Before Queenstown Lakes District Council

In the matter of	The Resource Management Act 1991
And	The Queenstown Lakes District proposed District Plan – Rezoning Hearing Topic 12 – Upper Clutha mapping

REBUTTAL STATEMENT OF EVIDENCE OF CHARLES YATES GRANT FOR

Seven Albert Town Property Owners (#1038)

Dated 28 April 2017

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anderson lloyd.

Qualifications and Experience

1 My full name is Charles Yates Grant.

2 I have been involved as a strategic advisor and project manager in a number of urban and rural lifestyle / productive land use projects throughout New Zealand,

3 Currently, I am the Director at Land Solutions Limited. Land Solutions Limited is a consultancy specialising in Integrated Rural Lifestyle/Productive Land Use Projects and Urban Subdivision Developments.

4 My certifications and professional memberships include:

(a) Diploma in Land Surveying (Otago University);

(b) Registered Surveyor;

(c) Member of New Zealand Institute of Surveyors; and

(d) Member Consulting Surveyors of New Zealand.

5 In preparing this evidence I have reviewed:

(a) Section 42a report dated 17 March 2017 "Strategic Overview and Common Themes" prepared by Craig Barr on behalf of Queenstown Lakes District Council; and

(b) Statement of Evidence of Helen Juliet Mellsop on behalf of Queenstown Lakes District Council dated 17 March 2017.

Scope of Evidence

6 My evidence addresses the following matters:

(a) The Township Zone and existing development as it relates to the boundary of the Clutha River ONF;

(b) The legal road at Wicklow Terrace in determining the boundary of the ONF;

(c) Bank instability in the area identified in the requested Clutha River ONF extension; and

(d) The flood limits for the Clutha River as they relate to the boundary of the Clutha River ONF.

7 This evidence is given on behalf of the Further Submitters (#1038)

Background

8 The Submission by Alan Cutler (Submission #110) sought that the ONF boundary on the true right bank either side of the State Highway Bridge at Albert Town be extended to include all open space and natural banks and terrace faces.

9 The Further Submitters (#1038) all own property at Albert Town that access off Alison Avenue and front onto the unformed Wicklow Terrace on the true right bank of the Clutha River upstream of the SH 6 Bridge.

10 Mr Cutler's Submission is opposed by the further submitters on the basis that the notified PDP boundary for the ONF of the Clutha River is more appropriate than the amended boundary sought by Mr Cutler.

11 It is noted that Mr Cutler has not pre-lodged any expert evidence in support of his submission, and the Council's landscape and planning reports in respect of this Hearing have supported the requested amendment.

Township zoning and ONF

12 Consideration of the ONF boundary as notified in the Proposed District plan ("PDP") indicates that the boundary location has been carefully considered by Council, not just here but all around the Albert Town area. Proper consideration has been given to the setting and that this is an established Residential Area. This is exemplified in Fig 29 of Dr Read's landscape report[1] and associated commentary which identifies the proposed landscape boundaries at the confluence of the Clutha and Hawea Rivers.

13 Conversely, Ms Mellsop's evidence dated 17 March 2017 records that 'the line was incorrectly translated from a marker pen line on an aerial to a precise GIS line'. There is no evidence supporting this statement proffered by Ms Mellsop, and it appears contrary to the very deliberate identification of the line in Dr Read's assessment, which clearly excludes the elevated boundary of Wicklow Terrace and the Road reserve. I attach as **Appendix A**, the extract of Dr Read's report referred to.

14 Ms Mellsop's Evidence also omits the zoning of the land identified in the extended ONF boundary is 'Township Zone' (Operative). This zoning is identified on Planning Map 24b which reflects the significant residential development of this land, and consequently, its effect on the terraces in this area being modified rather than natural. Ms Mellsop's Evidence does not refer to the naturalness of

[1] Report to Queenstown Lakes District Council on appropriate landscape classification boundaries within the District, with particular reference to Outstanding natural landscapes and Features

the terraces themselves, but just to their legibility and 'connection to' unmodified river bank landforms to the west and east (para 8.119).

15 Chapter 6 generally, policy 6.3.1.2 and rule 6.4.1.2 state that only Rural zoned land can be subject to the classification as either ONL or ONF (Outstanding Natural Landscape or Outstanding Natural Feature). In particular rule 6.4.1.2 states: "the landscape categories apply only to the rural zone". Rule 6.4.1.4 states:

> ***6.4.1.4*** *The landscape categories apply to lakes and rivers. Except where otherwise stated or shown on the Planning Maps, lakes and rivers are categorised as outstanding natural landscapes.*

16 Part 6.2 of the Landscape Chapter states the following:

> *Landscapes have been categorised into three classifications within the Rural Zone. These are Outstanding Natural Landscapes (ONL) and Outstanding Natural Features (ONF), where their use, development and protection are a matter of national importance under Section 6 of the RMA. The Rural Landscapes classification (RL) makes up the remaining Rural Zoned land and has varying types of landscape character and amenity values. Specific policy and assessment matters are provided to manage the potential effects of subdivision and development in these locations.*

17 The amended ONF boundary is also inconsistent with the section 42a report prepared by Mr Barr, which considers at section 20 the 'landscape boundaries and classifications on land other than rural'. Mr Barr's reasoning in this section acknowledges that the framework of the PDP primarily provides for the ONL and ONF classifications and boundaries within the Rural Zone (Chapter 21) and that the rules and assessment matters relating to the three landscape classification overlays (ONF, ONL, RLC) are in the Rural Zone.

