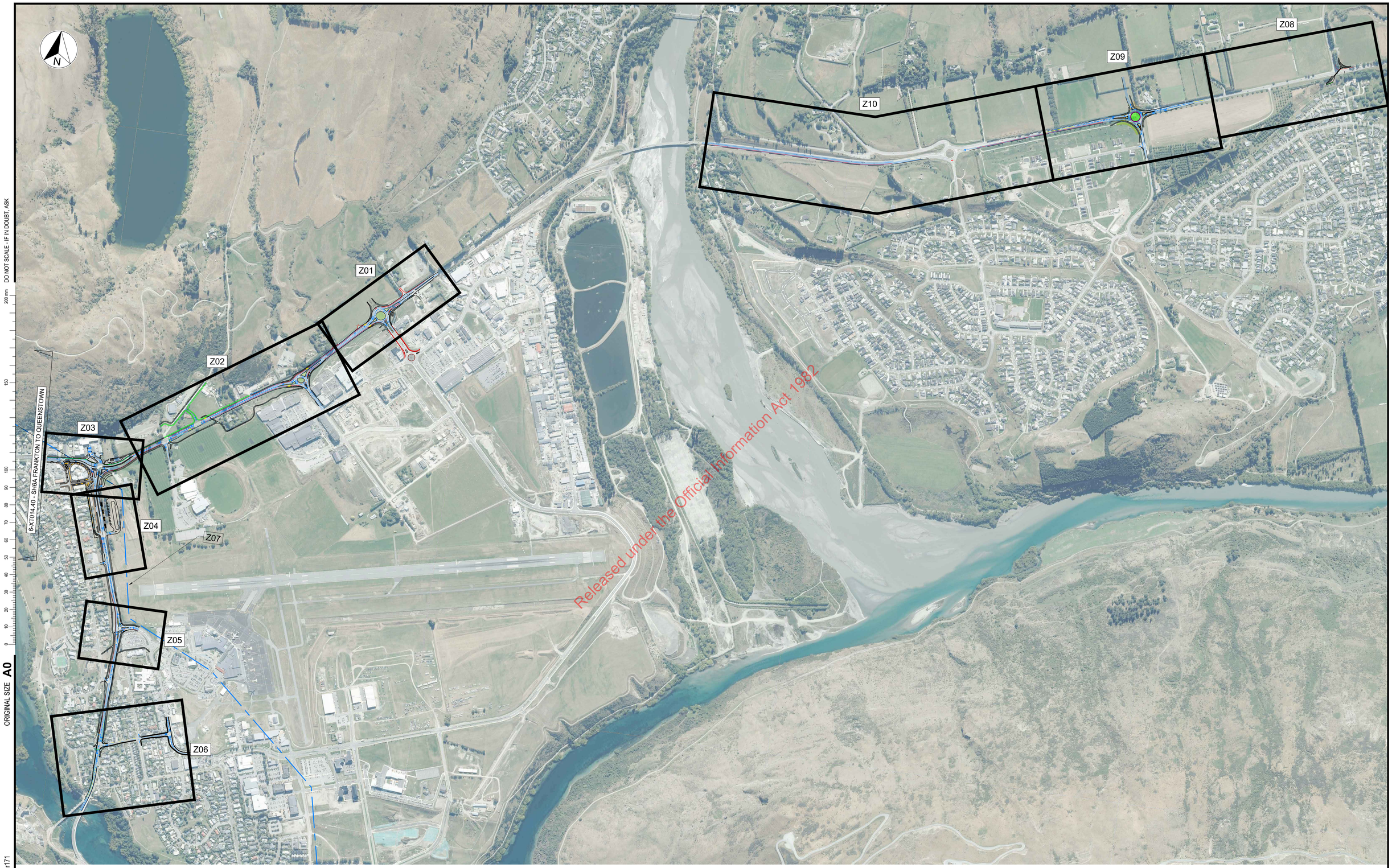
	Run-off road	Head-on	Intersection - Stalker Rd roundabout	Intersection - Howards Dr roundabout	Pedestrians	Cyclists	Motorcyclists
Exposure Comments	Forecasted volumes expected 26,000vdp	Forecasted volumes expected 26,000vdp	Forecasted volumes expected 26,000vdp	Forecasted volumes expected 26,000vdp	>100 Peds	50 - 100 Cyclists 26,000vdp No facilities for cyclists on arterial route	>100 ADT
Exposure Score	**4**	**4**	**4**	**4**	**4**	**3**	**4**
Likelihood Comments	***Factors that increase the likelihood include:*** - 1.5m wide shoulder throughout - No barriers - Winter conditions - Steep down grade WB from Stalker Rd to Shotover River bridge - 80km/hr speed limit ***Factors that decrease the likelihood include:*** - Good sight lines - Straight alignment - 3.2m wide lanes - as a traffic calming measure	***Factors that increase the likelihood include:*** - Steep down grade WB approach to Shotover River bridge - 80km/hr speed limit - ***Factors that decrease the likelihood include:*** - 1m Median strip for majority of length, wider in some locations - Straight alignment	***Factors that increase the likelihood include:*** - Non-signalised roundabout - ***Factors that decrease the likelihood include:*** - Minimum sight lines met at detailed design	***Factors that increase the likelihood include:*** - Non-signalised roundabout - ***Factors that decrease the likelihood include:*** - Minimum sight lines met at detailed design	***Factors that increase the likelihood include:*** - Limited pedestrian facilities - 80km/hr speed limit ***Factors that decrease the likelihood include:*** - Good sight lines - Low speed 40km/hr - Links to exisitng paths provided at roundabout at Howards Dr links and underpass at McDowell Dr - Pedestrian refuges provided at roundabout at Howards Dr - Underpass provided at McDowell Dr to pass beneath SH6	***Factors that increase the likelihood include:*** - 1.5m wide shoulder provided - Good sight lines - Steep downhill grade toward Shotover River Bridge - 80km/hr speed limit ***Factors that decrease the likelihood include:*** - Likely to be more competent cyclists using this corridor. Alternative routes available that provide for all levels ie. The off-road trails	***Factors that increase the likelihood include:*** - No separate motorcycle lanes - Steep downgrades toward Shotover River Bridge - 80km/hr speed limit ***Factors that decrease the likelihood include:*** - Consistent road corridor layout - Signalised intersections have protected right turns.
Likelihood Score	**2**	**2**	**3**	**3**	**3**	**3**	**2**
Severity Comments	***Factors that increase the severity include:*** - 80km/hr speed limit ***Factors that decrease the severity include:*** -	***Factors that increase the severity include:*** - 80km/hr speed limit ***Factors that decrease the severity include:*** -	***Factors that increase the severity include:*** - Impact angles - side impact possible - 80km/hr speed limit ***Factors that decrease the severity include:*** -	***Factors that increase the severity include:*** - Impact angles - side impact possible - 80km/hr speed limit ***Factors that decrease the severity include:*** -	***Factors that increase the severity include:*** - Speed is still 80 km/h. Safe and survivable speed for pedestrian is 30 km/h - ***Factors that decrease the severity include:*** -	***Factors that increase the severity include:*** - Speed is still 80 km/h. Safe and survivable speed for pedestrian is 30 km/h - Downhill grade toward Fernhill Shotover River Bridge - Vehicle vs Cyclist crash possible ***Factors that decrease the severity include:*** -	***Factors that increase the severity include:*** - Speed is still 80 km/h. Safe and survivable speed for pedestrian is 30 km/h - Vehicle vs motorcyclists crash possible ***Factors that decrease the severity include:*** - -
Severity Score	**4**	**3**	**3**	**3**	**4**	**4**	**4**
Existing Design Conditions	**32**	**24**	**36**	**36**	**48**	**36**	**32**
Opportunities	- Surfacing with good skid resistance - Part of maintenance programme - de-icing agent applied - Traffic calming to achieve posted speed, particularly on steep grade sections	-Traffic Calming measures eg. Narrow lanes. 3.25m lanes currently in design. Could also do wider lanemarking, or planting.	- Signalise	- Signalise	- Consider further grade separation for pedestrian crossings	- Consider signage to warn vehicles of their presence	- Provide improved skid resistance - Provide warning signage where there are steep downgrades
Exposure	**4**	**4**	**4**	**4**	**4**	**3**	**4**
Likelihood	**2**	**2**	**3**	**3**	**2**	**3**	**2**
Severity	**4**	**3**	**2**	**2**	**4**	**4**	**2**
With Suggested Safe System Impr	**32**	**24**	**24**	**24**	**32**	**36**	**16**

