Appendix C15 Environmental and Social Responsibility

Frankton to Queenstown

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Frankton to Queenstown - Single Stage Business Case – Social and Environmental Responsibility Screen

1 Introduction

The following report reviews the shortlisted interventions for the Frankton to Queenstown Single Stage Business Case against Waka Kotahi NZ Transport Agency's Social and Environmental Responsibility Screen.

The shortlisted options are as follows:

- Do Minimum – no widening of SH6A
- Virtual/Priority/Queue jump – requires minor localised widening of SH6A
- Trackless Tram – requires considerable widening of SH6A
- 4-laning of Frankton Road – requires considerable widening of SH6A
- Mass Rapid Transit– see separate screen*

Of these five options, the first four revolve around the utilisation of the existing SH6A corridor, with variations on widening of the existing corridor. The fifth option is an 'offline' option involving mass rapid transit (gondola/ferries) and hence is assessed separately.

Other elements of the project are likely to consist of:

- Upgrading of side streets/new or upgraded intersections
- Large retaining structures/cuts/fills
- Pedestrian and cyclist infrastructure
- Landscaping/streetscaping
- Lighting
- Demolition of buildings
- Removal of vegetation
- Potential for 3 waters/utilities upgrades as part of the project.

Given the location of the four options in or adjacent to the existing corridor we have assessed the corridor in its entirety in terms of the screening exercise ('broad screen), then identified for reach option, which items identified in the 'broad screen' are impacted.

2 Planning Context

The planning context applying to the existing SH6A corridor is summarised below:

2.1 Operative Queenstown Lakes District Plan – Relevant Provisions

2.1.1 Zoning and Overlays

The following zoning and overlays apply to land adjacent to the existing SH6A corridor:

- Low Density Residential Zone
- High Density Residential Zone
- Suburban Shopping Zone

2.1.2 Designations

A number of designations are located adjoining the existing SH6A corridor:

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Identifier	Requiring Authority	Notation
154	QLDC	Recreation Reserve
165	QLDC	Frankton Marina Local Purpose Reserve
200	QLDC	Recreation Reserve
228	QLDC	Local Purpose Reserve
286	QLDC	Recreation Reserve

2.1.3 Protected Features

The following protected features may be affected by the project as identified in the PDP:

Identifier	Protected Trees
240	Eucalyptus gunni trees (x2) (Sherwood Manor)

2.2 Proposed Queenstown Lakes District Plan – Relevant Provisions

2.2.1 Zoning and Overlays

The following zoning and overlays apply to land adjacent to the existing SH6A corridor:

- Lower Density Residential Zone
- High Density Residential Zone
- Informal Recreation Zone

Land potentially affected by 'offline' options is additionally zoned:

- Water Zone
- Rural General Zone

2.2.2 Designations

A number of designations are located adjoining the existing SH6A corridor:

Identifier	Requiring Authority	Notation
154	QLDC	Recreation Reserve
165	QLDC	Frankton Marina Local Purpose Reserve
200	QLDC	Tree Planting Reserve
228	QLDC	Recreation Reserve

2.2.3 Protected Features

The following protected features may be affected by the project as identified in the PDP:

Identifier	Protected Trees
240	Eucalyptus gunni trees (x2) (Sherwood Manor)

2.3 Regional Plan – Water for Otago Relevant Provisions

There are some minor watercourses that flow under SH6A that originate on the slopes above SH6A. Some of the widening options may require works within these watercourses, such as culvert extensions, however none of these watercourses are considered to be of high value and any works here are unlikely to require complex consenting

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considerations. The major widening options may also require retaining structures that will need to occupy the lake margins/bed in some discrete locations.

3 Key Effects for Consideration – Broad Screen

In progressing the necessary approvals for the project under the RMA the following effects will need to be assessed and methods proposed to avoid, remedy or mitigate any environmental effects (the below effects headings are taken from the Social and Environmental Responsibility Screen developed by the Transport Agency).

Effect	Comment
Natural Environment	• Lake Wakatipu also has considerable value both from a habitat and landscape perspective. Lake Wakatipu is also subject to the Kawarau River Water Conservation Order (1997). • Reclamation of the lake would have considerable environmental impacts. • Ferries would require considerable 'lakeside' infrastructure.
Cultural and Historic Heritage	• Lake Wakatipu was probably utilised as a māhika kai for inland bird species by Kai Tahu prior to European arrival. Lake Wakatipu is also a Statutory Acknowledgement under the Ngāi tahu Claims Settlement Act 1998. • 2 listed trees are located along the route that have specific protection under the district plan. Other QLDC street trees will also require removal.
Human Health	• There are a multitude of sensitive receivers adjacent to or in close proximity to the route predominantly residential properties and visitor accommodation. • Generally speaking in terms of the residential zonings adjacent to SH6A, the lakeside of SH6A is High Density Residential, and the uphill side is Low Density Residential. • Those options that take land will bring traffic on SH6A closer to existing properties including residential properties and visitor accommodation. This will bring an increase in noise and vibration effects, some of which may not be able to be adequately mitigated. Widening of the corridor into the high density residential zoned land increases the theoretical number of individuals exposed to higher noise levels due to the density of development anticipated in this zone (as opposed to the Lower Density Residential Zoned Land). • The widening options will also require a change to the current lighting environment along the route, potentially affecting dwellings and visitor accommodation.
Social	• The project will also require land currently recreation reserve of various status'. The social values of the community with regards to the recreation reserve land will need to be addressed. • Access to properties also impacted, with the potential for some residential properties to be purchased in their entirety.
Landscape and Urban Design	• The project offers some opportunities to enhance urban character / urban realm adjacent to the existing corridor. • The gondola option could give rise to high levels of visual and landscape effects depending on alignment.

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4 Option Screening

The below table summarizes (broadly) the effects associated with each option

	Risks and Impacts			LOW	MEDIUM	HIGH
Option	Natural Environment	Cultural and Historic Heritage	Human Health	Social	Landscape and Urban Design	
1 - Do Min						
2 - Virtual Priority						
3 - Trackless Tram						
4 - 4 Laning						

5 Technical Assessments

In terms of matters identified in through the Social and Environmental Responsibility Screen the following technical assessments will be required as the project advances, depending on the option chosen. Note that there may be other Council projects advanced concurrently that may address some of these issues (i.e. Project Manawa). Understanding the necessary mitigation in a number of areas (particularly noise) is considered critical.

- An ecological assessment will be required with regards to the activity in proximity to/within Lake Wakatipu (Option 4)
- Archaeological/Heritage impact assessment (Options 2-4)
- Arbour-cultural assessment on those Protected Trees in proximity to the route or to be removed as part of the project (Option 4)
- Cultural Impact Assessment (potentially – may be avoided through engagement with Iwi)
- Noise impact assessment – current and future noise environment, mitigation (Options 2-4).
- Preliminary Site Investigation/Detailed Site Investigation with regards to potentially contaminated sites along the arterial route.
- Landscape/urban design assessment with regards to the impacts of the project on the existing streetscape (Options 2-4)
- Lighting impact assessment (both in terms of streetlighting but also in relation to the light spill from vehicles) (options 2)

Additional to this, other likely technical assessments required include:

- Geotechnical assessment – retaining structures, cuts and fills.

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ENVIRONMENTAL AND SOCIAL RESPONSIBILITY SCREEN V2.FEBRUARY 2016

Use to assess options in the Indicative Business Case

Use this screen to identify opportunities and risks and assess options for state highway projects. Complete the screen for each option to distinguish them from one another or bundle options where appropriate. Screen results will signal where technical assessments are required and provide a written record to support the alternatives assessment required for statutory applications. For further assistance contact the EUD Team.

Additional instructions and content, including information sources, to help complete the screen can be found on the Highways Information Portal Screen pages here

Decide how many times screen should be filled out (Group Options) ▶ Answer screen questions using project information and suggested information sources ▶ Refer to screen questions explanation, particularly if you answered yes to any of the questions ▶ Complete page 2 of screen ▶ Incorporate page 2 text in IBC assessment of options table (Background and MCA)

PROJECT LOCATION: PROJECT PURPOSE: DATE: OPTION DESCRIPTION:

CATEGORY		QUESTION	ANSWER		USEFUL INFORMATION SOURCES
GENERAL	G1	What is the zoning of adjacent land? Are there any encumbrances on the land? e.g. Maori Reserve or other reserve/covenants	Rural	Commercial	District/Unitary Plan Zoning Maps
			Industrial	Residential	
			High density residential	Parks/open space	
	G2	Does the option disturb previously undisturbed land?	Y	N	
	G3	What is the construction timeframe?	>18 months	<18 months	
NATURAL ENVIRONMENT	NE1	Are there any outstanding/significant natural features (e.g. geological or geothermal)/landscapes?	Y	N	NZTA MapHub Environmental and Social Risk Map- Natural Environment
	NE2	Will the option affect the coastal marine area, wetlands, lakes, rivers, streams or their margins?	Y	N	Regional Plan Maps and Schedules
	NE3	Will the option affect areas of the conservation estate, or areas of known significance for biodiversity or known habitats of uncommon or threatened species?	Y	N	District Plan Maps and Schedules
	NE4	Is the option in an area of potential hazard risk e.g. fault lines, significant erosion, flooding, sea level rise etc?	Y	N	Department of Conservation
	NE5	Will more than 0.5 hectares of vegetation be removed?	Y	N	
		What type?			
CULTURAL AND HISTORIC HERITAGE	CH1	Are there sites/areas of significance to Maori within 200m of the area of interest?	Y	N	Iwi NZTA MapHub Environmental and Social Risk Map- Culture and Heritage Heritage New Zealand List NZ Archaeological Association District Plan Maps and Schedules Regional Plan Maps and Schedules IPENZ Heritage List NZTA GIS predictive models
	CH2	Are any recorded, scheduled or listed archaeological sites within 200m of the area of interest?	Y	N	
	CH3	Are any scheduled, listed or other important heritage buildings/ structures within 200m of the area of interest?	Y	N	
	CH4	Will the option affect the setting of any historic building/structure or archaeological site?	Y	N	
	CH5	Is a group of archaeological sites or an area of historic built environment (even partially) within 200m of the area of interest?	Y	N	
HUMAN HEALTH	HH1	What is the One Network Road Classification?	National	Regional	NZTA MapHub Environmental and Social Risk Maps- Human Health and Community which includes: - Designated airsheds (including one network classification) - Highly sensitive receivers Regional Council Contaminated sites Team
			Arterial	Collector	
	HH2	Is the area of interest designated as a non-compliant airshed?	Y	N	
	HH3	Are there medical sites, rest homes, schools, child care sites, residential properties, maraes or other sensitive receivers located within 200m of the area of interest?	Y	N	
	HH4	Does land use within 200m of the area of interest include industrial sites, chemical manufacturing or storage, petrol stations, vehicle maintenance, timber processing/treatment, substations, rail yards, landfills or involve other activities that may result in ground contamination? OR Are there HAIL or SLUR (contaminated) sites within 200m of the area of interest?	Y	N	
SOCIAL	S1	Does the option affect access to community facilities i.e. libraries, open space etc (either temporarily or permanently)?	Y	N	NZTA MapHub Project Team District Plan Maps Council and Community Strategy Documents
			Which?		
	S2	Does the option affect community cohesion and accessibility including vehicular connectivity on the local road network?	Y	N	
URBAN AND LANDSCAPE DESIGN	ULD 1	Are there opportunities to enhance infrastructure for, and/or improve access to, public transport and/or active modes of travel such as as walking and cycling?	Y	N	NZTA MapHub Environmental and Social Risk Map- Natural Environment (Scenic Routes) Regional Land Transport Plan Project Team Strategies and District Plan
	ULD2	Does the option enhance the development potential of adjacent land where appropriate?	Y	N	
	ULD3	Is the option located on a themed highway? Is the option part of or near a national cycle or walking route?	Y	N	
	ULD4	Are there opportunities to enhance the urban character, landscape character and visual amenity?	Y	N	

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Answers and Comments	Refer to screen questions explanation to help complete this part.

1. **Summarize the potential environmental and social risks/impacts associated with this option. Consider short and long term risks and impacts.**

NATURAL ENVIRONMENT:

CULTURAL AND HISTORIC HERITAGE:

HUMAN HEALTH:

SOCIAL:

The responses above will be used in the IBC assessment of options summary table: MCA of the Option.

URBAN AND LANDSCAPE DESIGN:

Incorporate the relevant comments from above into the economy, social and geography sections of the IBC assessment of options summary table.

2. **What are the environmental, social integration, landscape design or urban design benefits or opportunities presented by this option? Particularly record opportunities that could be lost if not considered early in the design process.**

3. **Are there any impacts, risks or opportunities which require preliminary technical assessments to help understand risks or opportunities? Is further information required to support the development of the detailed business case or can it be left until the detailed business case/pre-implementation?**

Completed by	s 9(2)(a)	
Reviewed by NZTA Project Manager		
Incorporated results into IBC assessment of options summary table?	**Yes**	**No**

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ENVIRONMENTAL AND SOCIAL RESPONSIBILITY SCREEN V2.FEBRUARY 2016

Use to assess options in the Indicative Business Case

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Additional instructions and content, including information sources, to help complete the screen can be found on the Highways Information Portal Screen pages here

Decide how many times screen should be filled out (Group Options) ▶ Answer screen questions using project information and suggested information sources ▶ Refer to screen questions explanation, particularly if you answered yes to any of the questions ▶ Complete page 2 of screen ▶ Incorporate page 2 text in IBC assessment of options table (Background and MCA)

PROJECT LOCATION: PROJECT PURPOSE: DATE: OPTION DESCRIPTION:

CATEGORY		QUESTION	ANSWER		USEFUL INFORMATION SOURCES
GENERAL	G1	What is the zoning of adjacent land? Are there any encumbrances on the land? e.g. Maori Reserve or other reserve/covenants	Rural	Commercial	District/Unitary Plan Zoning Maps
			Industrial	Residential	
			High density residential	Parks/open space	
	G2	Does the option disturb previously undisturbed land?	Y	N	
	G3	What is the construction timeframe?	>18 months	<18 months	
NATURAL ENVIRONMENT	NE1	Are there any outstanding/significant natural features (e.g. geological or geothermal)/landscapes?	Y	N	NZTA MapHub Environmental and Social Risk Map- Natural Environment
	NE2	Will the option affect the coastal marine area, wetlands, lakes, rivers, streams or their margins?	Y	N	Regional Plan Maps and Schedules
	NE3	Will the option affect areas of the conservation estate, or areas of known significance for biodiversity or known habitats of uncommon or threatened species?	Y	N	District Plan Maps and Schedules
	NE4	Is the option in an area of potential hazard risk e.g. fault lines, significant erosion, flooding, sea level rise etc?	Y	N	Department of Conservation
	NE5	Will more than 0.5 hectares of vegetation be removed?	Y	N	
		What type?			
CULTURAL AND HISTORIC HERITAGE	CH1	Are there sites/areas of significance to Maori within 200m of the area of interest?	Y	N	Iwi NZTA MapHub Environmental and Social Risk Map- Culture and Heritage Heritage New Zealand List NZ Archaeological Association District Plan Maps and Schedules Regional Plan Maps and Schedules IPENZ Heritage List NZTA GIS predictive models
	CH2	Are any recorded, scheduled or listed archaeological sites within 200m of the area of interest?	Y	N	
	CH3	Are any scheduled, listed or other important heritage buildings/ structures within 200m of the area of interest?	Y	N	
	CH4	Will the option affect the setting of any historic building/structure or archaeological site?	Y	N	
	CH5	Is a group of archaeological sites or an area of historic built environment (even partially) within 200m of the area of interest?	Y	N	
HUMAN HEALTH	HH1	What is the One Network Road Classification?	National	Regional	NZTA MapHub Environmental and Social Risk Maps- Human Health and Community which includes: - Designated airsheds (including one network classification) - Highly sensitive receivers Regional Council Contaminated sites Team
			Arterial	Collector	
	HH2	Is the area of interest designated as a non-compliant airshed?	Y	N	
	HH3	Are there medical sites, rest homes, schools, child care sites, residential properties, maraes or other sensitive receivers located within 200m of the area of interest?	Y	N	
	HH4	Does land use within 200m of the area of interest include industrial sites, chemical manufacturing or storage, petrol stations, vehicle maintenance, timber processing/treatment, substations, rail yards, landfills or involve other activities that may result in ground contamination? OR Are there HAIL or SLUR (contaminated) sites within 200m of the area of interest?	Y	N	
SOCIAL	S1	Does the option affect access to community facilities i.e. libraries, open space etc (either temporarily or permanently)?	Y	N	NZTA MapHub Project Team District Plan Maps Council and Community Strategy Documents
			Which?		
	S2	Does the option affect community cohesion and accessibility including vehicular connectivity on the local road network?	Y	N	
URBAN AND LANDSCAPE DESIGN	ULD 1	Are there opportunities to enhance infrastructure for, and/or improve access to, public transport and/or active modes of travel such as as walking and cycling?	Y	N	NZTA MapHub Environmental and Social Risk Map- Natural Environment (Scenic Routes) Regional Land Transport Plan Project Team Strategies and District Plan
	ULD2	Does the option enhance the development potential of adjacent land where appropriate?	Y	N	
	ULD3	Is the option located on a themed highway? Is the option part of or near a national cycle or walking route?	Y	N	
	ULD4	Are there opportunities to enhance the urban character, landscape character and visual amenity?	Y	N	

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Answers and Comments	Refer to screen questions explanation to help complete this part.

1. **Summarize the potential environmental and social risks/impacts associated with this option. Consider short and long term risks and impacts.**

NATURAL ENVIRONMENT:

CULTURAL AND HISTORIC HERITAGE:

HUMAN HEALTH:

SOCIAL:

The responses above will be used in the IBC assessment of options summary table: MCA of the Option.

URBAN AND LANDSCAPE DESIGN:

Incorporate the relevant comments from above into the economy, social and geography sections of the IBC assessment of options summary table.

2. **What are the environmental, social integration, landscape design or urban design benefits or opportunities presented by this option? Particularly record opportunities that could be lost if not considered early in the design process.**

3. **Are there any impacts, risks or opportunities which require preliminary technical assessments to help understand risks or opportunities? Is further information required to support the development of the detailed business case or can it be left until the detailed business case/pre-implementation?**

Completed by	s 9(2)(a)	
Reviewed by NZTA Project Manager		
Incorporated results into IBC assessment of options summary table?	**Yes**	**No**

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Frankton

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Frankton Single Stage Business Case – Social and Environmental Responsibility Screen

1 Introduction

The following report reviews the shortlisted interventions for the Frankton Single Stage Business Case against Waka Kotahi NZ Transport Agency's Social and Environmental Responsibility Screen.

The elements of the project are likely to consist of:

- Traffic management/traffic calming introduced to prevent north-south through trips (between Ross Street and Gray Street).
- Signalise and ban movements to/from McBride Street.
- Upgraded SH6/SH6A Roundabout
- New Public Transport Hub on the Frankton Golf Course site.
- Lucas Place - Signalised T intersection with bus priority measures (may need to shift south slightly to accommodate future MRT).
- SH6 Kawarau Road (Ross St to Kawarau Falls Bridge) - Fairly minor works through this section, relatively modest intersection works, northbound bus lane and improved ped/cycle crossings across SH6 (to reduce severance).
- SH6/Humphrey Street - Signalise intersection future proofed for possible 4-leg intersection to connect to Boyes Crescent and down to the lake (ferry access). Signalised primarily for pedestrian and cycle access across SH6.
- Humphrey Street Link (SH6 to Lucas Place) - Connection through from Humphrey/Douglas Street intersection to Lucas Place (and potential future connection into airport). Repurpose Robertson Street as residential and active travel link.

Given the location of the four options in or adjacent to the existing corridor we have assessed the corridor in its entirety in terms of the screening exercise ('broad screen), then identified for reach option, which items identified in the 'broad screen' are impacted.

2 Planning Context

The planning context applying to the existing SH6 and surrounds corridor is summarised below:

2.1 Operative Queenstown Lakes District Plan – Relevant Provisions

2.1.1 Zoning and Overlays

The following zoning and overlays apply to land adjacent to the existing SH6A corridor:

- Low Density Residential Zone
- Airport Mixed Use Zone
- Suburban Shopping Zone
- Rural General

2.1.2 Designations

A number of designations are located adjoining the existing SH6 corridor identified in the ODP:

Identifier	Requiring Authority	Notation
2	Queenstown Airport Corporation Limited	Aerodrome Purposes.

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Identifier	Requiring Authority	Notation
29	QLDC	Multi-purpose indoor and outdoor recreation, cultural and conference complex.
155	QLDC	Recreation Reserve
164	QLDC	Local Purpose Reserve (beautification)

2.1.3 Protected Features

The following protected features may be affected by the project as identified in the ODP:

Identifier	Item
47	Frankton Cemetery Walls and Gates
49	Brunswick Flour Mill Turbine and Stone Buildings

2.2 Proposed Queenstown Lakes District Plan – Relevant Provisions

2.2.1 Zoning and Overlays

The following zoning and overlays apply to land adjacent to the existing SH6A corridor:

- Lower Density Residential
- Informal Recreation
- Open Space – Community Purposes
- Rural General
- Airport Mixed Use
- Community Shopping Centre

2.2.2 Designations

A number of designations are located adjoining the existing SH6A corridor:

Identifier	Requiring Authority	Notation
2	Queenstown Airport Corporation Limited	Aerodrome Purposes.
29	QLDC	Multi-purpose indoor and outdoor recreation, cultural and conference complex.
155	QLDC	Recreation Reserve
164	QLDC	Local Purpose Reserve (beautification)

2.2.3 Protected Features

The following protected features may be affected by the project as identified in the PDP:

Identifier	Item
47	Frankton Cemetery Walls and Gates
49	Brunswick Flour Mill Turbine and Stone Buildings

2.3 Regional Plan – Water for Otago Relevant Provisions

There are no watercourses in the vicinity of the site likely to be affected by the proposed works.

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3 Key Effects for Consideration

In progressing the necessary approvals for the project under the RMA the following effects will need to be assessed and methods proposed to avoid, remedy or mitigate any environmental effects (the below effects headings are taken from the Social and Environmental Responsibility Screen developed by the Transport Agency).

Effect	Comment
Natural Environment	• The proposed works will not adversely affect any significant natural features, natural hazard or any significant vegetation. • The existing Frankton Golf Course is reserve land and will be impacted by the proposed roundabout and public transport hub options.
Cultural and Historic Heritage	• There are no identified areas or features of archaeological or cultural heritage within the project area. Two identified items, being the Frankton Cemetery Walls and Gates and the Brunswick Flour Mill Turbine and Stone Buildings are listed in the district plan as a historic site. These structures will be unaffected by the proposed works.
Human Health	• Whilst there are community facilities - schools, rest homes, childcare, medical, shopping and residential land uses within the vicinity of the proposal, there is limited change to the scale of activity from the existing at present. The major exception to this is the Humphrey Street extension which will introduce a new road adjacent to existing residential properties. It will also require relocation of the Fire Station. • Whilst there are potential HAIL sites in the vicinity of the proposed works, it is highly unlikely there will be a disturbance of contaminated land.
Social	• The proposal may affect access to a number of businesses and facilities during construction. • Following completion there will not be any ongoing effects on access. Some sites will have enhanced access provision.
Landscape and Urban Design	• There are no sensitive landscapes impacted by the proposed works. • The works will provide opportunities some urban realm enhancements.

4 Option Screening

The below table summarizes (broadly) the effects associated with each option

	Risks and Impacts			**LOW**	**MEDIUM**	**HIGH**
Option	Natural Environment	Cultural and Historic Heritage	Human Health	Social	Landscape and Urban Design	
Frankton traffic calming						
McBride Street						
SH6/6A Roundabout						

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	Risks and Impacts			LOW	MEDIUM	HIGH
Option	Natural Environment	Cultural and Historic Heritage	Human Health	Social	Landscape and Urban Design	
Public Transportation Hub						
Ross St to Kawarau Falls Bridge						
Lucas Place						
SH6/Humphrey Street						
Humphrey Street Link						

5 Technical Assessments

In terms of matters identified in through the Social and Environmental Responsibility Screen the following technical assessments will be required as the project advances,

- Noise impact assessment – current and future noise environment in relation to the Humphrey Street Extension.
- Given the loss of open space on both sides of SH6 from the Public Transport Hub some
- As identified for the other business cases, a 'global' archaeological authority for the works should be considered.
- Preliminary Site Investigation/Detailed Site Investigation with regards to potentially contaminated sites.

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QUALITY STATEMENT

PROJECT MANAGER	PROJECT TECHNICAL LEAD
s 9(2)(a)	s 9(2)(a)

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s 9(2)(a)	18/06/2020
REVIEWED BY	
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APPROVED FOR ISSUE BY	
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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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ENVIRONMENTAL AND SOCIAL RESPONSIBILITY SCREEN V2.JUNE 2015

Use to assess options in the Indicative Business Case

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CATEGORY		QUESTION	ANSWER		USEFUL INFORMATION SOURCES
GENERAL	G1	What is the zoning of adjacent land? Are there any encumbrances on the land? e.g. Maori Reserve or other reserve/covenants	Rural	Commercial	District/Unitary Plan Zoning Maps
			Industrial	Residential	
			High density residential	Parks/open space	
	G2	Does the option disturb previously undisturbed land?	Y	N	
	G3	What is the construction timeframe?	>18 months	<18 months	
NATURAL ENVIRONMENT	NE1	Are there any outstanding/significant natural features (e.g. geological or geothermal)/landscapes?	Y	N	NZTA MapHub Environmental and Social Risk Map- Natural Environment
	NE2	Will the option affect the coastal marine area, wetlands, lakes, rivers, streams or their margins?	Y	N	Regional Plan Maps and Schedules
	NE3	Will the option affect areas of the conservation estate, or areas of known significance for biodiversity or known habitats of uncommon or threatened species?	Y	N	District Plan Maps and Schedules
	NE4	Is the option in an area of potential hazard risk e.g. fault lines, significant erosion, flooding, sea level rise etc?	Y	N	Department of Conservation
	NE5	Will more than 0.5 hectares of vegetation be removed?	Y	N	
		What type?			
CULTURAL AND HISTORIC HERITAGE	CH1	Are there sites/areas of significance to Maori within 200m of the area of interest?	Y	N	Iwi NZTA MapHub Environmental and Social Risk Map- Culture and Heritage Heritage New Zealand List NZ Archaeological Association District Plan Maps and Schedules Regional Plan Maps and Schedules IPENZ Heritage List NZTA GIS predictive models
	CH2	Are any recorded, scheduled or listed archaeological sites within 200m of the area of interest?	Y	N	
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	CH5	Is a group of archaeological sites or an area of historic built environment (even partially) within 200m of the area of interest?	Y	N	
HUMAN HEALTH	HH1	What is the One Network Road Classification?	National	Regional	NZTA MapHub Environmental and Social Risk Maps- Human Health and Community which includes: - Designated airsheds (including one network classification) - Highly sensitive receivers Regional Council Contaminated sites Team
			Arterial	Collector	
	HH2	Is the area of interest designated as a non-compliant airshed?	Y	N	
	HH3	Are there medical sites, rest homes, schools, child care sites, residential properties, maraes or other sensitive receivers located within 200m of the area of interest?	Y	N	
	HH4	Does land use within 200m of the area of interest include industrial sites, chemical manufacturing or storage, petrol stations, vehicle maintenance, timber processing/treatment, substations, rail yards, landfills or involve other activities that may result in ground contamination?	Y	N	
		OR Are there HAIL or SLUR (contaminated) sites within 200m of the area of interest?	Y	N	
SOCIAL	S1	Does the option affect access to community facilities i.e. libraries, open space etc (either temporarily or permanently)?	Y	N	NZTA MapHub Project Team District Plan Maps Council and Community Strategy Documents
			Which?		
	S2	Does the option affect community cohesion and accessibility including vehicular connectivity on the local road network?	Y	N	
URBAN AND LANDSCAPE DESIGN	ULD 1	Are there opportunities to enhance infrastructure for, and/or improve access to, public transport and/or active modes of travel such as as walking and cycling?	Y	N	NZTA MapHub Environmental and Social Risk Map- Natural Environment (Scenic Routes) Regional Land Transport Plan Project Team Strategies and District Plan
	ULD2	Does the option enhance the development potential of adjacent land where appropriate?	Y	N	
	ULD3	Is the option located on a themed highway? Is the option part of or near a national cycle or walking route?	Y	N	
	ULD4	Are there opportunities to enhance the urban character, landscape character and visual amenity?	Y	N	

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SOCIAL:	

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Reviewed by NZTA Project Manager		
Incorporated results into IBC assessment of options summary table?	**Yes**	**No**

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ENVIRONMENTAL AND SOCIAL RESPONSIBILITY SCREEN V2.JUNE 2015

Use to assess options in the Indicative Business Case

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CATEGORY		QUESTION	ANSWER		USEFUL INFORMATION SOURCES
GENERAL	G1	What is the zoning of adjacent land? Are there any encumbrances on the land? e.g. Maori Reserve or other reserve/covenants	Rural	Commercial	District/Unitary Plan Zoning Maps
			Industrial	Residential	
			High density residential	Parks/open space	
	G2	Does the option disturb previously undisturbed land?	Y	N	
	G3	What is the construction timeframe?	>18 months	<18 months	
NATURAL ENVIRONMENT	NE1	Are there any outstanding/significant natural features (e.g. geological or geothermal)/landscapes?	Y	N	NZTA MapHub Environmental and Social Risk Map- Natural Environment
	NE2	Will the option affect the coastal marine area, wetlands, lakes, rivers, streams or their margins?	Y	N	Regional Plan Maps and Schedules
	NE3	Will the option affect areas of the conservation estate, or areas of known significance for biodiversity or known habitats of uncommon or threatened species?	Y	N	District Plan Maps and Schedules
	NE4	Is the option in an area of potential hazard risk e.g. fault lines, significant erosion, flooding, sea level rise etc?	Y	N	Department of Conservation
	NE5	Will more than 0.5 hectares of vegetation be removed?	Y	N	
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Reviewed by NZTA Project Manager		
Incorporated results into IBC assessment of options summary table?	**Yes**	**No**

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Appendix C16 Preliminary Geotechnical Assessment Reports

Arterials

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QUEENSTOWN TOWN CENTRE DBC
PRELIMINARY GEOTECHNICAL ASSESSMENT REPORT

PREPARED FOR THE WAKA KOTAHI NZ TRANSPORT AGENCY

August 2020

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This disclaimer shall apply notwithstanding that the report may be made available to other persons for an application for permission or approval to fulfil a legal requirement.

QUALITY STATEMENT

PROJECT MANAGER

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PROJECT TECHNICAL LEAD

s 9(2)(a)

PREPARED BY

s 9(2)(a)

REVIEWED BY

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APPROVED FOR ISSUE BY

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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
1	06/08/20	Final	s 9(2)(a)		s 9(2)(a)	s 9(2)(a)

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Waka Kotahi NZ Transport Agency

Queenstown Town Centre DBC

Preliminary Geotechnical Assessment Report

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APPENDICES

Appendix A Preliminary Geotechnical Assessment and Investigation Plans
Appendix B Geotechnical Testing Schedule

1. Introduction

Waka Kotahi NZ Transport Agency (Waka Kotahi) commissioned Stantec/WSP/Abley to carry out a Preliminary Geotechnical Appraisal of the Queenstown Arterials as part of the Queenstown Town Centre DBC.

The project is split into three Stages as shown in Figure 1 below.

The objectives of this report are to:

- Present the results of the preliminary desktop study and information known about the existing pavement and ground conditions
- Provide economic and design feasibility of concept solutions proposed
- Make recommendations for geotechnical investigation based on the desk study investigations and other relevant information.



Figure 1-1: Locality Plan

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2. Ground Conditions

2.1 Underlying Geology

The geology of central Queenstown comprises the schist of Queenstown Hill and Ben Lomond, which is bisected by the valley of Gorge Road, running north, Horne Creek drains Gorge Road, and is culverted through the centre of the town, out falling at the east end of Queenstown Bay.

The slopes of Queenstown Hill feature schist outcrops, particularly on the west face at Gorge Road, with the slopes above Belfast Terrace comprising Late Pleistocene glacier deposits forming the slope debris at the base of Queenstown Hill. These deposits are typically variable silts and sands above Hallenstein Street.

Lake Wakatipu has in the geological past been higher than currently, and this has led to alluvium and beach deposits which are typically found downhill of Hallenstein Street, overlying the Glacial deposits and schist bedrock. Boreholes at Melbourne Street indicated a depth of 20m or greater of alluvium.

The Gorge Road area comprises deeply incised Schist to unknown depth, with boreholes at Boundary Street encountering sand and gravels of increasing strength to a depth of 33m. This area is considered to have been originally glaciated with the deep incision formed as the Wakatipu glacier flowed north to Arthurs Point. As this glacier retreated, the gorge filled with the current glacial sands and gravels, with the area of Queenstown forming an outwash fan into Lake Wakatipu. The lowering of Lake Wakatipu occurred in several stages, evidenced by beach deposits at different levels. Beach deposits of depth approximately 5.0m were identified at Melbourne Street overlying the lake sediments.

The lake sediments found closer to the lake level are not exposed at the surface but are expected to be similar to the exposed sediments in Frankton and other parts of the Wakatipu Basin. These are typically fine low plasticity silts deposited in laminae each a few millimetres thick. The insitu strength of these sediments is reasonably high, however the behaviour of exposed cuts would most likely be similar to other parts of the Basin where some slumping occurs on exposed faces.

Around the Lakeview campground and Man Street there are areas of exposed schist from the base of Ben Lomond, which are relatively weak at the surface where they have been glaciated but expected to be competent below.

The area of One Mile Creek is a mapped inactive fault, and it is expected that the schist in this area will be heavily fractured within the valley of One Mile Creek. The stream bed typically runs on the schist bedrock in this area, with the area at the bottom of One Mile Creek mapped as fan deposits to the Lake level, which are expected to be of similar composition to that found in central Queenstown.

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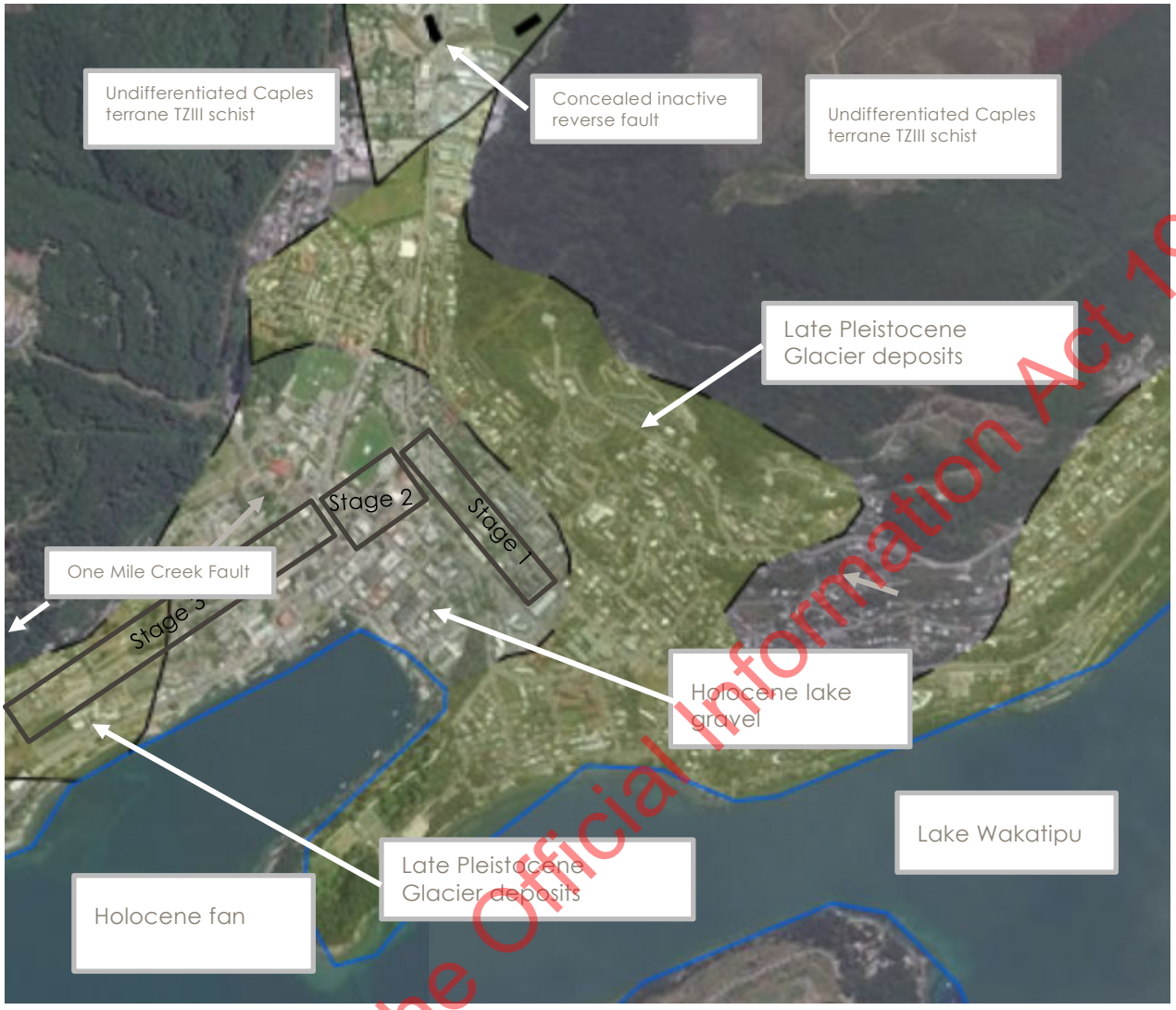


Figure 2-1: Map of Underlying Geology (GNS Science)

2.2 Ground water

Boreholes at Gorge Road observed a hydrostatic water table between 1.6m and 3.5m below the ground surface with additional flowing artesian water at approximately 5m depth. This ground water is expected to be related to Home Creek, with groundwater typically continuous with the lake levels.

2.3 Natural Hazards

Publicly available information was reviewed to assess the Natural Hazards at the site.

2.3.1 Faults

The GNS Active Faults database, and the report 'Seismic Hazard in the Queenstown Lakes District[1]' shows several fault lines within immediate proximity to the site location, all of which are inactive. A concealed fault lies 3km east of the centre of Queenstown, crossing SH6A in the north-south direction, with the One Mile Creek and Two Mile Creek faults mapped as Inactive to the west of Queenstown.

The Moonlight Fault, approximately 13km to the West of the site, is considered Inactive, though to the south the West Wakatipu Fault has recently been assessed as having a return period of 20,000 years[2].