18 Mr Barr, at para 20.15 states he has identified two areas in the Upper Clutha area where a landscape line is located over a zone other than a Rural Zone, being an area of LDR land on the base of Mt Iron, and an area of RLZ land on planning Map 22. Mr Barr's conclusion at para 20.18 then goes on to accept that in those two instances the landscape lines should be amended so they apply to rural zoned land.

19 Conversely, there is no specific mention in Mr Barr's report of Ms Mellsop's recommendation to amend the Clutha River ONF boundary in this area. Mr Barr's only mention of this amendment is in his summary table Appendix 2, which identifies that Mr Cutler's submission is partially accepted and that the Further Submission 1038 be rejected.

Legal Road

20 The terrace feature, comprising two flats and the terrace face itself, adjoining the Further Submitters' properties is in Public Ownership (legal Road). The legal road boundary extends much closer toward the true river banks, and represents an area of land under Council control and which could in the future become altered as a formed road, thereby further modifying this area now suggested as ONF.

21 When looking closely at Dr Read's positioning of the ONF boundary in **Appendix A,** it appears as though the boundary follows the boundary between the legal road and the river, which is an entirely logical outcome.

Bank Instability

22 The terrace referred to by Mr Cutler at this locality is not natural, having been engineered to some degree or another in response to land instability. These issues are potentially ongoing and further works may be required in the future.

23 I attach as **Appendix B** a report prepared by GeoSolve Ltd (GSL) identifying the results of geotechnical investigations carried out for the Otago Regional Council (ORC) to assess slope stability conditions and provide geotechnical inputs for the area up- and down-stream of the Albert Town Bridge. This area includes the land the subject of this submission.

24 Landslides at Albert Town have become evident over the last two decades. The hazard arises primarily where saturated fine-grained interglacial lake sediments (rather than outwash gravels) border the river. Field assessment and mapping has been carried out to enable informed evaluation of the potential for rapid mobility and likelihood of damage to properties. Survey monitoring of the terrace is, as I understand it, ongoing.

25 It is clear from this report that there are multiple areas along the banks of the River which may present a hazard of bank instability in the future and will therefore require engineering solutions to modify the land further to protect the township. An ONF status in these areas would make such necessary works potentially more difficult in the future and does not reflect the currently modified state of the terrace.

Flood Limits

26 If the "river" were defined in physical/geomorphological terms rather than legal terms from the cadastre, the notified line for the ONF coincides with that measure also. If the "margin" of a river is assessed as being the uppermost limit of the water's influence, I consider the reasonable lay person would ascribe such a

boundary on the ground where they perceive the boundary to be between the water and its adjacent land uses.

27 The Otago Regional Council rainfall flooding hazard overlay is identified in **Appendix C** as the blue hatched lines. Again, the flood line broadly coincides with the legal road boundary in this area and would provide a good approximation of the upper most limit of the river margin.