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Appendix D Drawings

Note: These drawings were the most up to version at the time of completing this assessment

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DO NOT SCALE - IF IN DOUBT, ASK

ORIGINAL SIZE **A0**

Last modified: November 4, 2020 By tgr171

1:5000@ A1
1:10000@ A3
0 50 100 150 200 250 300 350 400 450 500 m

REV	REVISIONS	DRN	CHK	APP	DATE
C	FINAL	s 9(2)(a)			16/11/2020
B	ISSUED FOR IQA REVIEW				02/10/2020
A	ISSUED FOR WORKSHOP				-

SURVEYED	-	-
DESIGNED	s 9(2)(a)	10/2020
DRAWN	s 9(2)(a)	10/2020
CAD REVIEW	s 9(2)(a)	10/2020
DESIGN CHECK	s 9(2)(a)	10/2020
DESIGN REVIEW	s 9(2)(a)	10/2020
APPROVED	s 9(2)(a)	10/2020
PROF REGISTRATION:	-	

Client:

Stantec

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp

ableyQUEENSTOWN BUSINESS CASE
FRANKTON WORKS

OVERVIEW PLAN
CONCEPT DESIGN

Status Stamp: **FINAL**

Date Stamp:

Scales: AS SHOWN

Drawing No.: 6-XT014.64-WSP-01-ZZ-DR-C-5001

Rev.: C

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DO NOT SCALE - IF IN DOUBT, ASK

ORIGINAL SIZE A1

JOINLINE SEE SHEET SET Z10

JOINLINE SEE SHEET SET Z08

FRANKTON-LADIES MILE HIGHWAY (SH6)

HOWARDS DRIVE

PROPOSED BUS LANE

3.5m
3.5m
3.741m
2.5m
4.0m
3.5m
3.5m
3.5m
4.0m
4.0m
4.0m
2.5m
4.0m
4.0m
4.0m
3.5m
3.5m

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1:500 @ A1
1:1000 @ A3
0 5 10 15 20 25 30 35 40 45 50 m

Last modified: November 4, 2020 By tgr171

REV	REVISIONS	DRN	CHK	APP	DATE
D	FINAL	s 9(2)(a)			16/11/2020
C	ISSUED FOR IQA REVIEW				02/10/2020
B	ISSUED FOR WORKSHOP				-
A	DRAFT FOR COMMENT				-

SURVEYED	-	-
DESIGNED	s 9(2)(a)	10/2020
DRAWN	s 9(2)(a)	10/2020
CAD REVIEW	s 9(2)(a)	10/2020
DESIGN CHECK	s 9(2)(a)	10/2020
DESIGN REVIEW	s 9(2)(a)	10/2020
APPROVED	s 9(2)(a)	10/2020
PROF REGISTRATION:	-	

Client:

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WSP

ABLEY

FRANKTON IMPROVEMENTS
LADIES MILE HIGHWAY

HOWARDS DRIVE INTERSECTION
CONCEPT DESIGN

Status Stamp: **FINAL**

Date Stamp: **16/11/2020**

Scales: 1:500 (A1), 1:1000 (A3)

Drawing No.: 6-XT014.64-WSP-01-Z09-DR-C-5101

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DO NOT SCALE - IF IN DOUBT, ASK

200 mm
150
100
90
80
70
60
50
40
30
20
10
0

ORIGINAL SIZE **A1**

JOINLINE SEE SHEET SET Z10

JOINLINE SEE SHEET SET Z09

PROPOSED
BUS LANE

3.3m
3.2m
3.5m
3.5m
3.2m

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1:500 @ A1
1:1000 @ A3

0 5 10 15 20 25 30 35 40 45 50 m

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REV	REVISIONS	DRN	CHK	APP	DATE
D	FINAL	s 9(2)(a)			16/11/2020
C	ISSUED FOR IQA REVIEW				02/10/2020
B	ISSUED FOR WORKSHOP				-
A	DRAFT FOR COMMENT				-

SURVEYED	-	-
DESIGNED	s 9(2)(a)	10/2020
DRAWN	s 9(2)(a)	10/2020
CAD REVIEW	s 9(2)(a)	10/2020
DESIGN CHECK	s 9(2)(a)	10/2020
DESIGN REVIEW	s 9(2)(a)	10/2020
APPROVED	s 9(2)(a)	10/2020

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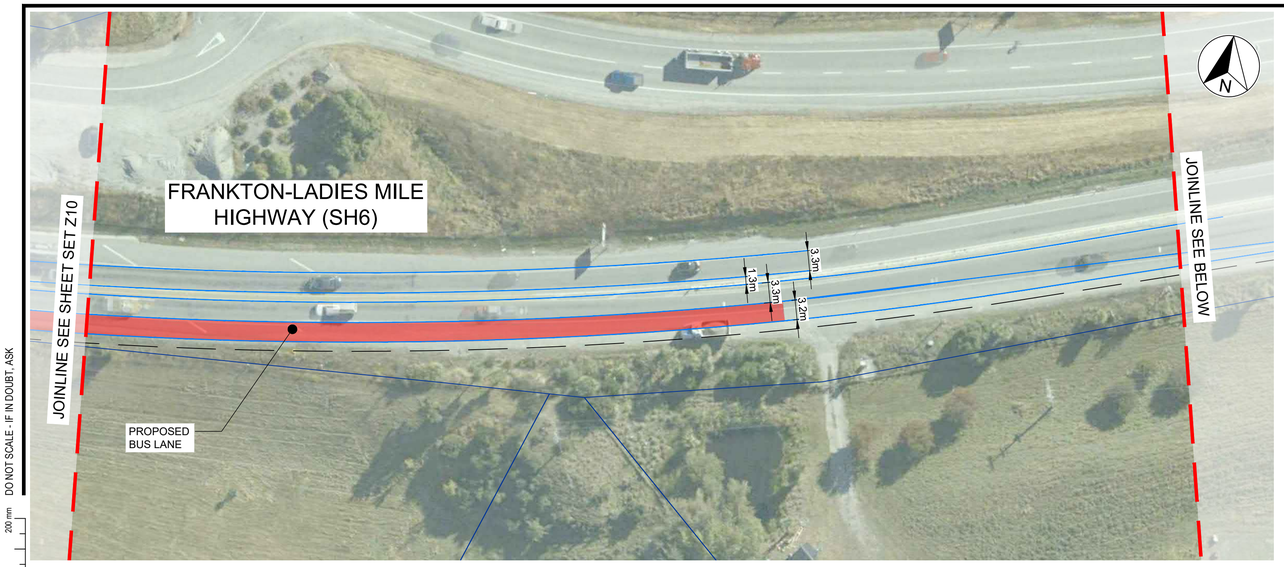
FRANKTON IMPROVEMENTS
LADIES MILE HIGHWAY

