

**BEFORE THE HEARINGS PANEL
FOR THE QUEENSTOWN LAKES PROPOSED DISTRICT PLAN**

IN THE MATTER of the Resource
Management Act 1991

AND

IN THE MATTER of Hearing Stream 13
– Queenstown Mapping
Annotations and
Rezoning Requests

**REBUTTAL EVIDENCE OF CHARLIE WATTS
ON BEHALF OF QUEENSTOWN LAKES DISTRICT COUNCIL**

GEOTECHNICAL ENGINEERING

11 July 2017

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Appendix 1 – Other relevant expertise

1. INTRODUCTION

1.1 My full name is Charlie Robert Watts. I have a Bachelor of Science Degree (University of Otago, Geology, 1985) and a Master of Science Degree (University of Canterbury, Engineering Geology Hons, 1988. I have been employed as an Engineering Geologist at Jacobs since 2013.

1.2 I am a Chartered Geologist and Chartered Engineer (Institute of Materials Minerals and Mining). I am a member of the following:

- (a) Fellow of Geological Society;
- (b) Member of NZ Geotechnical Society; and
- (c) Member of International Association of Engineering Geologists.

1.3 My current role entails working full time on the two following projects:

- (a) **NCTIR (North Canterbury Transport Infrastructure Rebuild), 2016 Nov to Present:** Principle Engineering Geologist for three large rockfall landslides north of Kaikoura that occurred during the 14 November Earthquakes. My role includes developing remedial measures to allow the State Highway 1 and the main truck railway line to reopen; and
- (b) **Sumner-Lyttelton Corridor – Sumner Rd 3B Preliminary Design, 2015 October to present:** The Golders/Jacobs Team was appointed by CCC/NZTA to complete the Preliminary Design and act as Principle Advisor during the Design and Construct tender and construction for the remedial works above Sumner Road. I currently hold the design manager's role as the Principles Advisor for the Rockfall Mitigation project.

1.4 A description of other relevant experience is set out in **Appendix 1:**

1.5 I confirm that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2014 and that I agree to comply with it. I confirm that I have considered all the material facts that I am aware of that might alter or detract from the opinions that I express, and that this evidence is within my area of

expertise except where I state that I am relying on the evidence of another person.

2. SCOPE

2.1 I did not provide evidence in chief for this hearing. I have been engaged by the Queenstown Lakes District Council (**Council**) to respond to submitter evidence filed on specific geotechnical issues, in relation to Hearing stream 13 of the Proposed District Plan (**PDP**).

2.2 My evidence is provided in response to the evidence of:

- (a) Jeff Bryant for Kerr Ritchie Architects (**48**);
- (b) Sean Dent, Appendix B (Geosolve Report) for Mount Crystal Limited (**150**);
- (c) Lucy Millton, Attachments D and E (Canterprise Report and Tonkin & Taylor Review) for B Grant (**318, 434**);
- (d) Paul Faulkner for Middleton Family Trust (**336**);
- (e) Paul Faulkner for Lake Wakatipu Station Limited (**478**);
- (f) Scott Edgar, Attachment (Geoconsulting Report) for LINZ (**661**);
- (g) Peter Nicolson for Gertrude's Saddlery Limited (**494**) and Larchmont Developments Limited (**527** and **1281**);
- (h) Robert Bond for Queenstown Park Limited (**806**) and Remarkables Park Limited (**807**);
- (i) Paul Faulkner for Queenstown Park Limited (**806**) and Remarkables Park Limited (**807**); and
- (j) David Rider for Jardine Family Trust, Remarkables Station Ltd and Homestead Bay Trustees Ltd (**715**).

3. JEFF BRYANT FOR KERR RITCHIE ARCHITECTS (48)

3.1 Jeff Bryant has filed geotechnical evidence on behalf of Kerr Ritchie Architects, in relation to an area of 10,524m² at 48 and 50 Peninsula Road, Kelvin Heights. The site is zoned Rural in the PDP and the submitter seeks that it be rezoned Low Density Residential.