Dated this 28th day of April 2017

Charles Yates Grant

Appendix A

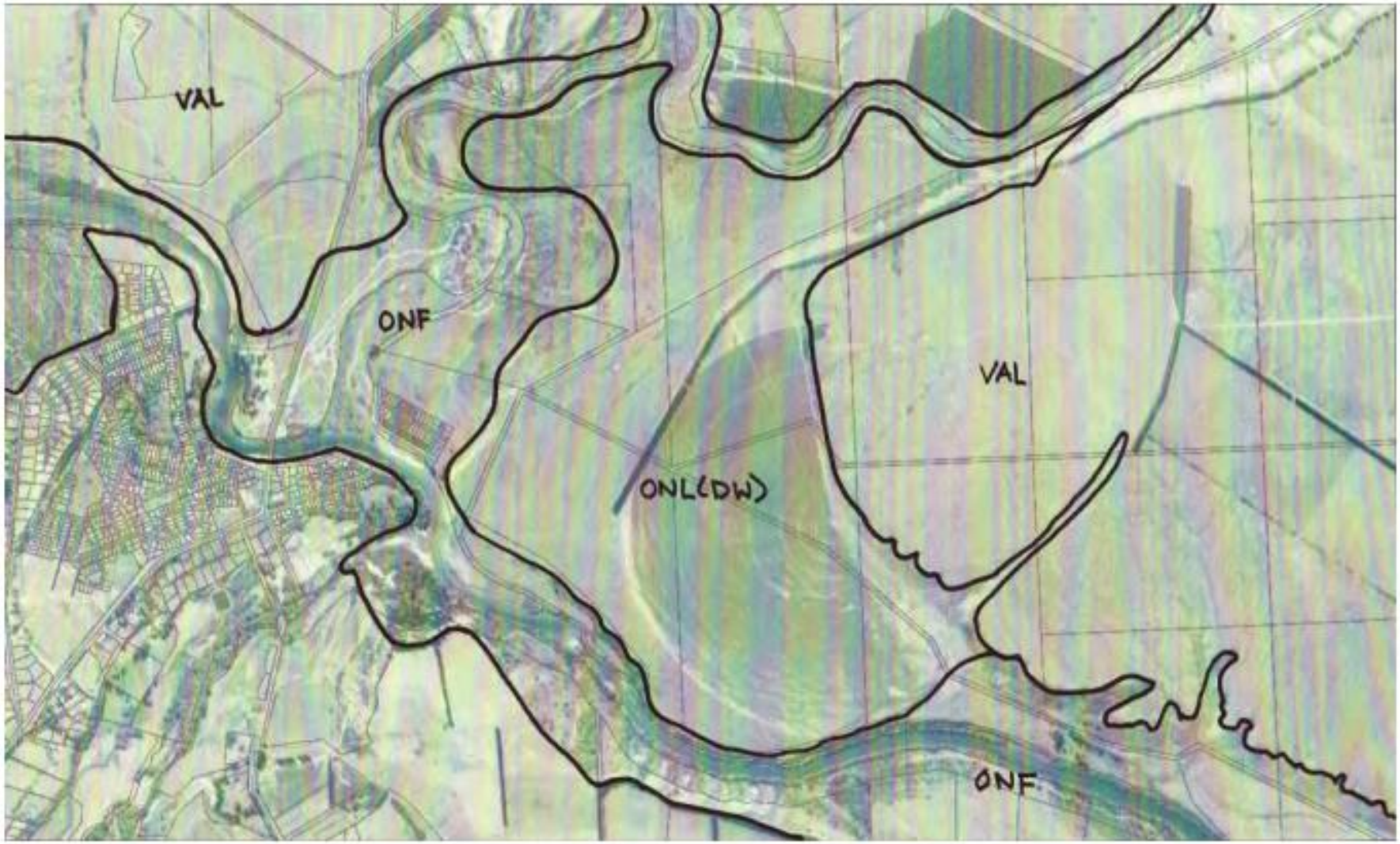

Fig29: Proposed landscape boundaries at the confluence of the Clutha and Hawea Rivers

Appendix B

Geotechnical Report and Stability Assessment

Albert Town Landslides

Report prepared for:

Otago Regional Council

Report prepared by:

GeoSolve Ltd

Distribution:

Otago Regional Council

GeoSolve Limited (File)

9 December 2014

GeoSolve Ref: 140722

ACENZ MEMBER

Table of Contents

1 Introduction

This report presents the results of geotechnical investigations carried out by GeoSolve Ltd (GSL) for the Otago Regional Council (ORC) to assess slope stability conditions and provide geotechnical inputs for the study area up- and down-stream of the Albert Town Bridge.

The investigations were carried out in accordance with GSL's proposal dated 2 December 2014, which outlines the scope of work and conditions of engagement.

Documents provided by ORC to GSL to inform this project included site inspection and briefing notes, and records of concerns and opinions expressed by local residents.

2 Site Description

The study area is located in Albert Town which is situated approximately 5.2 km northeast of central Wanaka, as shown in Figure 1 below.