[1] Seismic Hazard in Queenstown Lakes District, Mackey, Otago Regional Council, August 2015
[2] General distribution and characteristics of active faults and folds in the Queenstown Lakes and Central Otago districts, Otago, DJA Barrell, GNS Science Consultancy Report 2018/207 March 2019

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The nearest active fault to the site is the Cardrona-Nevis Fault (13km east of the site) which has a recurrence interval of 5,000 – 10,000 years. There are a number of active faults further to the east of the site, such as Pisa (32 km), Dunstan Fault (40km) and Cairnmuir Faults (40km). The site is 100km east of the Alpine Fault which has a recurrence interval of less than 2,000 years and is capable of major displacement (> 5m) in a single event.

2.3.2 Liquefaction susceptibility

The GNS Science Consultancy Report 2018/67 - *Assessment of liquefaction hazards in the Queenstown Lakes, Central Otago, Clutha and Waitaki districts of the Otago Region*, (June 2019) suggests that a large area of central Queenstown, extending south from Gorge Road along Horne Creek are susceptible to liquefaction, and has been given the classification B1, where geotechnical data indicates the localised presence of liquefaction susceptible material such as beach or stream sediments.

In addition, the expected alluvial fan deposits at One Mile Creek may be susceptible to liquefaction due to their loose nature and the presence of high water tables locally.

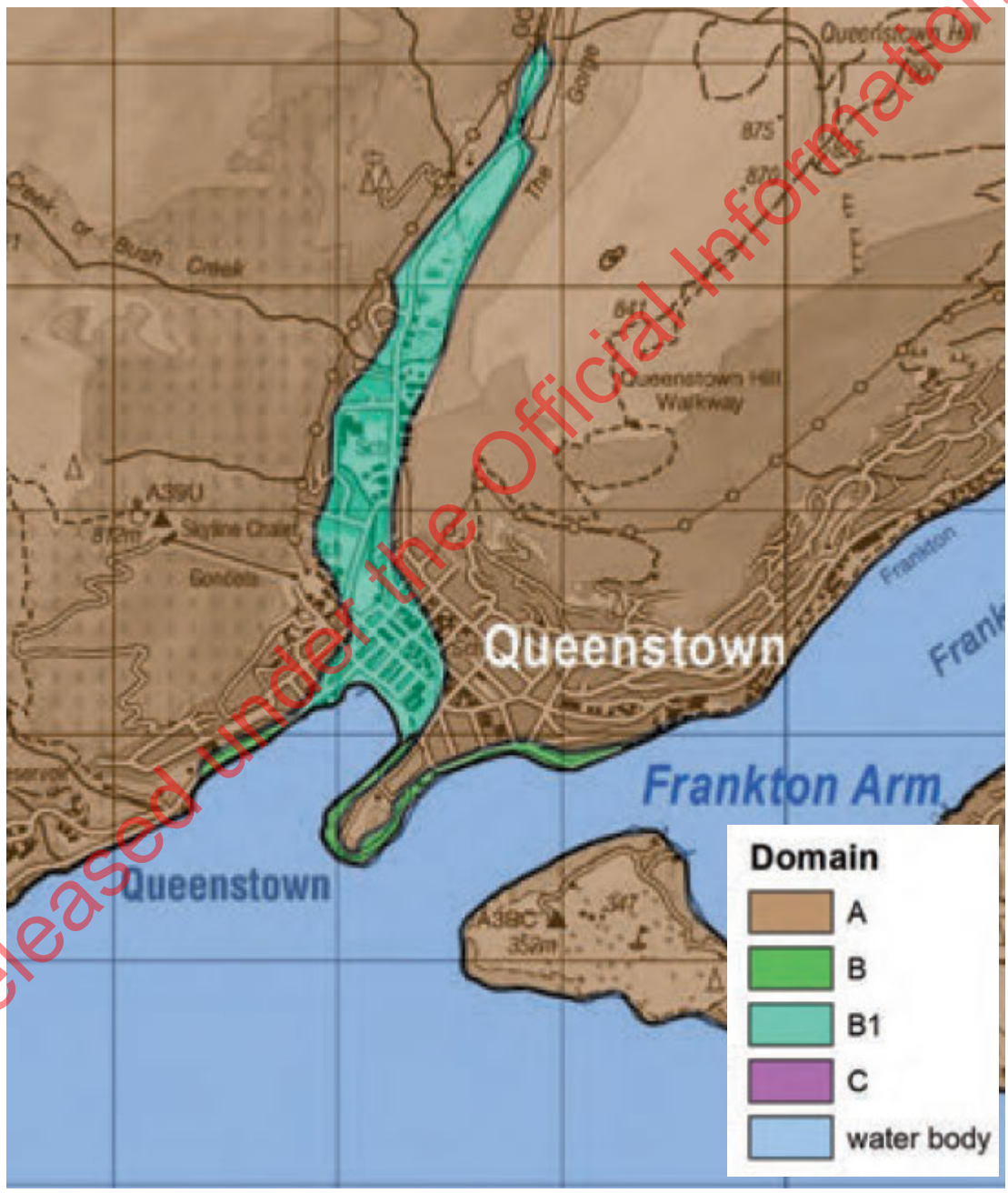


Figure 2-2: Liquefaction Domain B shown Green (GNS 2018)

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2.3.3 Land classification

Ground classification within proximity to the site are predominately classified as D – Deep or Soft Soil, indicating the ground will experience a higher seismic shaking when compared to rock. At sites along Man Street and towards One Mile, the depth to rock may be reduced, and therefore classification A – C may be present. Queenstown has a Modified Mercalli Intensity (MMI) Scale of 7 expected to be exceeded 1:100 years.

2.3.4 Contaminated Land

A Contaminated Land assessment of the areas within the arterials has not been undertaken.

2.3.1 Flooding

The levels of Lake Wakatipu and flows through Horne Creek will influence the flooding within central Queenstown.

Flooding is possible in Queenstown when the lake level reaches 311.3, and floor levels are set to above this for new construction. It is expected that new levels for construction relating to the arterials will be above this level a historical flood levels in 1999 was 312.8m[3].

Flow volumes and levels at Horne Creek has not been assessed as part of this study, but it is expected that a detailed hydrological assessment will be required to ensure that any issues relating to flooding of Horne Creek are mitigated as part of the designs, specifically for Stage 2.

One Mile Creek is also known to flood and is particularly susceptible to debris dams formed from fallen trees within the gulley. Recent (2019) flooding in One Mile Creek which damaged much of the trail within the valley was caused by wind damaged trees blocking parts of the creek.

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[3] https://www.orc.govt.nz/managing-our-environment/water/water-monitoring-and-alerts/kawarau/lake-wakatipu-at-willow-place

3. Proposed Works - Stage 1

3.1 Melbourne Street – Dublin Street to Beetham Street

No significant level changes or widening is expected as part of the arterials project, and therefore no significant geotechnical deep investigation is proposed. Footpath widening as part of the connection between Frankton Road and SH6A is proposed and shallow geotechnical investigation will be undertaken to confirm the ground conditions in this area.

3.2 Melbourne Street – Beetham Street to Henry Street

This is the proposed site of the Queenstown Community Centre, or Project Manawa, which is a proposed multi use building precinct in partnership between the Queenstown Lakes District Council and Ngai Tahu. The site is the subject of the Tonkin and Taylor 2003 report. This report details geotechnical investigations carried out as part of the planning for a multi-level complex, with underground car parking and excavations ranging from 13m to 18m depth.

The testing involved 10 bore holes on the site, installed with piezometers. This found Alluvial deposits, possibly including some beach deposits, up to 20 m thick, and comprising varying proportions of gravel and sand with minor to rare silt, overlying lake sediments at depth. The schist bedrock is expected to be at 30 metres or greater depth.

The Tonkin and Taylor report notes the importance of the brittle failure characteristics of the alluvium, meaning significant temporary works design may need to be under taken, and assessed a requirement for a permanent maintainable groundwater control system to be incorporated in the other three sides of the basements, with horizontal drains required if the ground water table intersected with the basement excavation.

Soil and rock anchored retaining walls are proposed for the development, which are likely to be required due to the level changes across the site.

Design of the retaining walls to Melbourne Street will require assessment of the rock levels to the north east (uphill) side of Melbourne Street. The phasing of the installation of the retaining walls depends heavily on the design intent for Project Manawa. It is expected that the retaining walls for the road will be independent of the Project Manawa buildings and will be significantly easier to install if the walls are installed before the commencement of building works.

Shallow foundations are recommended for the buildings from a bearing capacity point of view, but there has been no assessment of the liquefaction potential at the site, and therefore a specific liquefaction assessment should be undertaken to confirm the foundation design and to assess if there is a requirement for a piled solution.

3.3 Stage 1 - Proposed Geotechnical Testing

Trail Pits TP1 to TP7 and TP11 to TP14 are proposed pavement test pits to inform the pavement design for Melbourne Street from Dublin Street to Beetham Street.

Boreholes BH1 – BH6 are proposed around the Project Manawa site. These will confirm the depth to water in these locations to confirm the design for the cuts at the site, the nature of any retained material and for the lateral capacity of soils or rock at the base of the retaining walls. Boreholes BH3 – 6 are proposed to confirm the depth and quality of rock below the site and will be used to inform the design of tie back anchors for water flow. Piezometers are proposed to be installed in each of the boreholes to confirm the water levels and flow characteristics in the area and to inform the design against liquefaction.

It is expected that one borehole be taken to 30m below ground level to confirm the depth to bedrock, with the others being taken to a depth of 20m. This will allow for a retained height of approximately 10m to be assessed, with a toe depth of 5.0m below that which is suitable for an anchored wall, and an assessment of the ground conditions 5.0m below the base of the toe.

CPT testing will be undertaken in the boreholes at 3m intervals. An allowance for rock core UCS testing has been provided to confirm the properties for the rock if used for lateral resistance at the base of the retaining walls, or when rock anchored.

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It is expected that the surfacing material will be replaced following installation of the retaining walls, but TP9 – TP11 are proposed investigation test pits to confirm the nature of the soils beneath the road and therefore the temporary retaining requirements during the construction of the permanent works.

Additional boreholes and geotechnical laboratory testing of samples may also be required as part of Project Manawa, and the physical drilling of these could be coordinated. These have not been included within this testing schedule.

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4. Proposed Works - Stage 2

4.1 Templeton Way - Memorial Street

The proposed works to Memorial Streel and Templeton Way include the provision of retaining wall to the rugby fields on the Queenstown Recreation Ground, and an underpass at Horne Creek to convey the creek and pedestrians.

No specific information relating to expected geotechnical conditions at this site have been reviewed, however, a recent WSP investigation for the Boundary Street car park shows that the site there is underlain by interbedded layers of sands and silts underlain by very dense gravels. Here the upper 9 to 22 m of the soils at the site were found to consist of soft silts and loose sands, which increase in thickness over the southern and western parts of the site, suggesting that the area beneath the Rugby field and Horne Creek would be very susceptible to liquefaction.

Provision of retaining in this area could therefore prove problematic, with a gravity retaining wall potentially placing additional loads onto the liquefication susceptible layers. If a piled type walls is proposed, then the lateral resistance at the base of the piles must consider the loss of support which would be expected during liquefaction.

The new Recreation Ground Pump Station and upgrade to the rising main have recently been installed at the west end of the rugby field. In ground retaining physical works, and investigation works should avoid this infrastructure.

Horne Creek is indicated as being culverted or a bridge option through the west end of Memorial Street. The Creek is currently well below road level with vegetated banks. The design of culverting at this area should take account of the potential liquefiable strata below.

4.2 Man Street from Camp Street to Hay Street

No significant geotechnical works are proposed along Man Street from Camp Street to Hay Street, where there are properties adjoining the road.

Minor retaining may be required to widen the footpaths on the downhill side adjacent to Sofitel Hotel, and on the uphill side near Hays Street, which may require localised ground investigation during the pre-implementation phase.

4.3 Stage 2 - Proposed Geotechnical testing

Boreholes BH 7 to BH 10 are proposed to understand the ground conditions and water levels to inform the design of the retaining and for culverting and or bridge abutments if required to Horne Creek. Considering the ground conditions encountered at Boundary Street, it is expected that these boreholes may need to be taken to a depth of 30m.

Borehole BH11 and BH12 are proposed to provide a cross section of the ground profile perpendicular to the retaining wall, to understand what materials are being retained, and the design of any tie back structure.

It is expected that the surfacing material will be replaced following installation of the retaining walls, but TP15 – TP17 are proposed investigation test pits to confirm the nature of the soils beneath the road and therefore the temporary retaining requirements during the construction of the permanent works.

TP18 to TP24 are proposed to inform the design of new surfacing at Man Street from Camp Street to Hay Street.

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5. Proposed Works - Stage 3

5.1 Man Street and Thomson Street - Hay Street to Glasgow Street

The section of Man street from Hay Street to Thomson Street has the Colston Reserve to the north of the street, and any widening here will require uphill retaining. The length of Thomson Street to Glasgow street features a downslope retaining wall. Part of this wall was significantly damaged following a water main strike in 2019 and is currently being repaired. The MWH 2003 report identifies a fill bench below the road as being at possible risk of collapse and requiring further investigation

Man Street from Hay Street to Glasgow Street is part of the Lake View development and works here will be undertaken as part of this development. Therefore, there this report does not comment on works required in this area.

5.2 Thomson Street Link

This section is a new connection from Thomson Street to the new One Mile roundabout. The proposed road here will traverse the existing colluvium slope and will most likely require both uphill and downhill retaining to be constructed. This slope is expected to overlie schist bedrock at a depth below the existing ground level, but no investigations have been reviewed which specifically target this area.

The form of retaining wall would be assessed at the pre-implementation design stage, with the colluvium slope being suited to either a Terramesh type wall on the uphill and the downhill side, or an anchored retaining wall with anchors either extending into the colluvium or into the schist bedrock.

The majority of the slope is expected to comprise glacial deposits as colluvium from the slopes above, with the lower parts of the slope, towards One Mile creek potentially being river fan deposits from the One Mile creek, and to therefore comprise more silty and clay deposits. Due to the reducing lake level over geological time, there may be significant beach deposits of silt or sand in this area at the base of the slope.

5.3 One Mile Bridge/Overpass

A new bridge/overpass is proposed from the Thomson Street link to the One Mile roundabout. This is required to traverse the existing One Mile powerhouse track and the One Mile Creek, which will both pass beneath the bridge.

The One Mile Creek is mapped as an inactive fault, and as a result of this it is expected that the schist in this area will be fractured and damaged from the fault action. The fault is mapped to the west of the One Mile track, however the fracture zone in this area could extend out in the direction of the proposed bridge.

The MWH (2003) report notes of the risk from flooding at One Mile Creek, which was borne out in 2019 with the significant damage to the trail in one Mile Creek and blockage of the creek with fallen trees. The flow in the creek and the design of the proposed bridge to mitigate and water and debris flow would need to be assessed.

This area may be subject to liquefaction due to the alluvial fan deposits and the saturation of the ground in this area, therefore the bridge abutments are expected to be founded on the schist bedrock, and investigations are proposed to confirm the depth to schist in this area.

The bridge approaches are expected to be formed in the colluvium slope and will require similar retaining to that for the Thomson Street link.

5.4 Roundabout at One Mile

A new roundabout is proposed at One Mile. The levels for this roundabout are being developed, but it is expected that the roundabout will be at a slightly higher elevation than the current road. The alignment proposed in the Beca 'Fernhill End Option 3B' plan suggests the significant cut and fill volumes will be required, and that slopes or retaining will be required.

The soils expected around lake level may be fan deposits overlying lake sediments, and may be subject to liquefaction, which will be confirmed by the geotechnical testing.

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The form of retaining wall would be assessed at the pre-implementation design stage, with the colluvium slope being suited to either a Terramesh type wall on the uphill and the downhill side, or an anchored retaining wall with anchors either extending into the colluvium.

5.5 Stage 3 Proposed Geotechnical Testing

Investigation Pits TP25 to TP27 are proposed to confirm the nature of the soils beneath the proposed road alignment to inform the construction of the temporary works.

Boreholes BH12 to BH15 are proposed on the slope to confirm the materials on the slope, the depth of colluvium and the depth to bedrock, and the location of the piezometric surface in this area. This will inform the design of retaining required on this slope.

Boreholes BH16 and BH17 are proposed either side of the proposed bridge location to inform the design of the bridge abutments.

BH18 and BH19 are proposed to inform the design for the roundabout founding, to determine the founding strata and to confirm any compressible strata and the piezometric surface in the area. If retaining walls are proposed the boreholes will allow confirmation of the design parameters for the founding and the retained strata.

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6. References

- MWH. Preliminary Geotechnical Appraisal for Proposed Queenstown CBD Ring Roads. March 2007
- Tonkin and Taylor. Queenstown Community Centre, Geotechnical Investigations – Stage 1. November 2003
- Beca. Geotechnical Desk Study Review of Thompson Street Link, Queenstown. December 2017
- WSP Opus. Boundary Street Carpark Building Geotechnical Assessment Report, 2019
- Barrell DJA. 2019. Assessment of liquefaction hazards in the Queenstown Lakes, Central Otago, Clutha and Waitaki districts of the Otago Region. Lower Hutt (NZ): GNS Science. 99p. Consultancy Report 2018/67.
- Barrell DJA. 2019. General distribution and characteristics of active faults and folds in the Queenstown Lakes and Central Otago districts, Otago. Lower Hutt (NZ): GNS Science. 99p. Consultancy Report 2018/207.

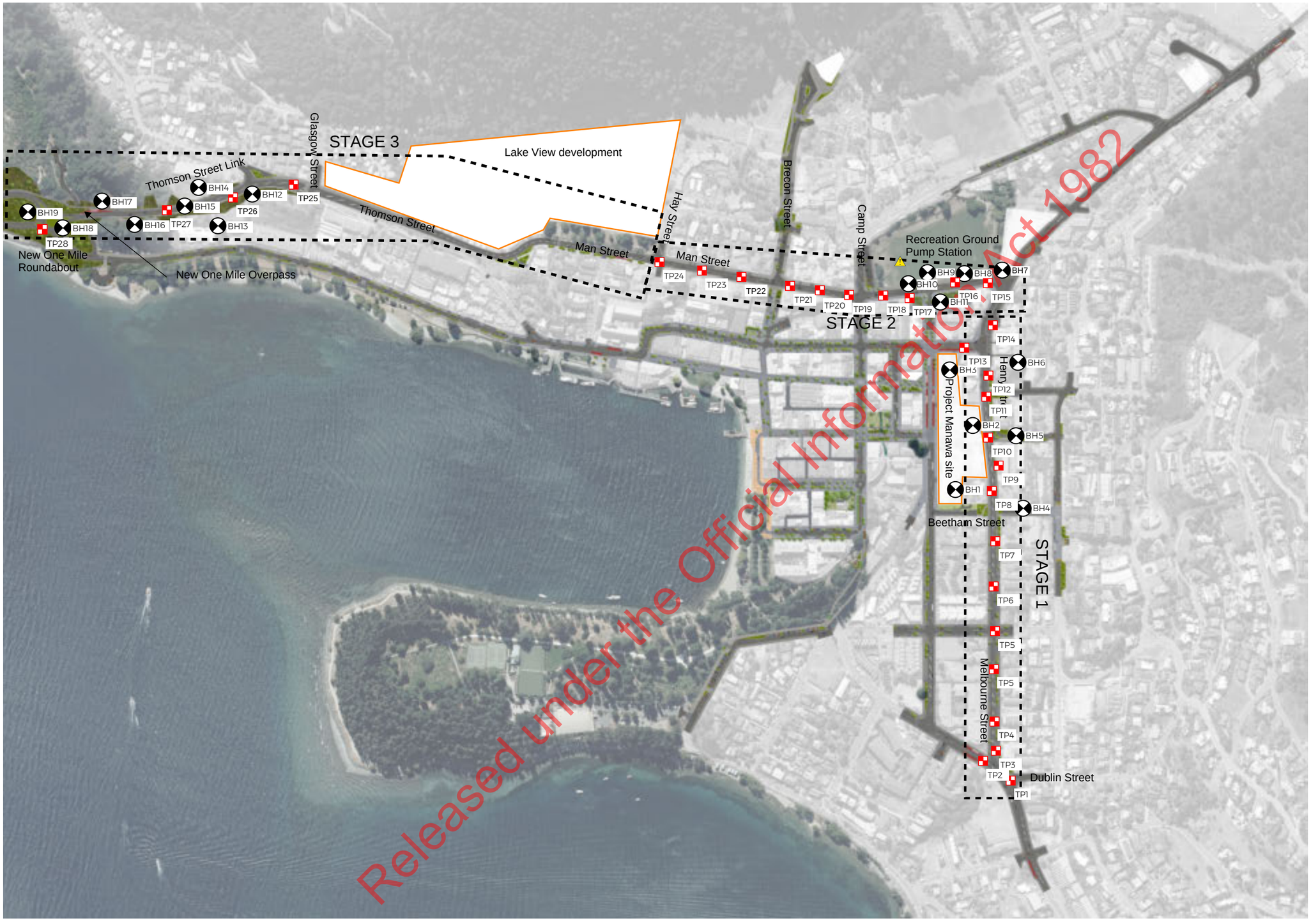
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Appendices

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Appendix A Preliminary Geotechnical Assessment and Investigation Plans

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REVISION	AMENDMENT	APPROVED	DATE
A	CONCEPT	s 9(2)(a)	28-07-2020
B	STAGE 2 AND 3 ADDED		07-07-2020

Client:

Stantec

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp

ableY

SCALES

ORIGINAL SIZE A3

DRAWN	DESIGNED	APPROVED
s 9(2)(a)	s 9(2)(a)	28-07-2020
DRAWING VERIFIED	**DESIGN VERIFIED**	**APPROVED DATE**
s 9(2)(a)	s 9(2)(a)	28-07-2020

CONCEPT

PROJECT

QUEENSTOWN TOWN CENTRE DBC
QUEENSTOWN ARTERIALS
STAGE 1, 2 AND 3

TITLE

PRELIMINARY GEOTECHINCAL INVESTIGATION PLAN

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
6-XT014.50_185GX	G01	A

Appendix B Geotechnical Testing Schedule

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GEOTECHNICAL TESTING ESTIMATE
QUEENSTOWN TOWN CENTRE ARTERIAL STAGE 1

Item	Description	Unit	Qty	Rate	Amount
8.1	**Scala Penetrometer and Hand Auger**				
8.1.1	Scala Penetrometer ([4m] maximum)	ea	14	200	$2,800.00
8.1.2	Hand Auger Excavation ([4m] maximum)	ea		200	$0.00
8. 1.3	Sample for laboratory testing	ea		40	$0.00
8. 1.4	(list items and define payment)	L S. / ea / m / km			$0.00
8.2	**Pavement Test Pit**				
8.2.1	Testpit Excavation (nominally [600mm] deep)	ea	11	1500	$16,500.00
8.2. 2	Density (field NDM)	ea	4	100	$400.00
8.2. 3	Sample for Laboratory Testing	ea	11	40	$440.00
8. 2. 4	Traffic Management (extra over (12.7. 1])	ea	1	6000	$6,000.00
8. 2.5	[list items and define payment)	L S. / ea / m / km			$0.00
8.3	**Investigation Test Pit**				
8.3.1	Excavation (4m maximum)	ea	3	827	$2,480.00
8.3.2	Density (field) NDM	ea			$0.00
8.3.3	Sample for Laboratory Testing	ea	3	40	$120.00
8.3.4	Traffic Management (extra over (12.7 .1])	L.S.	1	0	$0.00
8.3.5	[list items and define payment]	L.S./ ea / m / km			$0.00
8.4	**Lab Testing**				
8.4.1	Water Content - Natural	ea		35	$0.00
8.4.2	Atterberg Limits (inclusive of natural water content)	ea	6	300	$1,800.00
8.4.3	Grading by Wet Sieving	ea	11	180	$1,980.00
8.4.4	Grading by Dry Sieving	ea	11	180	$1,980.00
8.4.5	Grading (fine soils)	ea		320	$0.00
8.4.6	Consolidation Test (oedometer)	ea		1200	$0.00
8.4.7	Triaxial (Unconsolidated Undrained (UU) - 3 specimens) (38mm diameter)	ea	10	1500	$15,000.00

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GEOTECHNICAL TESTING ESTIMATE
QUEENSTOWN TOWN CENTRE ARTERIAL STAGE 1

Item	Description	Unit	Qty	Rate	Amount
8.4.8	Triaxial (Unconsolidated Undrained (UU)- single specimen) (38mm diameter)	ea			$0.00
8.4.9	Triaxial (Consolidated Undrained - 3 specimens)	ea			$0.00
8.4.10	CBR Test - Natural (Soaked or Unsoaked)	ea	14	190	$2,660.00
8.4. l 0a	CBR Test - Optimum (Soaked or Unsoaked)	ea		200	$0.00
8.4.11	Extra over (12.4.9/ a] for Lime or cement modified (Optimum or Natural)	ea		10	$0.00
8.4.12	NZ Standard/Heavy Compaction Test Soils	ea		525	$0.00
8.4.13	NZ Vibrating Hammer Compaction Test	ea		610	$0.00
8.4.14	Unconfined Compressive Strength (UCS) with modulus and Poisson ratio	ea	12	250	$3,000.00
8.4.15	Unconfined Compressive Strength (UCS) without modulus and Poisson ratio	ea		200	$0.00
8.4.16	Indirect Tensile Strength Test	ea		600	$0.00
8.4.17	Abrasion Test	ea		250	$0.00
8.4.18	Density of Rock Core (Bulk and Dry)	ea			$0.00
8.4.19	[list items and define payment]	L S. / ea / m / km			$0.00
8.5	**Miscellaneous Testing**				
8.5.1	Static Cone Penetrometer (CPT) Rig Establishment and Disestablishment	L.S.	1	12000	$12,000.00
8.5.2	CPT set-up at Test Location	ea	6	85	$510.00
8.5.3	Extra over [12.5.2) for Preparation and Saturation of Piezocone	ea		68	$0.00
8.5.4	CPT Test ([20m) max depth)	m	44	41	$1,804.00
8.5.5	CPTu Test ([20m] max depth)	m	44	41	$1,804.00
8.5.6	Dissipation Test (in CPTu)	hr		260	$0.00
8.5.7	Extra over [12.5.6) for Dissipation Test (in CPTu)	hr		260	$0.00
8.5.8	Standpipe (in CPT or CPTu)	ea		20	$0.00

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GEOTECHNICAL TESTING ESTIMATE
QUEENSTOWN TOWN CENTRE ARTERIAL STAGE 1

Item	Description	Unit	Qty	Rate	Amount
8.5.9	Standard Penetration Test (Borehole, Solid or Hollow Nose Raymond)	ea		75	$0.00
8.5.10	Down Hole Shear Vane ([20m) max depth)	ea			$0.00
8.5.11	Standpipe Piezometer (Borehole, up to [2] per hole)	ea	6	700	$4,200.00
8.5.12	Falling or Rising Head Permeability Test in Standpipe	ea			$0.00
8.5.13	Benkelman Beam Testing ([20m] spacing - both lanes)	km			$0.00
8.5.14	Falling Weight Deflectometer ([20m] spacing - single lane)	km	1.5	1500	$2,250.00
8.5.15	Hand Shear Vane Test	ea			$0.00
8.5.16	Traffic Management (extra over [12.7.1))	ea	1	10000	$10,000.00
8.5.17	[list items and define payment)	L.S. / ea / m / km			$0.00
8.6	**Borehole**				
8.6.1	Drilling rig establishment and Disestablishment	L.S.	1	1500	$1,500.00
8.6.2	Drilling rig set-up at borehole location	ea	6	150	$900.00
8.6.3	Wash Drilling ([40m) max depth)	m	40	94	$3,760.00
8.6.4	Core recovery - Soil ([40m) max depth)	m	240	300	$72,000.00
8.6.5	Drilling in Rock (no core recovery) ([40m) max depth)	m	40	225	$9,000.00
8.6.6	Extra over [12.6.5) for core recovery in rock at HQ size	m		225	$0.00
8.6.7	Extra over [12.6.5] for core recovery in rock at PQ Size	m		300	$0.00
8.6.8	Falling or Rising Head Permeability Test in Borehole	ea		640	$0.00
8.6.9	Log and Photograph Core ([40m] max depth)	ea	6	4230	$25,380.00
8.6.10	Traffic Management (extra over (12.7.1])	ea			$0.00

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GEOTECHNICAL TESTING ESTIMATE
QUEENSTOWN TOWN CENTRE ARTERIAL STAGE 1

Item	Description	Unit	Qty	Rate	Amount
8.6.11	[list items and define payment]	L.S./ ea / m / km			$0.00
8.7	**Miscellaneous and General (Client to Detail)**				
8.7.1	Traffic Management Plan, Mobilisation and Demobilisation	L.S.	1	5000	$5,000.00
8.7.2	[list items and define payment]	L.S./ ea / m / km			$0.00
8.8	**Miscellaneous (Tenderer to Detail as Applicable)**				
8.8.1	[list items and define payment]	L.S./ ea / m / km			$0.00
8.9	**Assessment of Results and Report**				
8.9.1	Geotechnical Investigations and Testing Results (Factual Report)	L.S.	1	20000	$20,000.00
TOTAL GEOTECHN ICAL TESTING: (Queenstown Town Centre Arterial Stage 1)					$225,268.00

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GEOTECHNICAL TESTING ESTIMATE
QUEENSTOWN TOWN CENTRE ARTERIAL STAGE 2

Item	Description	Unit	Qty	Rate	Amount
8.1	**Scala Penetrometer and Hand Auger**				
8.1.1	Scala Penetrometer ([4m] maximum)	ea	10	200	$2,000.00
8.1.2	Hand Auger Excavation ([4m] maximum)	ea		200	$0.00
8. 1.3	Sample for laboratory testing	ea		40	$0.00
8. 1.4	(list items and define payment)	L S. / ea / m / km			$0.00
8.2	**Pavement Test Pit**				
8.2.1	Testpit Excavation (nominally [600mm] deep)	ea	7	1500	$10,500.00
8.2. 2	Density (field NDM)	ea		100	$0.00
8.2. 3	Sample for Laboratory Testing	ea	7	50	$350.00
8. 2. 4	Traffic Management (extra over (12.7. 1])	ea	1	5000	$5,000.00
8. 2.5	[list items and define payment)	L S. / ea / m / km			$0.00
8.3	**Investigation Test Pit**				
8.3.1	Excavation (4m maximum)	ea	3	827	$2,480.00
8.3.2	Density (field) NDM	ea			$0.00
8.3.3	Sample for Laboratory Testing	ea	3	50	$150.00
8.3.4	Traffic Management (extra over (12.7 .1])	L.S.			$0.00
8.3.5	[list items and define payment]	L.S./ ea / m / km			$0.00
8.4	**Lab Testing**				
8.4.1	Water Content - Natural	ea		35	$0.00
8.4.2	Atterberg Limits (inclusive of natural water content)	ea	27	300	$8,100.00
8.4.3	Grading by Wet Sieving	ea	17	180	$3,060.00
8.4.4	Grading by Dry Sieving	ea	10	180	$1,800.00
8.4.5	Grading (fine soils)	ea		320	$0.00
8.4.6	Consolidation Test (oedometer)	ea	5	1200	$6,000.00
8.4.7	Triaxial (Unconsolidated Undrained (UU) - 3 specimens) (38mm diameter)	ea	10	1500	$15,000.00

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GEOTECHNICAL TESTING ESTIMATE
QUEENSTOWN TOWN CENTRE ARTERIAL STAGE 2

Item	Description	Unit	Qty	Rate	Amount
8.4.8	Triaxial (Unconsolidated Undrained (UU)- single specimen) (38mm diameter)	ea			$0.00
8.4.9	Triaxial (Consolidated Undrained - 3 specimens)	ea			$0.00
8.4.10	CBR Test - Natural (Soaked or Unsoaked)	ea	14	190	$2,660.00
8.4. I 0a	CBR Test - Optimum (Soaked or Unsoaked)	ea		200	$0.00
8.4.11	Extra over (12.4.9/ a] for Lime or cement modified (Optimum or Natural)	ea		10	$0.00
8.4.12	NZ Standard/Heavy Compaction Test Soils	ea		600	$0.00
8.4.13	NZ Vibrating Hammer Compaction Test	ea		610	$0.00
8.4.14	Unconfined Compressive Strength (UCS) with modulus and Poisson ratio	ea	10	250	$2,500.00
8.4.15	Unconfined Compressive Strength (UCS) without modulus and Poisson ratio	ea		200	$0.00
8.4.16	Indirect Tensile Strength Test	ea		225	$0.00
8.4.17	Abrasion Test	ea		250	$0.00
8.4.18	Density of Rock Core (Bulk and Dry)	ea			$0.00
8.4.19	[list items and define payment]	L S. / ea / m / km			$0.00
8.5	**Miscellaneous Testing**				
8.5.1	Static Cone Penetrometer (CPT) Rig Establishment and Disestablishment	L.S.	1	12000	$12,000.00
8.5.2	CPT set-up at Test Location	ea	5	85	$425.00
8.5.3	Extra over [12.5.2) for Preparation and Saturation of Piezocone	ea		68	$0.00
8.5.4	CPT Test ([20m) max depth)	m	50	41	$2,050.00
8.5.5	CPTu Test ([20m] max depth)	m		41	$0.00
8.5.6	Dissipation Test (in CPTu)	hr		260	$0.00
8.5.7	Extra over [12.5.6) for Dissipation Test (in CPTu)	hr		260	$0.00
8.5.8	Standpipe (in CPT or CPTu)	ea		20	$0.00

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GEOTECHNICAL TESTING ESTIMATE
QUEENSTOWN TOWN CENTRE ARTERIAL STAGE 2

Item	Description	Unit	Qty	Rate	Amount
8.5.9	Standard Penetration Test (Borehole, Solid or Hollow Nose Raymond)	ea		75	$0.00
8.5.10	Down Hole Shear Vane ([20m) max depth)	ea			$0.00
8.5.11	Standpipe Piezometer (Borehole, up to [2] per hole)	ea	5	700	$3,500.00
8.5.12	Falling or Rising Head Permeability Test in Standpipe	ea			$0.00
8.5.13	Benkelman Beam Testing ([20m] spacing - both lanes)	km			$0.00
8.5.14	Falling Weight Deflectometer ([20m] spacing - single lane)	km	0.5	1500	$750.00
8.5.15	Hand Shear Vane Test	ea			$0.00
8.5.16	Traffic Management (extra over [12.7.1))	ea	1	10000	$10,000.00
8.5.17	[list items and define payment)	L.S. / ea / m / km			$0.00
8.6	**Borehole**				
8.6.1	Drilling rig establishment and Disestablishment	L.S.	1	1500	$1,500.00
8.6.2	Drilling rig set-up at borehole location	ea	5	150	$750.00
8.6.3	Wash Drilling ([40m) max depth)	m		225	$0.00
8.6.4	Core recovery - Soil ([40m) max depth)	m	200	300	$60,000.00
8.6.5	Drilling in Rock (no core recovery) ([40m) max depth)	m		225	$0.00
8.6.6	Extra over [12.6.5) for core recovery in rock at HQ size	m		225	$0.00
8.6.7	Extra over [12.6.5] for core recovery in rock at PQ Size	m		300	$0.00
8.6.8	Falling or Rising Head Permeability Test in Borehole	ea		640	$0.00
8.6.9	Log and Photograph Core ([40m] max depth)	ea	5	4230	$21,150.00

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GEOTECHNICAL TESTING ESTIMATE
QUEENSTOWN TOWN CENTRE ARTERIAL STAGE 2

Item	Description	Unit	Qty	Rate	Amount
8.6.10	Traffic Management (extra over (12.7.1])	ea			$0.00
8.6.11	[list items and define payment]	L.S./ ea / m / km			$0.00
8.7	**Miscellaneous and General (Client to Detail)**				
8.7.1	Traffic Management Plan, Mobilisation and Demobilisation	L.S.	1	8000	$8,000.00
8.7.2	[list items and define payment]	L.S./ ea / m / km			$0.00
8.8	**Miscellaneous (Tenderer to Detail as Applicable)**				
8.8.1	[list items and define payment]	L.S./ ea / m / km			$0.00
8.9	**Assessment of Results and Report**				
8.9.1	Geotechnical Investigations and Testing Results (Factual Report)	L.S.	1	30000	$30,000.00
TOTAL GEOTECHN ICAL TESTING: (Queenstown Town Centre Arterial Stage 2)					$209,725.00

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GEOTECHNICAL TESTING ESTIMATE
QUEENSTOWN TOWN CENTRE ARTERIAL STAGE 3

Item	Description	Unit	Qty	Rate	Amount
8.1	**Scala Penetrometer and Hand Auger**				
8.1.1	Scala Penetrometer ([4m] maximum)	ea	4	200	$800.00
8.1.2	Hand Auger Excavation ([4m] maximum)	ea		200	$0.00
8. 1.3	Sample for laboratory testing	ea		40	$0.00
8. 1.4	(list items and define payment)	L S. / ea / m / km			$0.00
8.2	**Pavement Test Pit**				
8.2.1	Testpit Excavation (nominally [600mm] deep)	ea	2	1500	$3,000.00
8.2. 2	Density (field NDM)	ea		100	$0.00
8.2. 3	Sample for Laboratory Testing	ea	2	40	$80.00
8. 2. 4	Traffic Management (extra over (12.7. 1])	ea	1	5000	$5,000.00
8. 2.5	[list items and define payment)	L S. / ea / m / km			$0.00
8.3	**Investigation Test Pit**				
8.3.1	Excavation (4m maximum)	ea	2	1240	$2,480.00
8.3.2	Density (field) NDM	ea			$0.00
8.3.3	Sample for Laboratory Testing	ea	2	40	$80.00
8.3.4	Traffic Management (extra over (12.7 .1])	L.S.	1	5000	$5,000.00
8.3.5	[list items and define payment]	L.S./ ea / m / km			$0.00
8.4	**Lab Testing**				
8.4.1	Water Content - Natural	ea		35	$0.00
8.4.2	Atterberg Limits (inclusive of natural water content)	ea	4	300	$1,200.00
8.4.3	Grading by Wet Sieving	ea	4	180	$720.00
8.4.4	Grading by Dry Sieving	ea	2	180	$360.00
8.4.5	Grading (fine soils)	ea		320	$0.00
8.4.6	Consolidation Test (oedometer)	ea	5	1200	$6,000.00
8.4.7	Triaxial (Unconsolidated Undrained (UU) - 3 specimens) (38mm diameter)	ea	10	1500	$15,000.00

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GEOTECHNICAL TESTING ESTIMATE
QUEENSTOWN TOWN CENTRE ARTERIAL STAGE 3