3.2 Page 2 of the report attached to Mr Bryant's evidence refers to the presence of a large landslide which is described as "underlying the site". A further statement is that "there is no threat to any development", because the landslide is now considered dormant with

no signs of recent or historical activity. The report goes on to state that as "A rock fall source area ... is present above the property there is still a potential for rock falls". The report also states "A true understanding of rock fall threat is difficult to assess with any certainty although further study would help reduce this" and "it may be necessary to consider some form of rockfall barrier to protect and dwellings".

3.3 As the development is sited on an existing dormant landslide, I would recommend that further investigations are required to refine the geological model for the landslide and if the landslide could be reactivated during seismic (Serviceability Limited State (**SLS**) and Ultimate Limited State (**ULS**)) or static conditions before development is approved on the site.

3.4 Based on Mr Bryant's report, there appears to be uncertainty as to the magnitude of the rockfall risk on the site, and I recommend that this risk is assessed and quantified further before a decision on the suitability of this development on the site can be made.

4. GEOSOLVE REPORT ATTACHED TO EVIDENCE OF SEAN DENT FOR MOUNT CRYSTAL LIMITED (150)

4.1 Sean Dent has attached a report by GeoSolve Ltd dated August 2016 as Appendix B to his planning evidence on behalf of Mount Crystal Limited. I understand this is a rezoning from a Low Density Residential to Medium or High Density Residential zone. I also understand that there are hazards identified on the Council's Hazards maps.

4.2 The Geosolve (2016) assessment notes that the steeply sloping central and upper areas of the site in close proximity to the gully will be technically difficult to develop and high development costs may be incurred, and that the north eastern, western and southern areas of the site are expected to be more favourable for development. The report then states that further investigation will be required at design stage and mitigation measures are likely to be necessary.

4.3 Sections 3.2.3 (P.3) and the Conclusions & Recommendations (P.4) make what I consider to be reasonable points about geotechnical

risks that should be considered as part of any design process for future development on this site. These risks include, but are not limited to:

- (a) Static and seismic stability of gully slopes;
- (b) Building setbacks to provide adequate factors of safety against slope failure;
- (c) Specific foundation designs to take into account bearing capacities and slope issues;
- (d) Scour protection on gully sides;
- (e) Unfavourable orientation of schist foliation on the eastern slope; and
- (f) Areas of uncontrolled fill.

4.4 Overall, based on the Geosolve Report, I consider that the land is suitable for development of a medium or high density residential zone as long as the above risks are considered during the development, and I recommend the Proposed District Plan require this at the consenting stage.

5. CANTERPRISE REPORT AND TONKIN & TAYLOR GEOTECHNICAL REVIEW ATTACHED TO EVIDENCE OF LUCY MILLTON FOR B GRANT (318, 434)

5.1 Lucy Millton has attached a report by Canterprise dated 19 August 1997 and a geotechnical review by Tonkin & Taylor dated March 1998 as Attachments D and E to her planning evidence on behalf of B Grant, in relation to an area of 5516m² on Frankton Road near Marina Drive. The submitter seeks that the Rural Zone be changed to Low Density Residential (and included within the Urban Growth Boundary).

5.2 I note that the Canterprise report refers to trench logs which have not been provided with the Millton evidence. I note the following observations relating to the site, which are stated in the report:

- (a) Schist bedrock was encountered in 8 of the 12 test pits at 0.2m to 1.2m;
- (b) Glacial till is exposed on the upper slopes and is greater than 2m thick;

- (c) In the central part of the property the till is approximately 1m thick;
- (d) Active landslide has been mapped along the eastern boundary of the site
- (e) Retaining wall construction is stated as "necessary";
- (f) Section 3A states there are "no significant geotechnical constraints to the proposed roading layout";
- (g) No groundwater seepage was identified on the property;
- (h) Groundwater was encountered in test pits 11 and 12 adjacent to the landslide;
- (i) Sec 3B states "apart from normal engineering prudence in the provision of stormwater and seepage control, I don't consider there are any other groundwater issues affecting the development;"
- (j) Sec 3C states "beach or till materials have adequate bearing capacity";
- (k) Sec 3D states in relation to slope stability : "Lots 8 & 9 have had material deposited on them from the large landslide to the NE." "Any excavation into the landslide toe on Lot 9 should be retained in order to maintain the existing marginal stability;" and
- (l) Sec 4C and 4D also identifies a rockfall hazard for Lots 8 and 9.