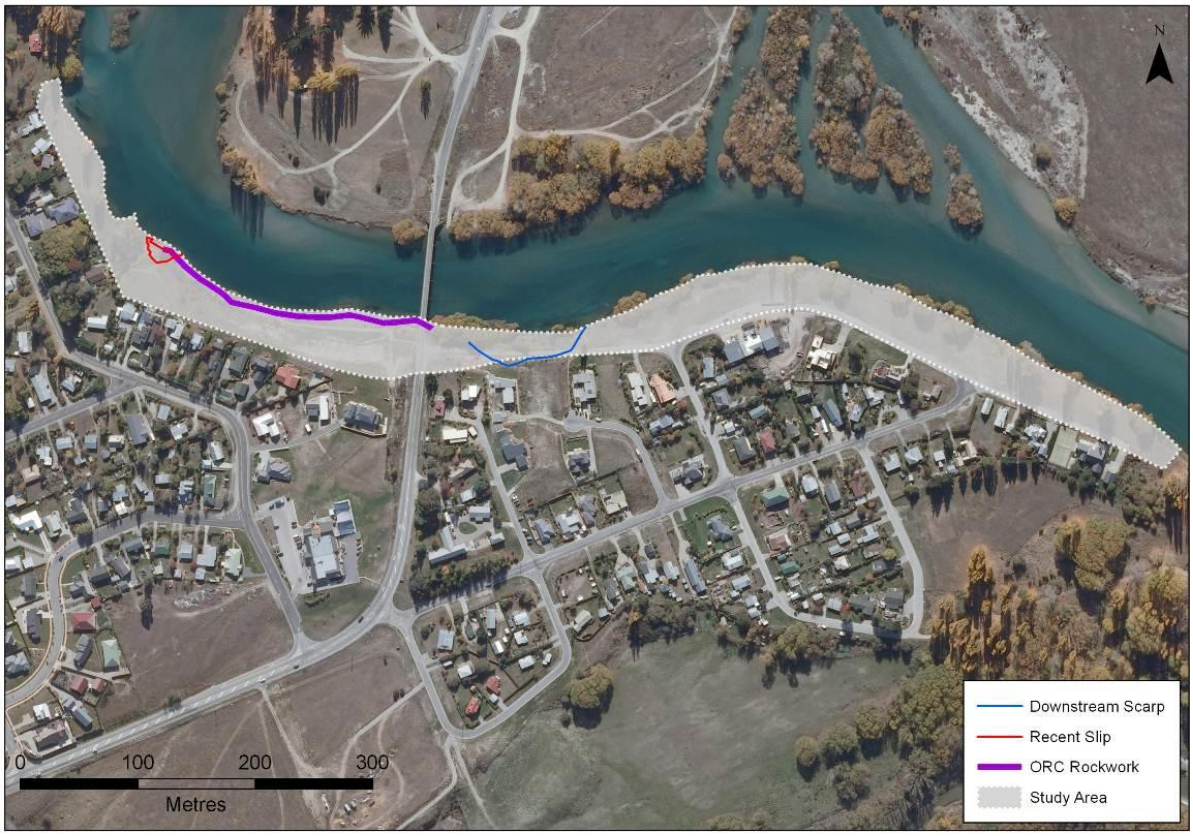

Figure 1: Site Location Plan (courtesy of Otago Regional Council)

The investigation covered the entire study area identified in Figure 1, with specific attention to the two identified instabilities 250 m upstream and 80 m downstream from Albert Town Bridge. The investigated areas can be accessed via a walking track off Albert Town – Lake Hawea Road. The track runs along the stream bank through the affected zones, with several residential lots located above.

3 Geotechnical Appraisal and Conditions

An engineering geological site appraisal has been undertaken. GSL visited the subject property on 3 December 2014 and undertook a detailed geotechnical site inspection. The site inspection was followed up with an intensive review of existing data and reports, including:

- Assessments undertaken by Geoconsulting Ltd for ORC (2014) and QLDC (2013)
- Technical comment from local resident and civil engineer Ben Mitchell (2014) (email correspondence with ORC)
- Albert Town Landslide Flood Level Mitigation Report including Slope Stability Assessment - Opus (2003)
- Bathymetric survey data 2003 – 2014 (TL Survey Services)
- Engineering Geology Project: Landslides Associated with the Hawea Advance Outwash Gravels and the post Albert Town Lake Silts in the Upper Clutha - Andrew Klahn 37687508
- Data, information and analysis held on GeoSolve files

The opinions expressed in this report are based upon ground investigation data obtained at discrete locations and historical information held within the GeoSolve database. The nature and continuity of subsoil conditions away from the investigation locations is inferred and cannot be guaranteed.

Key GeoSolve personnel involved have been:

Graham Salt BSc, BE, ME, PhD, CPeng, InTPE, FIPENZ - Lead Technical Specialist

Graham is a geotechnical Engineer with over 30 years' experience in pavements, engineering geology, geohydrology and geotechnical engineering. His main areas of interest are pavement design and structural evaluations, slope stability including seismic assessment, de-watering, materials, foundations, laboratory and field testing, design/ construction/ quality control of earth and rockfill embankments, reservoir engineering, numerical methods and software development. Much of his work has been in the upper Clutha River area, in association with hydroelectric power proposals. Graham's full CV can be found here: http://www.geosolve.co.nz/images/staff_CVs/CV%20GAS.pdf

Graeme Halliday BSc (Geology and Chemistry) - Senior Engineering Geologist

Graeme has a degree in geology and chemistry from the University of Auckland, and 40 years' experience as an engineering geologist in the lower South Island. He worked on the Manapouri and Clyde Dam projects, including landslide stabilisation work around the Clyde reservoir, one of the largest projects of its type in the world. He subsequently carried out landslide hazard mapping for the Queenstown Lakes District, and worked on many slope stability problems including the major 1999 Frankton Landslide at Queenstown, the 2000 collapse of the Nevis Bluff, and coastal landslide mapping at Moeraki. He has attended a number of international conferences where he presented papers on landslide topics. Following the Christchurch earthquakes, he worked for the Earthquake Commission (EQC) on stability issues in the Port Hills.

3.1 Geological Setting

The Clutha River in the Albert Town urban area is flanked by outwash gravel terraces from the last glaciation (Hawea Advance), which ended about 15,000 years ago. The river subsequently down-cut, entrenching into the outwash gravels and underlying glacial lake silts and Tertiary sediments.

This process resulted in landslides on the riverbanks as the river undercut the weak riverbank sediments (see Figure 2, Appendix A). A number of these landslides are currently active, and move in response to toe erosion during flood events. Others are inferred to be dormant.

The active Cardrona Fault is inferred to trend in schist bedrock beneath Albert Town, but there are no active scarps on the terrace surfaces and the position of the fault is not well constrained. The average return period for earthquakes on the fault is estimated to be 7500 years, so the risk is considered low. The greatest seismic risk is from the Alpine Fault, with a 30% probability of a magnitude 8 earthquake in the next 50 years that would likely generate severe shaking.