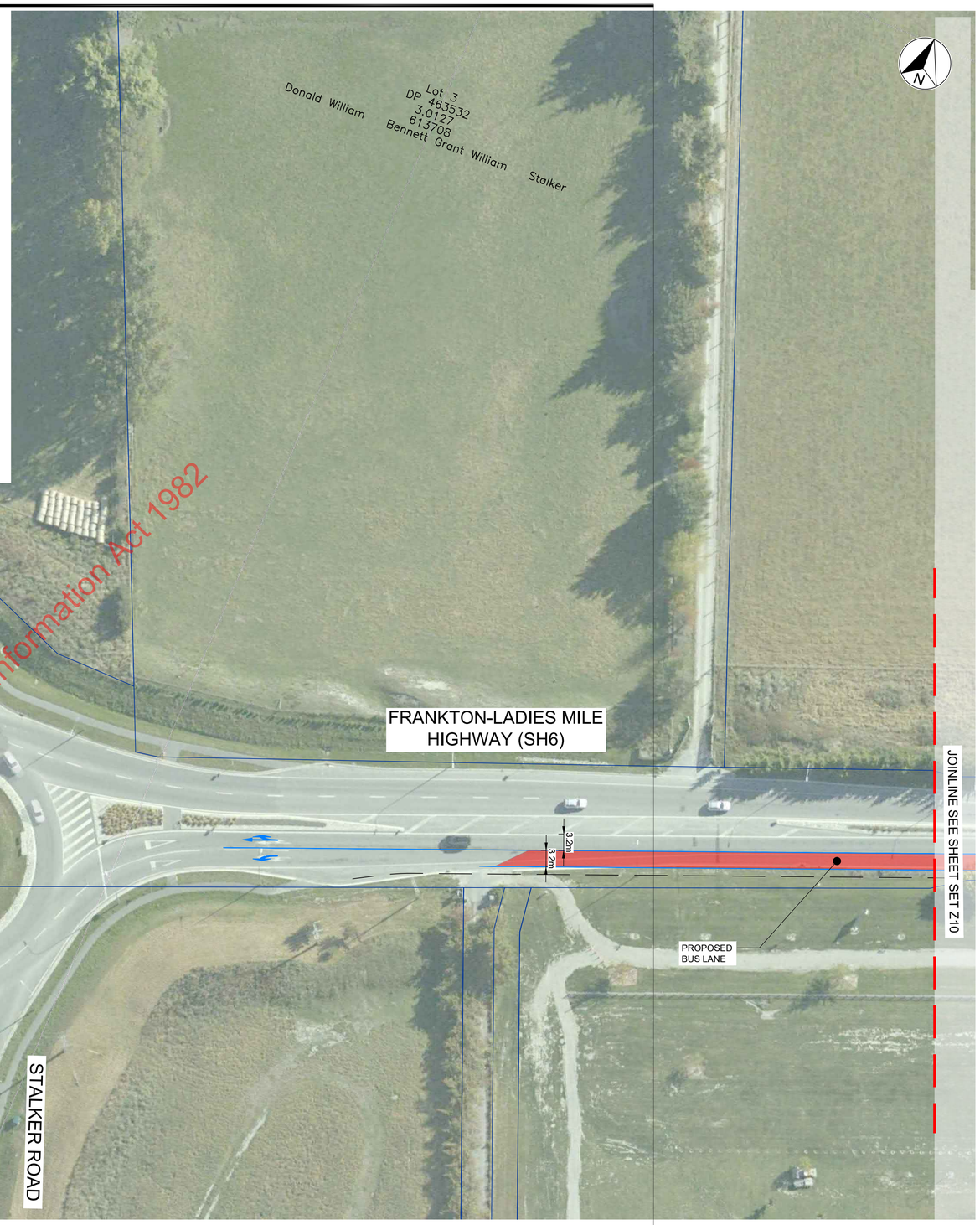
STALKERS RD/SH6 LADIES MILE BUS IMPROVMENTS
CONCEPT DESIGN - SHEET 1 OF 3

6-XT014.64-WSP-01-Z10-DR-C-5101

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DO NOT SCALE - IF IN DOUBT, ASK

200 mm
150
100
50
0

ORIGINAL SIZE **A1**

1:500 @ A1
1:1000 @ A3
0 5 10 15 20 25 30 35 40 45 50 m

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D	FINAL	s 9(2)(a)			6/11/2020
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B	ISSUED FOR WORKSHOP				-
A	DRAFT FOR COMMENT				-

SURVEYED	-	-
DESIGNED	s 9(2)(a)	10/2020
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APPROVED	s 9(2)(a)	10/2020
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FRANKTON IMPROVEMENTS
LADIES MILE HIGHWAY

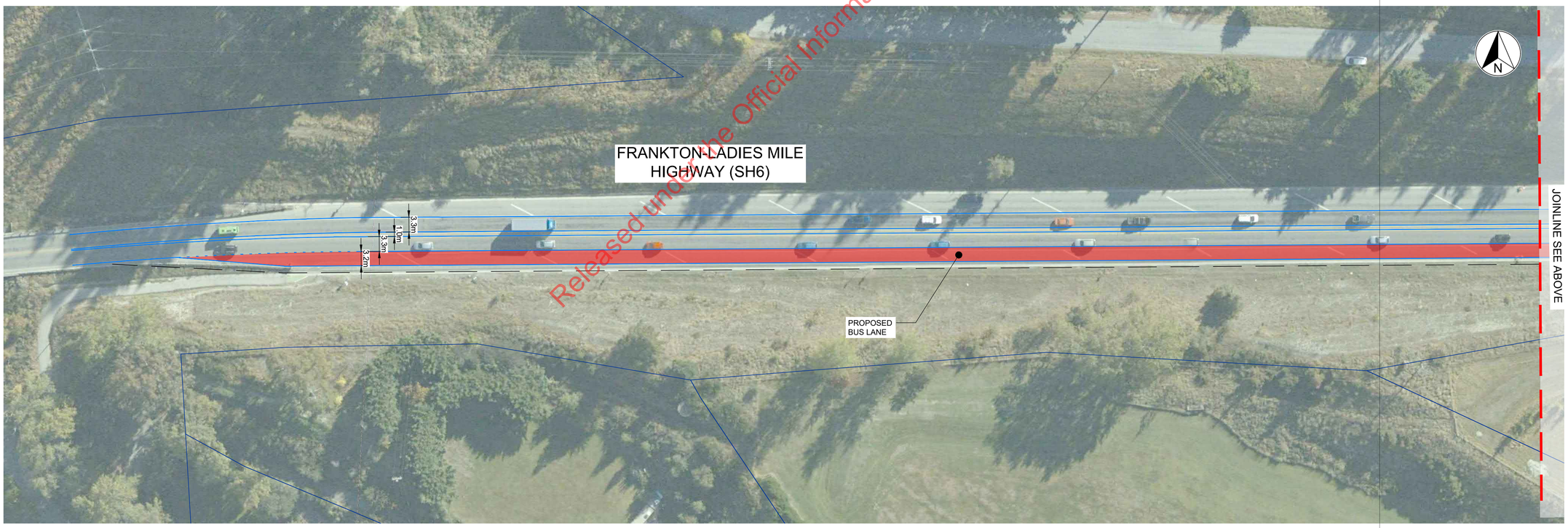
STALKERS RD/SH6 LADIES MILE BUS IMPROVMENTS
CONCEPT DESIGN - SHEET 2 OF 3

6-XT014.64-WSP-01-Z10-DR-C-5102

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1:500 @ A1
1:1000 @ A3
0 5 10 15 20 25 30 35 40 45 50 m