Item	Description	Unit	Qty	Rate	Amount
8.4.8	Triaxial (Unconsolidated Undrained (UU)- single specimen) (38mm diameter)	ea			$0.00
8.4.9	Triaxial (Consolidated Undrained - 3 specimens)	ea			$0.00
8.4.10	CBR Test - Natural (Soaked or Unsoaked)	ea	14	190	$2,660.00
8.4. l 0a	CBR Test - Optimum (Soaked or Unsoaked)	ea		200	$0.00
8.4.11	Extra over (12.4.9/ a] for Lime or cement modified (Optimum or Natural)	ea		10	$0.00
8.4.12	NZ Standard/Heavy Compaction Test Soils	ea		600	$0.00
8.4.13	NZ Vibrating Hammer Compaction Test	ea		610	$0.00
8.4.14	Unconfined Compressive Strength (UCS) with modulus and Poisson ratio	ea	10	250	$2,500.00
8.4.15	Unconfined Compressive Strength (UCS) without modulus and Poisson ratio	ea		200	$0.00
8.4.16	Indirect Tensile Strength Test	ea		225	$0.00
8.4.17	Abrasion Test	ea		250	$0.00
8.4.18	Density of Rock Core (Bulk and Dry)	ea			$0.00
8.4.19	[list items and define payment]	L S. / ea / m / km			$0.00
8.5	**Miscellaneous Testing**				
8.5.1	Static Cone Penetrometer (CPT) Rig Establishment and Disestablishment	L.S.	1	12000	$12,000.00
8.5.2	CPT set-up at Test Location	ea	8	85	$680.00
8.5.3	Extra over [12.5.2) for Preparation and Saturation of Piezocone	ea		68	$0.00
8.5.4	CPT Test ([20m) max depth)	m	50	41	$2,050.00
8.5.5	CPTu Test ([20m] max depth)	m		41	$0.00
8.5.6	Dissipation Test (in CPTu)	hr		260	$0.00
8.5.7	Extra over [12.5.6) for Dissipation Test (in CPTu)	hr		260	$0.00
8.5.8	Standpipe (in CPT or CPTu)	ea		20	$0.00

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GEOTECHNICAL TESTING ESTIMATE
QUEENSTOWN TOWN CENTRE ARTERIAL STAGE 3

Item	Description	Unit	Qty	Rate	Amount
8.5.9	Standard Penetration Test (Borehole, Solid or Hollow Nose Raymond)	ea		75	$0.00
8.5.10	Down Hole Shear Vane ([20m) max depth)	ea			$0.00
8.5.11	Standpipe Piezometer (Borehole, up to [2] per hole)	ea	8	800	$6,400.00
8.5.12	Falling or Rising Head Permeability Test in Standpipe	ea			$0.00
8.5.13	Benkelman Beam Testing ([20m] spacing - both lanes)	km			$0.00
8.5.14	Falling Weight Deflectometer ([20m] spacing - single lane)	km	0.75	1500	$1,125.00
8.5.15	Hand Shear Vane Test	ea			$0.00
8.5.16	Traffic Management (extra over [12.7.1))	ea	1	10000	$10,000.00
8.5.17	[list items and define payment)	L.S. / ea / m / km			$0.00
8.6	**Borehole**				
8.6.1	Drilling rig establishment and Disestablishment	L.S.	1	1500	$1,500.00
8.6.2	Drilling rig set-up at borehole location	ea	8	150	$1,200.00
8.6.3	Wash Drilling ([40m) max depth)	m		225	$0.00
8.6.4	Core recovery - Soil ([40m) max depth)	m	320	300	$96,000.00
8.6.5	Drilling in Rock (no core recovery) ([40m) max depth)	m		225	$0.00
8.6.6	Extra over [12.6.5) for core recovery in rock at HQ size	m		225	$0.00
8.6.7	Extra over [12.6.5] for core recovery in rock at PQ Size	m		300	$0.00
8.6.8	Falling or Rising Head Permeability Test in Borehole	ea			$0.00
8.6.9	Log and Photograph Core ([40m] max depth)	ea	8	4230	$33,840.00
8.6.10	Traffic Management (extra over (12.7.1])	ea			$0.00

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GEOTECHNICAL TESTING ESTIMATE
QUEENSTOWN TOWN CENTRE ARTERIAL STAGE 3

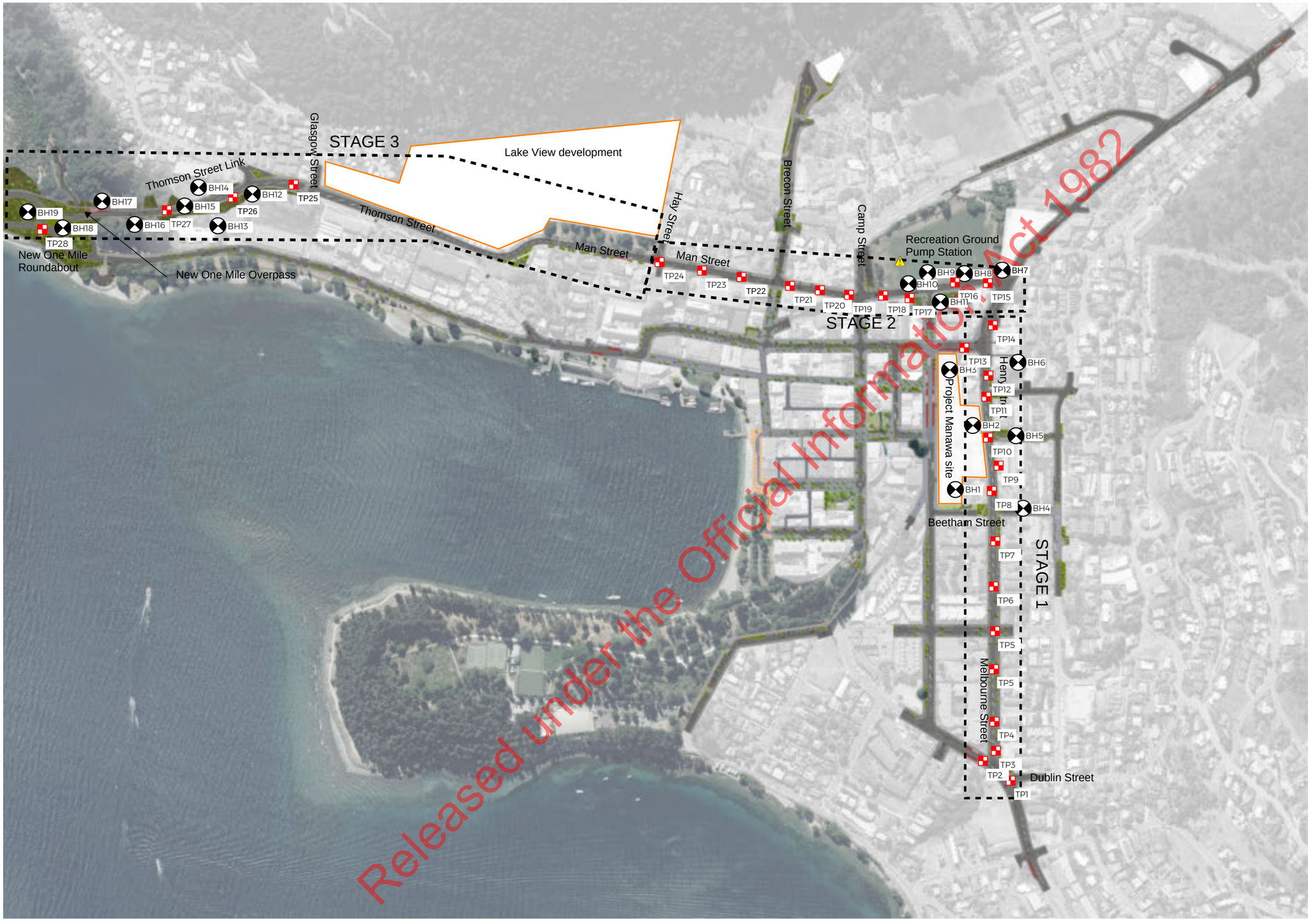
Item	Description	Unit	Qty	Rate	Amount
8.6.11	[list items and define payment]	L.S./ ea / m / km			$0.00
8.7	**Miscellaneous and General (Client to Detail)**				
8.7.1	Traffic Management Plan, Mobilisation and Demobilisation	L.S.	1	5000	$5,000.00
8.7.2	[list items and define payment]	L.S./ ea / m / km			$0.00
8.8	**Miscellaneous (Tenderer to Detail as Applicable)**				
8.8.1	[list items and define payment]	L.S./ ea / m / km			$0.00
8.9	**Assessment of Results and Report**				
8.9.1	Geotechnical Investigations and Testing Results (Factual Report)	L.S.	1	40000	$40,000.00
TOTAL GEOTECHN ICAL TESTING: (Queenstown Town Centre Arterial Stage 3)					$254,675.00

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A	CONCEPT	s 9(2)(a)	28-07-2020
B	STAGE 2 AND 3 ADDED		07-07-2020

Client:

Stantec

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp

ableY

SCALES

ORIGINAL SIZE A3

DRAWN	DESIGNED	APPROVED
s 9(2)(a)	s 9(2)(a)	28-07-2020
DRAWING VERIFIED	**DESIGN VERIFIED**	**APPROVED DATE**
s 9(2)(a)	s 9(2)(a)	28-07-2020

CONCEPT

PROJECT

QUEENSTOWN TOWN CENTRE DBC
QUEENSTOWN ARTERIALS
STAGE 1, 2 AND 3

TITLE

PRELIMINARY GEOTECHINCAL INVESTIGATION PLAN

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
6-XT014.50_185GX	G01	A

Frankton to Queenstown

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FRANKTON TO QUEENSTOWN SSBC
PRELIMINARY GEOTECHNICAL ASSESSMENT REPORT

PREPARED FOR THE WAKA KOTAHI NZ TRANSPORT AGENCY

July 2020

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QUALITY STATEMENT

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PROJECT TECHNICAL LEAD

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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
1	05/06/20	Draft	s 9(2)(a)		s 9(2)(a)	s 9(2)(a)

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Waka Kotahi NZ Transport Agency

Frankton to Queenstown SSBC

Preliminary Geotechnical Assessment Report

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APPENDICES

Appendix A Preliminary Geotechnical Assessment and Investigation Plans
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1. Introduction

Waka Kotahi NZ Transport Agency (Waka Kotahi) commissioned WSP NZ Ltd to carry out a Preliminary Geotechnical Appraisal of the proposed SH6A improvements as part of the Frankton to Queenstown (F2Q) Business Case. The site is located along SH6A from Frankton to Queenstown, Queenstown, Otago from RP 0000/0.000-5.600, (herein referred to as "the site") as shown on the locality plan below.

The objectives of this report are to:

- Present the results of the preliminary site walkover, desktop study, and information known about the existing pavement and ground conditions
- Provide economic and design feasibility of concept solutions proposed
- Make recommendations for geotechnical investigation based on the preliminary site walkover and other relevant information.

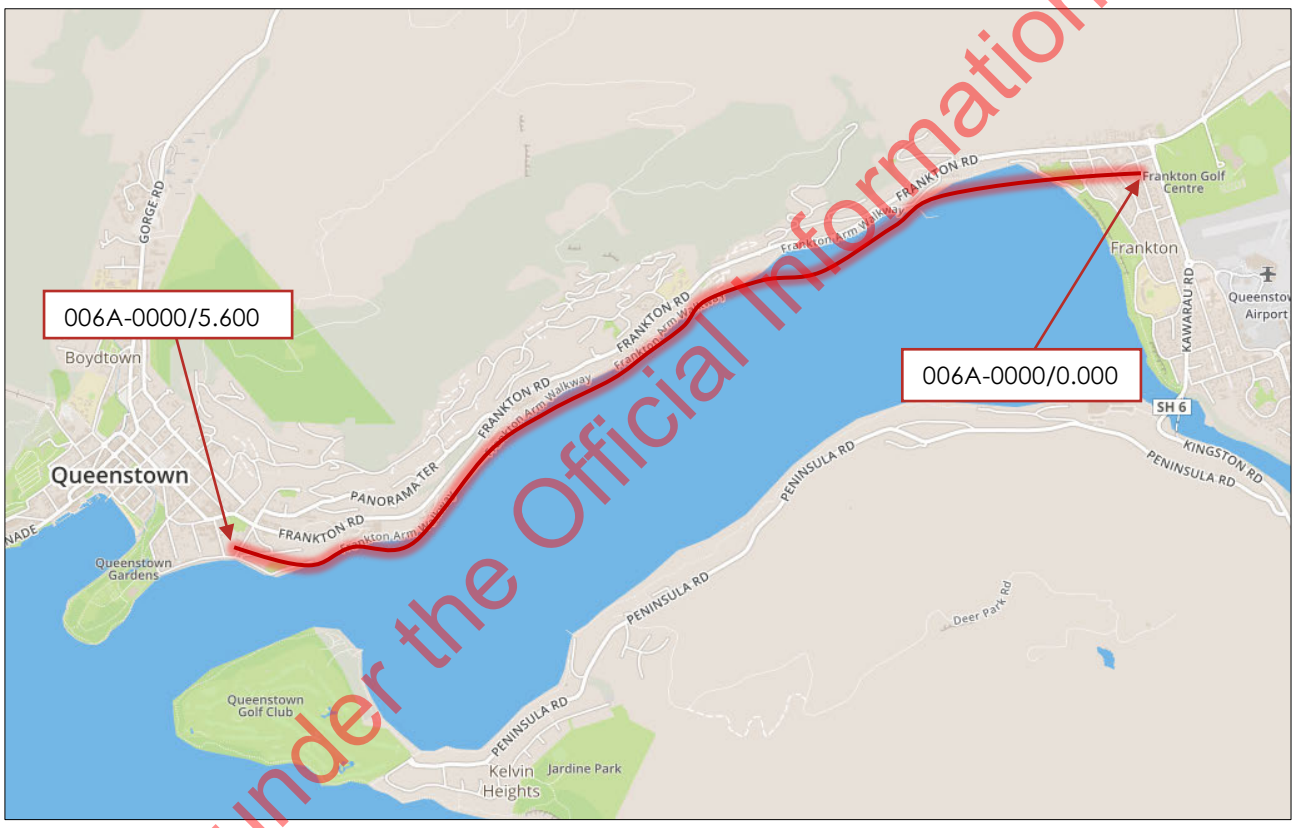


Figure 1-1: Locality Plan of The Site from Queenstown to Frankton

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2. Frankton Ground Conditions

2.1 Underlying Geology

The geological map of the Wakatipu area (GNS, 2000) indicates the site to be situated over three main geological boundaries; Holocene Lake Deposits at RP 0.000, Caples Terrane in the central corridor and Glacier Deposits near Queenstown Town Centre, RP 5.600.

The Holocene deposits are described as well sorted, rounded, fine to medium deposits with sand. Underlying rock consists of greywacke and schist. Schist of the Caples terraine forms the bedrock of Queenstown Hill, which are well foliated (Grade III) incipient segregation with minor parts green schist. The Late Pleistocene glacier deposits in Queenstown are generally unweathered, unsorted to sorted, with loose sandy gravel silt and sand (till). Underlying rocks consist of boulders, gravel, sand, silt and clay.

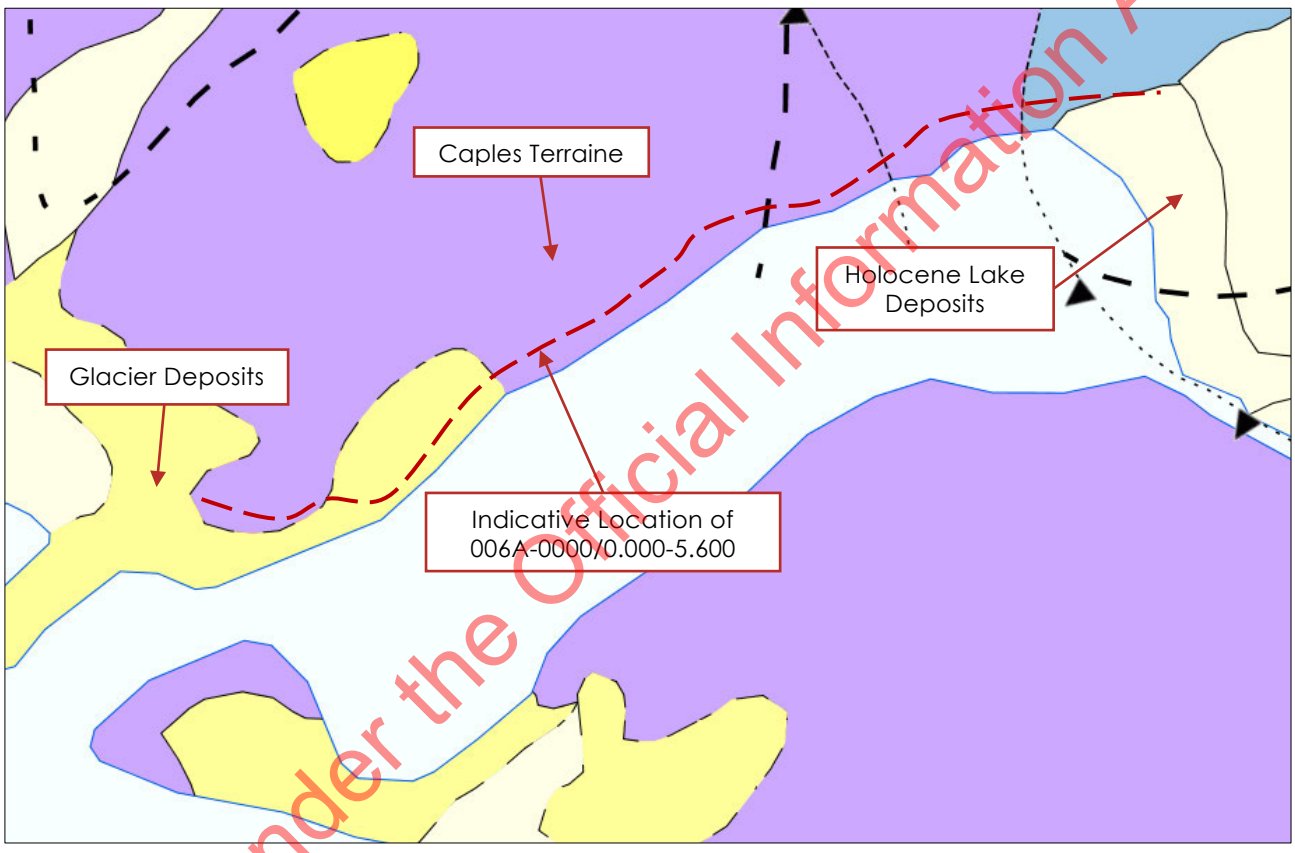


Figure 2-1: Map of Underlying Geology (GNS Science)

2.2 Ground Water

A borehole at the Five Mile Development encountered permeable sandy gravel to a depth of 90m, i.e. at least 20m below the lake surface. This suggests that the Frankton Flats aquifer is unconfined, and that much of the Frankton area has a deep ground water table. This aquifer is expected to be contiguous with the lake levels at the lake edge, and present where gravels exist at the lake edge.

2.3 Natural Hazards

The site and surrounding area was studied on GNS for publicly available information on hazards, as well as previous reports on perceived environmental, geological and geotechnical constraints.

It is concluded that the geotechnical risks associated to the site are active faults, landslides, and soil type.

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2.3.1 **Active Faults**

The GNS database shows several fault lines within proximity to the site location, all of which are inactive. Two concealed faults intersect the site, crossing SH6A in the north-south direction. There is also an approximate thrust fault intersecting the site in the north-south direction.

The Active Faults database (GNS) indicates the nearest active fault to the site is the Cardrona-Nevis Fault (13km east of RP0.000) and has a recurrence interval of 5,000 – 10,000 years. There are a number of active faults further to the east of the site, such as Pisa (32 km), Dunstan Fault (40km) and Cairnmuir Faults (40km). The site is 100km east of the Alpine Fault which has a recurrence interval of less than 2,000 years and is capable of major displacement (> 5m) in a single event.

2.3.2 **Landslides**

The New Zealand Landslide database indicates that Queenstown Hill is active with debris landslides. This includes three known landslide areas:

- Frankton Landslide
- Oak tree
- Perkins Landslide

2.3.2.1 Frankton Landslide



Figure 2-2: Frankton Landslide location

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The Frankton Landslide is a schist debris flow, which appears to be blocky undifferentiated schist blocks, and soil moving on the schist bedrock. The slide base is approximately 15m below the ground surface level, with the schist blocks sliding on a more intact schist bedrock. During the November 1999 Flood there was significant movement of the slip into the road, and of the road and the houses below. The cause of the Frankton Landslide is considered to have been saturation and loss of strength of the lower part of the slope, combined with high water levels within the slope. The combination of these factors increased the weight and reduced effective strength of the soil mass. The landslide is potentially a domino effect, with the base of the slope providing sufficient stability to hold the volume above. Removal of the material at the base of the slope could lead to further movement of the whole landslide.

Following the flooding, surface water drainage was installed at the head of the slope, but the head scarp crack appears to remain open. Surface water drainage installation was combined with installation of horizontal and Counterfort drainage over a large area of the landslide which reduced water levels by several meters. The landslide has remained reasonably stable since drainage installation.

A gabion faced Terramesh wall installed during 2000/01 as part of landslide stabilisation and the widening scheme for the SH6A Frankton Road Upgrade. The wall installation also included Vertical Trench drains (counterfort) to 1m above the existing road level. Excavations of the toe of the slip led to movements of around 0.5mm per day for a period of several weeks during construction, and significant rock buttressing was installed. Following completion, gabions were installed to provide a level surface for the road widening.



Figure 2-3: Frankton Road during November 1999 Flood and Frankton Landslide movement

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2.3.2.2 Oak Tree landslide

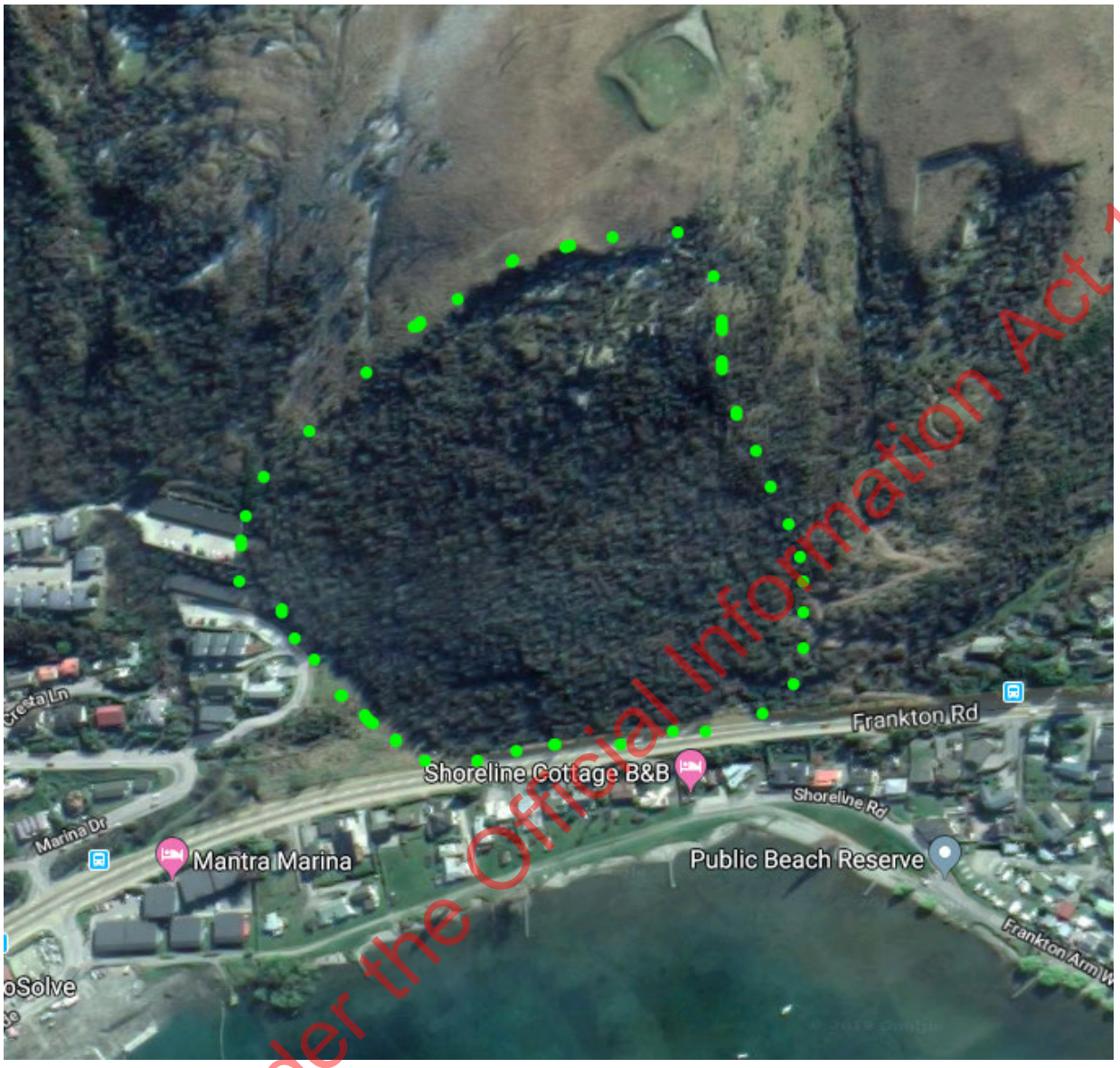


Figure 2-4: Oak Tree landslide location

The Oak Tree landslide comprises a main slip mass of chaotic debris of angular boulders/blocks with a varying fine matrix (schist/colluvium/lacustrine sediments). The slip mechanism is predominantly a failure along the schist foliation and since no wave cut benches are visible on the slip (present otherwise in this area around the 350m contour), this would indicate that the landslide has been reasonably active since the last glaciation. Globally, the landslide is considered marginally stable. It is unclear if the stability of the slip is governed by the piezometric water level, or the water table of the lake. The area at the toe appears to be a lobate mass, with a steep fringe, which is expected to have overridden the lake sediments

The installation of SH6A through the base of the landslide did not appear to affect its stability. Consequently, the risk at road level is considered to be potential rockfall and rock rollout, rather than mass movement of the landslide.

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2.3.2.3 Perkins Road landslide



Figure 2-5: Perkins Road landslide

The Perkins Road slip is 70m in length and extends half way across the existing carriageway. The toe of the slip is thought to extend below the water line into the lake.

The cause of the slip is considered to be a result of artesian pressures at the assumed slip plane. The source of the artesian pressures is likely to be water flow within the schist from the upslope, combined with the varying levels of Lake Wakatipu. When the lake levels are high water is unable to freely drain from the schist slip plane, resulting in loss of stability, shearing of layers of schist and mobilisation of surface material down the slope.

Movements were noticed after the November 1999 Flood event, with the presence of longitudinal cracks opposite the Perkins Road junction. Further movement was noticed during wet periods in the winter of 2000.

2.3.3 Ground Classification and Liquefaction

Ground classification within proximity to the site are predominately classified as D – Deep or Soft Soil, indicating the ground will experience a higher seismic shaking when compared to rock. Frankton has a Modified Mercalli Intensity (MMI) Scale of 7 expected to be exceeded 1:100 years. There is some likelihood of liquefaction-susceptible ground present in areas underlain by fan deltas where the ground water table is low. Liquefaction risk is relevant for Queenstown Town Centre where there is also loose to medium dense sediments and Shotover Delta 2.5km to the east of the site.

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2.3.4 Liquefaction

The liquefaction risk has been most recently mapped[1] for the Frankton area by GNS Science Consultancy in 2019. This report suggests that there is a liquefaction risk (Domain B) at the north end of the Frankton Arm, from Perkins to the BP roundabout. Domain B is described as occurring where the ground is predominantly underlain by poorly consolidated river or stream deposits, and there is a low to moderate risk of liquefaction. This typically occurs where streams could have historically drained into Lake Wakatipu, and therefore there are some discrete areas which could have a liquefaction risk along the whole length of SH6A where historic streams have flowed into the Lake.

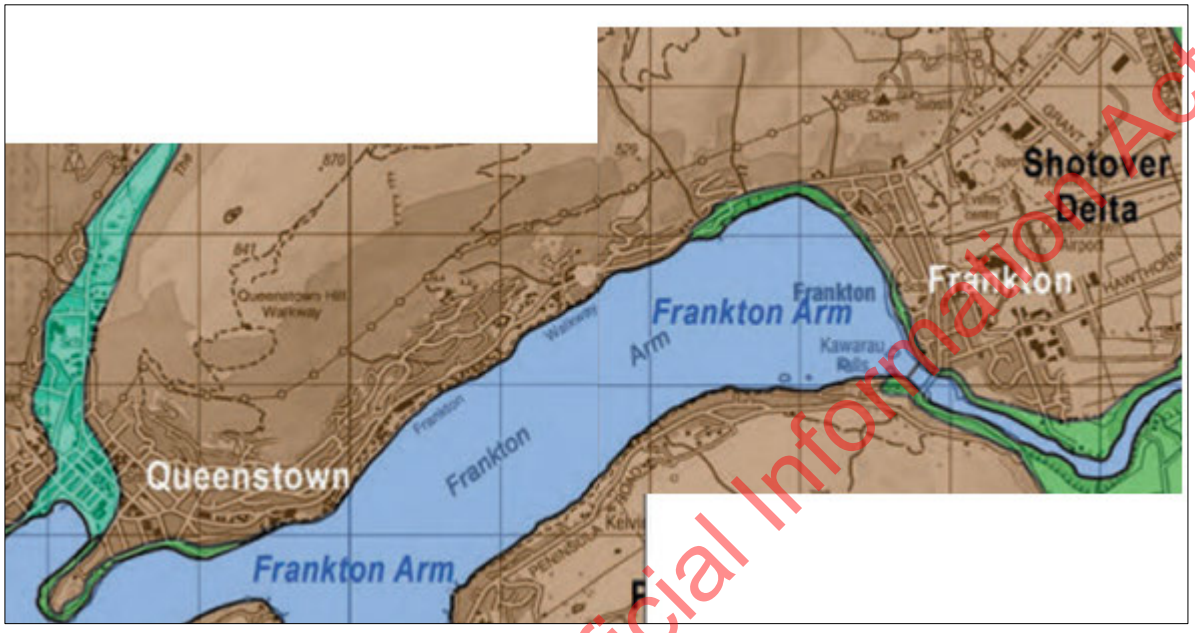


Figure 2-6: Liquefaction risk Frankton to Queenstown, GNS, 2019

2.3.5 Flooding

The site of SH6A has not been indicated to be at risk of inundation from a flood event.

Queenstown Town Centre, within proximity to the site has been indicated to be susceptible to flooding from high water levels in Lake Wakatipu. The extent of inundation predicted is approximately 120m from the natural lake level, which was observed in the November 1999 Flood. This is not expected to directly affect Frankton Road, however high lake levels may affect the areas which are part of landslides, and surface water flooding may affect culverts which cross the road.

2.4 ORC Contaminated Land Inquiry

The Otago Regional Council maintains a HAIL database (Hazardous Activities and Industries List) regarding any information the council holds pertaining to potential soil contamination at the site. It was confirmed that the following sites the area currently appear on the HAIL database maintained by ORC, as described in **Error! Reference source not found.** below.

Table 2-1: Land Parcels of Risk Listed in ORC HAIL Database

Key	Address	Site History	Potential Hazard
1	58 Stanley Street	Alpine Automart (currently Liquor)	Service stations including retail or commercial refuelling facilities
2	18 to 24 Stanley Street	Landfill Site (currently a Church)	Landfill Site

[1] Assessment of liquefaction hazards in the Queenstown Lakes, Central Otago, Clutha and Waitaki districts of the Otago Region, DJA Barrell, GNS Science Consultancy Report 2018/67 June 2019

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Key	Address	Site History	Potential Hazard
3	88 Frankton Road	Leary's Gully Landfill (currently Copthorne Hotel)	Landfill sites
4	53-65 Frankton Road	Landfill Site	Landfill sites. Contaminant concentrations below commercial criteria.
5	62 Frankton Road	Alpha Lodge	Storage tanks or drums for fuel, chemicals or liquid waste
6	11-17 Frankton Road and 21-25 Sydney Street	Bungy Backpackers (currently under construction)	Storage tanks or drums for fuel, chemicals or liquid waste
7	Sugar Lane	Frankton Marina Fuel Tanks	Storage tanks or drums for fuel, chemicals or liquid waste. Two underground tanks and dispensing equipment.
8	846 Frankton Road	Z Queenstown	Service stations including retail or commercial refuelling facilities
9	1067 Frankton Road	Frankton Mower (currently Mobil)	Motor vehicle workshops
10	1 McBride Street	Frankton Service Centre (currently Mobil)	Service stations including retail or commercial refuelling facilities.

2.5 Site History

Over 100 Historic aerial photographs, taken between 1929 to 2001 were available for review from Retrolens[2] and Google Earth from 2004 to 2020. **Error! Reference source not found.** below summarises the aerial photographs reviewed in relation to the site. These were also cross checked with historical maps from MapsPast[3] showing development of the site from 1929 to 2020.

Table 2-2: Summary of Freely Available Historic Aerials and Maps

Year	Site Observations	Surrounding Area
1929	Current existing route for SH6A for Queenstown to Frankton present	Current existing road network in Queenstown Town in place
1956	First document development of residential properties and town buildings at Queenstown Lake Front, densely populated. Main roads in Queenstown Town have been sealed.	Limited development of Queenstown Hill, and adjacent to SH6A
1964	No discernible changes from 1956, First documentation of SH6A being sealed. Development of residential dwellings at Frankton are present.	No discernible changes from 1956.
1973	Development of residential dwellings adjacent to SH6A are present.	Development of Gorge Road industrial area.
1978	No discernible changes from 1973.	Development of Fernhill residential area.
2001	First colour aerial freely available. Site appears to have no discernible changes since 1979.	Continued development of residential development on northern side of SH6A

[2] http://retrolenz.nz/
[3] http://mapspast.org.nz

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3. Proposed Works

This section describes the proposed works and concept geotechnical assessment of the works required at each of the locations. Refer also Appendix A

3.1 McBride Street Intersection (Sheet 1a)

3.1.1 Existing Infrastructure

SH6A Frankton Road consists of east, and west bound lanes, separated by a painted median. There is a shared use pedestrian/cycle path on the south side of the roadway. The pedestrian/cycle path is intersected at various points by vehicle crossings providing access to the commercial and residential properties. A cycle lane borders the east bound vehicle lane on the northern side of Frankton Road.

An existing batter slope lies to the north of the roadway. The terrain slopes moderately downhill to the west. The properties to the south of the roadway lie at a similar slope to the road. An existing concrete crib wall runs along the northern side of Frankton Road from the vicinity of the Yewlett Crescent intersection for approximately 100m.

3.1.2 Proposed Works

A new intersection is to be formed here, with a new bus stop to the west of McBride Street and a footpath on at the base of Towne Place.

No widening of the road is required here, but the arrangement of the lanes will be altered, with two bus stops and a pedestrian refuge island proposed. The existing shared path and kerbs to the south of Frankton Road will remain.

The existing batter slope and crib wall retaining structure to the north of Frankton Road will remain. A new pedestrian access way is proposed to follow the top of the batter slope/retaining wall structure of Towne Place.

3.1.3 Geotechnical Requirements

The ground in this area is considered to be of low to moderate liquefaction risk, this relates to the presence of a water table contiguous with the lake, and therefore at the elevation of McBride street is considered to be a low risk.

No significant geotechnical physical works are expected

3.1.4 Investigation Requirements

Test pits TP1.1 and 1.2 required at the proposed bus stop locations to confirm the ground conditions where minor earthworks will be undertaken on the south side of the road.

Refer to Appendix A for Trial Pit (TP) and Bore Hole (BH) testing locations.

3.2 Yewlett Bus lane to Marina widening (Sheet 1b and 2a)

3.2.1 Existing Infrastructure

On the north side of the road there is an existing concrete crib wall providing access to Towne Place to the west of Yewlett Crescent. There is an existing bus stop to the north side.

This length passes through the base of the Frankton and the Oak Tree landslides, which feature up slope gabion retaining walls to the north of the road,

To the south of Frankton Road, there is existing downslope retaining which has been installed on the Frankton and Oak Tree landslides to provide support to the road. This retaining varies from Gabion to timber crib, with timber battened wall above, and is in a reasonable state of repair.

The Frankton Landslide is described above, and relevant features at road level are a downslope gabion retaining wall of approximately 4m in height, and a gabion faced Terramesh wall with Counterfort drains on the upslope.

The Oak Tree landslide features a 5m high gabion wall along the east end of landslide and is heavily vegetated above.

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To the west of the Oak Tree landslide, the downslope properties have accesses from the road, and on the upslope side the undeveloped area (the area without trees) of 869 Marina Drive, features a shallow slope to the road.

3.2.2 Proposed Works

A bus stop and a pedestrian refuge island are proposed on the north of the road in the location of the existing bus stop.

The existing shared used cycle/pedestrian will remain to the south of the road way. An additional 2.7m of down slope path is proposed at the western end of the existing pathway, this is expected to be achieved through installation of additional gabions to the face of the downslope retaining walls. This will also require integration of the existing drainage installed as part of the mitigation works for the Frankton Landslide to be integrated into the new retaining system.

Between Oak Tree Landslide and Marina Drive there is sufficient existing width for development.

3.2.3 Geotechnical Requirements

The ground in this area is considered to be low to moderate liquefaction risk, however the most significant natural hazard in the area is considered to be the activation of the Frankton or Oak Tree Landslides.

3.2.3.1 Frankton Landslide

Due to the presence of the Counterfort drains within the Frankton Landslide retaining wall, it is considered to be particularly costly to increase the road width by 2m in the upslope direction. Road widening would involve installation of additional counterfort drains, and removal of the existing gabions. The temporary works for such an operation, in combination with the risk of activating the Frankton Landslide make this option appear difficult.

Increasing the width of the carriageway downslope would involve the installation of additional gabions adjacent to the face of the current gabions. Installation of additional gabions would require the removal of the top gabion to allow for construction of the surfacing, and construction design details to allow for the tying of one gabion basket to the next.

It may be possible to provide a new timber boardwalk structure for the footpath on the downslope of the existing retaining walls, however due to the potentially chaotic and variable nature of the landslide material here, it is currently considered that facing the existing retaining walls would be a better option. There is also a local failure of the existing retaining supporting the footpath at 969 Frankton Road that would be supported by the above option.

There is an existing manhole and drainage outfall which would need to be bridged locally or relocated away from the retaining wall.