3.2 Active Albert Town Landslides

A close geological examination of the right bank of the Clutha River within the study area as defined in the ORC briefing document, has identified only two currently active landslides (Figures 3 and 4, Appendix A). These are termed the Albert Town Upstream and Downstream Landslides.

The rapid landslide that moved in 2003 immediately upstream from the Albert Town Bridge (here termed the Benchmark Slide) has been removed, and the area stabilised by a rock buttress revetment. The protective rockwork appears to have been successful with no signs of further instability visible at this reach.

3.2.1 Albert Town Upstream Landslide

This is a small landslide about 30m wide in a steep terrace face that affects a section of the cycle track along the bank of the Clutha River, about 250m upstream of the Albert Town Bridge (see Appendix A, Fig. 3; and Appendix B, Fig. 5). It has undergone intermittent minor movements in recent years in response to flood events, including the development of a perimeter scarp up to 1.5 m high at the western margin, which produces an abrupt step in the cycle track.

There are several scarps within the landslide which is showing signs of retrogressing back up the slope. The toe is inferred to exit below river level in the deeply eroded thalweg of the river on the outside of the adjacent bend (Appendix B, Fig. 5). The rock revetment along the river bank terminates a few metres onto the landslide, and may be contributing to scouring of the river channel and bank in the landslide toe area immediately upstream owing to possible eddying action (see 3.2.1.1 below.

The landslide is developed largely in laminated lake silts, with outwash gravels lying above an old erosion surface in the upper landslide. A bedding plane-parallel translational sliding mechanism is inferred, due to the presence of weak clayey silt layers along the sub-horizontal bedding. The water table is inferred to generally rise away from the river with moderate gradient.

3.2.1.1 Likely Characteristics of Future Movement

With further flood induced toe erosion, this landslide is likely to continue to undergo minor movement manifested as intermittent creep, and retrogress further up the slope.

It is possible that a major retrogression towards the top of the steep terrace could be triggered by a major flood scour. The loss of support could possibly result in a relatively rapid movement event. However, owing to substantial side friction associated with the narrow width of the landslide, it is considered that velocities would likely be of the order of 1 metre/minute rather than the 1 metre/second inferred for the rapid 2003 event.

3.2.2 Albert Town Downstream Landslide

The feature (located as shown in Appendix A, Figure 4) is a long riverbank landslide that was studied in detail in an April 2009 University of Canterbury project by A. Klahn, guided by current GeoSolve staff. At that stage it was located entirely below the riverbank road, but in recent times it has retrogressed back to the road cut on the uphill side (Appendix B, Fig. 6). The displacements evident

on the road surface are minor, ranging from about 20-150 mm. A small sinkhole about 100 mm diameter is present on one of the scarps.

Toe erosion by the river during flood events is again considered the reason for the movement.

This landslide is developed largely in laminated lake silts, with outwash gravels lying above (Appendix B Fig. 6). A translational mechanism similar to the upstream landslide is inferred. The water table is inferred to rise at a moderate gradient away from the river.

The upper scarp feature at the top of the road-cut near the axis of the slide (see Appendix A, Figure 4) is about 300 mm high, exhibits local tension cracking, and extends about 25 m across the width of the 9 Bridgewater Road property. It cannot be visually traced further upstream or downstream.

The upper scarp exposes silty gravels (inferred to be colluvium), with lake sediment silts visible at one location (see Appendix B, Figure 6) . The face of the cut below the scarp is silty gravel colluvium.

The owner of the property advises that the scarp first formed about 2-3 years ago, but has not noticed significant movement since. Local tension cracking indicates minor current movement.

It is unclear whether the scarp is due to deep seated retrogression of the slide (as shown on the left-most retrogressed failure surface in Appendix B, Figure 6) , or to shallow slumping on the 30 degree cut slope caused by local withdrawal of support at the toe.

3.2.2.1 Likely Characteristics of Future Movement

With continuing toe erosion during floods the landslide is likely to undergo further minor movements. Movement characteristics may depend on the subsurface configuration of the failure surface.

- If the failure surface is shallow, future movement on the 30 degree slope is unlikely to be rapid, and risk to track users and adjacent properties is considered low.
- If the failure surface is deep-seated, future movement rates could be significant because the slide is wide in relation to its length in the direction of movement (minimal lateral restraint or “3D effect”). There are some more favourable aspects, mainly the low average inclination of the landslide and the residual strength condition that is likely to now be developed on most of the potential failure surface (see Appendix B, Fig. 6).

4 Summary

Landslides induced by river erosion at Albert Town have become evident over the last two decades. The hazard arises primarily where saturated fine-grained interglacial lake sediments (rather than outwash gravels) border the river. Field assessment and mapping has been carried out to enable informed evaluation of the potential for rapid mobility and likelihood of damage to properties.

Qualitatively it is considered that the recently activated (or reactivated) landslides do present concerns, but this initial stability assessment suggests that the main issues will be long term stability from incremental retrogressive landsliding rather than immediate hazards, as the likelihood of large scale en-masse rapid movement is relatively low.