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ORIGINAL SIZE A1

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REV	REVISIONS	DRN	CHK	APP	DATE
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B	ISSUED FOR WORKSHOP				-
A	DRAFT FOR COMMENT				-

SURVEYED	-	-
DESIGNED	s 9(2)(a)	10/2020
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DESIGN REVIEW	s 9(2)(a)	10/2020
APPROVED	s 9(2)(a)	10/2020
PROF REGISTRATION:	-	

Client:

Stantec | WAKA KOTAHI NZ TRANSPORT AGENCY | wsp | ableyFRANKTON IMPROVEMENTS
LADIES MILE HIGHWAY

STALKERS RD/SH6 LADIES MILE BUS IMPROVMENTS
CONCEPT DESIGN - SHEET 3 OF 3

6-XT014.64-WSP-01-Z10-DR-C-5103

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JOINLINE SEE SHEET Z2-DR-C-5103

ORIGINAL SIZE A1

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PROPOSED FERRY HILL DRIVE ACCESS

EXISTING ROUNDABOUT TO BE SIGNALISED

PROPOSED BUS LANES

FRANKTON-LADIES MILE HIGHWAY (SH6)

HAWTHORNE DRIVE

3.5m
1.5m
3.5m
1.0m
2.0m
3.5m
3.5m
3.5m
3.5m
4.5m
3.5m
3.5m
3.5m
3.8m
3.5m
3.7m
3.5m
3.5m
3.5m

1:500 @ A1
1:1000 @ A3
0 5 10 15 20 25 30 35 40 45 50 m

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REV	REVISIONS	DRN	CHK	APP	DATE
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C	ISSUED FOR IQA REVIEW				02/10/2020
B	ISSUED FOR WORKSHOP				-
A	DRAFT FOR COMMENT				-

SURVEYED	-	-
DESIGNED	s 9(2)(a)	09/2020
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APPROVED	s 9(2)(a)	10/2020
PROF REGISTRATION:	-	

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FRANKTON IMPROVEMENTS
HAWTHORNE DRIVE

HAWTHORNE DRIVE INTERSECTION
CONCEPT DESIGN

Status Stamp: **FINAL**

Date Stamp: **16/11/2020**

Scales: 1:500 (A1), 1:1000 (A3)

Drawing No.: 6-XT014.64-WSP-01-Z01-DR-C-5101

Rev.: D

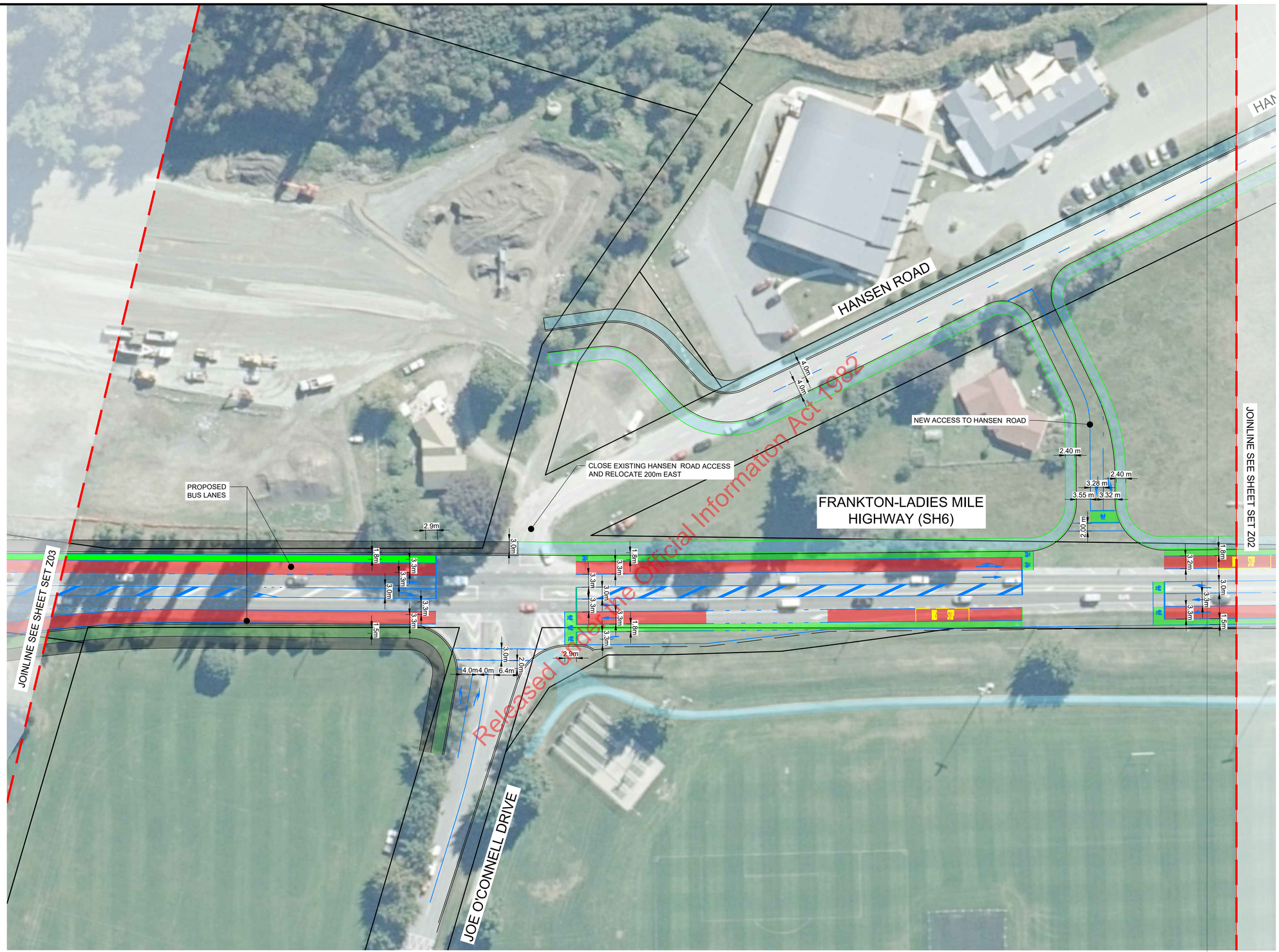
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ORIGINAL SIZE **A1**

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1:500 @ A1
1:1000 @ A3
0 5 10 15 20 25 30 35 40 45 50 m