3.2.3.2 Oak Tree Landslide

The road passes in front of the Oak Tree landslide, which is a slip mass of chaotic debris of angular boulders/blocks with a varying fine matrix of schist, colluvium and lacustrine sediments, with the road retained by a 5m high gabion wall. It has previously been noted that the cutting of SH6A did not affect the stability of the Oak Tree Landside. However, increasing the lane width on the north side of the road would require the removal and replacement of the existing gabion wall, which is not considered to be a cost effective solution, and therefore increased width for the cycle trail should be installed as gabions to the face of the existing downslope retaining.

3.2.4 Investigation Requirements

TP1.3 should be undertaken to confirm the founding required for the new bus stops.

It is considered that sufficient deep geotechnical investigation information is available for the Frankton and Oak Tree landslides, and that no deep geotechnical investigation to be undertaken within the Landslides to ensure that the drainage installed there is not compromised. Trail pits (TP1.4 – 1.6) should be undertaken, to confirm the founding of the proposed gabions or timber board walk required for the path width here.

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3.3 Marina Signalised intersections (Sheet 2b)

3.3.1 Existing Infrastructure

The Sugar Lane and Marina Drive intersection, and the entry and exit to the Z Service Station present a significant current issue in terms of traffic. There is an existing bus stop to the west of the Sugar Lane intersection on the south side

3.3.1.1 Proposed Works

Pedestrian signals will be installed at the intersection, with a new footpath on the south side approximately 2m wide. New bus lanes are required, meaning an increase in width of the carriageway.

At the entrance to Sugar Lane, an additional retaining wall is expected to be required on the south side of the road to achieve the required path width. This retaining wall is expected to be approximately 1.0 – 1.5m tall.

To provide access to the footpath at Marina Drive on the north side, minor retaining will be required to the existing storm water outlet.

The provision of a wider footpath will require the existing culvert headwall to be bridged or relocated.

3.3.1.2 Geotechnical Requirements

The provision of a new bus stop to west side of the Sugar Lane intersection would require the installation of new retaining walls into the existing bank. This bank is colluvium and appears to have been cut over steep to install the building platforms for the Sugar Lane developments.

3.3.1.3 Investigation Requirements

BH2.1 should be undertaken to provide information on the new retaining wall required to the south west of Sugar Lane.

3.4 Marina Drive to Perkins Road Bus Lane (Sheet 2b and 3a)

3.4.1 Existing Infrastructure

A footpath on the south side running to the Marina west section. There is a gabion wall to the south of the road retaining to the buildings on Sugar Lane, and a bund has been created on the south side of the footpath. Further to the west the Sugar Lane car park is approximately 1.5m below the existing carriageway. The north of the carriageway features a colluvium slope of approximately 45°, with a timber post catchfence wall along the base of part of the length. A stream discharges from a culvert headwall at the south side of the road.

3.4.2 Proposed Works

Provisions of new bus lanes require the widening of the carriageway along this length on both sides of the road. A new retaining wall is to be provided along the south side for new bus stops as part of the Marina Drive signals section, and the existing retaining wall on to the properties at Sugar Lane should be replaced. On the north side the colluvium bank will be retained with a timber pole wall to provide additional road width.

3.4.3 Geotechnical requirements

Further along the bank there is an existing retaining wall, consisting of approximately 1.5m high gabions, with a batter slope to the road above approximately 5m away. The installation of a new retaining wall along this length would require a retained height of approximately 4.5m. Such a retaining wall would likely be formed using Terramesh ties with a gabion facing, with the Terramesh extending towards the existing bank.

Further along the road a bund has been formed to provide an embankment towards the Sugar Lane west end. In order to provide a level platform towards the transformer, this bund would be removed, with minor timber pole retaining provided at the new bus stops. To provide level access into Sugar Lane, the area would be bulk filled.

An existing 1.0m timber catch fence has been installed along part of the length, with a 45° batter slope of colluvium behind. In order to achieve increased road width in this area, a new timber pole retaining wall should be installed within the bank.

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3.4.4 Investigation requirements.

BH2.2 and 2.3 to be undertaken to inform the design of the Terramesh retaining wall required at this location. BH2.6 undertaken to inform the design of the timber pole retaining walls on the north side.

3.5 Marina West Signalised intersection

3.5.1 Existing Infrastructure

This area currently features a colluvium slope on the south side with a bus stop at the head. The slope is approximately 2.0m tall, with no access from the highway to the car park.

On the north side Livingstone Lane is approximately 2.0m above the carriageway at the head of a colluvium slope.

3.5.2 Proposed Works

New access to the Marina is to be provided here. The area to the south is expected to be filled as part of the new intersection, with bulk fill earthworks required here to achieve levels, which would be graded to match the existing. A bulk fill depth of approximately 3.0m may be required.

3.5.3 Geotechnical requirements

This area is the eastern extent of the Perkins Road Landslide. No additional geotechnical works are expected in the area of the Perkins Road landslide as required for road widening. Bulk filling was undertaken for the construction of the Marina development, and this resulted in consolidation of the material at depth. Filling of this area could result in consolidation settlement which should be managed during construction.

Perkins Road is mapped as being potentially susceptible to liquefaction, and the permanent stream which runs between Marina Drive and Middleton Road, could result in some saturation of the ground in combination with the potential for liquefaction susceptible silty material deposited as part of the original delta which has become the Sugar Lane developments. Further investigation should be undertaken here to confirm the ground conditions.

3.5.4 Investigation requirements.

BH2.4 and 2.5 to be undertaken to inform the filling requirements and expectations for settlement in this area.

3.6 Perkins Road to Middleton Road (Sheet 3)

3.6.1 Existing Infrastructure

Between the Proposed Marina West signalised intersection and Middleton Road the downslope is retained by a series of aging polypropylene mesh reinforced (Fortrac) retaining walls of height up to 2.5m. These are currently in a fair condition, but are UV light sensitive, and will continue to degrade over time.

The north side of the carriageway comprises exposed schist cut face with Perkins Road above, though some gabion walls have been installed locally.

3.6.2 Proposed Works

Replacement of the Fortrac walls, or reconstruction over the face is recommended. Replacement could involve reconstruction with a similar but improved system, such as Terramesh, with a planted face (although being south facing it is difficult to establish vegetation during the winter months) or by facing the existing walls with gabions.

A timber boardwalk viewing platform at the bus stops is proposed, this is expected to be founded on piles bored into the colluvium

3.6.3 Geotechnical Requirements

This length passes over the Perkins Road Landslide, though no significant works are proposed in this area.

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Perkins Road area is mapped as being potentially susceptible to liquefaction. The permanent stream which runs between Marina Drive and Middleton Road could result in some saturation of the ground in combination with the lake levels.

Further investigation should be undertaken here to confirm the ground conditions if upgrades to the road are to be carried out.

3.6.4 Investigation Requirements

Investigation of the Perkins Road landslide may need to be undertaken if any works on surfacing of the road are to be undertaken. Trial Pits TP3.1 – 3.3 have been included as part of this investigation, and for the replacement of the existing Fortrac walls.

Borehole investigation for the installation of the timber board walk viewing platform are recommended (BH3.1)

3.7 Middleton Road to Battery Hill (Sheet 3b and 4a)

3.7.1 Existing Infrastructure

Middleton Road meets the carriageway at a colluvium slope, with a schist outcrop at the east side. A stacked stone wall is present at the west side, with a culverted open drain further west.

The downslope is a steep colluvium slope with some retaining. There is an access to the lower roads which must be maintained. On the down slope the highway is retained to the east of the access with a steep colluvium slope to the west.

On the south side of the road, there is an existing colluvium slope between the State Highway and the property accesses at Battery Hill.

The upslope comprises a 1:1 colluvium slope with the Beachwood apartments at the head of the slope.

3.7.2 Proposed Works

A new bus stop is to be provided at Middleton Road. An open drain has been installed at the base of the colluvium slope immediately west of Middleton Road. Formation of the intersection junction and the footpath will require this colluvium slope to be retained by a small timber pole retaining wall, with a drain behind. There is an existing transformer in the vicinity which may have to be relocated to provide sufficient clearance to the retaining walls. To the west of the transformer it is not possible to install a retaining wall on the south side of the road due to the requirement to retain access to the properties. Here the east bound bus stop is proposed to be lengthened towards Frankton.

To increase the width of the road and to provide a footpath along the length between Middleton Road and Battery Hill, it is proposed to install a new timber pole wall at the formed slope in front of the Beechwood Apartments to support the existing bank.

To increase the road width of the south side, would require building in front of the existing gabion wall. This would be technically feasible but would require an assessment of the design of the existing retaining wall.

3.7.3 Geotechnical Requirements

Formation of a bus stop to the east of Middleton Road will require excavation into the visible schist rock outcrop at the proposed location. This excavation is not expected to affect the stability of Middleton Road, however, the quality of the rock and location of the rock head should be confirmed prior to commencement of excavation works.

3.7.4 Investigation Requirements

BH3.2 is proposed to confirm the presence and quality of the rockhead at Middleton Road

BH4.1 is proposed to confirm the geotechnical properties of the slope at the Beechwood apartments

BH4.2 is proposed to confirm the founding for the proposed gabion wall on the south side.

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3.8 Battery Hill Pedestrian Signals (Sheet 4a)

3.8.1 Existing Infrastructure

The intersection of Battery Hill and Frankton Road features a bus lane and a shared path on the south side, with the existing accesses level with the road on the south side. On the north side there is the colluvium face to the Beechwood Apartments to the east and a schist faced and a concrete crib retaining wall approximately 1.5m high set back from the road to the west supporting the car park on the Remarkables Apartments.

3.8.2 Proposed Works

It is proposed to install signals at this intersection and to extend the bus stop on the north east corner of the intersection.

On the south side it is proposed to increase the width of the footpath bus stop area.

An existing timber crib retaining wall exists to the west of Potters Hill Drive. This is not proposed to be altered as part of the signals work.

3.8.3 Geotechnical considerations

A timber pole retaining wall approximately 1.0m high is proposed on the north side to support the existing colluvium slope.

A timber pole or gabion retaining wall of approximately 1.0m high is proposed on the south side to support the increased footpath width.

3.8.4 Proposed investigations

Assessment of the foundations of the buildings of the Beechwood apartments in this area should be undertaken as part of the design for the retaining wall.

BH4.3 is proposed on the north side to investigate the founding for the retaining wall here, and BH4.4 is proposed on the south side to investigate the retained material and the founding for the retaining wall to the bus stop.

3.9 Battery Hill to Goldfield Heights (south side shared path Supporting Infrastructure and north side footpath Supporting Infrastructure) Sheet 4

3.9.1 Existing infrastructure

From Potters Hill the SH6A crosses a gully, vegetated to the south, which contains a culvert draining under the road. To the south side the Alpine Village Apartments are set below the existing road with retaining walls to Frankton Road. The tennis courts of the (old) Alpine Village are further to the west, with minor retaining and a formed slope to the highway. There have been proposals in the past to develop the old Alpine Village site. On the north side the flat raised area of the Holiday Inn slopes towards the road, with schist outcropping on the inside of the corner.

3.9.2 Proposed works

There are two options to increase the width of the carriageway. Cutting into the schist bank on the north of the carriageway is feasible and will not affect the properties to the north.

3.9.2.1 North side

To reduce the amount of retaining required on the south side, it may be feasible to realign the road by cutting into the existing schist face.

3.9.2.2 South side

An existing culvert exists at the east of the (old) Alpine Village entrance. To achieve a suitable footpath on the north side of the carriageway, a new headwall and culvert extension, or a timber boardwalk and approaches, will be required to provide additional width across the gully.

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A viewing platform behind the bus stop has also been proposed opposite the Holiday Inn. The construction of this platform would most likely take the form of a braced pole structure comprising timber or steel poles 5.0m out of the ground, and 2.5m into the ground, with a timber deck. This would be placed downhill of the existing gabion retaining wall and should be designed to allow access to the site below, which currently runs at the base of this retaining wall. The design should be reviewed against previous hotel proposals for the site at 595 Frankton Road.

To allow for the provision of the Goldfield Heights bus stops, to the west of the access widening of the road of the downslope side would require retaining a slope of height approximately 5.0m. This could be achieved by the provision of anchored sheet piled or timber pole retaining wall, with anchors extending into the schist behind. An alternative solution would be the provision of a cantilevered structure for the shared path. This could be achieved through the provision of a piled wall within the carriageway, a ground beam at the head of the piles and a steel or concrete horizontal structure with a Deadman or a rock anchored system fixed back to the schist which is expected below the carriageway. Installation of such a system is expected to be relatively extensive and disruptive, but technically feasible. A third alternative would be to move the alignment of the carriageway to the north though the cutting of the schist face to achieve an increased road width. This would extend to the bus stops to the east of Goldfield Heights, where minor retaining would be required to support the lower parts of Goldfield Heights road.

3.9.3 Geotechnical requirements

To increase the road width of the south side, would require building in front of the existing gabion wall. This would be technically feasible but would require an assessment of the design of the existing retaining wall.

An existing culvert exists east of the (old) Alpine Village entrance. To achieve a suitable footpath on the north side of the carriageway a new headwall and culvert extension, or a timber boardwalk and approaches will be required to provide additional width.

Construction of the viewing platform would most likely take the form of a braced pole structure comprising timber or steel poles 5.0m out of the ground, and 2.5m into the ground, with a timber deck. This would be placed downhill of the existing gabion retaining wall and should be designed to allow access to the site below, which currently runs at the base of this retaining wall. The design should be reviewed against previous hotel proposals for the site at 595 Frankton Road.

A new bus stop and turn lane are proposed at the existing layby area opposite the Holiday Inn. The north side of the carriageway features a cut schist bank approximately 5.0m maximum height. The south side of the layby is a 5.0m high gabion retaining wall, which is expected to feature tie backs to the existing rock head, which will be present at some depth beneath the road.

3.9.4 Proposed investigations

The design of the existing gabion retaining walls to the east of the new south side bus stop should be reviewed.

Borehole BH4.5 is required to assess the stability of the gully and founding of the new headwall on the north side of the road.

BH4.6 is required to assess the founding requirements for the timber platform

BH4.7, BH4.8 and BH4.9 would be used to inform the design of the proposed 5.0m high retaining wall on the south side, and to understand the level of the schist rock in this area to confirm the design of rock anchors for the retaining wall.

TP4.4 and TP4.5 are proposed for the exploration of the schist rock to the north of the road if realignment of the road is required.

3.10 Goldfield Heights Intersection (Sheet 4)

3.10.1 Existing infrastructure

The existing intersection features a bus stop on the north side which is cut into an over steep colluvium bank.

On the south side there is a transformer opposite the bus stop, at the head of a steep downslope. This downslope is heavily vegetated and features a 1.0m or 2.0m high Fortrac retaining wall. Investigation of this area is required.

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3.10.2 Proposed works

The provision of a new signalised intersection at Goldfields Heights requires the installation of a new timber pole retaining wall to be installed to support a new footpath to connect the east side of Goldfield Heights.

There is an existing Fortrac retaining wall on the lake side of the which provides access to 563 Frankton Road. In order to increase the footpath width in this area, it is expected that the Fortrac wall should be increased in width by placing additional gabions in front of the current gabions, while also maintaining the access to 563 Frankton Road.

3.10.3 Geotechnical requirements

The existing down slope may need to be increased to provide the increased footpath width. This works will tie into the retaining wall to be installed for the section to the west.

3.10.3.1 Investigation requirements

Borehole BH4.8 is proposed to confirm the founding requirements for downslope retaining at the south side.

Trial Pit TP4 is required to confirm the founding for the retaining wall at the bottom of the Goldfield Heights Road.

3.11 Goldfield Heights to Larch Hill Place (Sheet 4)

3.11.1 Existing infrastructure

To the north of the carriageway, the colluvium formed slope below the Sherwood sign meets a steep gully which drains the Goldfield Heights area and passes under the road. The south side access to 551 Frankton road is steep with a timber fence on a gabion wall which appears to extend to the access road to the south. Frankton Road is supported on the downslope across the gully by an MSE wall that was constructed following the November 1999 Flood which washed out half of the width of Frankton Road.



Figure 3-1: Goldfield Heights dropout forming during November 1999 Flood (18 Nov) and MSE Wall reinstatement © 2000

On the north side there is exposed schist of variable quality, evidence by the rock bolting which has been installed. This exposed schist features some sections of gabion above of up to 5.0m. These gabion walls were constructed with the 2000/01 Frankton Road Upgrade to support the Golden Terrace area above, which limits the possibility of widening the road to the north.

There is an existing bus stop and transformer on the south side at the head of a colluvium slope down to the Remarkables Retreat access road.

The retaining walls on the access road to Remarkables Retreat below supporting Frankton Road are a mixture of gabion, Fortrac and timber post, and their condition should be assessed during detailed design.

3.11.2 Proposed works

In order to widen across the storm water culvert, it will be necessary to widen the existing MSE wall, which could be done by founding gabions, or modifying the top layers of the MSE wall.

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On the south side it is necessary to retain access which providing an additional 2.0m footpath width. It is expected that this will be achieved through the installation of timber pole retaining walls which are imbedded into the schist.

In the area of Remarkables Retreat, it is necessary to increase the footpath width. This will require the provision of either a timber boardwalk installed into the slope at the base of the existing retaining walls, or new facing of the existing gabion retaining walls.

3.11.3 Geotechnical requirements

The presence of the existing schist outcrops on the north side limits development on that side of the road.

On the south bank the schist is expected to be present at some depth below the road. It is expected that retaining walls will need to be embedded into the schist rock here due to the expected retained height.

3.11.4 Investigation requirements

BH4.10 and BH4.11 are proposed to inform the design of proposed timber retaining walls

BH5.1 – 5.4 are proposed to confirm the ground conditions for the down slope retaining walls or timber board walks proposed at the Remarkables retreat.

3.12 Larch Hill Intersection (Sheet 5)

3.12.1 Existing infrastructure

An existing timber crib retaining wall exists on the south side of Larch Hill, with an existing 2.5m gabion wall downhill of Larch Hill Place. The presence of these means that widening of the road on the uphill side is not really a possibility.

3.12.2 Proposed works

It is expected that a similar retaining solution will be required to that at the Remarkable Retreat, with increase downslope area available. However, in order to provide an increased footpath width at this location a 5.0m high retaining wall may be required. Temporary works issue with construction of a gravity retaining wall of this height would necessitate closure of the road and therefore an anchored pole wall is proposed.

3.12.3 Geotechnical requirements

As a result of approximately 5m retained height being required, it may be necessary to install anchors to the retaining wall which are founded at 2 – 2.5m below the road level and intersect with the schist rock expected at depth.

3.12.4 Investigation requirements

BH 5.6 and BH 5.7 are proposed to confirm the founding materials for the retaining walls, and BH 5.8 is proposed to confirm the depth to schist rock in the area for anchor founding.

3.13 Larch Hill to The Rees (south side shared path Supporting Infrastructure) Sheet 5

3.13.1 Existing infrastructure

From Larch Hill westwards on the north side the slope is heavily vegetated and steep with the properties of Larch Hill Place above. There are schist outcrops with shotcrete faces opposite the south side bus stop suggesting that lower strength schist is present in this area at road level. Towards Andrews Road there are 10m high gabion walls which appear to have been installed as a face to the lower quality schist on this side during the 2000/01 Frankton Road Upgrade.

On the south side the access road comprises a steep vegetated colluvium slope, with some areas of exposed schist. It is expected that while this slope is retaining, there is schist below the road.

An existing timber board walk has been installed between the bus stop west of Larch Hill and The Rees Hotel on the south side. This footpath is approximate 2m wide, but the construction of the boardwalks has not been assessed.

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The section between the timber board walk and Andrews Road is formed at the head of a colluvium slope of height approximately 4.0m which is heavily vegetated down to houses between

3.13.2 Proposed works

It is not proposed to change the alignment on the north side of the road

An increased in the footpath width of 2.0m is required along this length. This will involve both an upgrade or replacement of the existing timber board walk,

In order to provide an increased road width here, a new retaining wall is required to retain the increased road width on the south side.

An elevated timber viewing platform is proposed at the existing bus stop west of Larch Hill. It is expected that this will be installed on piles and will be a braced structure.

3.13.3 Geotechnical requirements

The existing down slope is expected to be formed from colluvium or dumped fill in combination with a cut face and Fortrac wall construction during the 2000/01 Upgrade. This slope will require retaining, and it is expected that the retaining walls would be installed into existing schist rock.

The increased alignment of the shared path will therefore require a new timber pole or Terramesh retaining wall of approximate height 4.0m, though the founding of this wall should be confirmed thought investigation.

The plan location of this wall should be assessed by reviewing the surveyed cross sections. If necessary, a new timber boardwalk could be provided on the lake side of the new retaining wall. This would be founded on piles embedded in either colluvium or schist bedrock.

3.13.4 Investigation requirements

Further investigation of the nature of the colluvium slopes to the access road is proposed.

Survey is required to assess the amount of downslope retaining, and geotechnical investigation required to confirm the depth of colluvium and location of schist rockhead.

It is expected that timber or steel pole retaining walls of this height may be embedded into the schist bedrock expected to be present at depth, and therefore borehole investigations will be undertaken to confirm these.

BH5.10 is proposed to understand the ground conditions for the proposed platform and BH5.9, 5.11, and 5.12 are proposed to understand the ground condition of the existing colluvium bank for the installation of the new retaining at the south side.

3.14 The Rees to Andrews Road (south side shared path Supporting Infrastructure) Sheet 6

3.14.1 Existing infrastructure

The access to the Rees hotel is provided by an anchored concrete post and panel wall retaining approximately 10m at maximum height.

3.14.2 Proposed works

To increase the footpath width on the south side it is proposed to provide a cantilevered walkway to the head of the retaining wall. It is expected that this will take the form of a Deadman anchor in the centre of the road, with concrete or steel beams extending over the top of the wall and founded on the schist below.

3.14.3 Geotechnical requirements

The geotechnical and structural design for the existing wall should be reviewed and assessed to confirm that any additional loading imposed by the cantilevered walkway can be accommodated.

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3.14.4 Investigation requirements

Geotechnical investigation will involve the assessment of the depth to the schist layer behind the wall. Any geotechnical investigation must be carefully planned to ensure that the existing anchors are avoided.

The design for the current wall should be assessed first, and if necessary BH5.13 undertaken

3.15 Hensman Road Intersection Sheet 6

3.15.1 Existing infrastructure

On the upslope side, recently installed soil nails at Andrews Road have been installed to improve this intersection. A 2.0m tall gabion retaining wall was constructed with the 2000/01 Frankton Road Upgrade to support Andrews Road.

Hensman Road features an existing crib retaining wall on the north side up Hensman Road.

There is a bus stop at on the south side of the road and a small culvert between Andrews and Hensman Roads which runs under Frankton Road and is piped down through 355 Frankton Road.

An existing timber post and panel retaining wall is present on the downhill side of Hensman Road, with an existing access present.

Steel king post retaining walls have recently been installed downslope of the intersection at the development of 355 and 359 Frankton Road

Fortrac walls are present on the downslope side at 353, 347 and 351 Frankton Road.

3.15.2 Proposed works

A widening of this area is required, particularly on the downhill side to provide a new footpath of width 4.0m. This requires a new retaining wall with the footpath widened by 2.0m

The bus stop shelters are proposed to be set back from the shared path, meaning additional retaining is required behind the current bus stops for the shelters.

No widening works are proposed on the north side.

3.15.3 Geotechnical requirements

The provision of retaining on the downslope may require an assessment of the design of the existing retaining walls at 359 Frankton Road, though it may be possible to found the structure of the new bus stops on end bearing piles, meaning that the existing walls are not loaded.

It is expected that the retaining works required to the areas opposite Hensman Road (347 to 355) will involve building out in front of the existing Fortrac retaining walls, potentially with reconstruction them depending on their quality. Gabion or Terramesh walls are proposed.

3.15.4 Investigation requirements

Review of the design for the steel retaining walls opposite Andrews Road is recommended. Assessment of the condition of the existing Fortrac walls is required, and Assessment of the bearing at the base of the existing retaining walls is proposed by the excavation of TP6.1 and TP6.2.

3.16 Hensman Road to new bus stops west of Hensman Road (south side shared path Supporting infrastructure). Sheet 6

3.16.1 Existing infrastructure

West from Hensman road on the downslope side the footpath is supported by a series of different retaining walls visible from the access road at 323 Frankton Road. These stand at the head of a colluvium slope with existing schist outcropping.

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3.16.2 Proposed works

In order to increase the width of the shared path in this area it is proposed to install a new retaining wall 2.0m from existing on south side. This will require an assessment of the existing retaining walls and by the placement of new gabions in front of the existing.

3.16.3 Geotechnical requirements

The quality and competency of the existing retaining walls on the downslope to be confirmed.

3.16.4 Investigation requirements

TP6.3 and 6.4 proposed to confirm bearing for new retaining wall facing to the existing walls.

3.17 New bus stops west of Hensman Road (Sheet 6)

3.17.1 Existing infrastructure

A gabion wall of maximum height 9.0m has been installed to the west of Hensman road intersection on the north side. This wall supports the colluvium slope below Hensman Road. Further to the west the slope is a constant grade to the road, with another up to 5.0m high gabion wall present on the north side. To the west of this wall the schist rock outcrops at the road to a maximum height of approximately 12m, with the colluvium slope above.

3.17.2 Proposed works

A new bus stop is required on the north side of the carriageway into the colluvium slope of Hensman Road to provide a future bus stop on the north side of the carriageway. This will require new retaining walls to support the existing colluvium slope.

A future bus stop widened shared path and a new viewing platform are proposed on the south side of the road. This is at the head of a heavily vegetated slope which is supported downslope by a Fortrac retaining wall of varying height.

3.17.3 Geotechnical requirements

The retaining walls on the north side colluvium slope may be up to 5.0m high and are therefore expected to be formed from anchored sheet piles or king posts, which are then excavated in front of to maintain stability of Hensman Road above.

The new south side downslope retaining is expected to either take the form of an anchored Terramesh or gabion wall, or an anchored piled wall. Temporary works at this location may prove difficult, with the temporary stability of the existing upslope gabion walls being problematic if they are undermined during construction. It may prove more cost effective to install the viewing platform using braced timber or steel poles, rather than to import and retain more material.

3.17.4 Investigation requirements

Boreholes BH6.1 to 6.3 are proposed to inform the ground conditions in the slope. BH6.1 is expected to be undertaken at Hensman Road to confirm the depth to schist rock in the area to allow for the design of anchors, and BH6.4 is proposed to confirm ground conditions at the toe of the retaining walls to mitigate against deeper seated failure.

BH6.5 and BH6.6 are proposed to inform the ground conditions at the retaining walls required on the downslope side and for the founding for poles relating to the timber retaining platform. BH6.7 and BH6.8 will be used to inform the depth and strength of schist rock for the design of rock anchors for the retaining walls.

3.18 New bus stops west of Hensman Road to Oaks Club (south side shared path Supporting Infrastructure) Sheet 6b and 7a

3.18.1 Existing infrastructure

On the north side of the carriageway there are a number of properties set back from the road between outcropping schist features. To the west the schist becomes less prominent and the slope reduces in angle.

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At the south side the access to The Point and Villa del Lago are at the base of a colluvium slope which extends down approximately 3.0m from Frankton Road.

To the south the access road to the Oaks Club features a Fortrac retaining wall of up to 3.0m height.

To the north of the road the slope appears to have schist outcropping at the base of approximately 2.0m height, with a colluvium slope of approximately 2m to a bench, with vegetation above.

3.18.2 Proposed works

No works are proposed on the north side of the road. On the south side of the road it is proposed to extend the footpath width by approximately 1.0m up to the Oaks Club while retaining the existing accesses. It is proposed that this retaining wall be Terramesh or gabion and is expected to be founded into schist or fill debris below the road.

The proposed footpath width at the Oaks Club is 3.0m, which will require an increased width of approximately 1.0m at the head of the retaining walls on the south side wall. This may require that the existing Fortrac walls are removed and replaced with gabions or Terramesh, with ties which extend under the road and into the existing schist bedrock.

It may also be possible to provide a retaining wall on the north side, by cutting into the existing schist face up to the bench.

3.18.3 Geotechnical requirements

The outcropping schist at the road level suggests that the road is founded on schist and potentially on fill material at the south side.

The condition of the existing Fortrac retaining walls should be assessed, and the formation of the road to confirm if it has been built as a cut to fill exercise, considering the exposed schist at the face.

3.18.4 Investigation requirements

Trail Pits TP6.5 to TP6.7 and TP7.1 to TP7.3 are proposed to confirm the founding requirements at the base of the new retaining walls.

3.19 Oaks Club Pedestrian Signals and Bus Stop (Sheet 7)

3.19.1 Existing infrastructure

The area features a 1.5m high colluvium slope on the north side of the carriageway. This becomes a flat grassed are which extends from up to 20m away from the road.

At the south side there is a 5.0m high retaining wall which provides the access to Oaks Club.

3.19.2 Proposed works

It is proposed to install a new bus stop into the colluvium slope at the north of the carriageway.

3.19.3 Geotechnical requirements

The slope is expected to be comprised of colluvium and a simple timber pole or gabion retaining wall is expected. It will also be possible to batter the existing slope to suit.

3.19.4 Investigation requirements

Trial Pit TP7.4 is proposed to confirm the ground conditions for the cut and for the retaining.

3.20 Oaks Club to Pounamu (south side shared path Supporting Infrastructure). Sheet 7

3.20.1 Existing infrastructure

There is an area of existing landslide on the north side of the road discovered during the 2000/01 Frankton Road Upgrade. The slip area has been addressed through the installation of a timber pole retaining wall with shotcrete behind. The north side footpath traverses over the top of this wall.

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3.20.2 Proposed works

No geotechnical works are proposed in this area, though the south side shared path is to be continued along its existing alignment

3.20.3 Geotechnical requirements

Although this area is not being developed, any works in the area should take account of the existing landslide. The cause of the original landslide has not been investigated, and if there are any issues which caused the landslide, such as reduced drainage capacity, these should be managed during the works.

3.20.4 Investigation requirements

No investigation is proposed in this area

3.21 Pounamu Bus Stops (Sheet 7)

3.21.1 Existing infrastructure

There is an existing bus stop on the north side of the road in front of the Pounamu apartments.

On the south side of the road the access road features existing retaining walls of varying quality and heights.

3.21.2 Proposed works

A new elevated timber viewing platform is proposed. This is expected to be formed from timber poles with a timber deck. The area below the poles may also require retaining. In order to allow for the share path on the south side, it may be possible to realign the road slightly by cutting into the existing schist outcrop between the Pounamu buildings (but would require the purchase of property so unlikely).

In order to provide the shared path of width 4.0m on the south side, a cantilevered timber pole wall is expected to be required of height approximately 3.0m.

3.21.3 Geotechnical requirements

The presence of the schist outcrop between the Pounamu apartments indicates that there is schist rock present at shallow depths beneath the road. The elevated timber viewing platform proposed on the south side of the could be founded on colluvium or schist depending on the depth.

A new cantilevered timber pole retaining wall is expected to be required opposite the south bus stop, depending on the depth to the schist in this area, the poles could be founded in colluvium or in the schist.

3.21.4 Investigation requirements

Condition assessment of the existing retaining walls on the south side of the road is required to ensure suitability, though it is expected that they may be removed or built over as part of the improvements.

BH 7.2 and 7.3 are proposed to confirm the depth of schist in this area.

BH7.4 and 7.5 are proposed to confirm the founding requirements for the proposed elevated walkway and any retaining which is required below the walkway.

3.22 Pounamu to Suburb Street (south side shared path Supporting Infrastructure) Sheet 7

3.22.1 Existing infrastructure

The south side of the road features minor existing downslope retaining walls to the access road on the south side. These retaining walls are of varying age and quality, with varying retained heights of up to 3.0m.

The north side of the road in front of the Pounamu apartments is gently sloping towards the road.

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3.22.2 Proposed works

A new path is required on the south side is required to be 4.0m wide, which will be formed by the installation of new timber pole or gabion retaining wall in front of the existing retaining walls.

3.22.3 Geotechnical requirements

If this section needs to be widened, the existing retaining walls to the access roads should be assessed, and if necessary, removed before being backfilled.

3.22.4 Investigation requirements

Assessment of the state of the existing retaining walls is required to confirm their suitability for any additional traffic loading. Trial Pits TP7.5 – 7.6 are proposed to confirm the founding for new retaining walls.

3.23 Suburb Street Bus Lane (Sheet 8a)

3.23.1 Existing infrastructure

An existing gabion retaining wall is present on the south side of the carriageway just to the east of Suburb Street. The Copthorne Hotel features a flat area to the north of the carriageway.

3.23.2 Proposed works

Widening of the existing footpath by extension of the existing retaining wall eastwards.

3.23.3 Geotechnical requirements

Extension of the existing retaining wall will all for the increased width of the shared path on the south side.

3.23.4 Investigation requirements

A condition assessment of the existing retaining wall should be undertaken. Trail Pit 8.1 to be undertaken to confirm the founding conditions for the extension of the retaining wall.

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Appendices









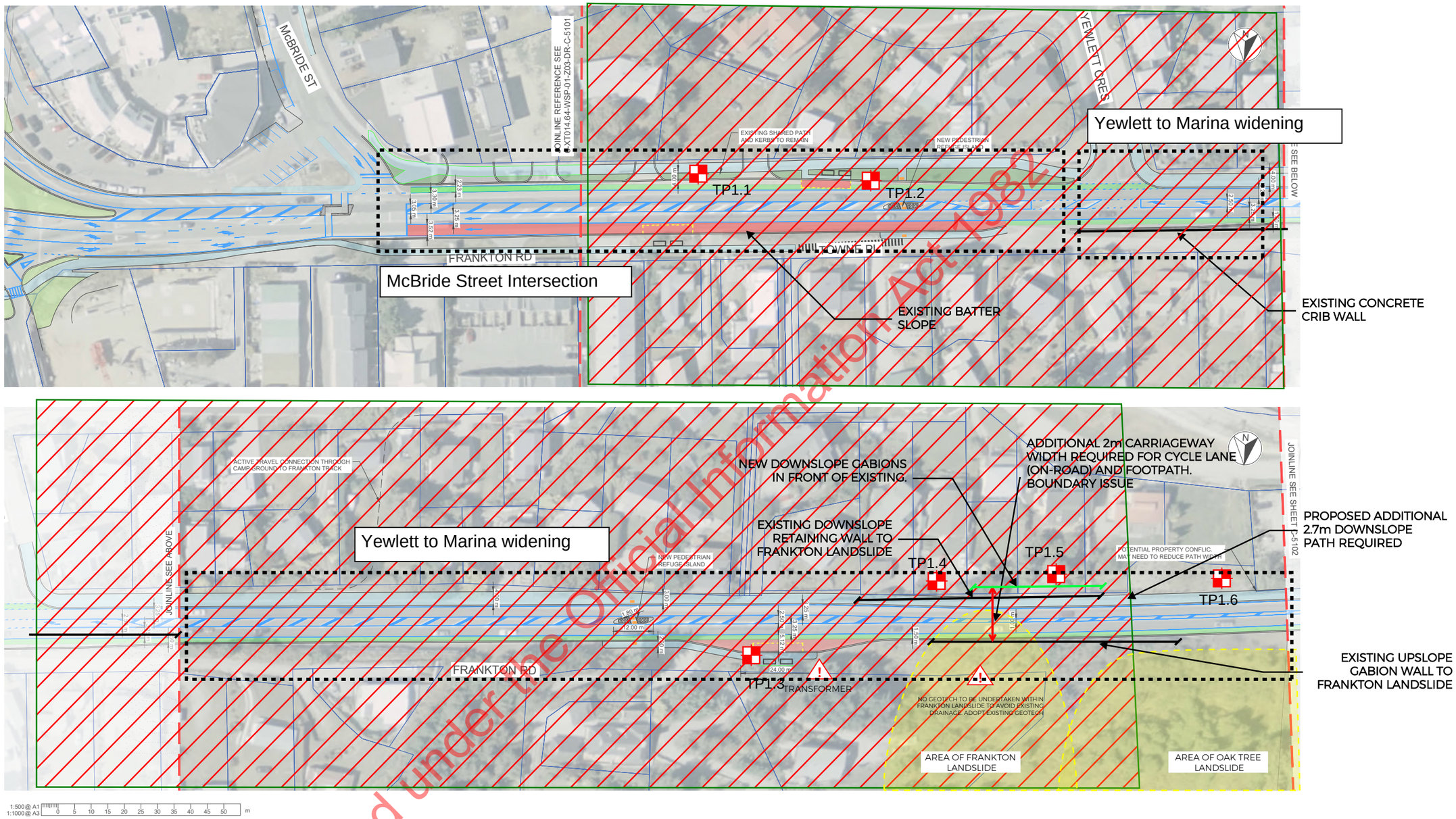




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Appendix A Preliminary Geotechnical Assessment and Investigation Plans