5 Conclusions and Recommendations

- The study area exhibits two active landslides, which are discussed in this report. No additional areas of instability have been identified within the study area.
- Beyond the study area, a number of active and inferred dormant landslides are known to exist in the wider Albert Town region (see Appendix A, Figure 2). These have been identified in the course of earlier hydroelectric investigations and are inferred to have similar mechanisms as the two instabilities within the study area.
- The upstream landslide is likely to continue to creep slightly and episodically, and regress up the slope with ongoing flood induced toe erosion. Velocities in case of failure would be expected to be in the order of 1 metre/minute.
- The downstream landslide is likely to experience continuing further minor movements. Even though the landslide may regress a short distance up the road, the risk of a major retrogression into the properties above the cut is considered low due to the relatively moderate slopes. For the same reason, the risk of rapid movement is considered low also.
- Overall, we consider that a significant long-term problem is presented by the two landslides within the study area, owing to on-going river bed degradation and bank undermining causing continued retrogression of the failure zones. However imminent rapid failure of either landslide is unlikely unless triggered by a major flood or earthquake.
- As arranged, GeoSolve will shortly present recommendations for a suitable surveillance program, contingency response measures, and concept mitigation options. Critical short-term arrangements will be in place for the Christmas / New Year holiday period in case of serious developments.
- Irrigation on the upper terrace is not considered to be a significant exacerbating factor, as the surficial outwash gravels are relatively free draining. The dominant failure driver is considered to be loss of toe support owing to river scour, rather than saturation of the terrace soils.
- The passage of pedestrian and cycle traffic onto the marked instabilities (Appendix A, Figures 3 & 4) and on the upper terrace (Figure 3) and elsewhere within the study area is not considered to apply sufficient loadings to be a significant exacerbating factor.
- Under present conditions, in the event of either landslide within the study area mobilising it is likely that ground movement would be sufficiently slow to provide warning and escape time for persons in the unstable areas. However following a major flood or earthquake, the hazard may be elevated with potential for a rapid landslide with little immediate warning.

6 Applicability

This report has been prepared for the benefit of Otago Regional Council with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

Report prepared by:

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Gina Schmitz
Graduate Geotechnical Engineer

Hank Stocker
Senior Engineer

Investigated for GeoSolve Ltd by:

.....

Graeme Halliday
Senior Engineering Geologist

Reviewed and Authorised for GeoSolve Ltd by:

.....

Graham Salt
Technical Director

Appendix A: Site Plans

Clutha River Landslides
Albert Town Region

N

Landslide on left bank

Cardrona Fault
(active, no surface trace)

Albert Town Landslides

Halliday's Bluff Landslide

Downs Landslide

Morris Landslide

Flats Landslide

Recent landslide in river bank

0.5 km 1 km

Legend

- Active Landslide
- Inferred dormant Landslide
- Fault

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Clutha River Landslides Albert Town Region	Figure 2 GSH & GCS Dec 2014

Albert Town Upstream Landslide

GEOSOLVE

Albert Town Upstream Landslide	Figure 3
	GSH & GCS Dec 2014

Legend

- Active Scarp
- Terrace Edge
- Rock Protection

50m 100m

Albert Town Downstream Landslide

Legend

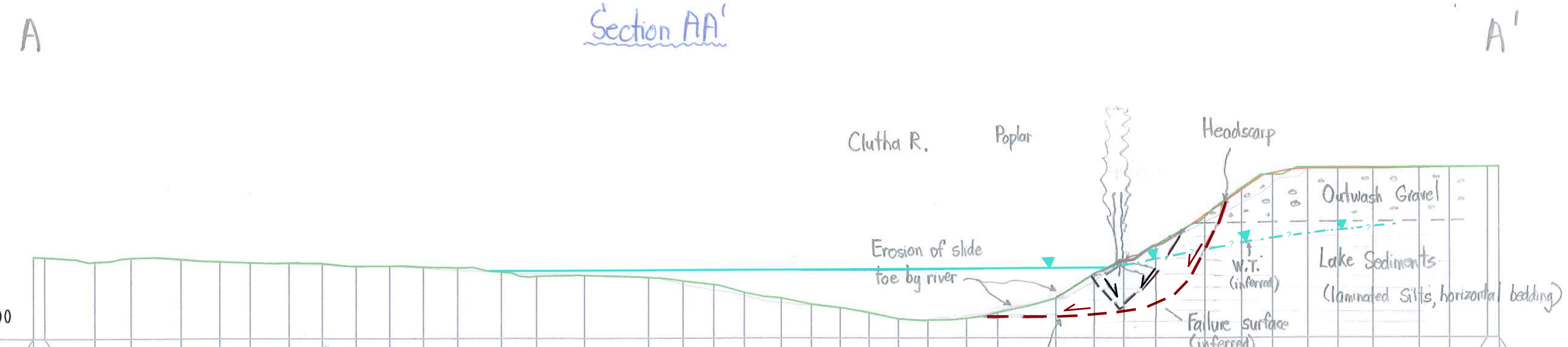
- Active Scarp
- Terrace Edge
- Shallow Drain

GeoSolve

Albert Town Downstream Landslide	Figure 4
	GSH & GCS Dec 2014

Appendix B: Cross Sections

Section AA'



