Before Queenstown Lakes District Council

In the matter of	The Resource Management Act 1991
And	The Queenstown Lakes District Proposed District Plan Topic 13 Queenstown Mapping – Group 1B (Queenstown Urban (Frankton and South))

SUMMARY STATEMENT OF EVIDENCE OF JEFF BRYANT FOR

LINZ Submitter # 661

Dated 21 August 2017

QUALIFICATIONS AND EXPERIENCE

1. My full name is Jeffrey (Jeff) Martin Bryant. I am an engineering geologist with over 42 years' experience and hold the qualifications BSc (geology) from Victoria University and MSc (engineering geology) from Canterbury University.

2. I am a Fellow of the Geological Society (London) and by validation am entitled to the designation Chartered Geologist. I am also a member of the New Zealand Geotechnical Society and am affiliated through them to the International Association of Engineering Geologists.

3. My present employment is as principal, Geoconsulting Ltd, a geotechnical consulting business I set up in 1994. My business operates out of Queenstown.

4. Since 1983 I have had extensive experience throughout the Central Otago and Southern Lakes regions advising on roading projects, irrigation schemes, power schemes, building developments, subdivisional developments and other infrastructure projects.

5. Of particular relevance is my involvement with the new Kawarau Falls Bridge and associated southern approaches, hazard assessment and hearing evidence for two properties directly opposite on the south side of Peninsula Road (Pt Lot 3 DP 27200 and Lot 2 DP 390970).

6. In addition to providing geotechnical advice to civil engineering projects, I have often been called upon to provide advice on natural hazards affecting roads, walkways and river users on behalf of local and regional councils, DoC, Trails Trusts and land owners.

7. I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2014. This evidence has been prepared in accordance with it and I agree to comply with it. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

1 SCOPE OF EVIDENCE

8. I have been asked by the Submitter to prepare evidence in relation to a hazard assessment of the subject land. This includes:

    a. Assessment of hazards identified on QLDC hazards register;

    b. Assessment of additional hazards,

    c. Suitability of land for development.

9. My evidence is based on the following sources of information:

    a. Walkover survey of this property, land near the crest of Peninsula Hill, the land to the north fronting SH 6, and the land on the south side of Peninsula Road.

    b. Examination of aerial photographs (including stereoscopic pairs) and satellite images.

    c. Review of previous Geoconsulting reports on properties to the south and west.

GEOMORPHOLOGY AND GEOLOGY

10. The subject area lies on a degraded terrace remnant on the footslopes of Peninsula Hill (818 m). A central gully divides the subdivision (falling between Lots 8 & 9) with a second drainage line passing through the eastern part (Lots 1-3) with little surface expression. Only ephemeral flows are expected in these courses.

11. Schist bedrock underlies the hillside but the only outcrops in the subdivision are on the north side of Lots 5 & 6. Elsewhere, rock is exposed near the crest of the hill, intermittently along the south side of Peninsula Road and either side of SH 6 below Lots 11-14. Rock is suspected of underlying the eastern part of the subdivision at shallow depths and possibly the western part as well.

12. A large and very old landslide extends from just below the eastern peak of Peninsula Hill to more or less the level of Peninsula Road in the vicinity of the western part of the subdivision but to lower levels further round to the east. The downslope extent is difficult to determine as the lower slopes are blanketed by colluvium.

13. Colluvium is derived from erosion of the loose landslide debris to the east and rock cliffs to the west. The sand and gravel material is transported downslope initially by gravity and remobilised by rainfall runoff to be deposited on the lower, flatter slopes. Exposures of colluvium immediately above and below the road clearly show water-laid deposits. Loess, a wind deposited silty fine sand, caps the colluvial deposits on lower slopes.

14. Road widening associated with the new bridge's southern approaches have exposed a suite of glacial and post-glacial sediments (till, lake sediments, deltaic sediments). It is likely that some of these sediments extend back upslope and underlay colluvium in the vicinity of the proposed subdivision.

QLDC WEBMAP HAZARDS REGISTER

15. The QLDC Hazards Register identifies broad categories of hazards based on some interpretation and generalisations centred round a knowledge of the underlying material type. The proposed subdivision occupies a transition area between several known hazards whose boundaries have not been clearly defined. The hazards recognised as affecting this area are:

    - Landslide area – Active schist debris landslide (upslope of Lots 12-19).
    - Landslide area - Non verified (Lots 1 – 8).
    - Landslide area – Areas of fine grained soils susceptible to sliding (part or all of Lots 9 – 19).
    - Landslide area – Areas susceptible to falls (upslope of Lots 12 – 19).
    - Liquefaction risk – LIC1 or LIC1(P).
    - Debris flow hazard (between Lots 8 & 9).