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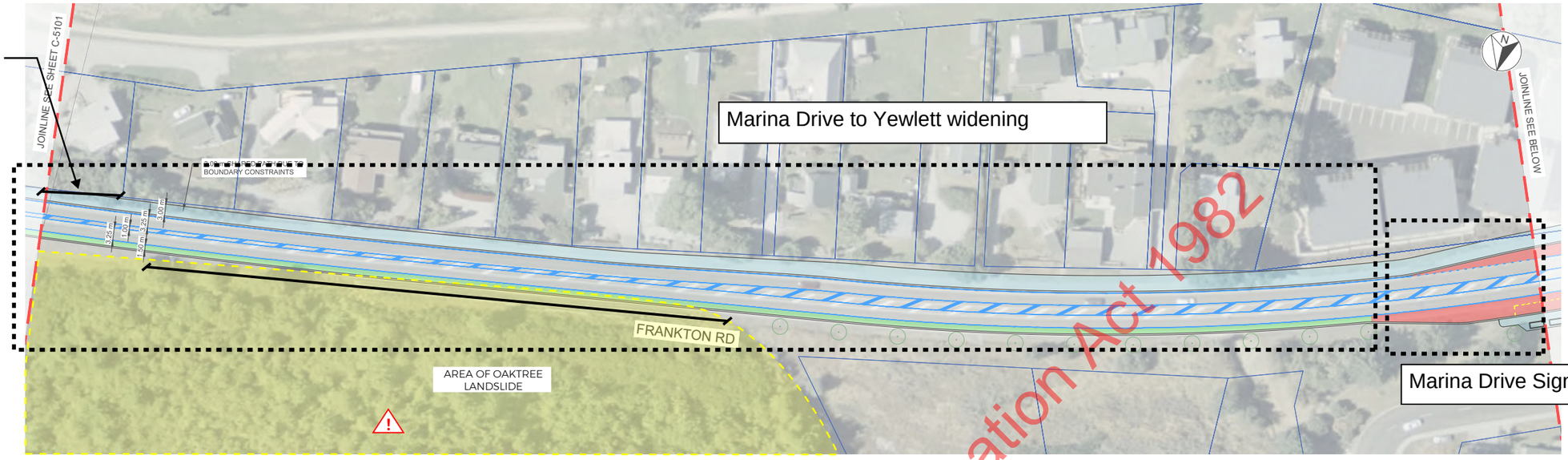
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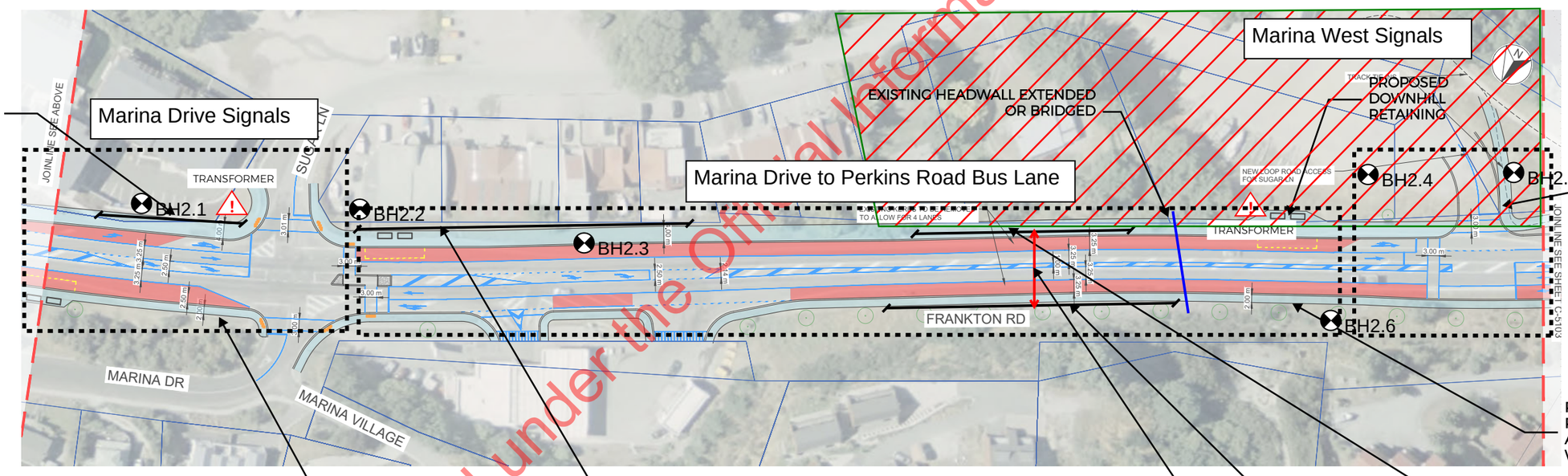
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6-XT014.40/245GX	C1	A

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PROPOSED RETAINING WALL



STORMWATER WITH PROPOSED MINOR RETAINING WALL

PROPOSED 4m RETAINING WALL WITH TERRAMESH TIE BACKS INSTALLED BELOW THE ROAD TO SUPPORT FOOTPATH WIDENING AT EXISTING BANK

ADDITIONAL ~1.5m CARRIAGEWAY WIDTH REQUIRED FOR CYCLE LANE (ON-ROAD) AND FOOTPATH

EXISTING 1m TIMBER CATCHFENCE WALL WITH COLLUVIUM BANK BEHIND

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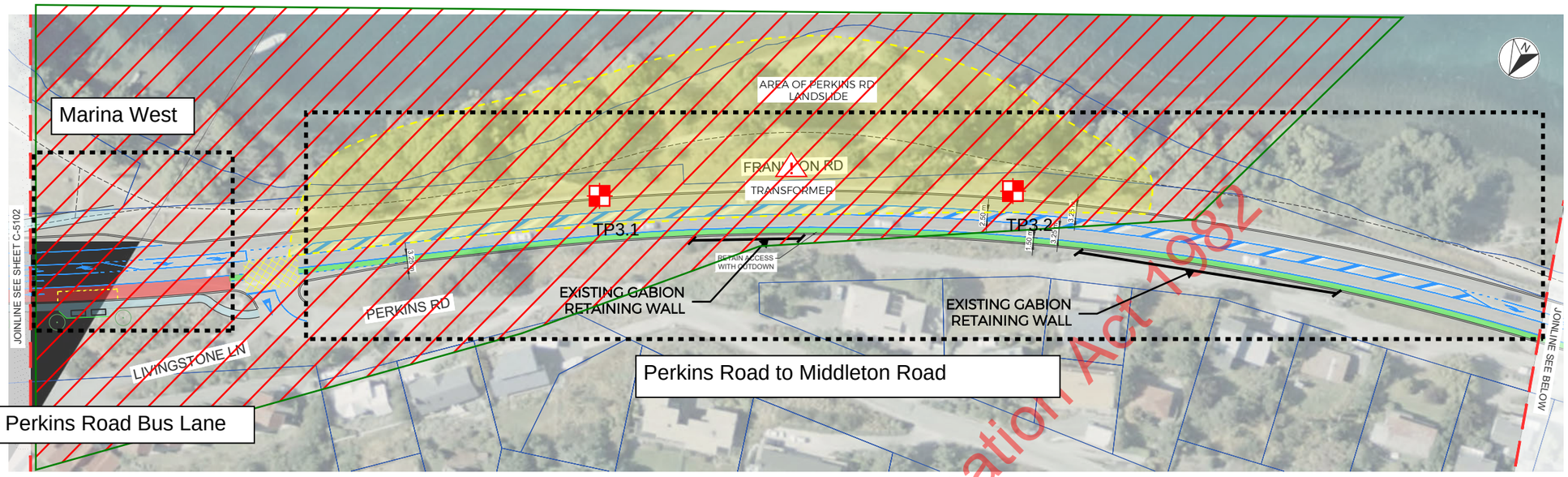
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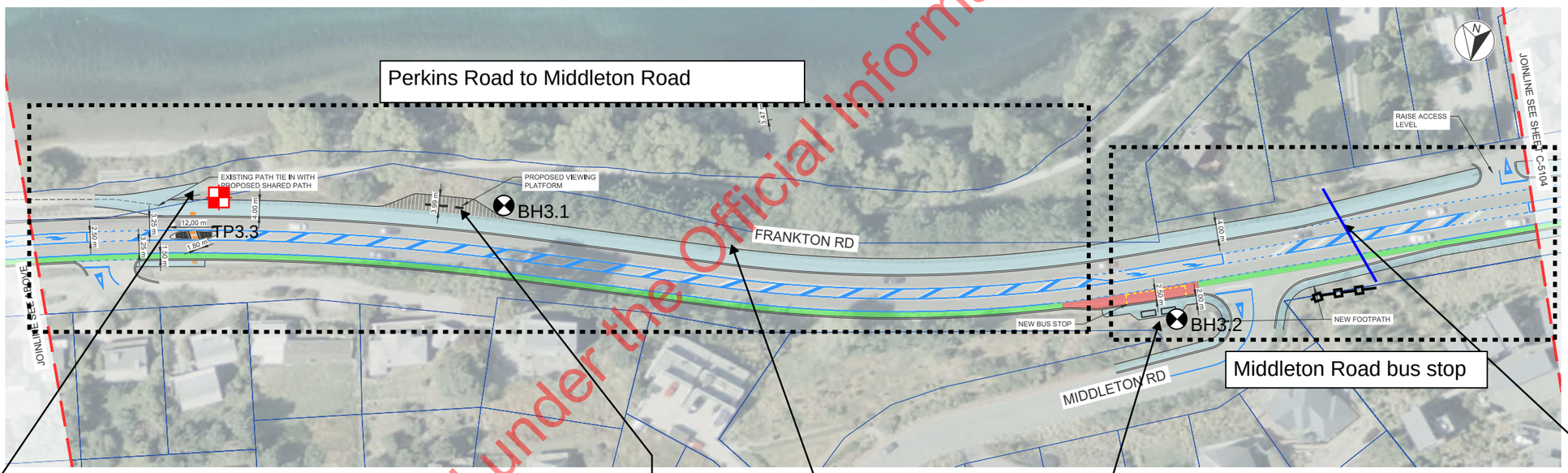
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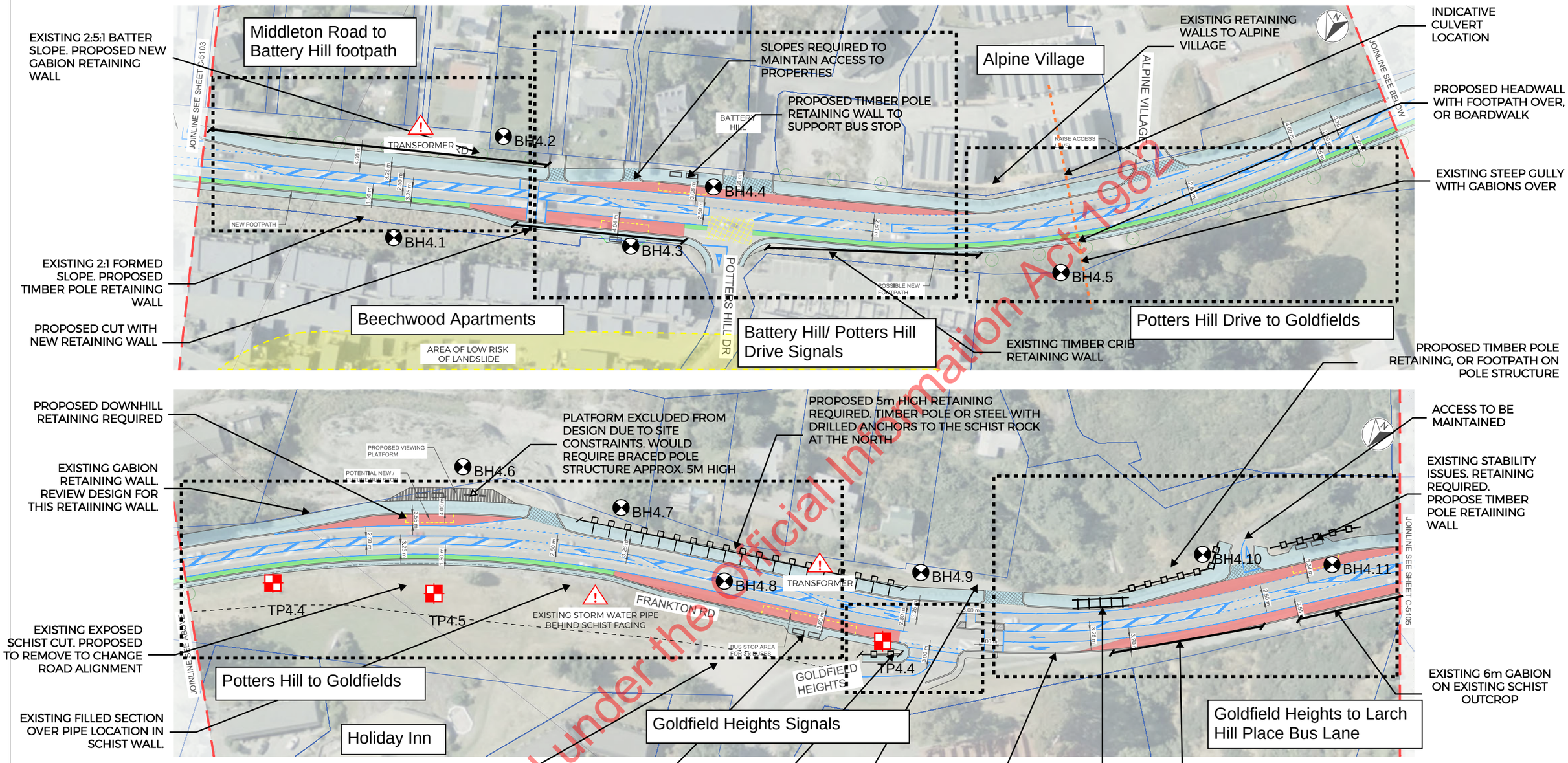
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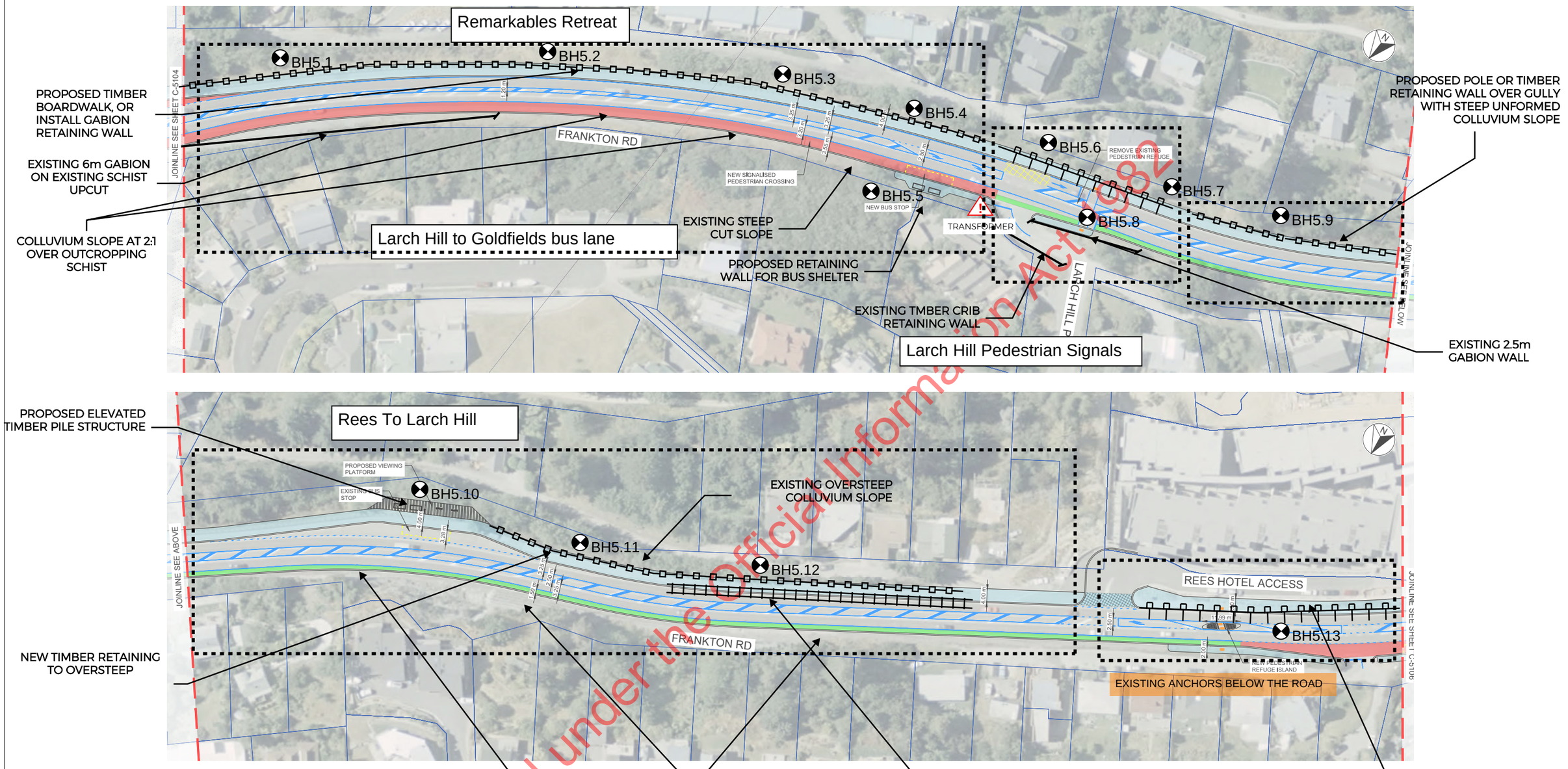
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EXISTING ANCHORED PRECAST PANEL RETAINING WALL. CONFIRMATION OF DESIGN REQUIRED TO CONSTRUCT CANTILEVERED WALKWAY

EXISTING STEEL RETAINING WALL

EXISTING 4TRAC RETAINING WALLS

NEW RETAINING WALLS IN FRONT OF EXISTING TO WIDEN FOOTPATH BY 2M

EXISTING TIMBER POLE AND GABION RETAINING WALLS WITH SCHIST OUTCROPPING AT THE HEAD OF COLLUVIUM SLOPE

FOOTPATH TO BE INCREASED IN WIDTH BY 2M BY BUILDING IN FRONT WITH NEW GABIONS

PROPOSED 5m ACHORED PILE WALL TO SUPPORT STEEP UPSLOPE

BENCHED COLLUVIUM SLOPE

Andrews Road to the Rees

Hensman Road Signalised intersection

New bus stop West of Hensman Road

EXISTING 2m TALL GABION RETAINING WALL

EXISTING SOIL NAILED SLOPE

EXISTING 1m HIGH GABION WALL

EXISTING 9m HIGH GABION WALL

PROPOSED RETAINING WALL TO SUPPORT VIEWING PLATFORM AND FOOTPATH AT 5-10m HEIGHT

New bus stop West of Hensman

Oaks Club to Hensman Road west bus stop

EXISTING TIMBER CRIB WALL

CULVERT

EXISTING EXPOSED SCHIST FACE

EXISTING 3m HIGH GABION WALL

EXISTING GABION WALL 5m HIGH WITH EXPOSED SCHIST FACE ABOVE

EXISTING EXPOSED SCHIST BLUFF

EXISTING STACKED STONE WALL 1m HIGH AT KERBLINE

EXISTING LARGE SCHIST BOULDER

NEW GABION OR TERRAMESH WALL TO PROVIDE ADDITIONAL 2M FOOTPATH WIDTH

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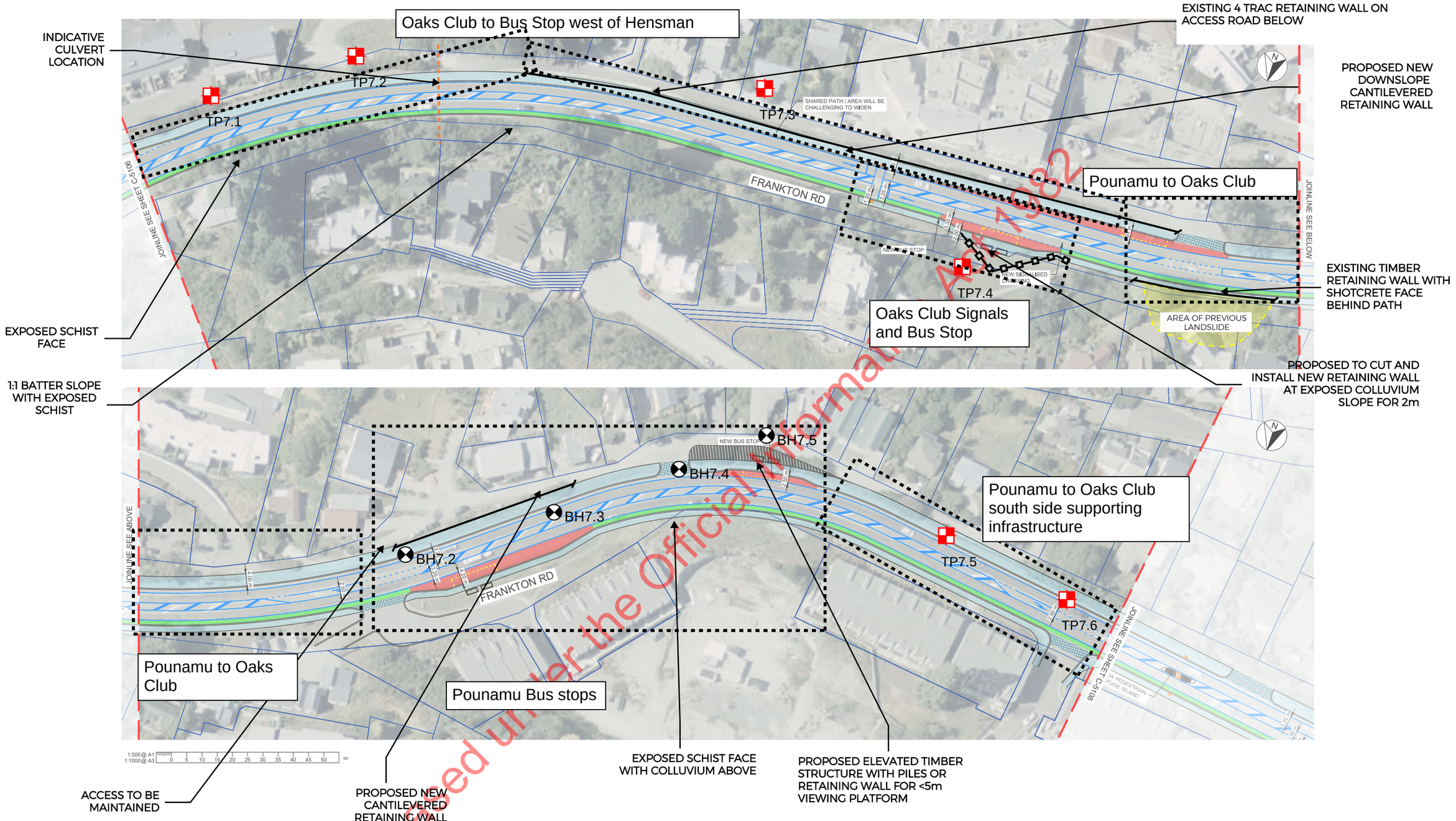
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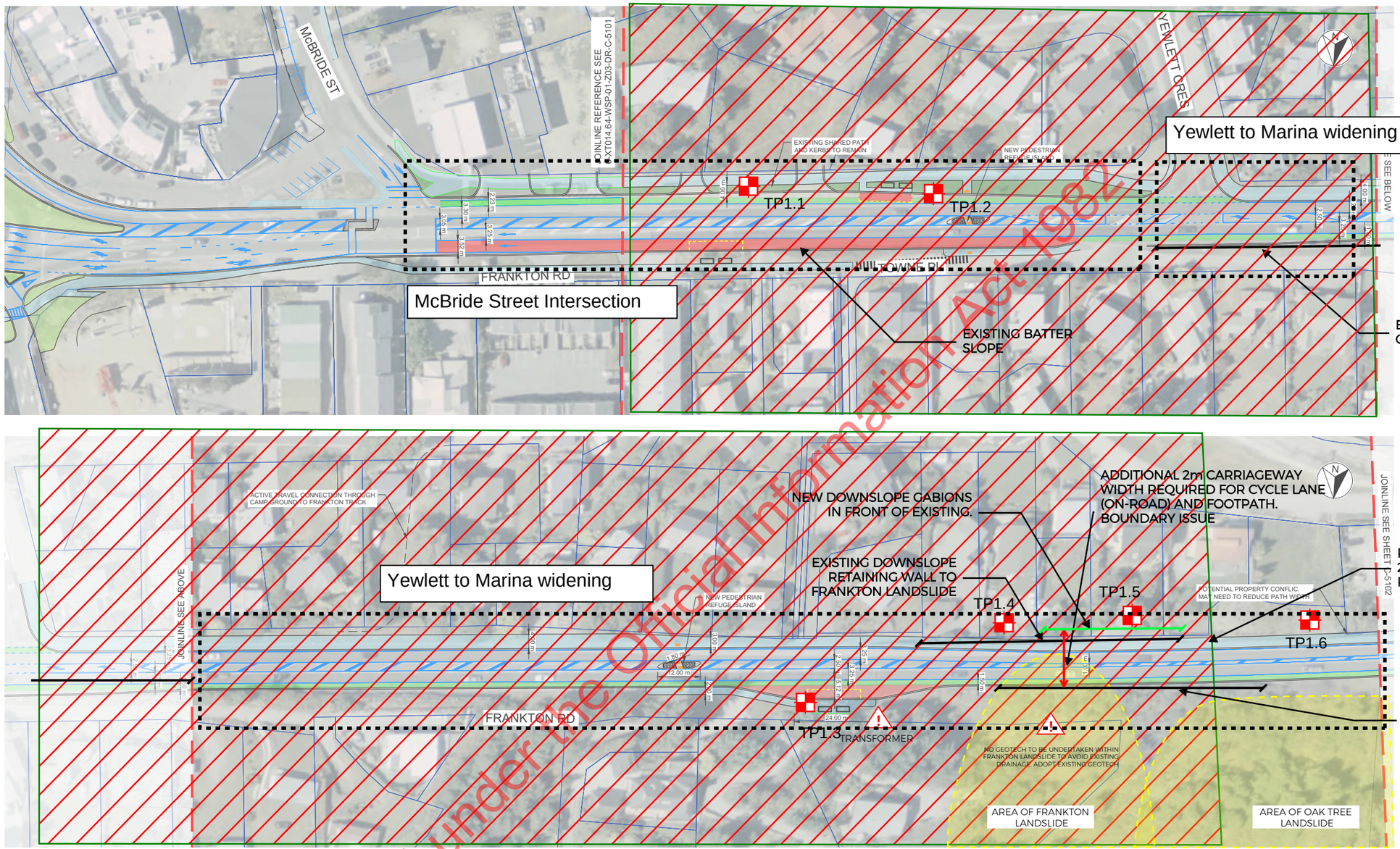
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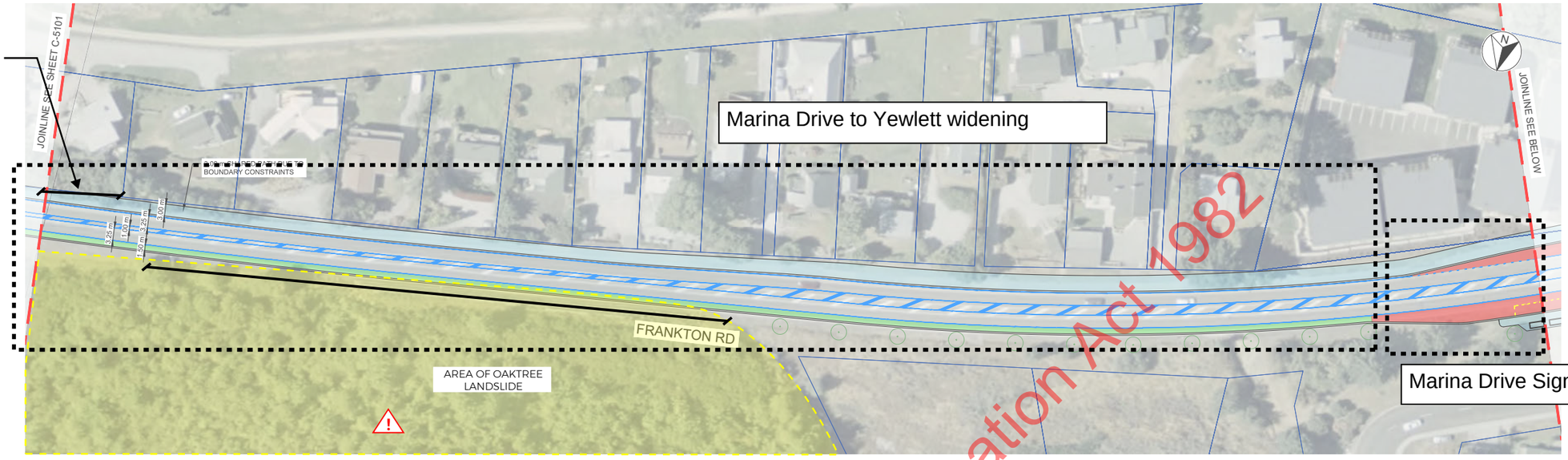
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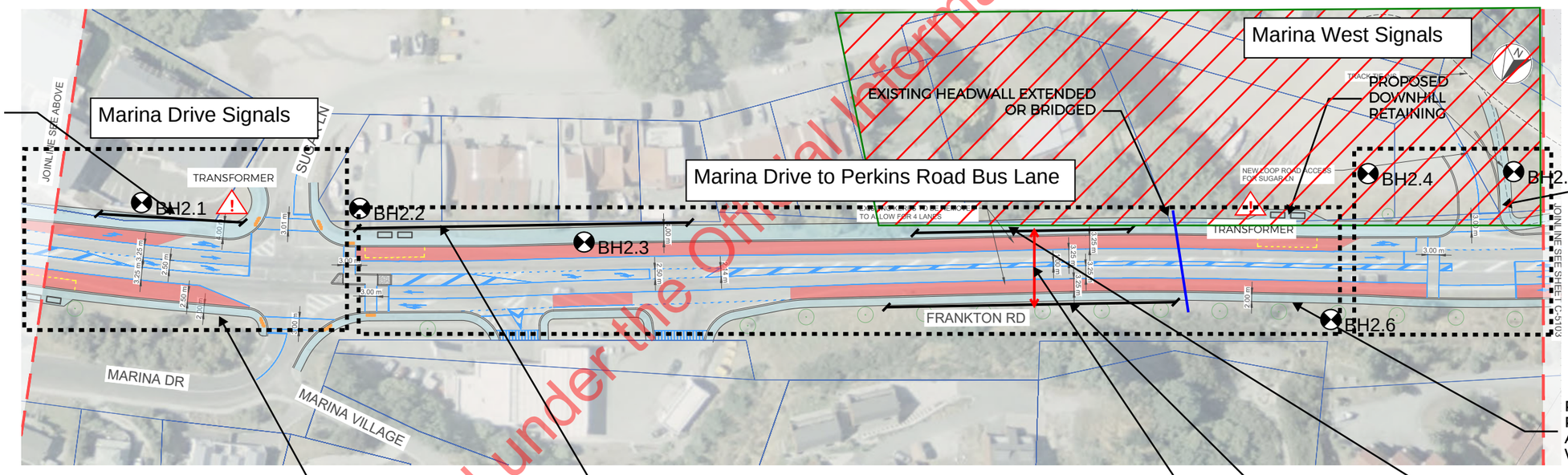
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PROPOSED RETAINING WALL



STORMWATER WITH PROPOSED MINOR RETAINING WALL

PROPOSED 4m RETAINING WALL WITH TERRAMESH TIE BACKS INSTALLED BELOW THE ROAD TO SUPPORT FOOTPATH WIDENING AT EXISTING BANK

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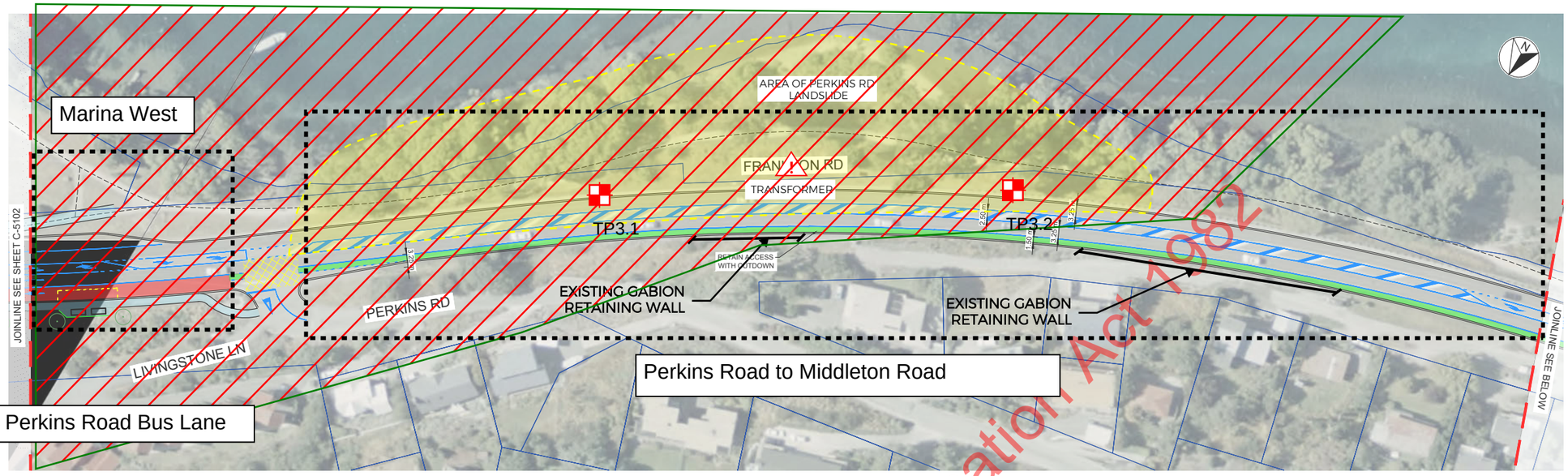
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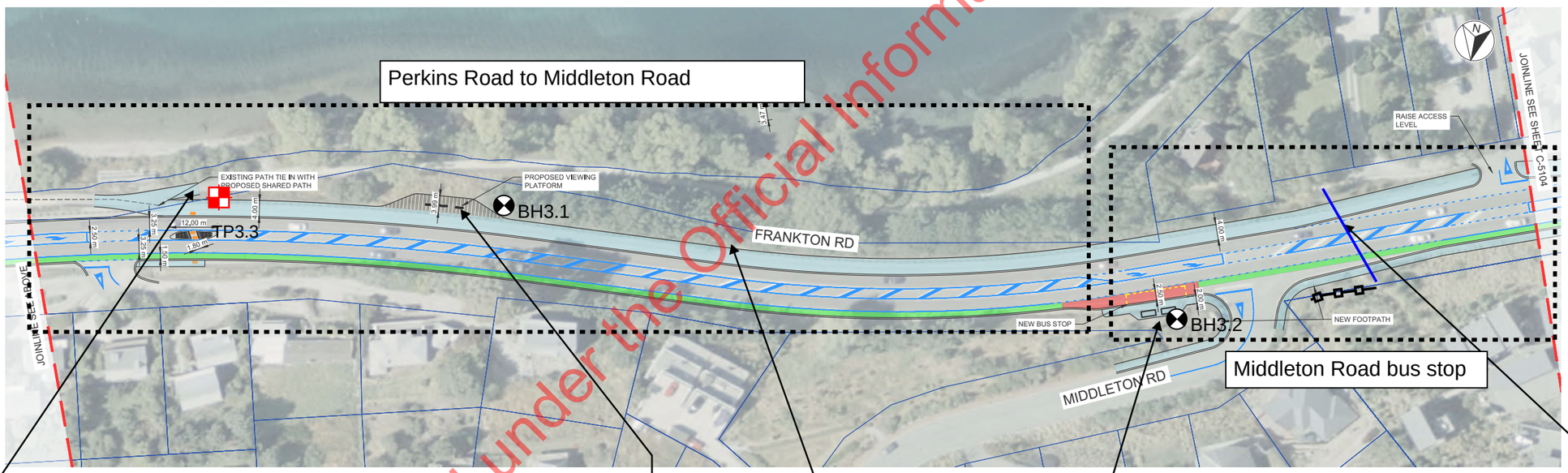
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PROPOSED EXCAVATION OF SCHIST ROCK

EXISTING OPEN DRAIN TO BE INTERCEPTED WITH NEW FOOTPATH. PROPOSED UPSLOPE RETAINING WALL WITH DRAIN BEHIND

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EXISTING 2.5:1 BATTER SLOPE. PROPOSED NEW GABION RETAINING WALL

EXISTING 2:1 FORMED SLOPE. PROPOSED TIMBER POLE RETAINING WALL

PROPOSED CUT WITH NEW RETAINING WALL

Middleton Road to Battery Hill footpath

JOINLINE SEE SHEET C-5103

TRANSFORMER

BH4.1

BH4.2

BH4.3

BH4.4

BH4.5

NEW FOOTPATH

SLOPES REQUIRED TO MAINTAIN ACCESS TO PROPERTIES

PROPOSED TIMBER POLE RETAINING WALL TO SUPPORT BUS STOP

BATTERY HILL

Alpine Village

ALPINE VILLAGE

RAISE ACCESS COVER

EXISTING RETAINING WALLS TO ALPINE VILLAGE

INDICATIVE CULVERT LOCATION

JOINLINE SEE BELOW

PROPOSED HEADWALL WITH FOOTPATH OVER, OR BOARDWALK

EXISTING STEEP GULLY WITH GABIONS OVER

Beechwood Apartments

AREA OF LOW RISK OF LANDSLIDE

POTTERS HILL DR

Battery Hill/ Potters Hill Drive Signals

POSSIBLE NEW FOOTPATH

EXISTING TIMBER CRIB RETAINING WALL

Potters Hill Drive to Goldfields

PROPOSED TIMBER POLE RETAINING, OR FOOTPATH ON POLE STRUCTURE

PROPOSED DOWNHILL RETAINING REQUIRED

EXISTING GABION RETAINING WALL. REVIEW DESIGN FOR THIS RETAIINING WALL.

PROPOSED VIEWING PLATFORM

POTENTIAL NEW / REALIGNED ROAD

BH4.6

PLATFORM EXCLUDED FROM DESIGN DUE TO SITE CONSTRAINTS. WOULD REQUIRE BRACED POLE STRUCTURE APPROX. 5M HIGH

PROPOSED 5m HIGH RETAINING REQUIRED. TIMBER POLE OR STEEL WITH DRILLED ANCHORS TO THE SCHIST ROCK AT THE NORTH

BH4.7

BH4.8

BH4.9

TRANSFORMER

TP4.4

TP4.5

EXISTING STORM WATER PIPE BEHIND SCHIST FACING

FRANKTON RD

BUS STOP AREA FOR 2 BUSES

GOLDFIELD HEIGHTS

TP4.4

ACCESS TO BE MAINTAINED

EXISTING STABILITY ISSUES. RETAINING REQUIRED. PROPOSE TIMBER POLE RETAIINING WALL

BH4.10

BH4.11

JOINLINE SEE SHEET C-5105

EXISTING 6m GABION ON EXISTING SCHIST OUTCROP

EXISTING EXPOSED SCHIST CUT. PROPOSED TO REMOVE TO CHANGE ROAD ALIGNMENT

JOINLINE SEE ABOVE

Potters Hill to Goldfields

EXISTING FILLED SECTION OVER PIPE LOCATION IN SCHIST WALL.