Datum: 365.000

OFFSETS	EXISTING SURFACE	2004 SURFACE	DIFFERENCE
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-175.70	376.30		
-168.70	375.68		
-163.67	376.20		
-156.75	376.03		
-151.39	375.68		
-147.15	375.54		
-141.75	375.51		
-137.13	375.42		
-132.40	375.03		
-127.73	375.05		
-123.07	374.91		
-118.29	374.80		
-112.23	374.24		
-107.30	373.63		
-100.64	373.72		
-91.69	373.44		
-86.91	372.92		
-82.69	372.43		
-78.41	371.32		
-73.27	370.54		
-69.08	369.69		
-65.05	369.20		
-61.03	368.54		
-56.97	367.64		
-52.82	367.45		
-47.47	367.69		
-43.15	368.50		
-35.09	370.53		
-29.72	373.91	373.93	-0.01
-25.58	375.74	375.85	-0.11
-21.09	377.90	377.82	0.08
-14.24	381.77	382.05	-0.28
-9.18	385.77	385.50	0.26
-4.90	387.59	387.80	-0.21
0.00	388.58	388.44	0.14
4.19	388.61	388.45	0.16
9.08	388.59	388.45	0.14
15.53	388.60	388.54	0.06
19.75	388.61	388.61	0.00
25.08	388.63		
26.68	388.67		

CH: 90.000

Horizontal/ Vertical Scale:
1 : 1000 (A4)

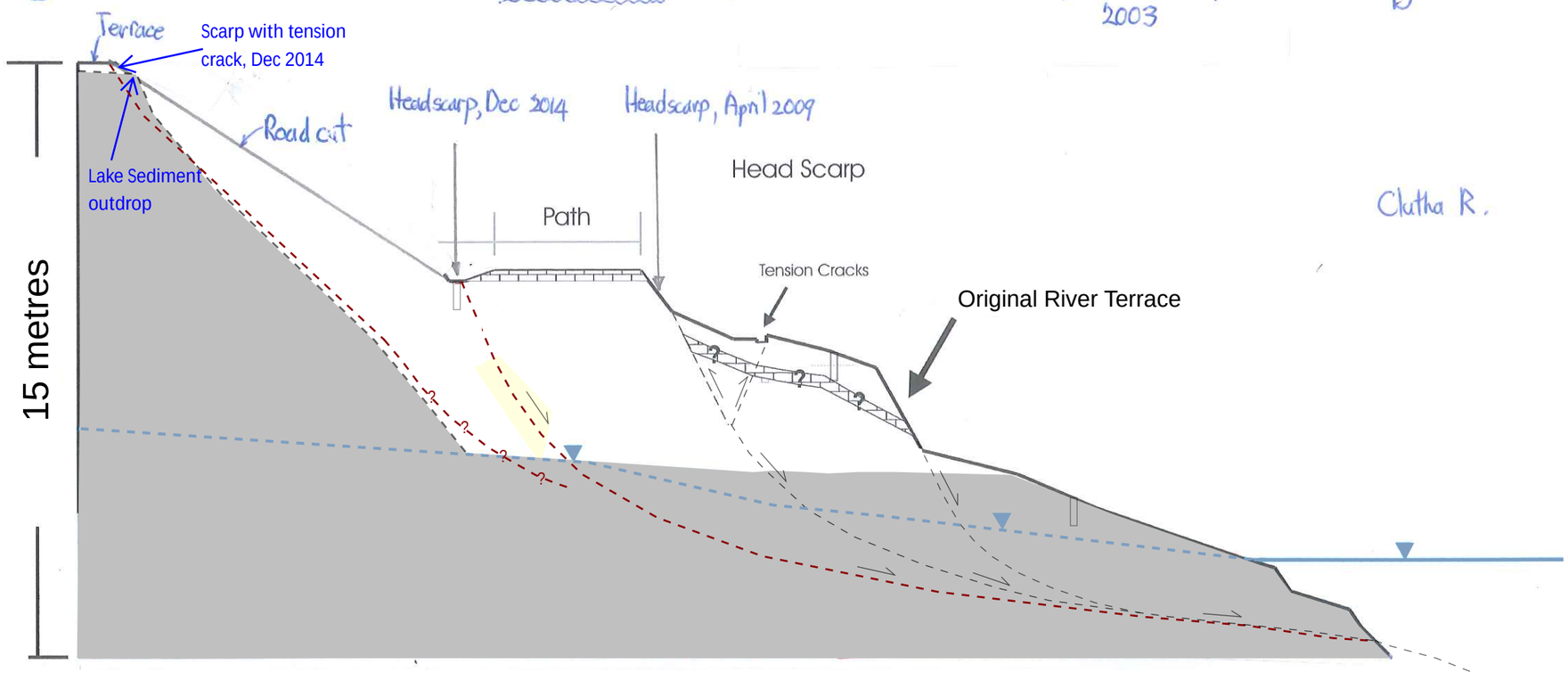
GeoSolve

Albert Town Upstream Landslide Cross Section A - A'	Figure 5
	GSH and GCS Dec 2014

B

Section BB' (Modified from A. Khan, U.C. thesis) 2003

B'