LANDSLIDE HAZARD ASSESSMENT

16. The large landslide identified on the webmap and confirmed by mapping is comparable to many others around Central Otago – Lakes District. The bulk of the landslide appears to terminate above the road, however, later depositions of colluvium have mostly obscured the toe. Some large blocks have attained greater mobility and moved further downslope of the toe. Field work found no evidence for activity and the adjacent property (48 Peninsula Road) has not been subject to disturbance since its occupation (1970's). I have concluded the landslide is dormant; i.e not currently active and unlikely to have been active in historical times.

17. Mr Charlie Watts, acting on behalf of QLDC, has recommended further investigations and stability analyses to inform the planning approval process. Since my earlier report, the toe of the landslide has been defined more clearly and it no longer appears to extend down into the area of interest. Accordingly, I don't believe further investigations into landslide stability would be either necessary or meaningful.

18. For the landslide to be a threat, it would have to move some 25 m across Peninsula Road to reach the property boundary and about another 15-20 m to reach the lots' boundary. Such mobility does not seem plausible given that very old, pre-existing landslides are considered to be resilient to all but major

earthquakes. There would have been a number of seismic events in the many millennia since emplacement and yet no evidence exists for disruption of the glacial or post-glacial sediments on the lower slopes. My opinion is that, during severe earthquake shaking, the threat from landslide reactivation is likely to be non-existent to minor compared to the threat of structural damage to any building from the shaking itself and rockfall damage (discussed below).

19. No evidence was found for the landslide area (non-verified) shown on the webmap as lying upslope of Lots 1 – 8. Mapping revealed a series of contiguous rock outcrops separated by pockets of shallow soil overburden. It was concluded no such landslide threat exists.

20. No evidence was found for any instability in fine grained soils in the slopes below Lots 9 – 19. An active landslide is known some 100 m to the east extending between Peninsula Road and SH 6 but no signs of failure are known in the area of interest. Road widening associated with the southern approaches to the new Kawarau Bridge has exposed rock in the central part flanked by fine-grained sediments. Sections of cut slope considered to be susceptible to instability have been supported by gabion basket walls designed to resist failure. There is thus no extant threat to the proposed subdivision upslope.

21. Numerous large blocks were noted in the area of interest, notably Lots 13 – 19. Other rocks may have escaped notice due to thick vegetation obscuring the ground. No rocks were found to the west (Lots 1 – 8) which seems to have been protected by topographical traps on the uphill side of Peninsula Road. It is not entirely clear whether the blocks within Lots 13 – 19 have derived from rockfalls or whether they have been transported there by landslide movement. Studies on properties upslope of Peninsula Road have led to the conclusion that rockfalls have occurred only sporadically and that there is no historical evidence for recent activity. The threat from rockfalls upslope of the road was seen as very low to extremely low. Furthermore, Peninsula Road would be expected to halt most if not all moving rocks and thus the threat to the proposed lots would also be similarly low. Additional protection, in the form of a 2 m high, reinforced earth bund, could be constructed between the southern lot boundary of Lots 11-19 and Peninsula Road.

LIQUEFACTION HAZARD ASSESSMENT

22. The terrace on which the subdivision is planned is underlain by gravelly sediments and is well drained to the north and towards the central gully. Groundwater does appear on the cut slopes adjacent to the SH 6 southern approaches following prolonged wet spells but for the most part is absent. The available evidence suggests that the site is not susceptible to liquefaction.

DEBRIS FLOW HAZARD ASSESSMENT

23. Debris flow deposits were noted in the gully flanks between Lots 8 & 9 indicating large volumes of sediment have been mobilised and deposited as a fan either side of the water course below the road. Since deposition, the stream has downcut through this fan and is now incised some 5-8 m below the fan surface. The absence of large scale erosion on the hillside above suggests transport of debris is no longer an active process. Nevertheless, it would be prudent to construct some training bunds to ensure any debris flows are constrained within the gully and don't spread across into the neighbouring lots.

SUITABILITY FOR DEVELOPMENT

24. Despite a number of potential hazards being identified on the QLDC hazards register most are considered to not be relevant to the proposed subdivision. Rock fall and debris flow hazards have a very low to extremely low risk potential for the area of interest. Modest earthwork structures are recommended to mitigate this risk. With these recommendations in place, the area covered by the 19 lots is considered suitable for development.

DATED this 14TH day of August 2017

Jeff Bryant