Holiday Inn

Goldfield Heights Signals

Goldfield Heights to Larch Hill Place Bus Lane

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

REALIGNMENT OF THE ROAD WOULD REQUIRE ASSESSMENT OF THE SLOPE HERE AND MAY AFFECT THIS INFORMAL CAR PARK

PROPOSED RETAINING REQUIRED FOR EXISTING CUT WITH OVERSTEEP BANK BEHIND

PROPOSED MINOR RETAINING REQUIRED AROUND FOOTPATH AND DRAIN

EXISTING GABION RETAINING WALL

EXISTING FORMED BATTER SLOPE

PROPOSED TIMBER BRIDGE STRUCTURE OVER CULVERT

EXISTING 4m GABION ON EXISTING SCHIST OUTCROP WITH ANCHORED SHOTCRETE

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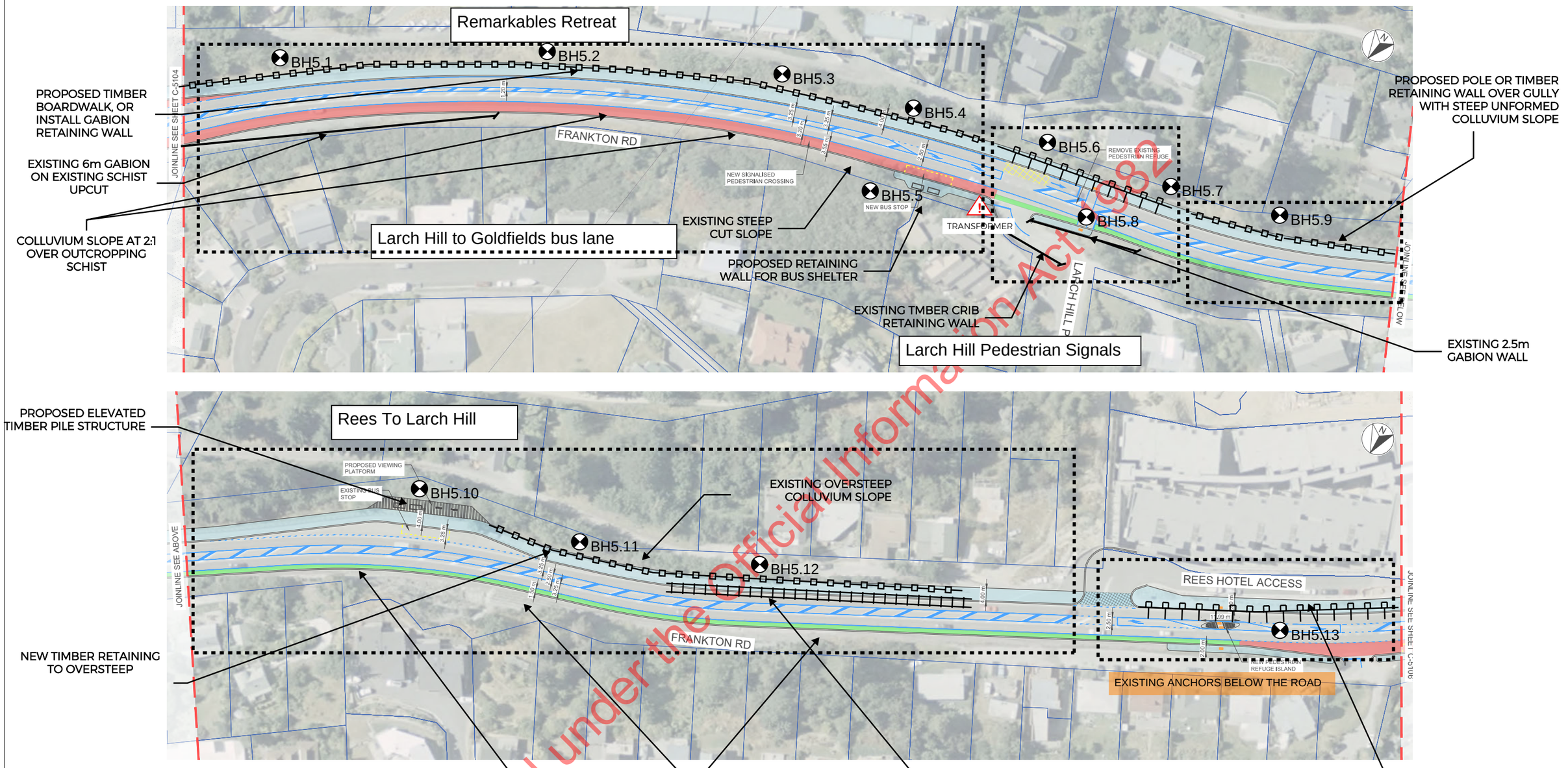
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PRELIMINARY GEOTECHNICAL ASSESSMENT AND INVESTIGATION PLAN

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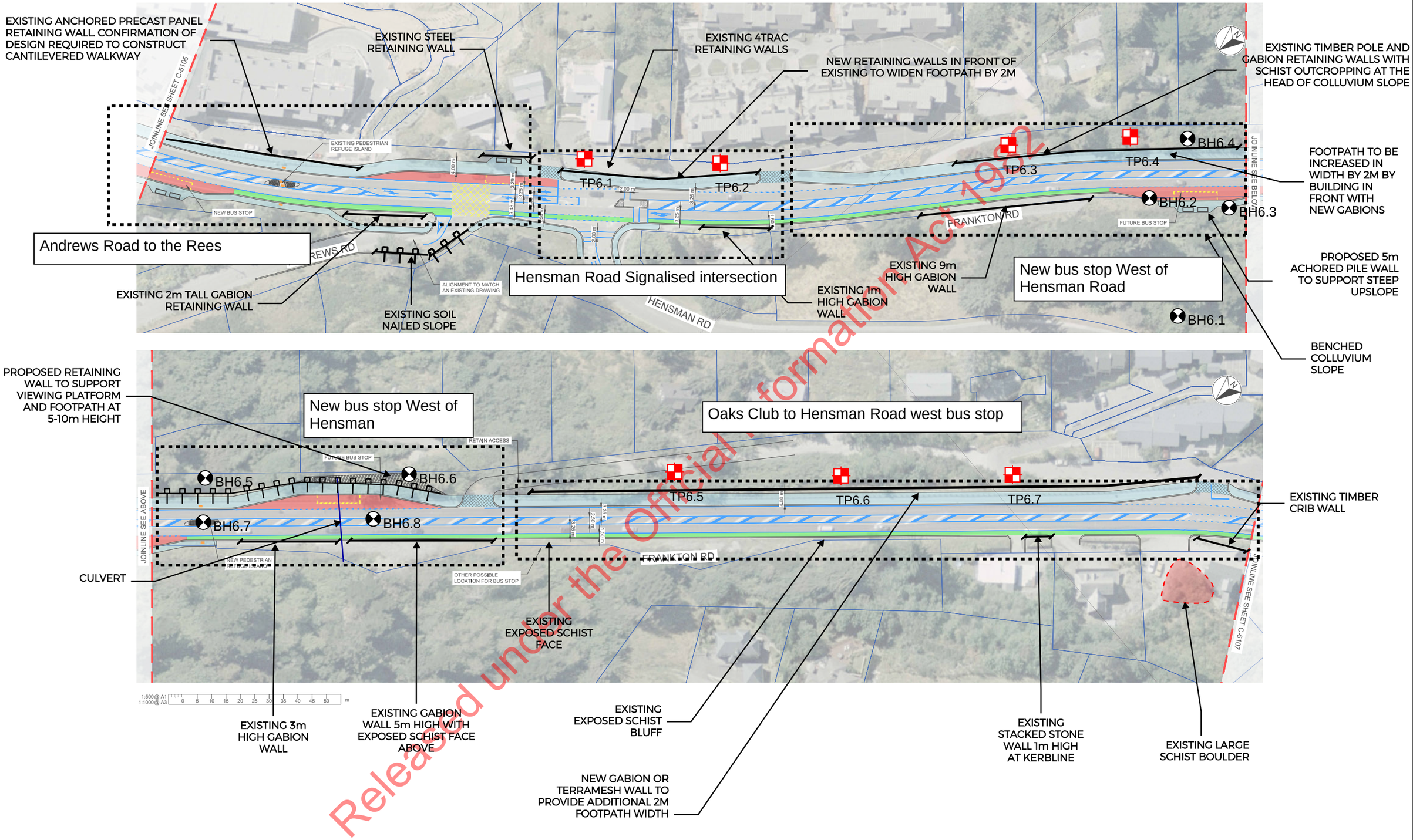
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Oaks Club to Bus Stop west of Hensman

INDICATIVE CULVERT LOCATION

EXISTING 4 TRAC RETAINING WALL ON ACCESS ROAD BELOW

PROPOSED NEW DOWNSLOPE CANTILEVERED RETAINING WALL

TP7.1

TP7.2

TP7.3

TP7.4

SHARED PATH / AREA WILL BE CHALLENGING TO WIDEN

FRANKTON RD

NEW BUS STOP

NEW SIGNALISED CROSSING

Pounamu to Oaks Club

JOIN LINE SEE BELOW

JOIN LINE SEE SHEET C5108

Oaks Club Signals and Bus Stop

AREA OF PREVIOUS LANDSLIDE

EXISTING TIMBER RETAINING WALL WITH SHOTCRETE FACE BEHIND PATH

EXPOSED SCHIST FACE

1:1 BATTER SLOPE WITH EXPOSED SCHIST

PROPOSED TO CUT AND INSTALL NEW RETAINING WALL AT EXPOSED COLLUVIUM SLOPE FOR 2m

BH7.5

BH7.4

BH7.3

BH7.2

NEW BUS STOP

FRANKTON RD

JOIN LINE SEE ABOVE

Pounamu to Oaks Club south side supporting infrastructure

TP7.5

TP7.6

JOIN LINE SEE SHEET C5108

NEW PEDESTRIAN REFUGE ISLAND

Pounamu to Oaks Club

Pounamu Bus stops

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

ACCESS TO BE MAINTAINED

PROPOSED NEW CANTILEVERED RETAINING WALL

EXPOSED SCHIST FACE WITH COLLUVIUM ABOVE

PROPOSED ELEVATED TIMBER STRUCTURE WITH PILES OR RETAINING WALL FOR <5m VIEWING PLATFORM

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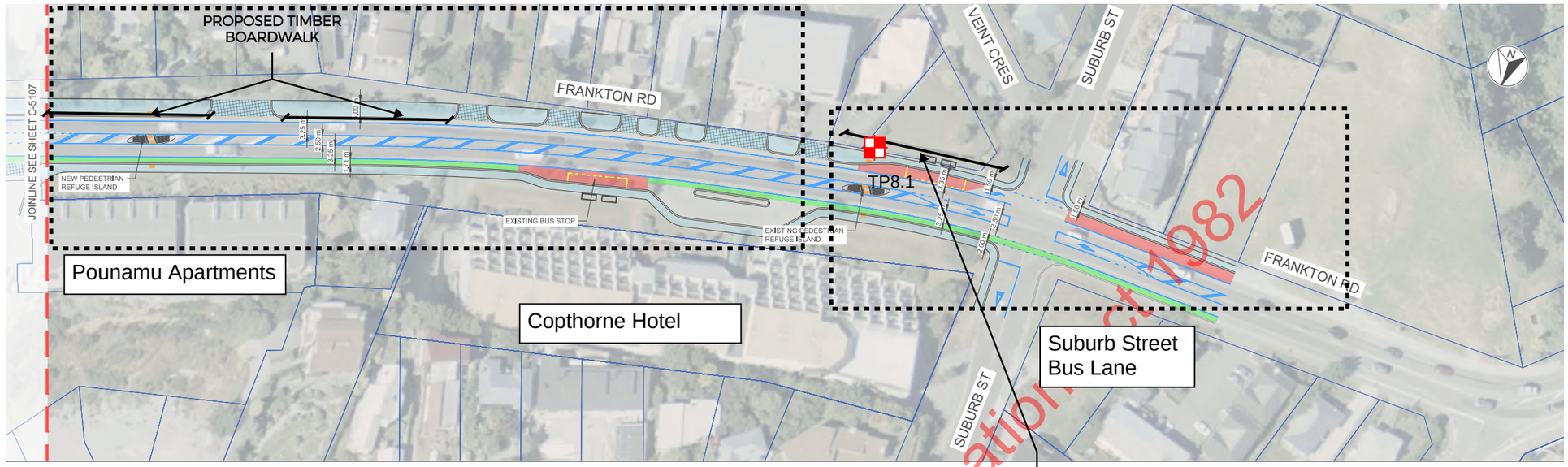
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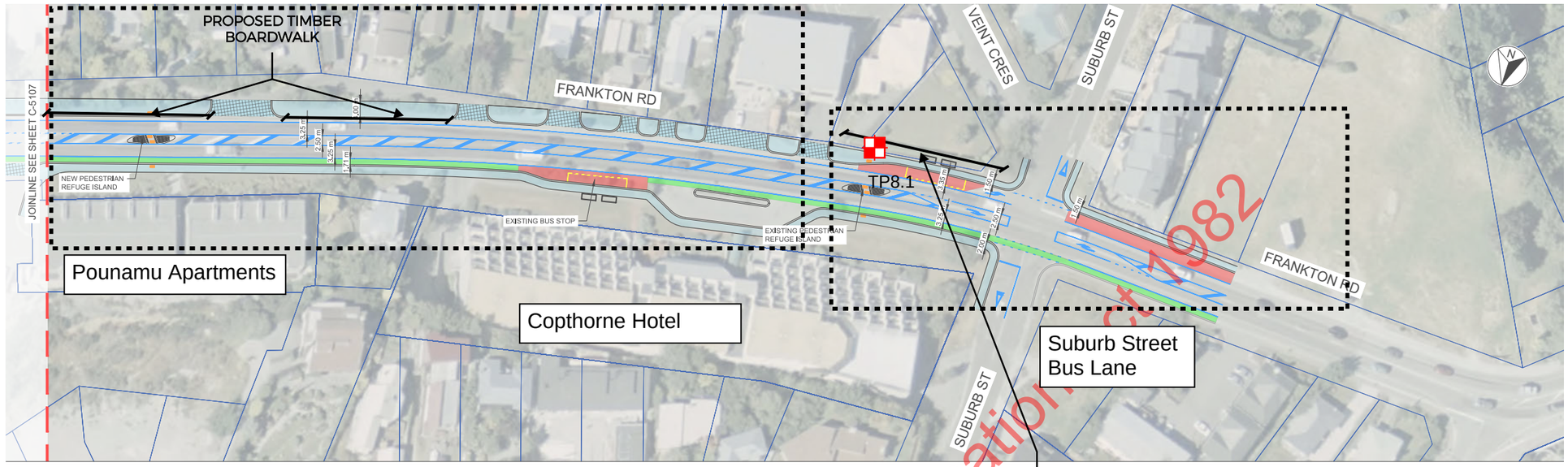
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Appendix B Geotechnical Testing Schedule

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GEOTECHNICAL TESTING ESTIMATE
FRANKTON TO QUEENSTOWN

Item	Description	Unit	Qty	Rate	Amount
8.1	**Scala Penetrometer and Hand Auger**				
8.1.1	Scala Penetrometer ([4m] maximum)	ea	26	200	$5,200.00
8.1.2	Hand Auger Excavation ([4m] maximum)	ea		200	$0.00
8. 1.3	Sample for laboratory testing	ea		40	$0.00
8. 1.4	(list items and define payment)	L S. / ea / m / km			$0.00
8.2	**Pavement Test Pit**				
8.2.1	Testpit Excavation (nominally [600mm] deep)	ea	0	1500	$0.00
8.2. 2	Density (field NDM)	ea		100	$0.00
8.2. 3	Sample for Laboratory Testing	ea	0	40	$0.00
8. 2. 4	Traffic Management (extra over (12.7. 1])	ea	0	5000	$0.00
8. 2.5	[list items and define payment)	L S. / ea / m / km			$0.00
8.3	**Investigation Test Pit**				
8.3.1	Excavation (4m maximum)	ea	26	1240	$32,240.00
8.3.2	Density (field) NDM	ea			$0.00
8.3.3	Sample for Laboratory Testing	ea	26	40	$1,040.00
8.3.4	Traffic Management (extra over (12.7 .1])	L.S.	1	5000	$5,000.00
8.3.5	[list items and define payment]	L.S./ ea / m / km			$0.00
8.4	**Lab Testing**				
8.4.1	Water Content - Natural	ea		35	$0.00
8.4.2	Atterberg Limits (inclusive of natural water content)	ea	25	300	$7,500.00
8.4.3	Grading by Wet Sieving	ea	25	180	$4,500.00
8.4.4	Grading by Dry Sieving	ea		180	$0.00
8.4.5	Grading (fine soils)	ea		320	$0.00
8.4.6	Consolidation Test (oedometer)	ea	5	1200	$6,000.00
8.4.7	Triaxial (Unconsolidated Undrained (UU) - 3 specimens) (38mm diameter)	ea	20	1500	$30,000.00

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GEOTECHNICAL TESTING ESTIMATE
FRANKTON TO QUEENSTOWN

Item	Description	Unit	Qty	Rate	Amount
8.4.8	Triaxial (Unconsolidated Undrained (UU)- single specimen) (38mm diameter)	ea			$0.00
8.4.9	Triaxial (Consolidated Undrained - 3 specimens)	ea			$0.00
8.4.10	CBR Test - Natural (Soaked or Unsoaked)	ea	26	190	$4,940.00
8.4. I 0a	CBR Test - Optimum (Soaked or Unsoaked)	ea		200	$0.00
8.4.11	Extra over (12.4.9/ a] for Lime or cement modified (Optimum or Natural)	ea		10	$0.00
8.4.12	NZ Standard/Heavy Compaction Test Soils	ea		600	$0.00
8.4.13	NZ Vibrating Hammer Compaction Test	ea		610	$0.00
8.4.14	Unconfined Compressive Strength (UCS) with modulus and Poisson ratio	ea	40	250	$10,000.00
8.4.15	Unconfined Compressive Strength (UCS) without modulus and Poisson ratio	ea		200	$0.00
8.4.16	Indirect Tensile Strength Test	ea		225	$0.00
8.4.17	Abrasion Test	ea		250	$0.00
8.4.18	Density of Rock Core (Bulk and Dry)	ea			$0.00
8.4.19	[list items and define payment]	L S. / ea / m / km			$0.00
8.5	**Miscellaneous Testing**				
8.5.1	Static Cone Penetrometer (CPT) Rig Establishment and Disestablishment	L.S.	1	12000	$12,000.00
8.5.2	CPT set-up at Test Location	ea	20	85	$1,700.00
8.5.3	Extra over [12.5.2) for Preparation and Saturation of Piezocone	ea		68	$0.00
8.5.4	CPT Test ([20m) max depth)	m		41	$0.00
8.5.5	CPTu Test ([20m] max depth)	m	300	41	$12,300.00
8.5.6	Dissipation Test (in CPTu)	hr		260	$0.00
8.5.7	Extra over [12.5.6) for Dissipation Test (in CPTu)	hr		260	$0.00
8.5.8	Standpipe (in CPT or CPTu)	ea		20	$0.00

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GEOTECHNICAL TESTING ESTIMATE
FRANKTON TO QUEENSTOWN

Item	Description	Unit	Qty	Rate	Amount
8.5.9	Standard Penetration Test (Borehole, Solid or Hollow Nose Raymond)	ea		75	$0.00
8.5.10	Down Hole Shear Vane ([20m) max depth)	ea			$0.00
8.5.11	Standpipe Piezometer (Borehole, up to [2] per hole)	ea	43	800	$34,400.00
8.5.12	Falling or Rising Head Permeability Test in Standpipe	ea			$0.00
8.5.13	Benkelman Beam Testing ([20m] spacing - both lanes)	km			$0.00
8.5.14	Falling Weight Deflectometer ([20m] spacing - single lane)	km	0	1500	$0.00
8.5.15	Hand Shear Vane Test	ea			$0.00
8.5.16	Traffic Management (extra over [12.7.1))	ea	1	10000	$10,000.00
8.5.17	[list items and define payment)	L.S. / ea / m / km			$0.00
8.6	**Borehole**				
8.6.1	Drilling rig establishment and Disestablishment	L.S.	1	1500	$1,500.00
8.6.2	Drilling rig set-up at borehole location	ea	43	150	$6,450.00
8.6.3	Wash Drilling ([40m) max depth)	m		225	$0.00
8.6.4	Core recovery - Soil ([40m) max depth)	m	645	300	$193,500.00
8.6.5	Drilling in Rock (no core recovery) ([40m) max depth)	m		225	$0.00
8.6.6	Extra over [12.6.5) for core recovery in rock at HQ size	m		225	$0.00
8.6.7	Extra over [12.6.5] for core recovery in rock at PQ Size	m		300	$0.00
8.6.8	Falling or Rising Head Permeability Test in Borehole	ea			$0.00
8.6.9	Log and Photograph Core ([40m] max depth)	ea	43	4230	$181,890.00
8.6.10	Traffic Management (extra over (12.7.1])	ea	10	7500	$75,000.00

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GEOTECHNICAL TESTING ESTIMATE
FRANKTON TO QUEENSTOWN

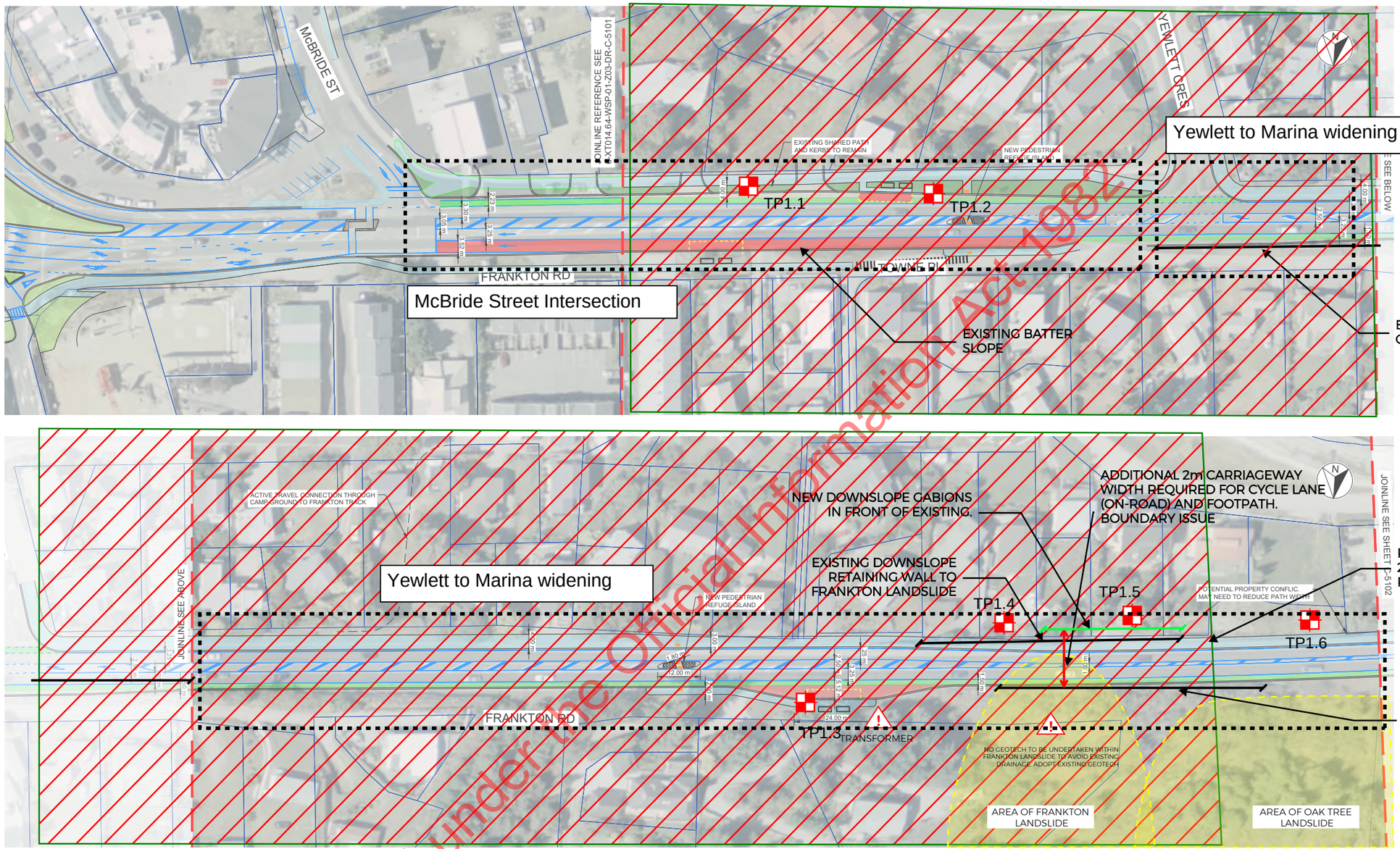
Item	Description	Unit	Qty	Rate	Amount
8.6.11	[list items and define payment]	L.S./ ea / m / km			$0.00
8.7	**Miscellaneous and General (Client to Detail)**				
8.7.1	Traffic Management Plan, Mobilisation and Demobilisation	L.S.	1	5000	$5,000.00
8.7.2	[list items and define payment]	L.S./ ea / m / km			$0.00
8.8	**Miscellaneous (Tenderer to Detail as Applicable)**				
8.8.1	[list items and define payment]	L.S./ ea / m / km			$0.00
8.9	**Assessment of Results and Report**				
8.9.1	Geotechnical Investigations and Testing Results (Factual Report)	L.S.	1	70000	$70,000.00
TOTAL GEOTECHNICAL TESTING: (SH6A)					$710,160.00

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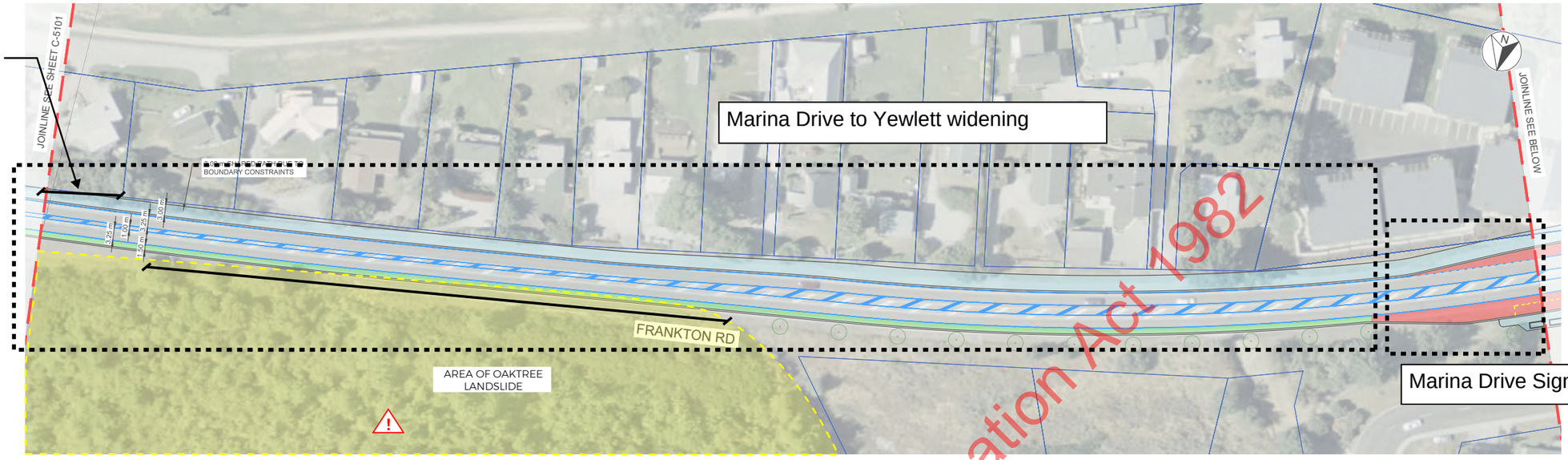
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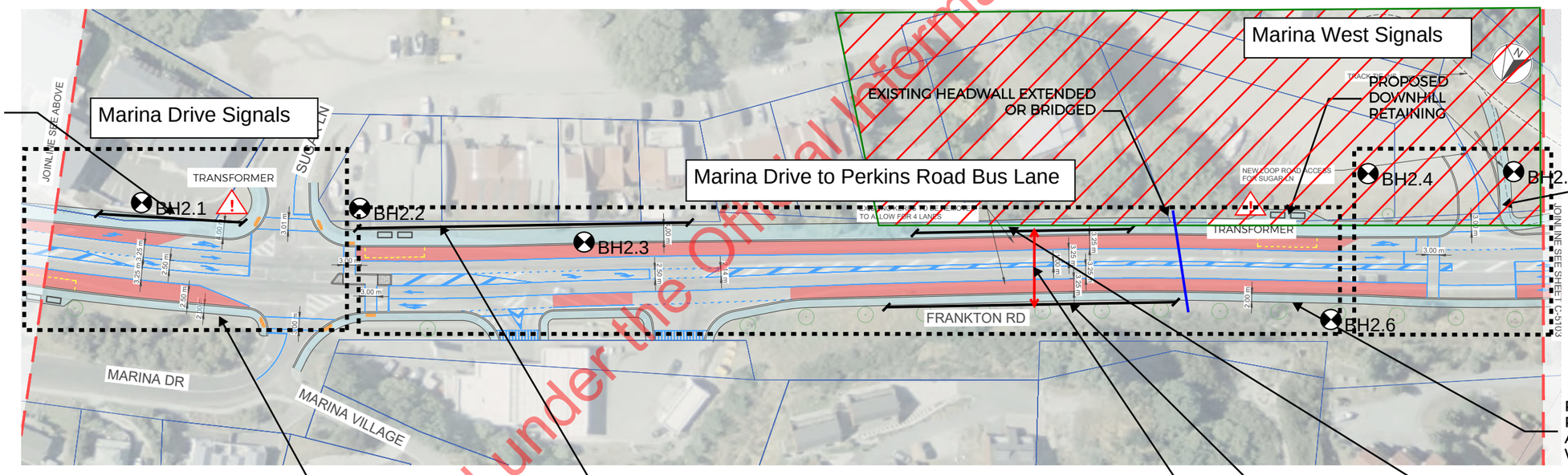
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EXISTING RETAINING WALL SHOWING SIGNS OF DEGRADITION. PROPOSED RETAINING WALL TO BE BUILT INFRONT



PROPOSED RETAINING WALL



STORMWATER WITH PROPOSED MINOR RETAINING WALL

PROPOSED 4m RETAINING WALL WITH TERRAMESH TIE BACKS INSTALLED BELOW THE ROAD TO SUPPORT FOOTPATH WIDENING AT EXISTING BANK

ADDITIONAL ~1.5m CARRIAGEWAY WIDTH REQUIRED FOR CYCLE LANE (ON-ROAD) AND FOOTPATH

EXISTING 1m TIMBER CATCHFENCE WALL WITH COLLUVIUM BANK BEHIND

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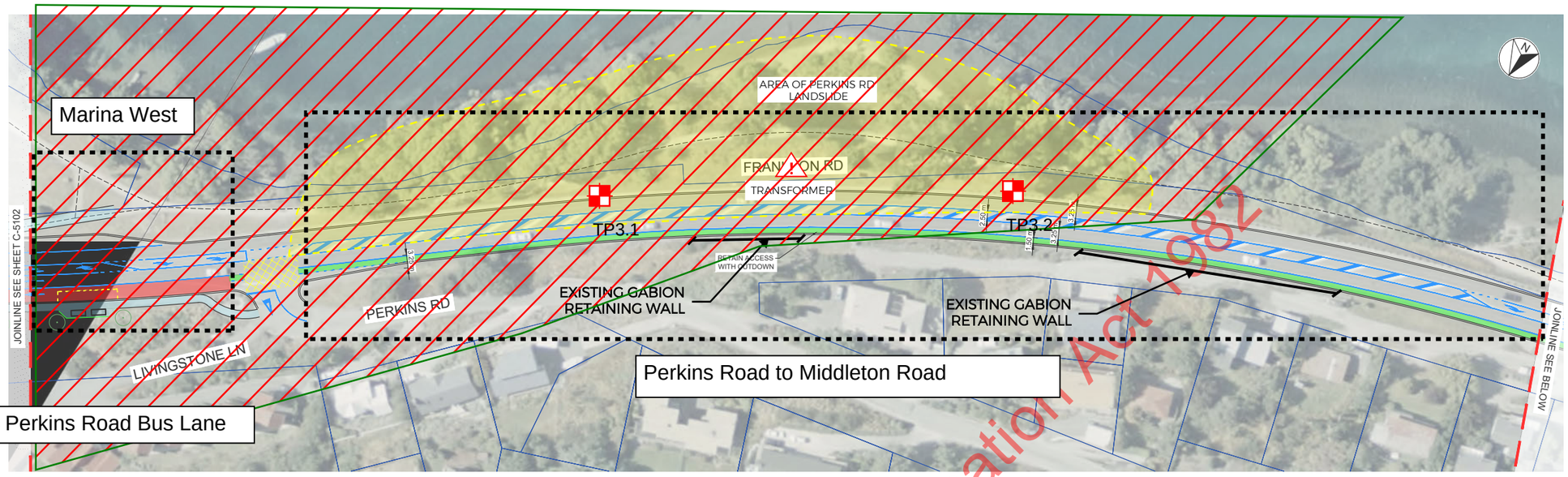
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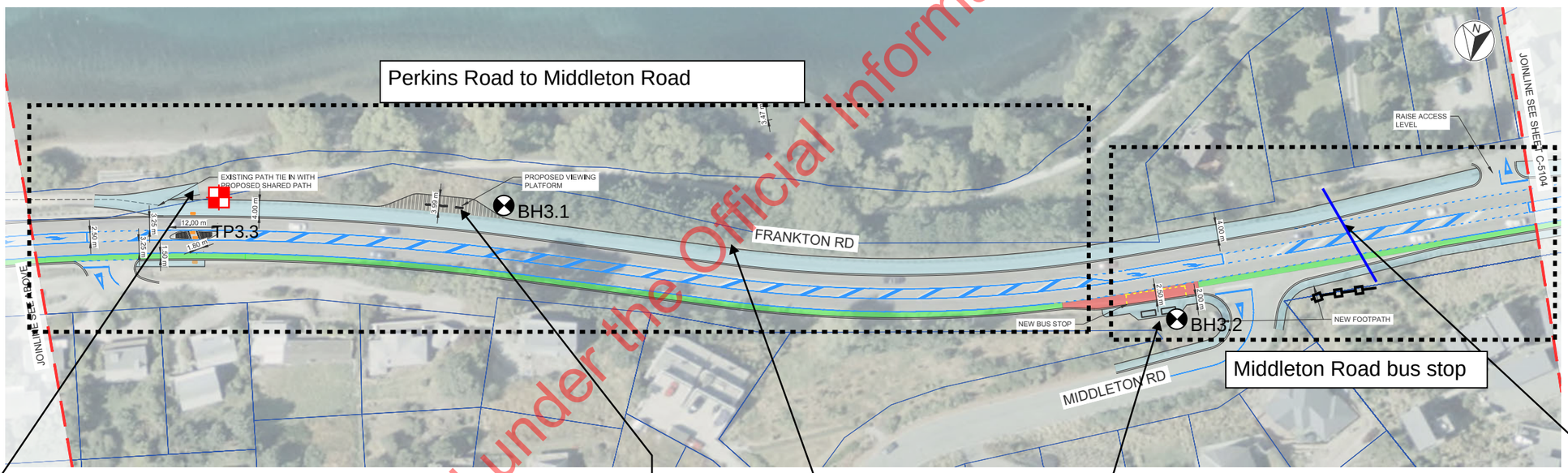
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EXISTING
4 TRAC WALL, CURRENRTLY IN FAIR CONDITION
TO BE FACED WITH GABIONS OR REPLACED