REV	REVISIONS	DRN	CHK	APP	DATE
D	FINAL	s 9(2)(a)			6/11/2020
C	ISSUED FOR IQA REVIEW				2/10/2020
B	ISSUED FOR WORKSHOP				-
A	DRAFT FOR COMMENT				-

SURVEYED	-	-
DESIGNED	s 9(2)(a)	10/2020
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CAD REVIEW	s 9(2)(a)	10/2020
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DESIGN REVIEW	s 9(2)(a)	10/2020
APPROVED	s 9(2)(a)	10/2020
PROF REGISTRATION:	-	

Client:

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FRANKTON IMPROVEMENTS
GRANT RD TO JOE O'CONNELL DR

SH6/JOE O'CONNELL & HANSEN RD INTERSECTIONS CONCEPT DESIGN

6-XT014.64-WSP-01-Z02-DR-C-5101

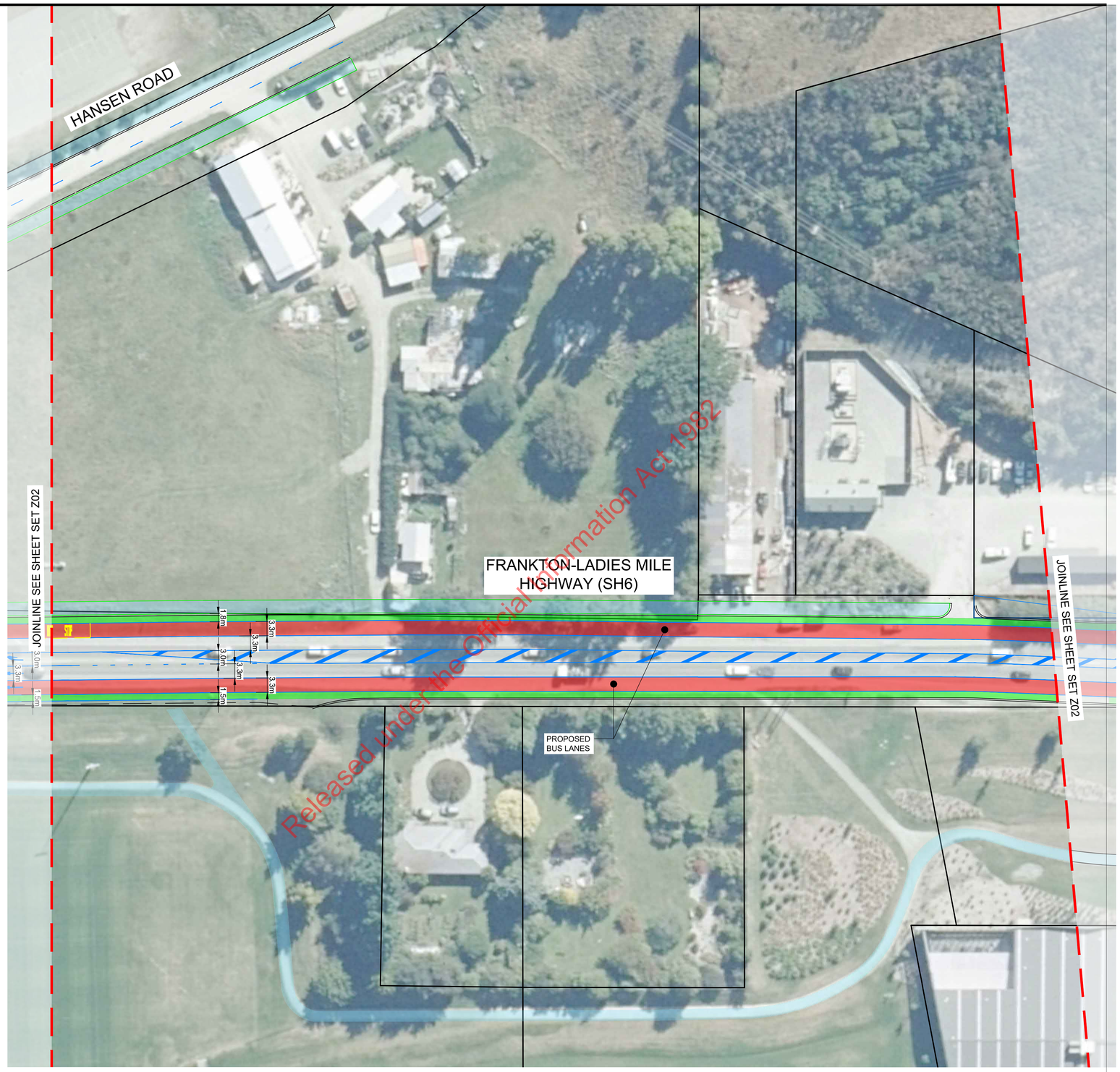
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DO NOT SCALE - IF IN DOUBT, ASK

200mm 150 100 90 80 70 60 50 40 30 20 10 0

ORIGINAL SIZE **A1**



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1:500 @ A1
1:1000 @ A3
0 5 10 15 20 25 30 35 40 45 50 m

Last modified: November 4, 2020 By tgr171

REV	REVISIONS	DRN	CHK	APP	DATE
D	FINAL	s 9(2)(a)			16/11/2020
C	ISSUED FOR IQA REVIEW				02/10/2020
B	ISSUED FOR WORKSHOP				-
A	DRAFT FOR COMMENT				-

SURVEYED	-	-
DESIGNED	s 9(2)(a)	10/2020
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DESIGN CHECK	s 9(2)(a)	10/2020
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PROF REGISTRATION:	-	

Client:

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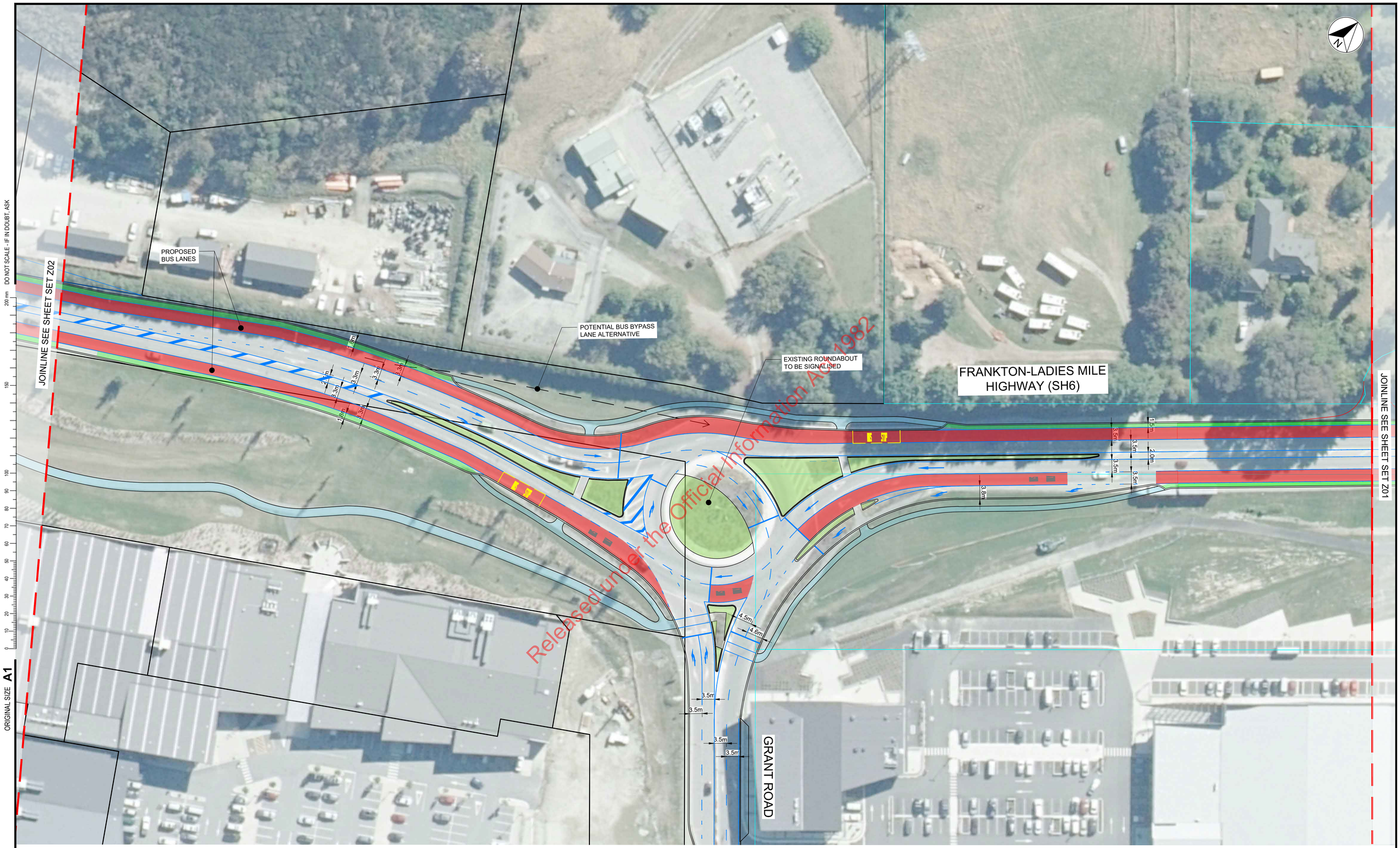
FRANKTON IMPROVEMENTS
GRANT RD TO JOE O'CONNELL DR

SH6 LINK BETWEEN HANSEN RD & GRANT RD
CONCEPT DESIGN

6-XT014.64-WSP-01-Z02-DR-C-5102

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ORIGINAL SIZE A1

1:500 @ A1
1:1000 @ A3
0 5 10 15 20 25 30 35 40 45 50 m

Last modified: November 10, 2020 By tgr171

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C	ISSUED FOR IQA REVIEW				02/10/2020
B	ISSUED FOR WORKSHOP				-
A	DRAFT FOR COMMENT				-

SURVEYED	-	-
DESIGNED	s 9(2)(a)	10/2020
DRAWN	s 9(2)(a)	10/2020
CAD REVIEW	s 9(2)(a)	10/2020
DESIGN CHECK	s 9(2)(a)	10/2020
DESIGN REVIEW	s 9(2)(a)	10/2020
APPROVED	s 9(2)(a)	10/2020
PROF REGISTRATION:	-	

Client: Stantec · WAKA KOTAHI NZ TRANSPORT AGENCY · wsp · ably

FRANKTON IMPROVEMENTS
GRANT RD TO JOE O'CONNELL DR

SH6/GRANT RD INTERSECTION
CONCEPT DESIGN

Status Stamp: **FINAL**
Date Stamp: **16/11/2020**
Scales: 1:500 (A1), 1:1000 (A3)
Drawing No.: 6-XT014.64-WSP-01-Z02-DR-C-5103
Rev.: D

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DO NOT SCALE - IF IN DOUBT, ASK

ORIGINAL SIZE **A1**

Last modified: November 4, 2020 By tgr171

FRANKTON ROAD (SH6A)

FRANKTON-LADIES MILE HIGHWAY (SH6)

GRAY STREET

McBRIDE STREET

DRIVING RANGE

JOINLINE SEE SHEET SET Z02

JOINLINE SEE SHEET SET Z04

JOINLINE REFERENCE DRAWING: 6-XT014.40-WSP-01-ZZ-DR

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1:500 @ A1
1:1000 @ A3
0 5 10 15 20 25 30 35 40 45 50 m

REV	REVISIONS	DRN	CHK	APP	DATE
D	FINAL	s 9(2)(a)	s 9(2)(a)	s 9(2)(a)	6/11/2020
C	ISSUED FOR IQA REVIEW				02/10/2020
B	ISSUED FOR WORKSHOP				-
A	DRAFT CONCEPT				-

SURVEYED	-	-
DESIGNED	s 9(2)(a)	10/2020
DRAWN	s 9(2)(a)	10/2020
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DESIGN CHECK	s 9(2)(a)	10/2020
DESIGN REVIEW	s 9(2)(a)	10/2020
APPROVED	s 9(2)(a)	10/2020
PROF REGISTRATION:	-	

Client:

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FRANKTON IMPROVEMENTS
FRANKTON INTERSECTION

CONCEPT DESIGN
PLAN VIEW

Status Stamp: **FINAL**

Date Stamp: **16/11/2020**

Scales: 1:500 (A1). 1:1000 (A3)

Drawing No.: 6-XT014.64-WSP-01-Z03-DR-C-5101

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FUTURE BUS HUB EXPANSION

KAWARAU ROAD (SH6)

JOINLINE SEE SHEET SET Z03

JOINLINE SEE SHEET SET Z05

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DO NOT SCALE - IF IN DOUBT, ASK

200 mm 150 100 90 80 70 60 50 40 30 20 10 0

ORIGINAL SIZE A1

Last modified: November 4, 2020 By tgr171

REV	REVISIONS	DATE
D	FINAL	16/11/2020
C	ISSUED FOR IQA REVIEW	02/10/2020
B	ISSUED FOR WORKSHOP	-
A	DRAFT FOR COMMENT	-

s 9(2)(a)

SURVEYED	-	-
DESIGNED	s 9(2)(a)	10/2020
DRAWN	s 9(2)(a)	10/2020
CAD REVIEW	s 9(2)(a)	10/2020
DESIGN CHECK	s 9(2)(a)	10/2020
DESIGN REVIEW	s 9(2)(a)	10/2020
APPROVED	s 9(2)(a)	10/2020
PROF REGISTRATION:	-	

Client: Stantec WAKA KOTAHI NZ TRANSPORT AGENCY WSP ABLEY

FRANKTON IMPROVEMENTS
SH6/KAWARAU RD - BUS HUB

CONCEPT DESIGN
OPTION 1

Status Stamp: FINAL

Date Stamp: 02/10/2020

Scales: 1:500 (A1), 1:1000 (A3)