5.3 The above comment (in paragraph 5.2(k)) about retaining any excavation on Lot 9 is in my view significant. Excavating at the toe of a landslide is one of the principal methods of reducing landslide stability.

5.4 In Section 4, "Falling debris and slippage" are noted as the main geotechnical constraints. These relate specifically to the active landslide mass to the north east (affecting Lots 8, 9 and 10). I would recommend that further investigation is completed to determine the risk of movement of the active landslide during seismic (SLS and ULS) or static conditions before development is approved on the site. During this investigation the rockfall risk to the development should be assessed.

5.5 Overall, based on the Canterprise Report, I do not consider that Lots 8, 9 and 10 are suitable for development of a low density residential zone, based on the information included within the Canterprise Report and the Tonkin & Taylor review.

6. PAUL FAULKNER FOR MIDDLETON FAMILY TRUST (336)

6.1 Paul Faulkner has filed geotechnical evidence on behalf of the Middleton Family Trust, in relation to an area of 38.6 ha at Lot 2 DP409336, Middleton Road. The site is zoned Low Density Residential with Queenstown Heights Overlay in the PDP. The submitter seeks that the 'Queenstown Heights' Overlay be removed. I understand that the overlay requires 1500 m² min lot size due to natural hazards on the site.

6.2 In Mr Faulkner's evidence, three reports are referred to:

- (a) T&T report 880044;
- (b) T&T report 880044.300; and
- (c) Geosolve Report 150639.

6.3 These reports refer to the close proximity of the Queenstown Hill Landslide to the Remarkables View subdivision, which is adjoining land to the east and is not part of the submitter's site. Mr Faulkner states that the findings of these reports are not representative of the entire landslide hazard.

6.4 The submitter has therefore not provided a geotechnical investigation or evidence that addresses natural hazards within the site subject to the submission.

6.5 As the reports referred to in Mr Faulkner's evidence do not provide any information relating to the land in question, I do not consider they provide relevant information, and I consider the submitter needs to provide the equivalent type of information for the site itself to support the rezoning to low density residential development in this area.

7. PAUL FAULKNER FOR LAKE WAKATIPU STATION LIMITED (478)

- 7.1 Paul Faulkner has filed geotechnical evidence on behalf of Lake Wakatipu Station Limited, in relation to an area of 14,305 ha at Halfway Bay. The site is zoned Rural in the PDP and the submitter seeks that it be rezoned Rural Visitor, which I understand would provide for primarily residential and visitor accommodation.
- 7.2 We note natural hazards identified on the site by Mr Faulkner are as follows:
- (a) Alluvial fan;
 - (b) Liquefaction;
 - (c) Flooding; and
 - (d) Stream Avulsion.
- 7.3 Mr Faulkner also states "*it is feasible that development could occur subject to appropriate engineering assessment and mitigation.*" Mr Faulkner also mentions the strong ground shaking hazard from the Alpine fault.
- 7.4 For '**Zone A**' the following is stated, "*there is a reduced liquefaction risk due to this area being elevated ... Localised set-backs are needed from the terrace slope on northern side of Zone A .*"
- 7.5 For '**Zone B**' the following is stated, "*Liquefaction risk exists and potential flooding... Liquefaction is manageable. To manage flooding risks, detailed assessments will be needed. A preliminary assessment indicates areas close to the terrace slope toe on the south-west side of Zone B are likely to be suitable for development*".
- 7.6 The risks highlighted by Mr Faulkner are in my view conventional geotechnical risks encountered in alluvial areas. In my opinion, the comments regarding development being possible subject to appropriate engineering assessment and design are reasonable, and I would recommend the Proposed District Plan requires such assessments at the consenting stage.

8. SCOTT EDGAR, ATTACHMENT (GEOCONSULTING REPORT) FOR LINZ (661)

8.1 LINZ has sought the rezoning of land at Peninsula Road from Rural to Low Density Residential. Provided with the planning evidence of Scott Edgar is a report by Geoconsulting, authored by Jeff Bryant.