PROPOSED TIMBER BOARDWALK FOR VIEWING PLATFORM

EXISTING 4 TRAC WALL CURRENTLY IN FAIR CONDITION, TO BE REPLACED OR FACED WITH GABIONS

PROPOSED EXCAVATION OF SCHIST ROCK

EXISTING OPEN DRAIN TO BE INTERCEPTED WITH NEW FOOTPATH. PROPOSED UPSLOPE RETAINING WALL WITH DRAIN BEHIND

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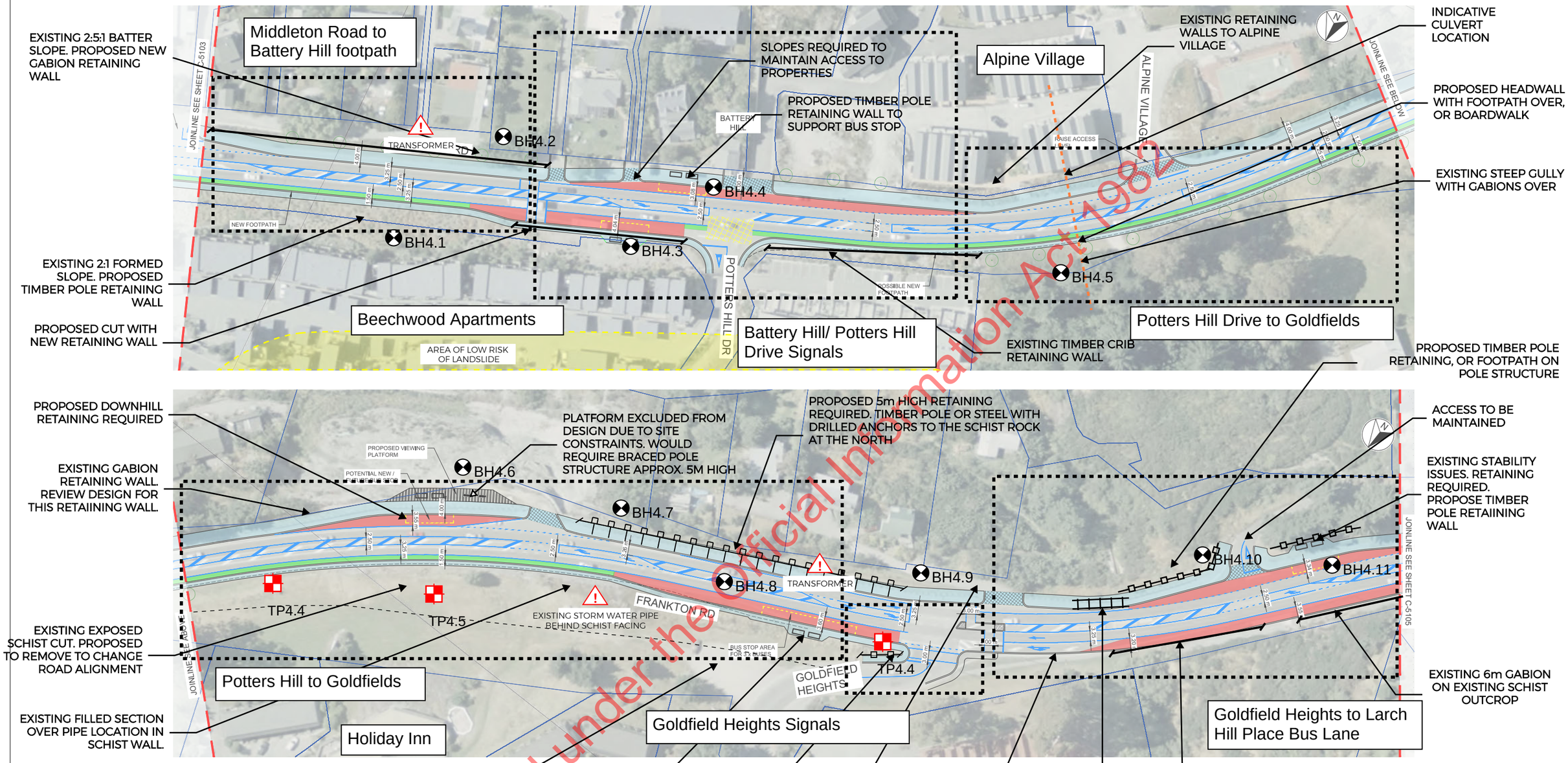
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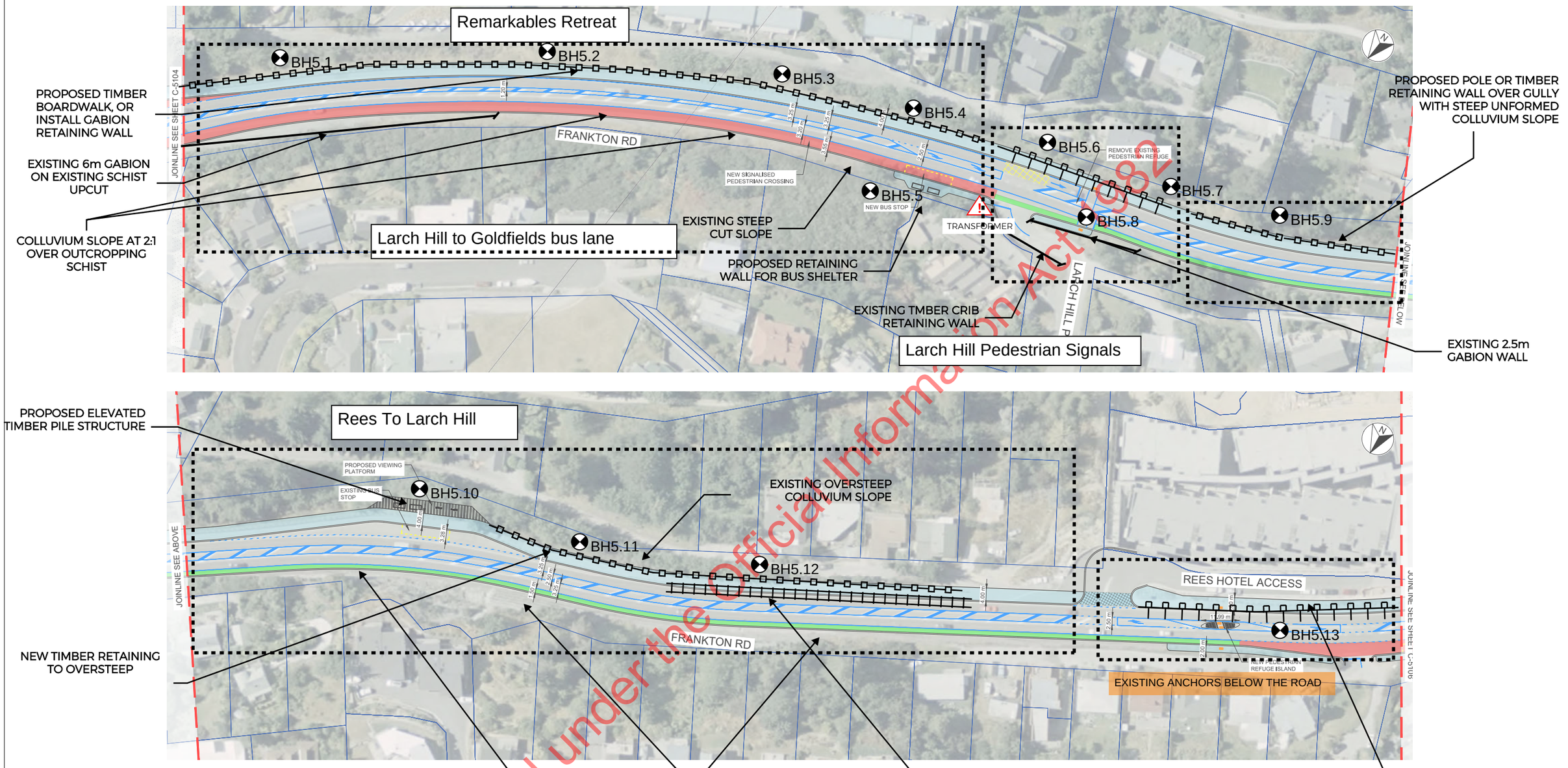
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SCALES

ORIGINAL SIZE A3

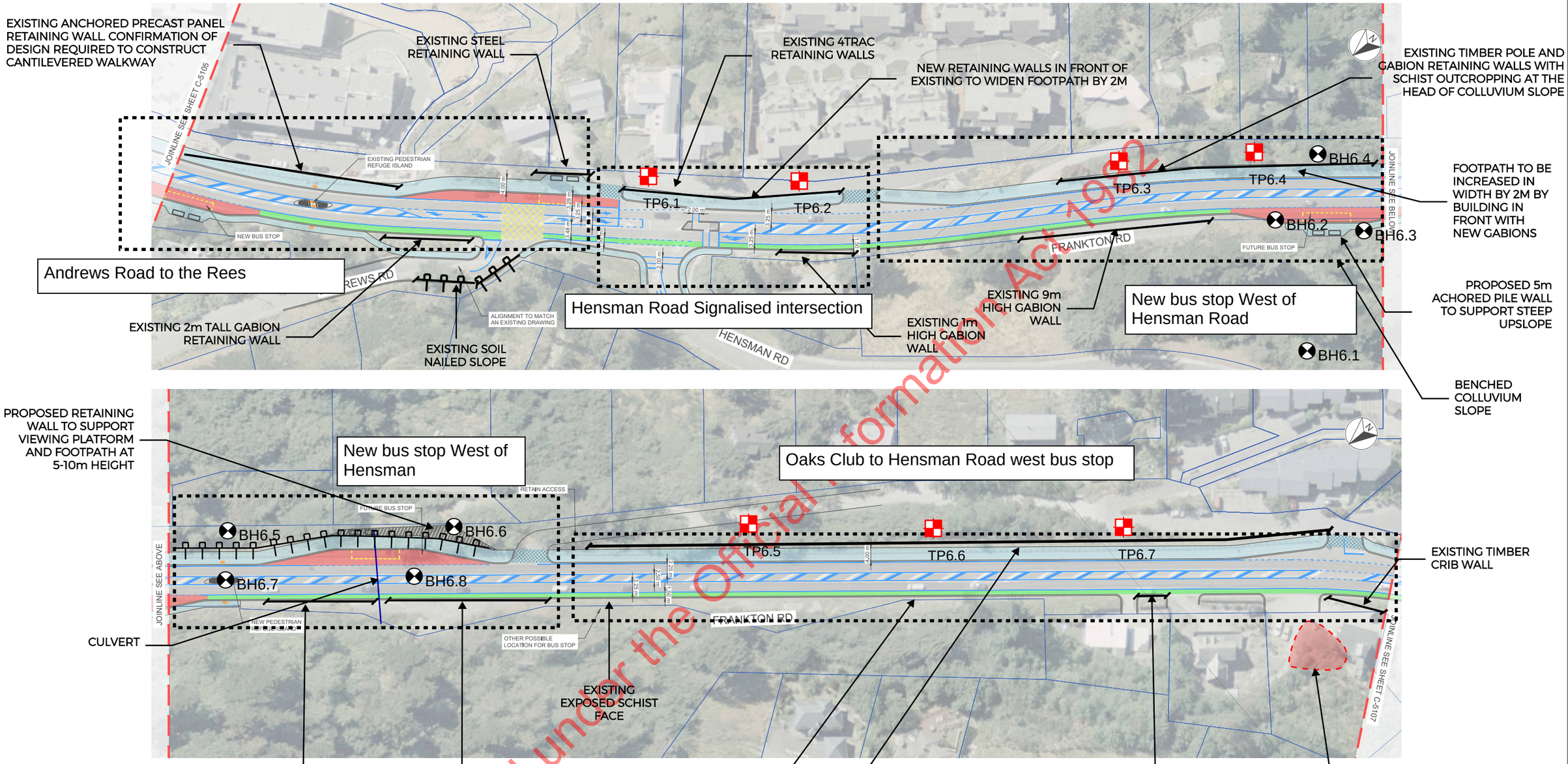
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s 9(2)(a)		29-05-2020

FOR INFORMATION ONLY

PROJECT
WAKA KOTAHI
PRELIMINARY GEOTECHNICAL APPRAISAL
QUEENSTOWN TO FRANKTON (Q2F) BUSINESS CASE

TITLE
PRELIMINARY GEOTECHNICAL ASSESSMENT AND INVESTIGATION PLAN

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
6-XT014.40/245GX	C5	A



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A	FOR INFORMATION ONLY	s 9(2)(a)	09-06-2020

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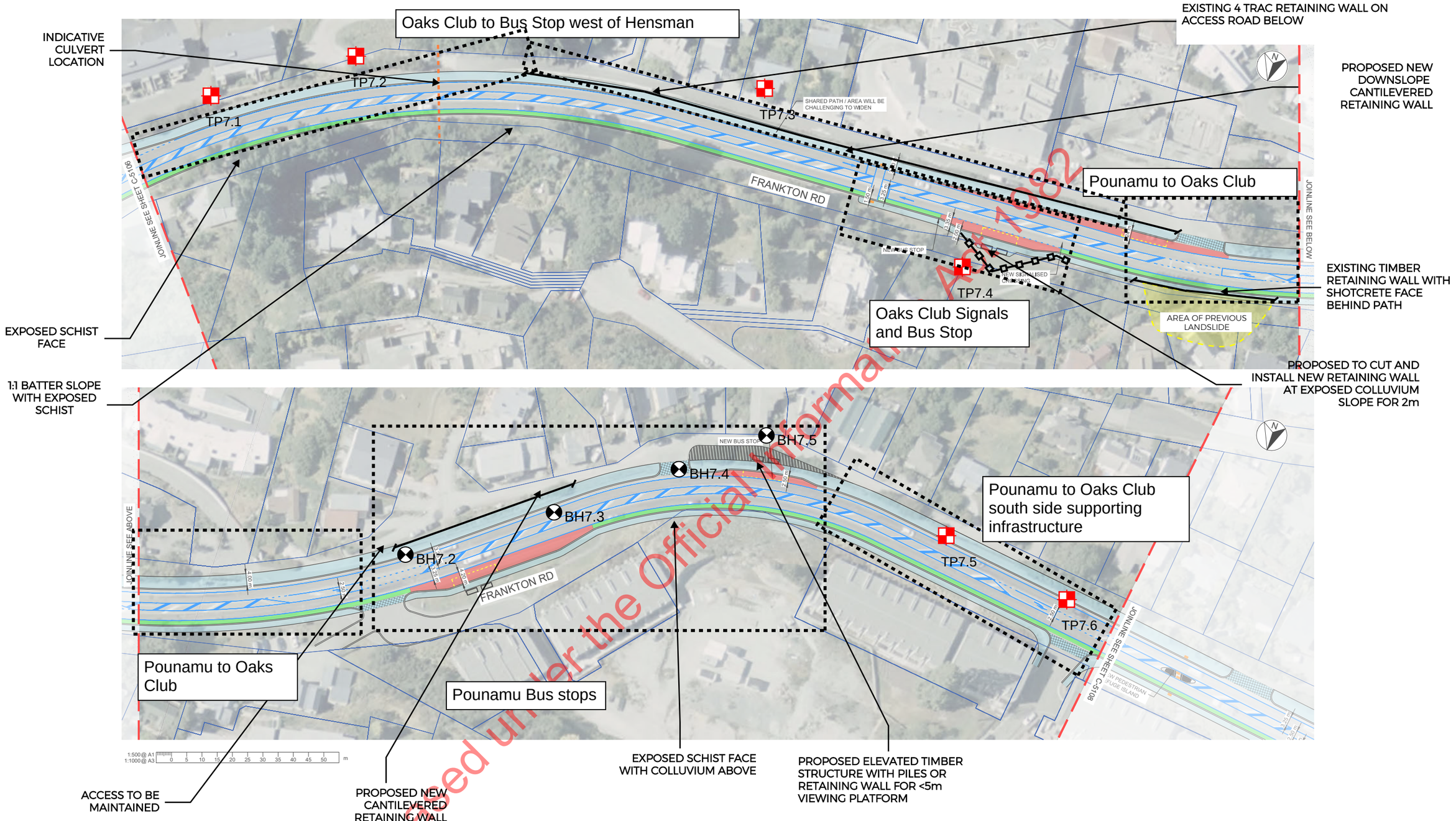
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WAKA KOTAHI
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QUEENSTOWN TO FRANKTON (Q2F) BUSINESS CASE

TITLE
PRELIMINARY GEOTECHNICAL ASSESSMENT AND INVESTIGATION PLAN

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
6-XT014.40/245GX	C6	A



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A	FOR INFORMATION ONLY	s 9(2)(a)	09-06-2020

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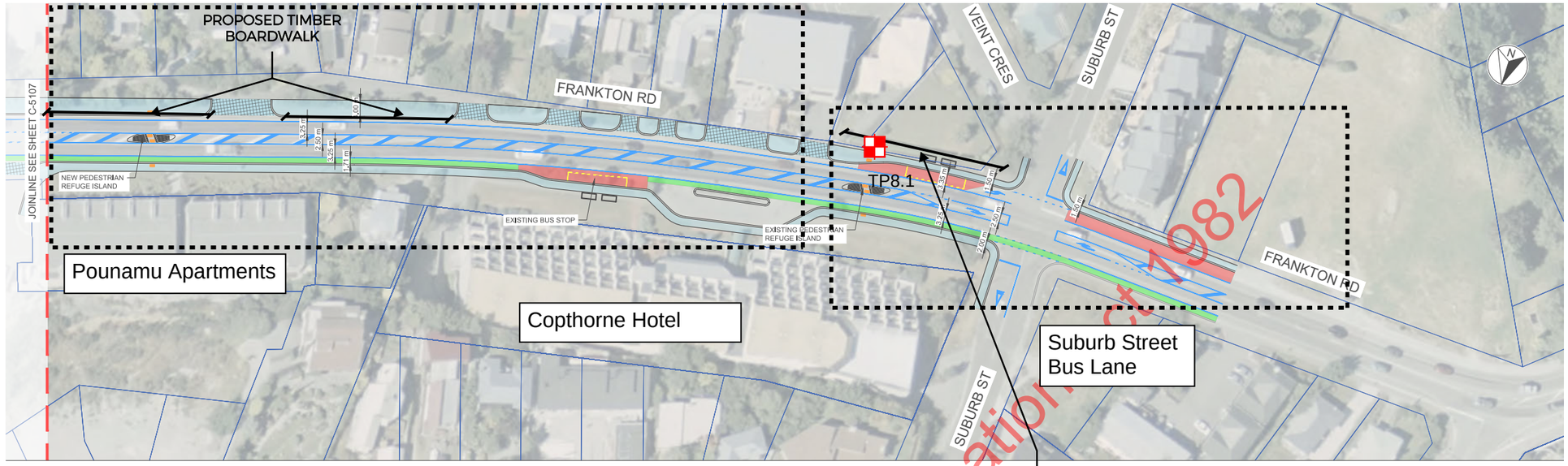
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DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
s 9(2)(a)		29-05-2020

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PROJECT
WAKA KOTAHI
PRELIMINARY GEOTECHNICAL APPRAISAL
QUEENSTOWN TO FRANKTON (Q2F) BUSINESS CASE

TITLE
PRELIMINARY GEOTECHNICAL ASSESSMENT AND INVESTIGATION PLAN

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
6-XT014.40/245GX	C7	A



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A	FOR INFORMATION ONLY	[redacted]	09-06-2020

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SCALES

ORIGINAL SIZE A3

DRAWN [redacted]

DESIGNED

APPROVED 29-05-2020

DRAWING VERIFIED s 9(2)(a)

DESIGN VERIFIED

APPROVED DATE 29-05-2020

FOR INFORMATION ONLY

PROJECT
WAKA KOTAHI
PRELIMINARY GEOTECHNICAL APPRAISAL
QUEENSTOWN TO FRANKTON (Q2F) BUSINESS CASE

TITLE
PRELIMINARY GEOTECHNICAL ASSESSMENT AND INVESTIGATION PLAN

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
6-XT014.40/245GX	C8	A

GEOTECHNICAL TESTING ESTIMATE
FRANKTON TO QUEENSTOWN

Item	Description	Unit	Qty	Rate	Amount
8.1	**Scala Penetrometer and Hand Auger**				
8.1.1	Scala Penetrometer ([4m] maximum)	ea	26	200	$5,200.00
8.1.2	Hand Auger Excavation ([4m] maximum)	ea		200	$0.00
8. 1.3	Sample for laboratory testing	ea		40	$0.00
8. 1.4	(list items and define payment)	L S. / ea / m / km			$0.00
8.2	**Pavement Test Pit**				
8.2.1	Testpit Excavation (nominally [600mm] deep)	ea	0	1500	$0.00
8.2. 2	Density (field NDM)	ea		100	$0.00
8.2. 3	Sample for Laboratory Testing	ea	0	40	$0.00
8. 2. 4	Traffic Management (extra over (12.7. 1])	ea	0	5000	$0.00
8. 2.5	[list items and define payment)	L S. / ea / m / km			$0.00
8.3	**Investigation Test Pit**				
8.3.1	Excavation (4m maximum)	ea	26	1240	$32,240.00
8.3.2	Density (field) NDM	ea			$0.00
8.3.3	Sample for Laboratory Testing	ea	26	40	$1,040.00
8.3.4	Traffic Management (extra over (12.7 .1])	L.S.	1	5000	$5,000.00
8.3.5	[list items and define payment]	L.S./ ea / m / km			$0.00
8.4	**Lab Testing**				
8.4.1	Water Content - Natural	ea		35	$0.00
8.4.2	Atterberg Limits (inclusive of natural water content)	ea	25	300	$7,500.00
8.4.3	Grading by Wet Sieving	ea	25	180	$4,500.00
8.4.4	Grading by Dry Sieving	ea		180	$0.00
8.4.5	Grading (fine soils)	ea		320	$0.00
8.4.6	Consolidation Test (oedometer)	ea	5	1200	$6,000.00
8.4.7	Triaxial (Unconsolidated Undrained (UU) - 3 specimens) (38mm diameter)	ea	20	1500	$30,000.00

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GEOTECHNICAL TESTING ESTIMATE
FRANKTON TO QUEENSTOWN

Item	Description	Unit	Qty	Rate	Amount
8.4.8	Triaxial (Unconsolidated Undrained (UU)- single specimen) (38mm diameter)	ea			$0.00
8.4.9	Triaxial (Consolidated Undrained - 3 specimens)	ea			$0.00
8.4.10	CBR Test - Natural (Soaked or Unsoaked)	ea	26	190	$4,940.00
8.4. I 0a	CBR Test - Optimum (Soaked or Unsoaked)	ea		200	$0.00
8.4.11	Extra over (12.4.9/ a] for Lime or cement modified (Optimum or Natural)	ea		10	$0.00
8.4.12	NZ Standard/Heavy Compaction Test Soils	ea		600	$0.00
8.4.13	NZ Vibrating Hammer Compaction Test	ea		610	$0.00
8.4.14	Unconfined Compressive Strength (UCS) with modulus and Poisson ratio	ea	40	250	$10,000.00
8.4.15	Unconfined Compressive Strength (UCS) without modulus and Poisson ratio	ea		200	$0.00
8.4.16	Indirect Tensile Strength Test	ea		225	$0.00
8.4.17	Abrasion Test	ea		250	$0.00
8.4.18	Density of Rock Core (Bulk and Dry)	ea			$0.00
8.4.19	[list items and define payment]	L S. / ea / m / km			$0.00
8.5	**Miscellaneous Testing**				
8.5.1	Static Cone Penetrometer (CPT) Rig Establishment and Disestablishment	L.S.	1	12000	$12,000.00
8.5.2	CPT set-up at Test Location	ea	20	85	$1,700.00
8.5.3	Extra over [12.5.2) for Preparation and Saturation of Piezocone	ea		68	$0.00
8.5.4	CPT Test ([20m) max depth)	m		41	$0.00
8.5.5	CPTu Test ([20m] max depth)	m	300	41	$12,300.00
8.5.6	Dissipation Test (in CPTu)	hr		260	$0.00
8.5.7	Extra over [12.5.6) for Dissipation Test (in CPTu)	hr		260	$0.00
8.5.8	Standpipe (in CPT or CPTu)	ea		20	$0.00

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GEOTECHNICAL TESTING ESTIMATE
FRANKTON TO QUEENSTOWN

Item	Description	Unit	Qty	Rate	Amount
8.5.9	Standard Penetration Test (Borehole, Solid or Hollow Nose Raymond)	ea		75	$0.00
8.5.10	Down Hole Shear Vane ([20m) max depth)	ea			$0.00
8.5.11	Standpipe Piezometer (Borehole, up to [2] per hole)	ea	43	800	$34,400.00
8.5.12	Falling or Rising Head Permeability Test in Standpipe	ea			$0.00
8.5.13	Benkelman Beam Testing ([20m] spacing - both lanes)	km			$0.00
8.5.14	Falling Weight Deflectometer ([20m] spacing - single lane)	km	0	1500	$0.00
8.5.15	Hand Shear Vane Test	ea			$0.00
8.5.16	Traffic Management (extra over [12.7.1))	ea	1	10000	$10,000.00
8.5.17	[list items and define payment)	L.S. / ea / m / km			$0.00
8.6	**Borehole**				
8.6.1	Drilling rig establishment and Disestablishment	L.S.	1	1500	$1,500.00
8.6.2	Drilling rig set-up at borehole location	ea	43	150	$6,450.00
8.6.3	Wash Drilling ([40m) max depth)	m		225	$0.00
8.6.4	Core recovery - Soil ([40m) max depth)	m	645	300	$193,500.00
8.6.5	Drilling in Rock (no core recovery) ([40m) max depth)	m		225	$0.00
8.6.6	Extra over [12.6.5) for core recovery in rock at HQ size	m		225	$0.00
8.6.7	Extra over [12.6.5] for core recovery in rock at PQ Size	m		300	$0.00
8.6.8	Falling or Rising Head Permeability Test in Borehole	ea			$0.00
8.6.9	Log and Photograph Core ([40m] max depth)	ea	43	4230	$181,890.00
8.6.10	Traffic Management (extra over (12.7.1])	ea	10	7500	$75,000.00

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GEOTECHNICAL TESTING ESTIMATE
FRANKTON TO QUEENSTOWN

Item	Description	Unit	Qty	Rate	Amount
8.6.11	[list items and define payment]	L.S./ ea / m / km			$0.00
8.7	**Miscellaneous and General (Client to Detail)**				
8.7.1	Traffic Management Plan, Mobilisation and Demobilisation	L.S.	1	5000	$5,000.00
8.7.2	[list items and define payment]	L.S./ ea / m / km			$0.00
8.8	**Miscellaneous (Tenderer to Detail as Applicable)**				
8.8.1	[list items and define payment]	L.S./ ea / m / km			$0.00
8.9	**Assessment of Results and Report**				
8.9.1	Geotechnical Investigations and Testing Results (Factual Report)	L.S.	1	70000	$70,000.00
TOTAL GEOTECHNICAL TESTING: (SH6A)					$710,160.00

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Frankton

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FRANKTON TO QUEENSTOWN SSBC
PRELIMINARY GEOTECHNICAL ASSESSMENT REPORT

PREPARED FOR THE WAKA KOTAHI NZ TRANSPORT AGENCY

July 2020

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This disclaimer shall apply notwithstanding that the report may be made available to other persons for an application for permission or approval to fulfil a legal requirement.

QUALITY STATEMENT

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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
1	22/07/20	Final draft	s 9(2)(a)		s 9(2)(a)	s 9(2)(a)
2	11/11/20	Updated for SH6/6A Intersection Change Final	s 9(2)(a)		s 9(2)(a)	s 9(2)(a)

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Waka Kotahi NZ Transport Agency

Frankton to Queenstown SSBC

Preliminary Geotechnical Assessment Report

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APPENDICES

Appendix A Preliminary Geotechnical Assessment and Investigation Plans
Appendix B Geotechnical Testing Schedule

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INTRODUCTION

Waka Kotahi (NZ Transport Agency) commissioned Stantec/WSP/Abley to carry out a Preliminary Geotechnical Appraisal of the proposed SH6/SH6A intersection improvements as part of the Frankton and Ladies Mile SSBC.

The site is located on the intersection of SH6/SH6A (SH6 RP 0983/11.95), Frankton, Queenstown, Otago (the site) as shown on the locality plan below.

The objectives of this report are to:

- Present the results of the preliminary desktop study and information known about the existing pavement and ground conditions
- Provide economic and design feasibility of concept solutions proposed
- Make recommendations for geotechnical investigation based on the desk study investigations and other relevant information.

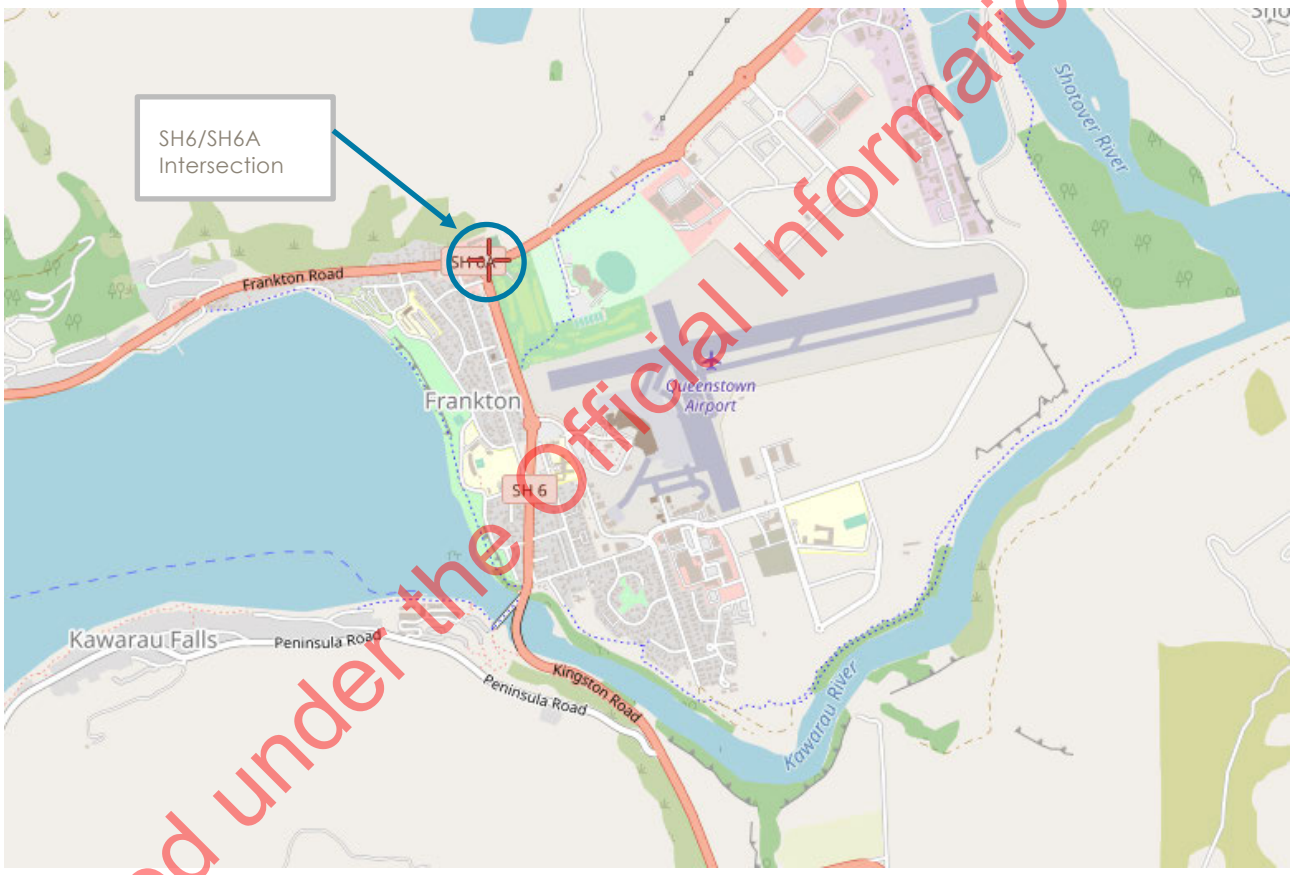


Figure 1: Locality Plan of The Site at the Intersection of SH6 and SH6A

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1. Frankton Ground Conditions

1.1 Underlying Geology

The geological map of the Wakatipu area (GNS, 2000) indicates that the site is at intersection of the Schist of Peak A3B2 (the continuation of Queenstown Hill towards Lake Johnston), the Fan deposits of Frankton Flats and the Lake gravels of Lake Wakatipu. Landslide material is present to the north of the site, along the side of the schist of Peak A3B2.

The Fan deposits of the Frankton Flats are thought to have been deposited when the level of Lake Wakatipu was higher and the Shotover and Kawarau rivers were also at higher bed elevations. These deposits are expected to be loose, commonly angular, boulders, gravel, sand, and silts.

The ground surface falls away towards Lake Wakatipu to the west of SH6, and the deposits represent the reducing Lake level over time, but are expected to be well sorted, fresh, rounded, fine to medium gravels in benches.

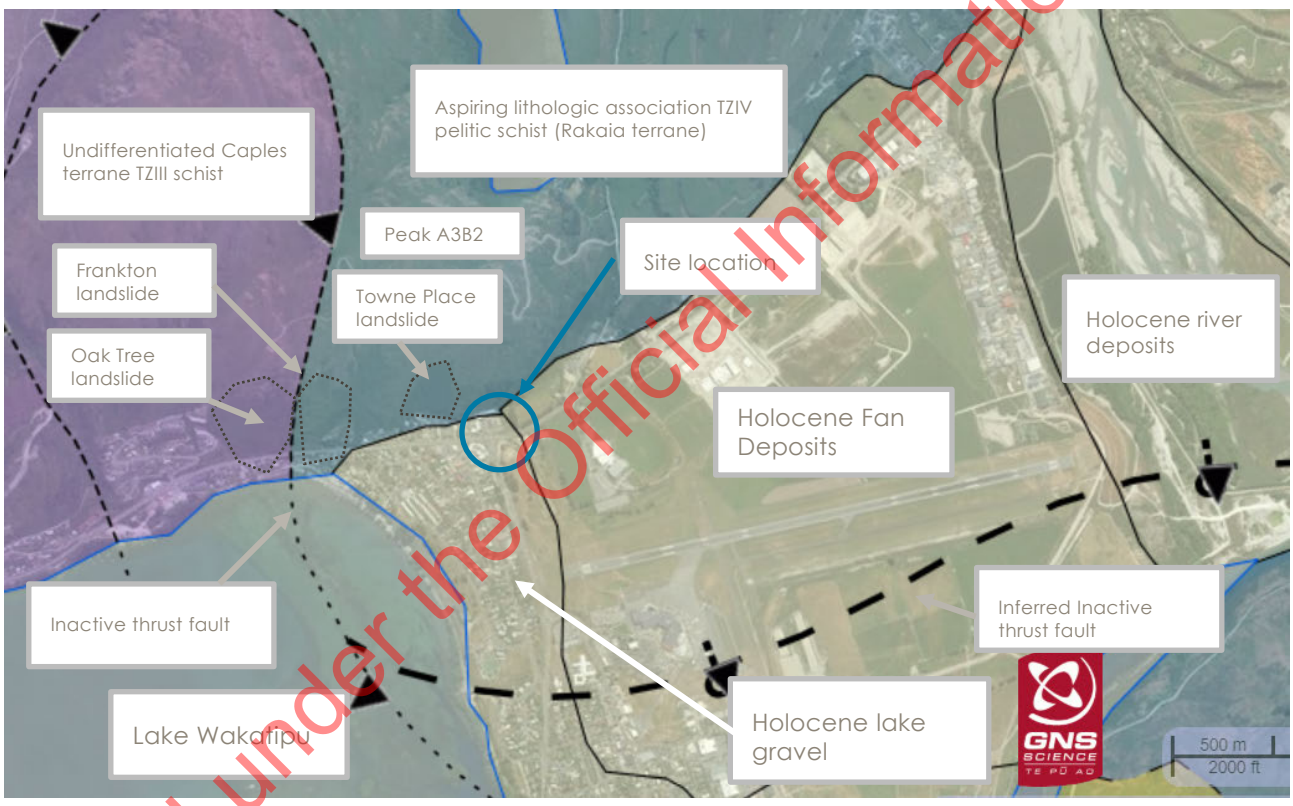


Figure 2: Map of Underlying Geology (GNS Science)

1.2 Ground water

A borehole at the Five Mile Development encountered permeable sandy gravel to a depth of 90m, i.e. at least 20m below the lake surface. This suggests that the Frankton Flats aquifer is unconfined, and that much of the Frankton area has a deep ground water table. This aquifer is expected to be contiguous with the lake levels at the lake edge, reducing in level away from the lake, and therefore possible 5 – 10m below lake level at the site location

1.3 Natural Hazards

Publicly available information was reviewed to assess the Natural hazards at the site.

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1.3.1 Active Faults

The GNS Active Faults database, and the report 'Seismic Hazard in the Queenstown Lakes District[1]' shows several fault lines within immediate proximity to the site location, all of which are inactive. A concealed fault lies 1km west of the site location, crossing SH6A in the north-south direction. There is also an approximate thrust fault 1km south of the site in the east-west direction. The Moonlight Fault, approximately 13km to the West of the site, is considered Inactive, though to the south the West Wakatipu Fault has recently been assessed as having a return period of 20,000 years[2].

The nearest active fault to the site is the Cardrona-Nevis Fault (13km east of the site) which has a recurrence interval of 5,000 – 10,000 years. There are a number of active faults further to the east of the site, such as Pisa (32 km), Dunstan Fault (40km) and Cairnmuir Faults (40km). The site is 100km east of the Alpine Fault which has a recurrence interval of less than 2,000 years and is capable of major displacement (> 5m) in a single event.

1.3.2 Landslides

The New Zealand Landslide database records the Frankton Landslide to the north of SH6A, and to the west of the site. The Oak Tree landside to the west of the Frankton Landslide and Towne Place landslide to the west are also pertinent to the site. Both landslides are discussed in the report relating to Frankton to Queenstown and are not expected to specifically affect this site.

The south face of Peak A3B2 is mapped as an Active Landslide according to the Otago Natural Hazards Database, and is the location of the Towne Place landslide, based on the research of Cunningham 1994[3]. This section of the hill has had the base cut away by the historic movement of the Shotover River and is now comprised of colluvium slope debris.

1.3.3 Ground Classification

Ground classification within proximity to the site are predominately classified as D – Deep or Soft Soil, indicating the ground will experience a higher seismic shaking when compared to rock. Frankton has a Modified Mercalli Intensity (MMI) Scale of 7 expected to be exceeded 1:100 years.

1.3.4 Liquefaction

The liquefaction risk has been most recently mapped[4] for the Frankton area by GNS Science Consultancy in 2019. This report suggests that there is a liquefaction risk (Domain B) at the north end of the Frankton Arm, from Perkins to the BP roundabout. Domain B is described as occurring where the ground is predominantly underlain by poorly consolidated river or stream deposits, and there is a low to moderate risk of liquefaction.

At the site location it is considered that the ground water table is sufficiently deep that the liquefaction related risk is considered low.

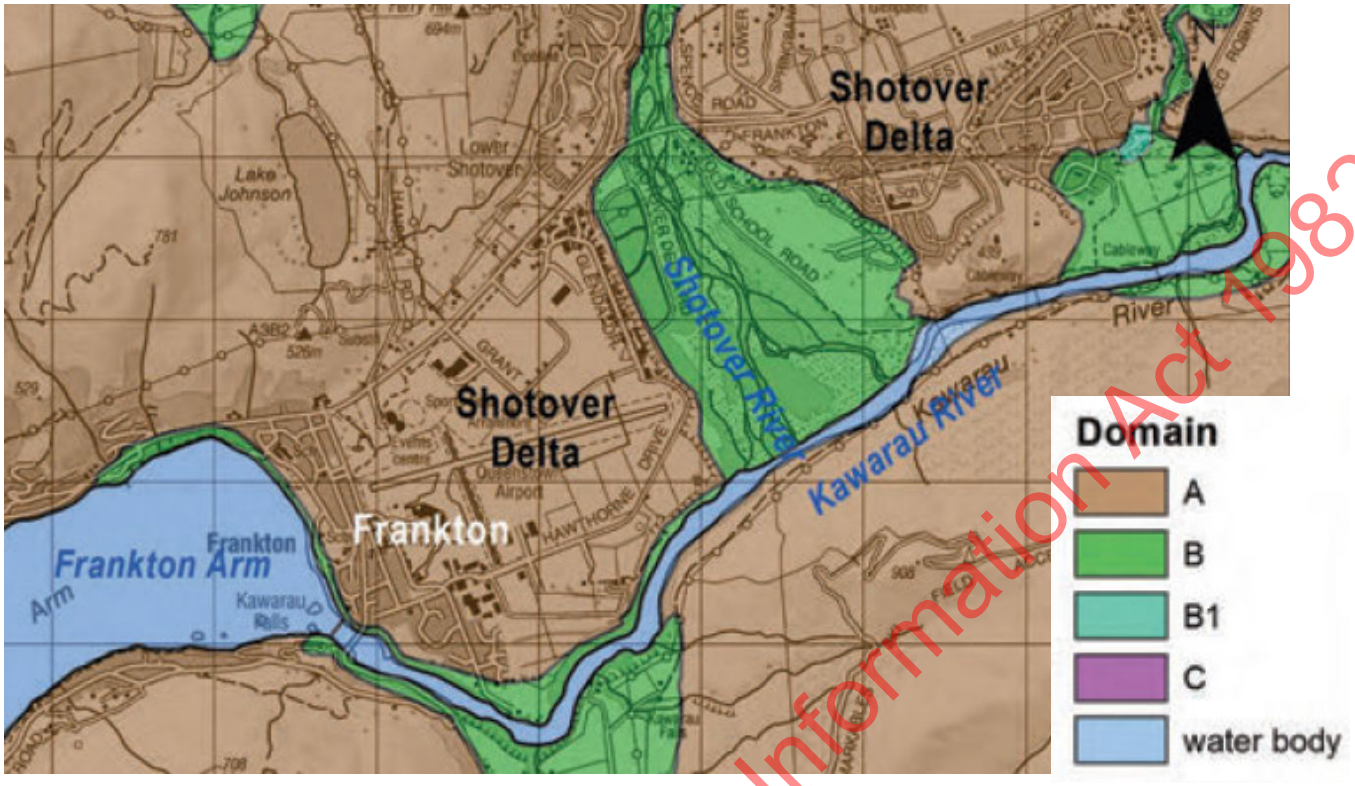
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[1] Seismic Hazard in Queenstown Lakes District, Mackey, Otago Regional Council, August 2015

[2] General distribution and characteristics of active faults and folds in the Queenstown Lakes and Central Otago districts, Otago, DJA Barrell, GNS Science Consultancy Report 2018/207 March 2019

[3] Land use planning and development suitablity in Queenstown, Master Thesis, University of Otago, 1994

[4] Assessment of liquefaction hazards in the Queenstown Lakes, Central Otago, Clutha and Waitaki districts of the Otago Region, DJA Barrell, GNS Science Consultancy Report 2018/67 June 2019



1.3.5 Flooding

The Frankton area is not considered to be at risk of inundation from a flood event.