Drawing No.: 6-XT014.64-WSP-01-Z04-DR-C-5101

Rev.: D

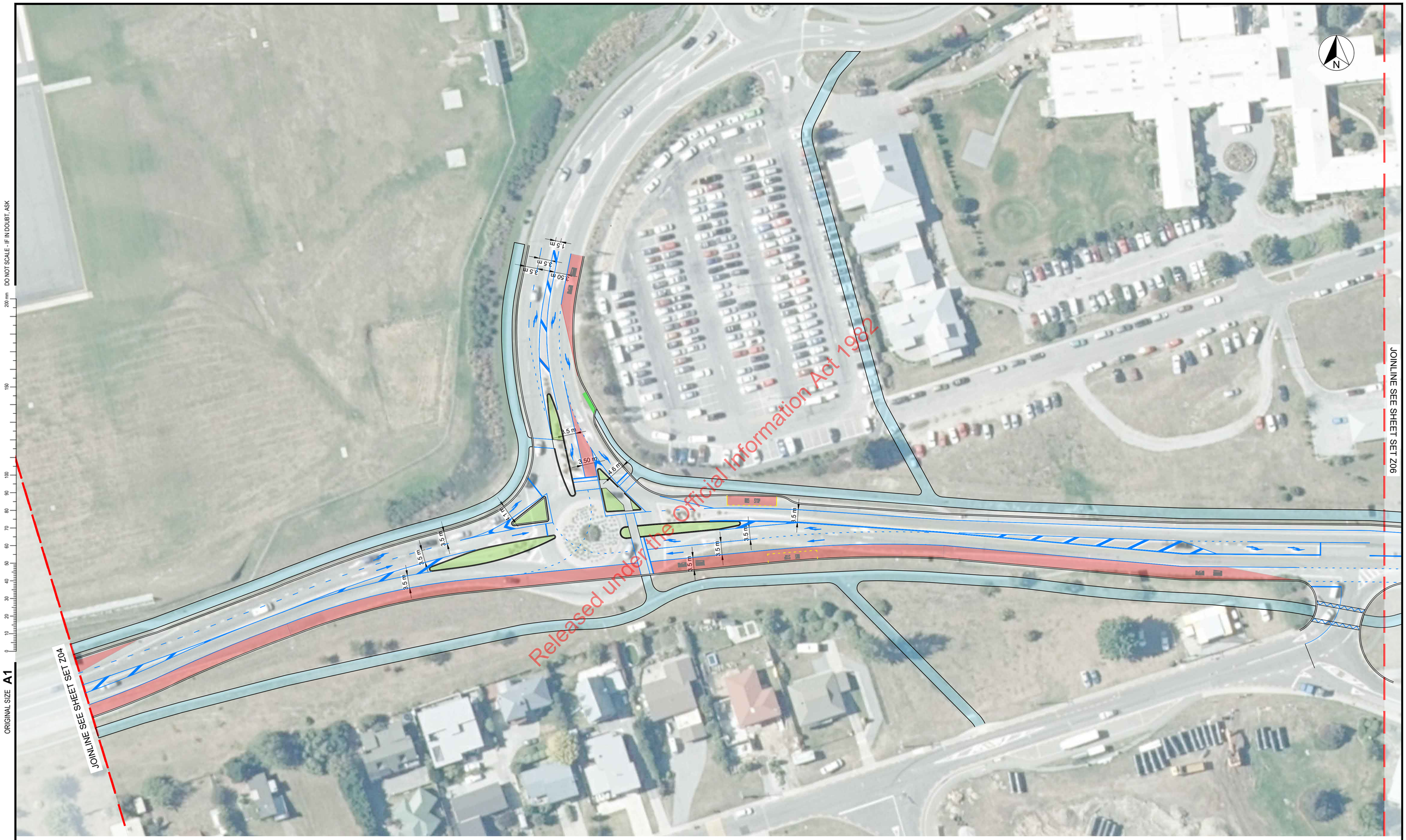
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DO NOT SCALE - IF IN DOUBT, ASK

ORIGINAL SIZE **A1**

Last modified: November 4, 2020 By tgr171



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1:250 @ A1
1:500 @ A3
0 4 8 12 16 20 24 m

REV	REVISIONS	DRN	CHK	APP	DATE
D	FINAL	s 9(2)(a)			16/11/2020
C	ISSUED FOR IQA REVIEW				02/10/2020
B	ISSUED FOR WORKSHOP				-
A	DRAFT FOR COMMENT				-

SURVEYED	-	-
DESIGNED	s 9(2)(a)	10/2020
DRAWN	s 9(2)(a)	10/2020
CAD REVIEW	s 9(2)(a)	10/2020
DESIGN CHECK	s 9(2)(a)	10/2020
DESIGN REVIEW	s 9(2)(a)	10/2020
APPROVED	s 9(2)(a)	10/2020
PROF REGISTRATION:	-	

Client:

Stantec

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp

abley

FRANKTON IMPROVEMENTS
SH6/LUCAS PLACE

SH6/LUCAS PL INTERSECTION
CONCEPT DESIGN

Status Stamp: **FINAL**

Date Stamp: **16/11/2020**

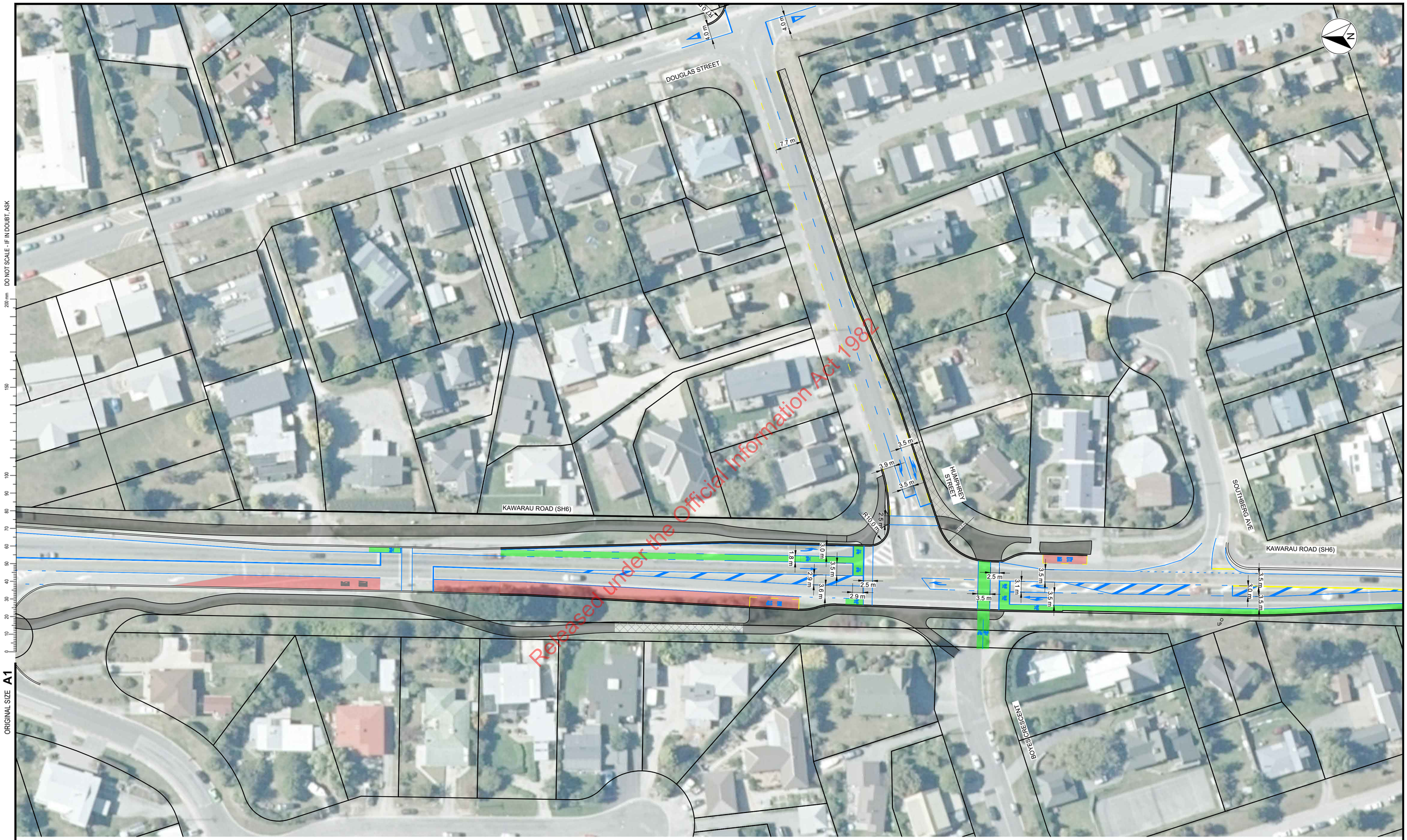
Scales: 1:500 (A1), 1:1000 (A3)