8.2 The Geoconsulting report identifies the following natural hazards on the site:

- (a) two landslide hazards, the first a large inactive landslide and the second the potential instability of glacial and post glacial material on the lower slopes;
- (b) rockfall hazard from the schist outcrops above Peninsula Road with particular emphasis on the eastern end of the development;
- (c) debris flow hazard that is present in the central gully between the two blocks of low density housing; and
- (d) liquefaction hazard which Mr Bryant concludes "is not considered to be an issue affecting the site."

8.3 The Geoconsulting report recommends more detailed study on the rockfall and debris flow hazards, to determine if the risks are of an acceptable level or whether some mitigation measure is necessary.

8.4 I would recommend that the above more detailed study proposed by the Geoconsulting report also includes further investigation to refine the geological model for the landslide hazard on site. This investigation should also consider if the landslide could be reactivated during seismic (SLS and ULS) or static conditions before development is approved on the site.

8.5 The information included in the Geoconsulting report does not contain sufficient information on the natural hazards of the site to demonstrate it is suitable for low density residential development. Set out in paragraphs 8.3 and 8.4 is the additional work I suggest is required.

9. PETER NICOLSON FOR GERTRUDE'S SADDLERY LIMITED (494) AND LARCHMONT DEVELOPMENTS LIMITED (527 AND 1281)

9.1 Peter Nicolson has filed geotechnical evidence on behalf of Gertrude's Saddlery Limited and Larchmont Developments Limited, in relation to an area of 6.6353 ha at 111 Atley Road, Arthurs Point. The site is zoned part Rural and part Low Density Residential. The submitter seeks that the part zoned Rural be rezoned for residential purposes (i.e., to Low Density Residential and be included within the Urban Growth Boundary).

9.2 Mr Nicolson's report makes the following pertinent points:

- (a) The site is expected to comprise schist bedrock with overlying terrace alluvium &/or glacial deposits, overlain by loess & thin colluvium;
- (b) A severe seismic risk exists over the Wakatipu region as a whole. Slope stability hazards are confined to areas close to the southern boundary where schist bluffs have formed;
- (c) There is nil to low risk liquefaction risk for the northern part of the site. There is nil to low risk liquefaction risk for the southern part of the site. The only impediment to development might be localised surficial instability related to bluffs; and
- (d) The site overall is considered suitable for low density residential use, subject to standard site-specific engineering solutions applicable at the detailed design phase of future development and construction.

9.3 I have not carried out my own site walkover or desk study of this site. However, having reviewed Mr Nicolson's evidence, it appears reasonable and has raised the following key issues which should be examined and assessed during any detail design process:

- (a) consideration of severe seismic risks when designing foundations and retaining walls in particular;
- (b) site-specific geotechnical investigation to confirm the shallow ground conditions for foundations design;
- (c) development close to steep slopes;

- (d) site-specific geotechnical investigation be made during rock excavation to identify any potential stability issues; and
- (e) consideration and an allowance of perched groundwater and appropriate drainage in building platforms.

9.4 I would recommend any low density residential zoning ensures that there is an ability to consider these issues at subdivision or development stage. In my view, that reporting should discuss the level of risk posed by, and the need or otherwise for, mitigation relating to these hazards.

10. QUEENSTOWN PARK LIMITED (806) AND REMARKABLES PARK LIMITED (807)

ROBERT BOND

10.1 Robert Bond has filed geotechnical evidence on behalf of Queenstown Park Limited (806) and Remarkables Park Limited, in relation to an area of 2000 ha at Queenstown Station (formerly Cone Peak Station). His evidence focuses in particular on proposed pods for residential development in Rural Residential Activity Areas, and commercial, community, residential or visitor accommodation in the Rural Visitor Activity Areas proposed by this submitter.

10.2 Mr Bond's report states the following concerning various natural hazards:

- (a) rock fall is a risk "*across the entire site, various erosional rock fall sites were identified.*" The rock fall hazard rating varies from none or very low to high. Four key areas of deep seated large landslides were noted to affect the site. Where steep slopes were identified, with heights over 4m, a shallow landslide or slope hazard was identified;
- (b) the potential for liquefaction to occur on the site has been assessed as Low to Medium; and
- (c) in localised areas, soft ground associated with high groundwater tables has been identified.