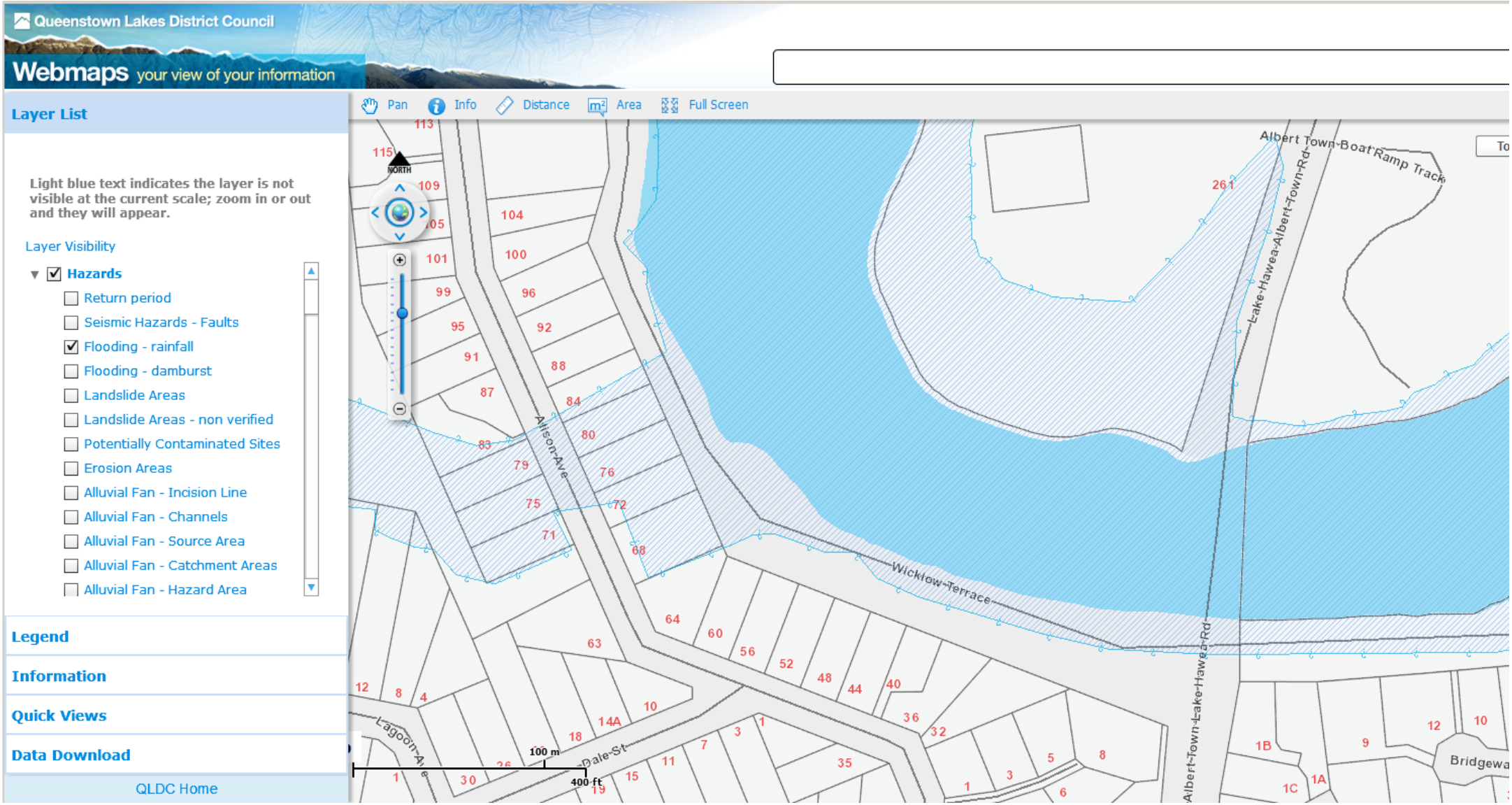
Legend

- Lake Silts
- Pavement
- Colluvium
- Retrogressed Failure Surface
- Water Table
- Inferred Water Table
- Possible Failure Surface

GeoSolve

Albert Town Downstream Landslide Cross Section B - B'	Figure 6
	GSH and GCS Dec 2014

Appendix C


Queenstown Lakes District Council
Webmaps your view of your information
Layer List
Light blue text indicates the layer is not visible at the current scale; zoom in or out and they will appear.
Layer Visibility
Hazards
Return period
Seismic Hazards - Faults
Flooding - rainfall
Flooding - damburst
Landslide Areas
Landslide Areas - non verified
Potentially Contaminated Sites
Erosion Areas
Alluvial Fan - Incision Line
Alluvial Fan - Channels
Alluvial Fan - Source Area
Alluvial Fan - Catchment Areas
Alluvial Fan - Hazard Area
Legend
Information
Quick Views
Data Download
QLDC Home
Pan
Info
Distance
Area
Full Screen
NORTH
Albert Town-Boat Ramp Track
Lake Hawea-Albert Town Rd
Wicklow Terrace
Albert Town-Lake Hawea Rd
Allen Ave
Dale St
Lagoon Ave
100 m
400 ft