1.4 ORC Contaminated Land Inquiry

The Otago Regional Council maintains a HAIL database (Hazardous Activities and Industries List regarding any information the council may hold pertaining to potential soil contamination at the site. It was confirmed that the site adjacent to the area currently appear on the HAIL database maintained by ORC, as described in Table 1-1 and Figure 3.

Table 1-1 Land Parcels of Risk Listed in ORC HAIL Database

Key	Address	Site History	Potential Hazard
1	1067 Frankton Road	Frankton Mower (currently Mobil)	Motor vehicle workshops
2	1 McBride St	Frankton Service Centre (currently Mobil)	Service stations including retail or commercial refuelling facilities.
3	1094 Frankton Road	Service Station (currently BP)	Service stations including retail or commercial refuelling facilities.
4	Frankton Road	Cemeteries	Current cemetery.
5	20 Douglas St	Queenstown Hospital	Storage tanks or drums for fuel, chemicals or liquid waste. Record of 400L underground tank.
6	Sir Henry Wigley Dr	Queenstown Airport	Airports including fuel storage, workshops, washdown areas, or fire practice areas.

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Figure 3: Land Parcels of Risk Listed in ORC HAIL Database

1.5 Site History

73 Historic aerial photographs, taken between 1929 to 2001 were available for review from Retrolens[5] and Google Earth from 2004 to 2020. Table 1-2 below summarises the aerial photographs reviewed in relation to the site. These were also cross checked with historical maps from MapsPast[6] showing development of the site from 1929 to 2020.

Table 1-2: Summary of Freely Available Historic Aerials and Maps

Year	Site Observations	Surrounding Area
1929	Graveyard adjacent to SH6, north of the site. Existing route for SH6 south of the site is present (unsealed).	Kawarau Bridge under construction, 1km south. Grass runway present east of the site. Historic maps show planning for a cemetery 400m to the east of the site.
1956	First document development of urban dwellings, sparsely populated.	Residential dwellings at location of current 5-Mile centre. Aerials show no development of other cemetery locations.
1964	Frankton subdivision has been developed with numerous residential properties visible near the edge of Lake Wakatipu. Frankton corner shops present. First documentation of sealed road of SH6/SH6A.	No discernible changes from 1956.

[5] http://retrolenz.nz/
[6] http://mapspast.org.nz

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Year	Site Observations	Surrounding Area
1971	Continued development of more urban dwellings	Airport runway has been sealed and extended further towards SH6.
1979	Golf course directly adjacent to east of site.	No discernible changes from 1971.
2001	Site appears to have no discernible changes since 1979.	Area east of the site has seen development of Queenstown Events Centre.
2012		An area east of the site has been cleared for the 5 Mile Shopping Complex development site.

1.6 Observed Ground Conditions

The observed ground conditions are as expected.

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2. Proposed Works

The proposed works are described in three sections, relating to the signalised roundabout at the SH6 and SH6a, the transport hub to the south of this, and works along Ladies Mile.

2.1 SH6 and SH6A Junction

The junction of SH6 and SH6A at Frankton has been identified as an existing issue in terms of congestion and lack of public transport priority and active travel facilities. With the increased land use along the Frankton - Ladies Mile Corridor (SH6) provision of bus priority measures, active travel improvements, a Transport hub to the south the current intersection and the potential for transit orientated development, including an Emergency Precinct, the intersection requires a significant upgrade.

This is proposed to be achieved though the provision of a large signalised intersection, utilising bus lanes and active travel routes.

A proposal for the works is given in Appendix A.

2.1.1 Site History

The intersection of SH6 and SH6A and the road layout around this area of Frankton are shown on the 1929 maps and may have been present earlier. The 1956 aerial photographs indicate only minor development in this area, with the junction existing as a gravel intersection on the 1956 aerial, with the first development visible on the 1964 aerial, around a gravel T intersection. The junction appears more formalised on the 1973 aerial, with grassed islands and turn lanes. The 2001 aerial photographs show the development of the BP service station. The development of the current roundabout in the winter of 2001 removed evidence of earlier works in the area[7].

2.1.2 Cut to Fill Earthworks

The works for the intersection will involve cut to fill earthworks to form the carriageway.

The underlying soils are expected to comprise alluvial gravels and therefore are considered suitable for the bulk earthworks proposed. Appropriate temporary batters will be required for any cut slopes.

The site is mapped as being across the Holocene Lake deposits and the Holocene River fan deposits. While the predominant geology across the site is expected to be well rounded silts, sands and gravels, there may be areas with sand or silt lenses relating to areas of historic beaches and deltas. Therefore, material should be screened prior to use.

A cut to fill volumes assessment has not been undertaken, but it is expected that the area of the current golf course north west corner would be utilised balance cut or fill to mitigate the need for removal of material off site.

The ground water level has not yet been assessed in this area but is expected to be contiguous with the lake and significantly lower than the expected cuts, and therefore no significant pumping or works relating to water are expected.

The adjacent Frankton Cemetery will require some earthworks in its vicinity, however it is expected that the works will be of sufficient distance to not disturb ground at the cemetery.

2.1.3 Underpasses

No underpasses are proposed at this location

2.1.4 Retaining Walls/batter slopes

Some level differences will necessitate new retaining walls or batter slopes specifically between the intersection and the BP petrol station. The existing edge of seal at the BP station may need to be retained in the temporary case. Retaining walls in this area are expected to be around 1.0m in height and be formed from concrete, masonry or timber.

[7] Queenstown Properties 2001 Ltd, SH6/6a Intersection, Frankton Roundabout. Opus 2001

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2.1.5 Proposed Geotechnical Testing

Trial Pits TP1 to TP5 are proposed in the centre and at each leg of the intersection to confirm the pavement design requirements.

2.2 Frankton Transport Hub

Plans for the Frankton Transport hub are in the preliminary stages and are shown in Appendix A. New roading infrastructure including bus standing will be provided. Future development may include small to medium rise buildings

2.2.1 Site History

There is a historic drainage ditch which appears on historic photographs extending from the west of the cemetery southwards, which is still visible south of the golf course track.

The remainder of the Transport hub area appears to have historically been fields, with the original ground surface profile of minor north south hummocks being utilised for the development of the golf course.

2.2.2 Future amenity buildings

Lightweight amenity buildings at the bus hub are expected to be timber buildings to NZS3604:2011 or similar, and will therefore be founded on shallow concrete strip or pile foundations. The form of the buildings has not been confirmed, however, it is expected that this may require foundations suitable for a medium rise building. These foundations are expected to bear on the Holocene gravels. The depth of these gravels to be determined during on site testing and are expected to be between 1.0 and 2.0m depth.

2.2.3 Proposed Geotechnical Testing

Trial Pits TP6 to TP 8 are proposed pavement pits relating to upgrades to the road at the Frankton Transport hub.

Trial Pits TP9 to TP 11 are proposed pavement pits relating to the upgraded intersection at Lucas Place.

2.3 Frankton - Ladies Mile (SH6)

To provide pedestrian and Active Travel across SH6, underpasses are proposed at the locations as shown in Appendix A. Additional development is expected along the Ladies Mile corridor, but this is not assessed as part of this report.

2.3.1 Underpasses

Pedestrian and cyclist underpasses are proposed for SH6. These are expected to be formed from precast concrete units, with suitable bearing expected at depth onto the Holocene River deposits.

Retaining walls to the approaches of the underpasses are expected to be formed from concrete and are proposed to retain the road adjacent to the slope from the underpass. Suitable bearing at depth and lateral resistance will be confirmed by geotechnical testing

The permanent ground water level in this area has not been assessed but is expected to be at a depth of around 90m, as found from the boreholes undertaken for the 5 Mile development. There are however historic channels on the side of Peak A3B2, which discharge into the area of Ladies Mile, which may suggest minor discontinuous perched water tables. For example, there is a pond at 111 Frankton Road and similar ponds and streams are expected to have existed along the length of Ladies Mile historically. There may therefore be local perched water tables in the vicinity of the proposed underpasses. Where these are present, it may be necessary to drain them, and these could be drained either in a westerly direction, towards the lake, or east towards the Shotover River.

Since SH6A is a regionally significant road[8] it is considered that the underpasses and their approaches should be designed to mitigate against liquefaction and for the road to be operable following a MM7 event.

[8] The NZ Transport Agency's Bridge manual SP/M/022, Third edition, Amendment 3, Figure 2.1(b)

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2.3.2 Proposed Geotechnical Testing

Site specific testing at each of the underpass locations is recommended to confirm ground conditions, with boreholes BH1 and BH1 proposed at each underpass these to be CPTu to a depth of approximately 15m, and Trial pits TP12 to TP 19 are proposed at each leg of the roundabout and at each end of the proposed underpass.

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Appendices













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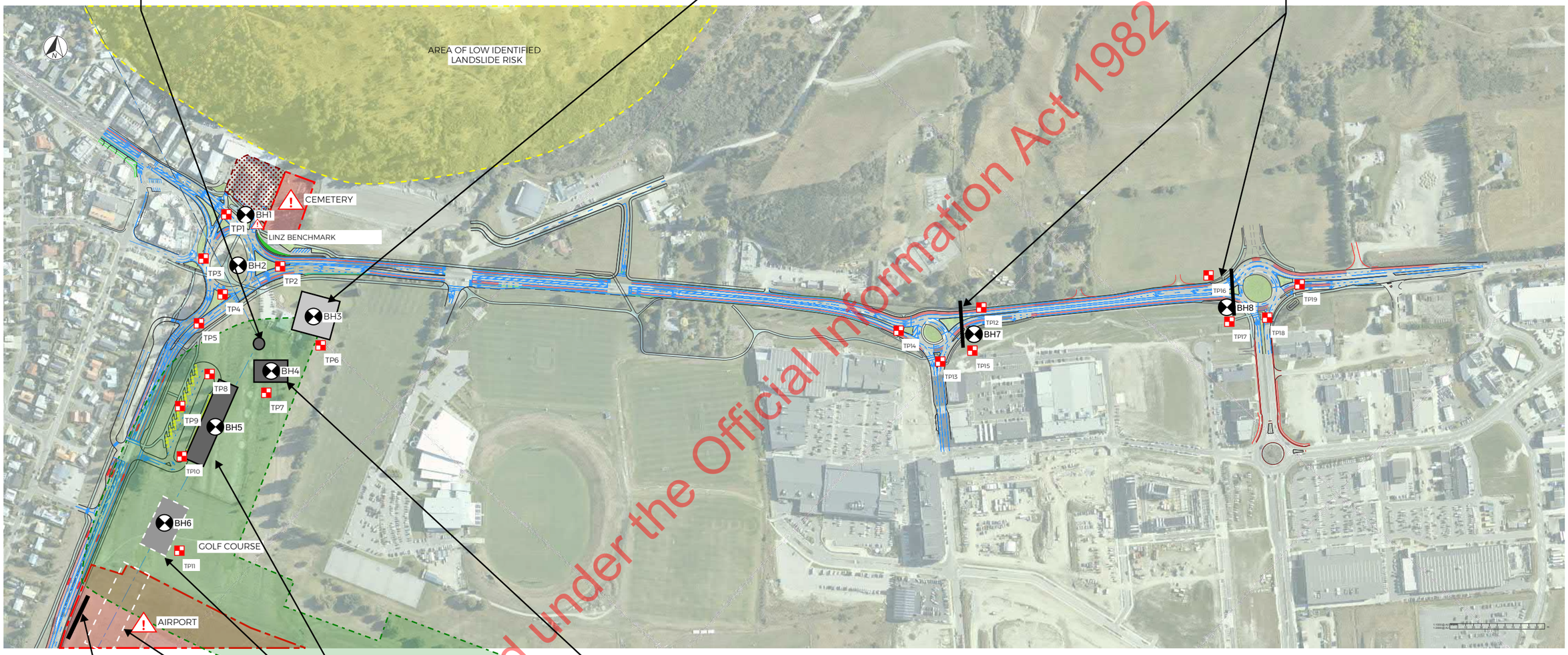
Appendix A Preliminary Geotechnical Assessment and Investigation Plans

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PROPOSED GONDOLA TOWER LOCATION

PROPOSED TRANSIT ORITENTED BUILDINGS

PROPOSED UNDERPASS AS PART OF FUTURE DEVELOPMENT



PROPOSED LOW TO MEDIUM RISE AMMENITY BUILDINGS

PROPOSED GONDOLA BASE STATION WITH UNDERGROUND STORAGE

PROPOSED BELOW GROUND GONDLA HANGAR

PROPOSED GONDOLA UNDERPASS AT END OF RUNWAY

EXISITING MSE WALL SUPPORTING END OF RUNWAY.
REVIEW DESIGN INFORMATION

ALL PROPOSED BUILDING LOCATIONS INDICATIVE AND SUBJECT TO CHANGE

KEY:

- AREA OF RISK FOR EXISTING LAND USE
- AREA OF LOW RISK OF LANDSLIDE
- EXISTING GOLF COURSE
- SITES WITH RISK OF CONTAMINATION
- PROPOSED BOREHOLE LOCATION

BOREHOLE LOCATIONS:

1. RETAINING AT SERVICE STATION. POTENTIAL FOR EXISTING SERVICES
2. ROUNDABOUT EXCAVATION AND BEARING
3. GONDOLA BASE AND BUILDING
4. MEDIUM/LIGHT WEIGHT BUILDING FOUNDATION
5. POTENTIAL UNDERPASS LOCATION AS PART OF FUTURE DEVELOPMENT
6. POTENTIAL UNDERPASS LOCATION AS PART OF HIF

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A	FOR INFORMATION ONLY	s 9(2)(a)	29-05-2020

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SCALES

ORIGINAL SIZE A3

DRAWN s 9(2)(a) | DESIGNED | APPROVED 29-05-2020

DRAWING VERIFIED s 9(2)(a) | DESIGN VERIFIED | APPROVED DATE 29-05-2020

FOR INFORMATION ONLY

PROJECT
WAKA KOTAHI
PRELIMINARY GEOTECHNICAL APPRAISAL
FRANKTON AND LADIES MILE BUSINESS CASE

TITLE
PRELIMINARY GEOTECHNICAL ASSESSMENT AND INVESTIGATION PLAN

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
6-XT014.64/375GX	C1	A

Appendix B Geotechnical Testing Schedule

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GEOTECHNICAL TESTING ESTIMATE
FRANKTON

Item	Description	Unit	Qty	Rate	Amount
8.1	**Scala Penetrometer and Hand Auger**				
8.1.1	Scala Penetrometer ([4m] maximum)	ea	22	200	$4,400.00
8.1.2	Hand Auger Excavation ([4m] maximum)	ea		200	$0.00
8. 1.3	Sample for laboratory testing	ea		40	$0.00
8. 1.4	(list items and define payment)	L S. / ea / m / km			$0.00
8.2	**Pavement Test Pit**				
8.2.1	Testpit Excavation (nominally [600mm] deep)	ea	12	1500	$18,000.00
8.2. 2	Density (field NDM)	ea		100	$0.00
8.2. 3	Sample for Laboratory Testing	ea	12	40	$480.00
8. 2. 4	Traffic Management (extra over (12.7. 1])	ea	4	2500	$10,000.00
8. 2.5	[list items and define payment)	L S. / ea / m / km			$0.00
8.3	**Investigation Test Pit**				
8.3.1	Excavation (4m maximum)	ea	10	827	$8,266.67
8.3.2	Density (field) NDM	ea			$0.00
8.3.3	Sample for Laboratory Testing	ea	10	40	$400.00
8.3.4	Traffic Management (extra over (12.7 .1])	L.S.	1	3000	$3,000.00
8.3.5	[list items and define payment]	L.S./ ea / m / km			$0.00
8.4	**Lab Testing**				
8.4.1	Water Content - Natural	ea		35	$0.00
8.4.2	Atterberg Limits (inclusive of natural water content)	ea	4	300	$1,200.00
8.4.3	Grading by Wet Sieving	ea	4	180	$720.00
8.4.4	Grading by Dry Sieving	ea	4	180	$720.00
8.4.5	Grading (fine soils)	ea		320	$0.00
8.4.6	Consolidation Test (oedometer)	ea		1200	$0.00
8.4.7	Triaxial (Unconsolidated Undrained (UU) - 3 specimens) (38mm diameter)	ea	8	1500	$12,000.00

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GEOTECHNICAL TESTING ESTIMATE
FRANKTON

Item	Description	Unit	Qty	Rate	Amount
8.4.8	Triaxial (Unconsolidated Undrained (UU)- single specimen) (38mm diameter)	ea			$0.00
8.4.9	Triaxial (Consolidated Undrained - 3 specimens)	ea			$0.00
8.4.10	CBR Test - Natural (Soaked or Unsoaked)	ea	22	190	$4,180.00
8.4. l 0a	CBR Test - Optimum (Soaked or Unsoaked)	ea		200	$0.00
8.4.11	Extra over (12.4.9/ a] for Lime or cement modified (Optimum or Natural)	ea		10	$0.00
8.4.12	NZ Standard/Heavy Compaction Test Soils	ea		525	$0.00
8.4.13	NZ Vibrating Hammer Compaction Test	ea		610	$0.00
8.4.14	Unconfined Compressive Strength (UCS) with modulus and Poisson ratio	ea		250	$0.00
8.4.15	Unconfined Compressive Strength (UCS) without modulus and Poisson ratio	ea		200	$0.00
8.4.16	Indirect Tensile Strength Test	ea		600	$0.00
8.4.17	Abrasion Test	ea		250	$0.00
8.4.18	Density of Rock Core (Bulk and Dry)	ea			$0.00
8.4.19	[list items and define payment]	L S. / ea / m / km			$0.00
8.5	**Miscellaneous Testing**				
8.5.1	Static Cone Penetrometer (CPT) Rig Establishment and Disestablishment	L.S.	1	12000	$12,000.00
8.5.2	CPT set-up at Test Location	ea	2	85	$170.00
8.5.3	Extra over [12.5.2) for Preparation and Saturation of Piezocone	ea		68	$0.00
8.5.4	CPT Test ([20m) max depth)	m	0	41	$0.00
8.5.5	CPTu Test ([20m] max depth)	m	40	41	$1,640.00
8.5.6	Dissipation Test (in CPTu)	hr		260	$0.00
8.5.7	Extra over [12.5.6) for Dissipation Test (in CPTu)	hr		260	$0.00
8.5.8	Standpipe (in CPT or CPTu)	ea		20	$0.00

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GEOTECHNICAL TESTING ESTIMATE
FRANKTON

Item	Description	Unit	Qty	Rate	Amount
8.5.9	Standard Penetration Test (Borehole, Solid or Hollow Nose Raymond)	ea		75	$0.00
8.5.10	Down Hole Shear Vane ([20m) max depth)	ea			$0.00
8.5.11	Standpipe Piezometer (Borehole, up to [2] per hole)	ea	2	700	$1,400.00
8.5.12	Falling or Rising Head Permeability Test in Standpipe	ea			$0.00
8.5.13	Benkelman Beam Testing ([20m] spacing - both lanes)	km			$0.00
8.5.14	Falling Weight Deflectometer ([20m] spacing - single lane)	km	2	1500	$3,000.00
8.5.15	Hand Shear Vane Test	ea			$0.00
8.5.16	Traffic Management (extra over [12.7.1))	ea	1	10000	$10,000.00
8.5.17	[list items and define payment)	L.S. / ea / m / km			$0.00
8.6	**Borehole**				
8.6.1	Drilling rig establishment and Disestablishment	L.S.	1	1500	$1,500.00
8.6.2	Drilling rig set-up at borehole location	ea	2	150	$300.00
8.6.3	Wash Drilling ([40m) max depth)	m	0	94	$0.00
8.6.4	Core recovery - Soil ([40m) max depth)	m	20	300	$6,000.00
8.6.5	Drilling in Rock (no core recovery) ([40m) max depth)	m	0	225	$0.00
8.6.6	Extra over [12.6.5) for core recovery in rock at HQ size	m		225	$0.00
8.6.7	Extra over [12.6.5] for core recovery in rock at PQ Size	m		300	$0.00
8.6.8	Falling or Rising Head Permeability Test in Borehole	ea		640	$0.00
8.6.9	Log and Photograph Core ([40m] max depth)	ea	2	4230	$8,460.00
8.6.10	Traffic Management (extra over (12.7.1])	ea			$0.00

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GEOTECHNICAL TESTING ESTIMATE
FRANKTON

Item	Description	Unit	Qty	Rate	Amount
8.6.11	[list items and define payment]	L.S./ ea / m / km			$0.00
8.7	**Miscellaneous and General (Client to Detail)**				
8.7.1	Traffic Management Plan, Mobilisation and Demobilisation	L.S.	1	5000	$5,000.00
8.7.2	[list items and define payment]	L.S./ ea / m / km			$0.00
8.8	**Miscellaneous (Tenderer to Detail as Applicable)**				
8.8.1	[list items and define payment]	L.S./ ea / m / km			$0.00
8.9	**Assessment of Results and Report**				
8.9.1	Geotechnical Investigations and Testing Results (Factual Report)	L.S.	1	40000	$40,000.00
TOTAL GEOTECHN ICAL TESTING: (Queenstown Town Centre Arterial Stage 1)					$152,836.67

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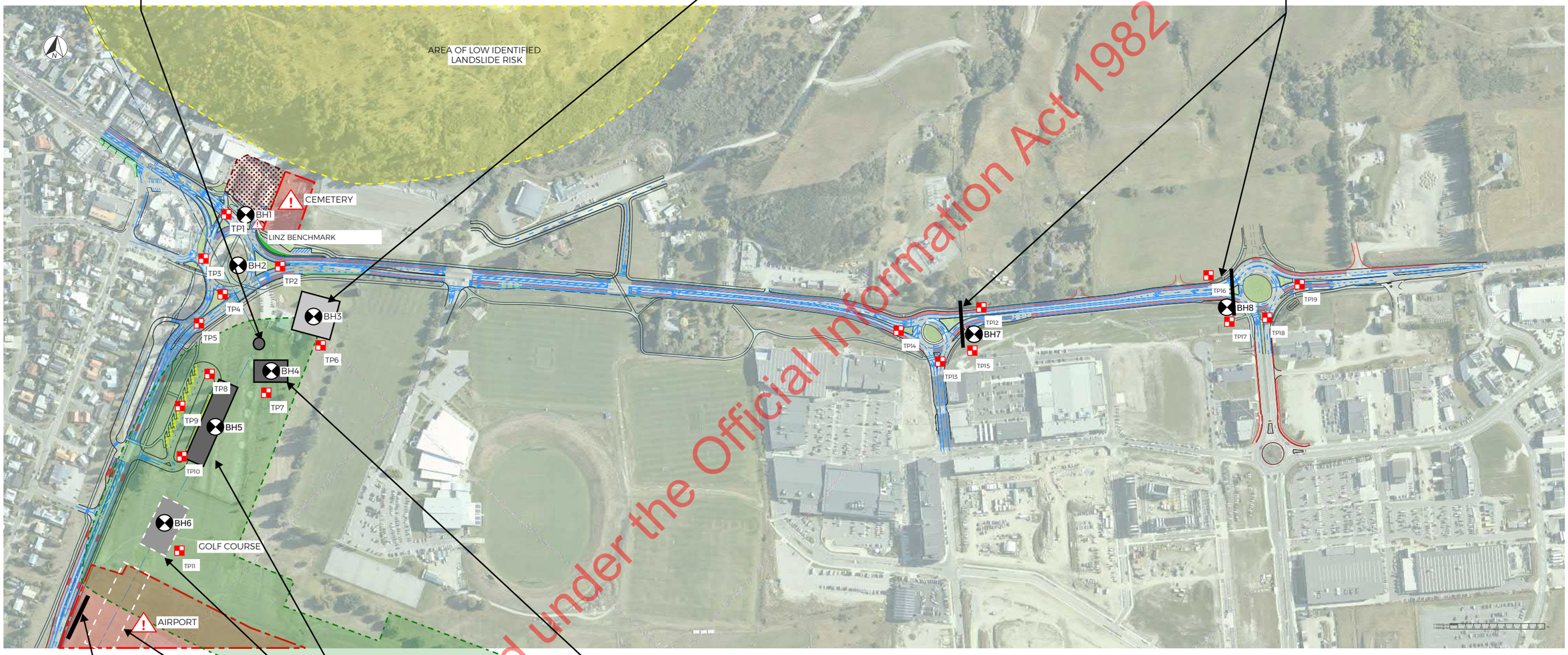
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PROPOSED GONDOLA TOWER LOCATION

PROPOSED TRANSIT ORITENTED BUILDINGS

PROPOSED UNDERPASS AS PART OF FUTURE DEVELOPMENT



PROPOSED LOW TO MEDIUM RISE AMMENITY BUILDINGS

PROPOSED BELOW GROUND GONDLA HANGAR

EXISITING MSE WALL SUPPORTING END OF RUNWAY. REVIEW DESIGN INFORMATION

PROPOSED GONDOLA UNDERPASS AT END OF RUNWAY

PROPOSED GONDOLA BASE STATION WITH UNDERGROUND STORAGE

ALL PROPOSED BUILDING LOCATIONS INDICATIVE AND SUBJECT TO CHANGE

KEY:

- AREA OF RISK FOR EXISTING LAND USE
- AREA OF LOW RISK OF LANDSLIDE
- EXISTING GOLF COURSE
- SITES WITH RISK OF CONTAMINATION
- PROPOSED BOREHOLE LOCATION

BOREHOLE LOCATIONS:

1. RETAINING AT SERVICE STATION. POTENTIAL FOR EXISTING SERVICES
2. ROUNDABOUT EXCAVATION AND BEARING
3. GONDOLA BASE AND BUILDING
4. MEDIUM/LIGHT WEIGHT BUILDING FOUNDATION
5. POTENTIAL UNDERPASS LOCATION AS PART OF FUTURE DEVELOPMENT
6. POTENTIAL UNDERPASS LOCATION AS PART OF HIF

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PROJECT
WAKA KOTAHI
PRELIMINARY GEOTECHNICAL APPRAISAL
FRANKTON AND LADIES MILE BUSINESS CASE

TITLE
PRELIMINARY GEOTECHNICAL ASSESSMENT AND INVESTIGATION PLAN

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
6-XT014.64/375GX	C1	A

GEOTECHNICAL TESTING ESTIMATE
FRANKTON

Item	Description	Unit	Qty	Rate	Amount
8.1	**Scala Penetrometer and Hand Auger**				
8.1.1	Scala Penetrometer ([4m] maximum)	ea	22	200	$4,400.00
8.1.2	Hand Auger Excavation ([4m] maximum)	ea		200	$0.00
8. 1.3	Sample for laboratory testing	ea		40	$0.00
8. 1.4	(list items and define payment)	L S. / ea / m / km			$0.00
8.2	**Pavement Test Pit**				
8.2.1	Testpit Excavation (nominally [600mm] deep)	ea	12	1500	$18,000.00
8.2. 2	Density (field NDM)	ea		100	$0.00
8.2. 3	Sample for Laboratory Testing	ea	12	40	$480.00
8. 2. 4	Traffic Management (extra over (12.7. 1])	ea	4	2500	$10,000.00
8. 2.5	[list items and define payment)	L S. / ea / m / km			$0.00
8.3	**Investigation Test Pit**				
8.3.1	Excavation (4m maximum)	ea	10	827	$8,266.67
8.3.2	Density (field) NDM	ea			$0.00
8.3.3	Sample for Laboratory Testing	ea	10	40	$400.00
8.3.4	Traffic Management (extra over (12.7 .1])	L.S.	1	3000	$3,000.00
8.3.5	[list items and define payment]	L.S./ ea / m / km			$0.00
8.4	**Lab Testing**				
8.4.1	Water Content - Natural	ea		35	$0.00
8.4.2	Atterberg Limits (inclusive of natural water content)	ea	4	300	$1,200.00
8.4.3	Grading by Wet Sieving	ea	4	180	$720.00
8.4.4	Grading by Dry Sieving	ea	4	180	$720.00
8.4.5	Grading (fine soils)	ea		320	$0.00
8.4.6	Consolidation Test (oedometer)	ea		1200	$0.00
8.4.7	Triaxial (Unconsolidated Undrained (UU) - 3 specimens) (38mm diameter)	ea	8	1500	$12,000.00

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GEOTECHNICAL TESTING ESTIMATE
FRANKTON

Item	Description	Unit	Qty	Rate	Amount
8.4.8	Triaxial (Unconsolidated Undrained (UU)- single specimen) (38mm diameter)	ea			$0.00
8.4.9	Triaxial (Consolidated Undrained - 3 specimens)	ea			$0.00
8.4.10	CBR Test - Natural (Soaked or Unsoaked)	ea	22	190	$4,180.00
8.4. l 0a	CBR Test - Optimum (Soaked or Unsoaked)	ea		200	$0.00
8.4.11	Extra over (12.4.9/ a] for Lime or cement modified (Optimum or Natural)	ea		10	$0.00
8.4.12	NZ Standard/Heavy Compaction Test Soils	ea		525	$0.00
8.4.13	NZ Vibrating Hammer Compaction Test	ea		610	$0.00
8.4.14	Unconfined Compressive Strength (UCS) with modulus and Poisson ratio	ea		250	$0.00
8.4.15	Unconfined Compressive Strength (UCS) without modulus and Poisson ratio	ea		200	$0.00
8.4.16	Indirect Tensile Strength Test	ea		600	$0.00
8.4.17	Abrasion Test	ea		250	$0.00
8.4.18	Density of Rock Core (Bulk and Dry)	ea			$0.00
8.4.19	[list items and define payment]	L S. / ea / m / km			$0.00
8.5	**Miscellaneous Testing**				
8.5.1	Static Cone Penetrometer (CPT) Rig Establishment and Disestablishment	L.S.	1	12000	$12,000.00
8.5.2	CPT set-up at Test Location	ea	8	85	$680.00
8.5.3	Extra over [12.5.2) for Preparation and Saturation of Piezocone	ea		68	$0.00
8.5.4	CPT Test ([20m) max depth)	m	0	41	$0.00
8.5.5	CPTu Test ([20m] max depth)	m	40	41	$1,640.00
8.5.6	Dissipation Test (in CPTu)	hr		260	$0.00
8.5.7	Extra over [12.5.6) for Dissipation Test (in CPTu)	hr		260	$0.00
8.5.8	Standpipe (in CPT or CPTu)	ea		20	$0.00

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GEOTECHNICAL TESTING ESTIMATE
FRANKTON

Item	Description	Unit	Qty	Rate	Amount
8.5.9	Standard Penetration Test (Borehole, Solid or Hollow Nose Raymond)	ea		75	$0.00
8.5.10	Down Hole Shear Vane ([20m) max depth)	ea			$0.00
8.5.11	Standpipe Piezometer (Borehole, up to [2] per hole)	ea	8	700	$5,600.00
8.5.12	Falling or Rising Head Permeability Test in Standpipe	ea			$0.00
8.5.13	Benkelman Beam Testing ([20m] spacing - both lanes)	km			$0.00
8.5.14	Falling Weight Deflectometer ([20m] spacing - single lane)	km	2	1500	$3,000.00
8.5.15	Hand Shear Vane Test	ea			$0.00
8.5.16	Traffic Management (extra over [12.7.1))	ea	1	10000	$10,000.00
8.5.17	[list items and define payment)	L.S. / ea / m / km			$0.00
8.6	**Borehole**				
8.6.1	Drilling rig establishment and Disestablishment	L.S.	1	1500	$1,500.00
8.6.2	Drilling rig set-up at borehole location	ea	8	150	$1,200.00
8.6.3	Wash Drilling ([40m) max depth)	m	0	94	$0.00
8.6.4	Core recovery - Soil ([40m) max depth)	m	80	300	$24,000.00
8.6.5	Drilling in Rock (no core recovery) ([40m) max depth)	m	0	225	$0.00
8.6.6	Extra over [12.6.5) for core recovery in rock at HQ size	m		225	$0.00
8.6.7	Extra over [12.6.5] for core recovery in rock at PQ Size	m		300	$0.00
8.6.8	Falling or Rising Head Permeability Test in Borehole	ea		640	$0.00
8.6.9	Log and Photograph Core ([40m] max depth)	ea	8	4230	$33,840.00
8.6.10	Traffic Management (extra over (12.7.1])	ea			$0.00

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GEOTECHNICAL TESTING ESTIMATE
FRANKTON

Item	Description	Unit	Qty	Rate	Amount
8.6.11	[list items and define payment]	L.S./ ea / m / km			$0.00
8.7	**Miscellaneous and General (Client to Detail)**				
8.7.1	Traffic Management Plan, Mobilisation and Demobilisation	L.S.	1	5000	$5,000.00
8.7.2	[list items and define payment]	L.S./ ea / m / km			$0.00
8.8	**Miscellaneous (Tenderer to Detail as Applicable)**				
8.8.1	[list items and define payment]	L.S./ ea / m / km			$0.00
8.9	**Assessment of Results and Report**				
8.9.1	Geotechnical Investigations and Testing Results (Factual Report)	L.S.	1	40000	$40,000.00
TOTAL GEOTECHN ICAL TESTING: (Queenstown Town Centre Arterial Stage 1)					$201,826.67

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Appendix C17 Road Transport Emissions Assessment

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Insightful solutions. Empowering advice.

QLDC Road Transport Emissions Assessment

Prepared for: Matt Roberts, QLDC

Job Number: QLDC-J053

Issue Date: 12 November 2020

Prepared by: s 9(2)(a) Technical Director, Transportation Planning

Reviewed by: s 9(2)(a) Associate Transportation Planner

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Introduction

Queenstown Lakes District Council (QLDC) commissioned Abley to estimate and forecast annual carbon emissions of district wide road traffic using total vehicle kilometres travelled (VKT) data from the Queenstown-Lakes Tracks Transportation model. The purpose was to calculate the carbon dioxide equivalent amount emitted by all vehicles travelling in the district annually for the next 30 years. This technical note reports the findings of this assessment.

Methodology and results

The modelled VKT was extracted for the Queenstown Transport Business Case (QTBC) model run which includes the full suite of transportation projects including the New Zealand Upgrade Programme (NZUP) and Crown Infrastructure Partner (CIP) packages as well as enhanced public transport provision, mode shift and behaviour change elements and infrastructure improvements (including full Stage 1 through 3 town centre arterials) delivered through the QTBC. The modelled VKT for each year and period including annualised results are summarised in the table below.

Table 1 Modelled VKT by year and period

Period	2018	2028	2048	2018-48 Change	2018-48 %age Change
AM Peak	145,736	197,837	259,859	114,123	78%
Inter Peak	150,340	206,288	288,064	137,724	92%
PM Peak	188,966	256,029	355,044	166,078	88%
Annual	643,601,405	879,868,106	1,217,723,917	574,122,512	89%

The future forecast changes in vehicle types and vehicle fuel types are considered in the assessment since not all fuels and vehicle sizes generate the same levels of pollutants, and electric and hybrid vehicles are expected to represent a larger share of the national vehicle fleet in future years.

Ministry of Transport (MoT) data on the current composition of the NZ vehicle fleet[1], as well as MoT projections of future fleet composition[2] were applied to include this within the assessment. Adjustments were made to heavy vehicles percentages in the fleet composition to reflect typical heavy vehicle volumes in the District. This enabled VKT by fleet composition to be calculated for each year as shown in the following table:

[1] https://www.transport.govt.nz/assets/Import/Uploads/Research/Documents/NZ-Vehicle-Fleet-Statistics-2018_web.xlsx
[2] https://www.transport.govt.nz/assets/Uploads/Research/Transport-Outlook/Documents/c0ab63ceb9/VFEM-run20170719-Adj-ghgfuel-FY.xlsx

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Table 2 Fleet and fuel type composition by year (%age)

Fleet/fuel type	2018	2028	2048
Diesel (less HGV)	14.62%	13.57%	3.97%
Diesel plug-in	0.01%	0.65%	4.63%
Electric	0.33%	7.95%	46.10%
Petrol	78.02%	64.36%	16.75%
Petrol plug-in	0.09%	2.60%	8.30%
Hybrid diesel	0.01%	0.01%	0.01%
Hybrid petrol	1.05%	5.00%	14.41%
Heavy Vehicles	5.84%	5.84%	5.84%

To extract the emission results, Ministry for the Environment (MfE) emission factors per km[3] were applied to the VKT values extracted from the model, to calculate carbon equivalent emissions. The results are shown in the table below.

Table 3 Current and forecast carbon emissions by year ((kg C02-e)

Fleet/fuel type	2018	2028	2048	2018-48 Change	2018-48 %age Change
Diesel (less HGV)	25,406,026	28,246,726	13,036,702	-13,630,983	-54%
Diesel plug-in	5,168	639,064	7,157,479	7,627,960	147611%
Electric	52,337	1,532,241	14,035,572	14,901,870	28473%
Petrol	134,572,852	132,984,105	54,647,822	-86,863,046	-65%
Petrol plug-in	63,791	2,162,195	10,921,954	11,531,395	18077%
Hybrid diesel	8,085	17,825	21,782	13,997	173%
Hybrid petrol	1,367,794	7,784,077	35,455,389	36,181,889	2645%
Heavy Vehicles	17,059,353	19,243,641	20,980,238	3,924,349	23%
Total (tonnes C02 -e)	178,535	192,610	156,257	-26,313	-15%

Conclusion

The emissions modelling demonstrates that road transport emissions in the District are forecast to reduce by 15% between 2018 and 2048 despite an 89% increase in VKT in the District. The increase in VKT is below the growth in population and employment (which is forecast to double between 2018 and 2051[4]), due to a mode shift away from private vehicle usage in the Wakatipu area.

The two main contributors to the reduction in road transport emissions are the mode shift towards more sustainable transport delivered through the NZUP and QTBC programmes, and changing fleet fuel types over the next 30 years.

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[3] https://www.mfe.govt.nz/publications/climate-change/measuring-emissions-guide-organisations-2019-detailed-guide
[4] https://www.qldc.govt.nz/community/population-and-demand