10.3 At 2,000ha, the site in question is significant in area, with various geotechnical hazards present in specific zones across the site. For this reason it is not possible to be prescriptive about engineering measures to mitigate these risks across the whole site. I recommend that as development is considered in the specific pods addressed by Mr Bond, as a minimum, the following geotechnical risks (discussed in the submissions) be considered:

- (a) liquefaction, soft ground, slope stability, rockfall, shallow bearing capacity and settlement issues for all structures that may be sensitive to ongoing movements; and
- (b) in order to assess these risks, further localised site investigation and evaluation will be required.

10.4 I would recommend the Proposed District Plan zone requires this. Overall, based on Mr Bond's evidence, I am satisfied that the specific pods of land could be rezoned as suggested.

PAUL FAULKNER

10.5 Paul Faulkner has also filed geotechnical evidence in relation to Queenstown Station. His evidence focuses on a proposed gondola through the Station.

10.6 Mr Faulkner has provided a summary of the natural hazards that include; landslides, rockfall, debris flows, liquefaction and lateral spreading, alluvial fan risk, flooding and avalanches. Mr Faulkner notes that the *"hazards in the corridor are expected to be manageable over the lifetime of the structure provided the detailed design phase addresses local conditions along the route."*

10.7 Mr Faulkner states that *"In high mountain terrain full avoidance of all hazards is not technically feasible however, I consider the corridor route to be in the lowest risk areas, given the other non-geotechnical constraints on the route."*

10.8 At this stage only a preliminary risk assessment has been completed. The assessment records that *"The risk of intolerable negative impact on the gondola from natural hazards is considered to be low based on a qualitative assessment. Provided appropriate design is completed"*

for future consent stages, ensuring risk is at an acceptable and tolerable level, is considered to be achievable."

10.9 The evidence also outlines that "*Further assessment will be required for future consenting stages of a gondola development within the proposed corridor. This work should be completed for resource and/or building consent as appropriate.*"

10.10 Mr Faulkner's evidence acknowledges the multiple natural hazards. I agree with Mr Faulkner that his evidence is only a preliminary risk assessment, and I strongly agree that there will be a need for further investigations and assessment to "*ensuring risk is at an acceptable and tolerable level*".

10.11 I recommend the PDP require these further assessments (discussed in the submission) to be undertaken, prior to issuing of any consent.

11. DAVID RIDER FOR JARDINE FAMILY TRUST, REMARKABLES STATION LTD AND HOMESTEAD BAY TRUSTEES LTD (715)

11.1 David Rider has filed geotechnical evidence on behalf of Jardine Family Trust, Remarkables Station Ltd and Homestead Bay Trustees Ltd (715), in relation to an area of 162.46 ha at Homestead Bay. The submitter seeks to rezone Rural land to Jacks Point Zone.

11.2 In his evidence Mr Rider has identified the following hazards relating to the site:

- (a) liquefaction; and
- (b) alluvial fan which include flooding and flow of "debris".

11.3 Mr Rider also states his opinion as follows:

Provided the QLDC assess these hazards in accordance with their Code of Practice for Subdivision and Land development and NZS4404:2010 then adequate mechanisms are in place for these hazards to be mitigated.

11.4 Overall, I consider Mr Rider's statements to be reasonable and I have no significant comments other than to advise that the current level of

reporting presented provides only an overview of the geotechnical risks that exist on the site. Targeted, site specific investigation and specific engineering design should be carried out to assess whether mitigation is needed for the risks listed at specific construction sites within the wider area, and I recommend this is a requirement in the PDP under any new urban zone.