Drawing No.: 6-XT014.64-WSP-01-Z05-DR-C-5101

Rev.: D

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1:500 @ A1
1:1000 @ A3
0 5 10 15 20 25 30 35 40 45 50 m

DO NOT SCALE - IF IN DOUBT, ASK

200 mm 150 100 90 80 70 60 50 40 30 20 10 0

ORIGINAL SIZE A1

Last modified: November 4, 2020 By tgr171

REV	REVISIONS	DRN	CHK	APP	DATE
C	FINAL	s 9(2)(a)			16/11/2020
B	ISSUED FOR IQA REVIEW				02/10/2020
A	DRAFT FOR COMMENT				-

SURVEYED	-	-
DESIGNED	s 9(2)(a)	10/2020
DRAWN	s 9(2)(a)	10/2020
CAD REVIEW	s 9(2)(a)	10/2020
DESIGN CHECK	s 9(2)(a)	10/2020
DESIGN REVIEW	s 9(2)(a)	10/2020
APPROVED	s 9(2)(a)	10/2020
PROF REGISTRATION:	-	

Client:

Stantec

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp

abley

FRANKTON IMPROVEMENTS
HUMPHREY STREET

CONCEPT DESIGN
OPTION 1 - SHEET 1 OF 2

Status Stamp: **FINAL**

Date Stamp: **16/11/2020**

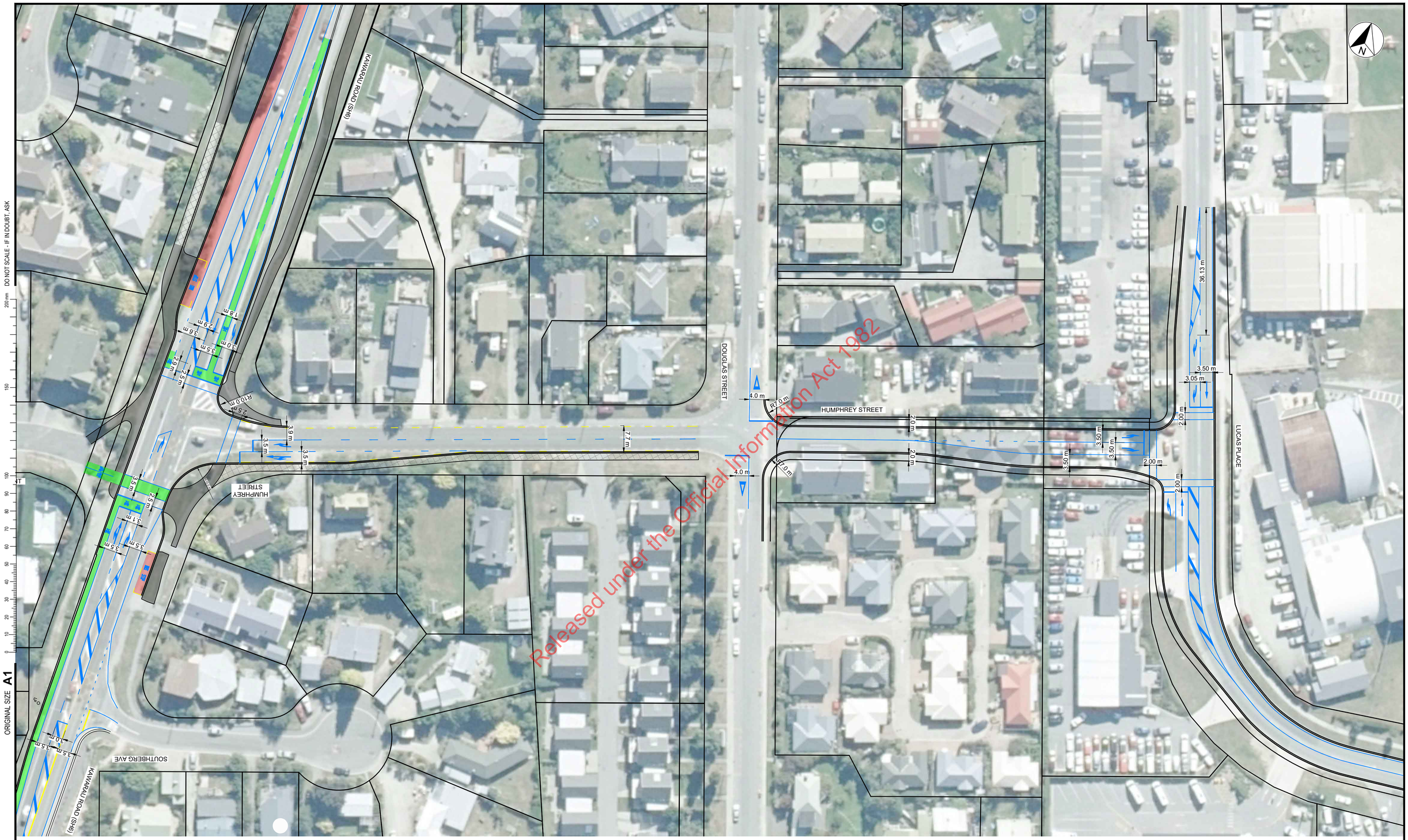
Scales: 1:500 (A1), 1:1000 (A3)

Drawing No.: 6-XT014.64-WSP-01-Z06-DR-C-5101

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REV	REVISIONS	DRN	CHK	APP	DATE
C	FINAL	s 9(2)(a)			6/11/2020
B	ISSUED FOR IQA REVIEW				02/10/2020
A	DRAFT FOR COMMENT				

SURVEYED	-	-
DESIGNED	s 9(2)(a)	10/2020
DRAWN	s 9(2)(a)	10/2020
CAD REVIEW	s 9(2)(a)	10/2020
DESIGN CHECK	s 9(2)(a)	10/2020
DESIGN REVIEW	s 9(2)(a)	10/2020
APPROVED	s 9(2)(a)	10/2020
PROF REGISTRATION:	-	

Client: Stantec, WAKA KOTAHI NZ TRANSPORT AGENCY, wsp, ably

FRANKTON IMPROVEMENTS
HUMPHREY STREET

CONCEPT DESIGN
OPTION 1 - SHEET 2 OF 2

Status Stamp: **FINAL**
Date Stamp: **16/11/2020**
Scales: 1:250 (A1), 1:500 (A3)
Drawing No.: 6-XT014.64-WSP-01-ZZ-DR-C-5102
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