Charlie Watts

11 July 2017

APPENDIX 1
OTHER RELEVANT EXPERTISE

1. **Sumner-Lyttelton Corridor – Deans Head Landslide Peer Review, 2015 October to 2016:** I completed the peer review of the design of the Deans Head Slope Remediation. My review resulted in an evaluation of another Option "Removal of the Landslide Material", which became the preferred Option.
2. **Whitewash Head Road Retaining Wall, Christchurch:** A retaining wall on Whitewash Head Road collapsed during a heavy rainfall event impacting the stability of Whitewash Head Road, which provided access to approximately 10 houses. I was the team lead for the investigation and design and also completed some of the construction supervision.
3. **Sumner-Lyttelton Corridor – Wakefield Ave Detailed Design, 2015 August to 2016:** Jacobs were awarded the detailed design of rockfall remediation along Wakefield Avenue in Sumner. I was the team lead for the detailed design of the rockfall remediation along Wakefield Avenue.
4. **Mass Movement – Technical Advisor, Senior Geotechnical Engineer / Engineering Geologist, Sept 2014 to 2016:** Advising the Council on technical matters associated with the five Class 1 Mass Movement features on the Port Hills. Review concept and detailed design for proposed remedial measures for the mass movement features. Providing CCC contemporary relevant advice on Port Hill geotechnical issues.
5. **Slope Stability Evaluation Panel (SSEP), Senior Engineering Geologist, Feb 2011 to present:** Following the 2011 Canterbury earthquakes, I was seconded to this group working in Sectors One and Four assessing rockfall hazards and developing remedial measures. Established and standardised procedures to allow contractors to stabilise rockfall hazards in the field with the appropriate design and factor of safety. Recently been involved on Gondola Bluffs East assessment and design where high risk areas will be treated with drill and blast remediation. Our team was on call during March 2014 and Easter 2014 rain event callouts, where the team assessed life and safety associated with slope stability issues during these rain events. Several these call outs were in the Lyttelton Basin providing valuable insight in to the types of failures on the Port Hills associated with heavy rain events. Involved in the development and design for remedial measures for Car Crash Corner and a rebuild of a retaining wall on Whitewash Head.

6. **Lei Pui Street Natural Terrain Hazard Investigation, Hong Kong, 2003 to 2004.** Senior Geotechnical Engineer and Team Leader for the study included aerial photo interpretation, engineering geological mapping and hazard assessment. Make presentations to client and write up engineering geological aspects of project. Responsible for technical aspects of project and three field mapping teams.
7. **Landslip Preventive Measures Programme, Hong Kong 2003 to 2004**
Senior Geotechnical Engineer providing input in to various investigations and design of Landslip Preventive Measures in Hong Kong, which involved both soil and rock slopes. Remediation measures included debris flow barriers, retaining walls and rockbolt and mesh solutions.
8. **MELEN Project, Turkey, 2002.** Senior Geotechnical Engineer working for the Engineer responsible for all geotechnical aspects of the job. The MELEN JV includes 160km of pipeline and platform, five tunnels, water treatment plant and pumping stations (capital cost US \$600 million), the work was divided into eleven contract packages. Responsible for a team of two senior geological engineers working for the JV. The team was requested by the JV to solve any geotechnical issues related to the civil engineering works. Responsibilities included:
 - 8.1 The overall co-ordination of slope design of the pipeline platform
 - 8.2 Designed slopes for 160km of platform and remedial works for one tunnel portal failure
 - 8.3 Completed investigations, design and remedial works on 13 landslides on the platform alignment and two landslides within the pumping station excavation.
9. **Roxburgh Gorge Landslides Study, New Zealand 1996. Client Contact Energy & ECNZ:** Identification and hazard assessment of Roxburgh Gorge Landslides. A total of 34 landslides were identified, with 23 classified as major and 11 minor. Study involved aerial photography interpretation, reconnaissance mapping, general stability and hazard assessment and recommendations for long term Roxburgh Dam safety.
10. **Clyde Power Project, New Zealand 1989 to 1995. Client Contact Energy & ECNZ:** Providing geotechnical input in all aspects of investigations, construction, reporting and monitoring of the NZ \$350 million landslide stabilisation programme. Reporting engineering geologist for the Cairnmuir Landslide Remedial Works, which involved drainage drives (3m diameter drill and blast) and drilling, and extensive surface works. Assist with the development and design of remedial measures and control and management

of May and September movement incidents. Other responsibilities included cored and percussion drilling design and supervision, drill core, tunnel, shaft, trench and surface works logging and interpretation. Engineering Geologist for Jacksons Creek and Dunlays Orchard Landslides involving investigations and construction of remedial works options. Responsibilities included: design of investigations and instrumentation; development and review of geological and groundwater model; drainage drilling design and supervision; report preparation; drill core, drainage drives, shaft, test pit logging and interpretation. Reporting engineering geologist for Jacksons Creek Slide during lake filling.