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Attention: NCC Environmental Planning

Updates to Slope Instability Susceptibility Overlay as a result of Plan Change 29

Background

Beca Ltd was commissioned by Nelson City Council (NCC) in 2020 to produce a map overlay outlining areas potentially susceptible to slope instability and the potential impacts from the run-out of slope instability. The overlay produced was subsequently subdivided into three tiers of slope instability susceptibility and a run-out zone, based on feedback and recommendations from the Slope Instability Technical Advisory Group (SI-TAG). The overlay, incorporating recommendations from the SI-TAG, was delivered to NCC in the Beca report entitled *NCC Slope Instability Overlay Report*, dated 9 December 2021 (Beca, 2021). Mapping of the overlay identified four categories of slope instability and run-out susceptibility as follows:

- Tier I – Areas of known active instability with previous slope failures impacting residential properties,
- Tier II – Areas identified as having elevated susceptibility to slope instability,
- Tier III – Areas identified as susceptible to slope instability, and
- Run-out zones - Areas where debris from upslope instability may run out into.

Following the August 2022 severe weather event, NCC requested that the overlay be compared with, and updated, to address damage observed following the event. The updated overlay was delivered to NCC in the Beca report entitled *NCC Slope Instability post August 2022* (Beca, 2023).

In 2023 Nelson City Council proposed a plan change to the Nelson Resource Management Plan (NRMP), which focused on housing and natural hazards (including slope instability) within Nelson's urban area. This was known as Plan Change 29 (PC29). As part of PC29, the 2023 Slope Instability Tiers I, II and III were identified as 'Slope Instability Area Overlays' numbered 1, 2 and 3 (corresponding to Tiers I, II and III), and the 'Run-out zones' were identified as a 'Debris Run-out Area Overlay'. Planning provisions associated with the Slope Instability Area Overlays and Run-out zones were also proposed as part of PC29.

Slope angle calculation

It came to our attention in 2024 during the Plan Change 29 (PC29) process, that the software provider, ArcGIS Pro (Esri) had released a patch in June 2022 to resolve an issue affecting the slope geoprocessing tool in the ArcGIS Pro Software. The issue in the software had resulted in an error in the slope angle calculations that had been used for the slope instability susceptibility overlays in the 2020, 2021, and 2023 assessments. The slope angle issue was carried over into the post-August 2022 review of the overlay as it used the same methodology and datasets applied in the initial assessment, and therefore used the original slope angle dataset.

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It appears that the error showed a modelled difference of up to 9 degrees of slope angle (with the error reporting a steeper slope than actual). The difference appears to vary depending on the slope, with less variance at shallow and steep slopes. The differences in slope angle caused by the issue are as presented in Table 1.

Table 1: Summary of slope angle changes due to error

Overestimated slope angle caused by error (used in overlay creation)	Actual slope angle once error corrected	Maximum difference in slope angle
0-10°	0-7°	3°
10-15°	7-11°	4°
15-20°	11-15°	5°
20-25°	15-19°	6°
25-30°	19-23°	7°
30-35°	23-27°	8°
35-40°	27-31°	9°
40-45°	31-36°	9°
45-80°	36-77°	9°

During the PC29 process, Beca re-calculated the slope angle using the patched version of the software and reassessed the boundaries of the overlay (Chamberose, 2024). No updates needed to be made to the methodology during the revision. The following amendments occurred as a result of the re-assessment:

- The coverage of Tier III of the Slope Instability Overlay was reduced, with some properties being removed entirely.
- Some ridgeline areas were removed from the Slope Instability Overlay.
- Generally, the runout zone of the Slope Instability Overlay has less coverage, with some properties being removed from the runout zone entirely. However, some properties that were once in the slope instability areas (i.e. Tier III) are now wholly or partially within the runout zone. This is because some areas considered susceptible to slope instability are also considered susceptible to the runout from instabilities further upslope. As these areas were initially included in the slope instability overlay, they were not considered in the subsequent runout assessment.
- No new properties have been included in the Slope Instability Overlay as a result of the reassessment.

Further changes as a result of PC29 process

Additional changes were made to the Slope Instability Overlay as a result of the NCC PC29 process. Following expert conferencing, evidence was provided by expert witnesses Cameron Lines and Dr Sally Hargraves, on behalf of submitters (GeoSolutions and Baseline Geotechnical, 2024). Mr. Lines and Dr Hargraves submitted evidence relating to the positioning of the overlay boundaries, area covered by the overlay, assigned Tier classification, and extents of the run-out zone at specific sites within Nelson. Beca undertook a review of the supplied evidence with consideration of the regional scale, the corrected slope angle dataset, and the methodology from the 2021 and 2023 assessments (Chamberose, 2024). As a result of the information provided, Beca made the following amendments to the Slope Instability Overlay accompanying the technical report:

- Woodford/Sunningdale Drive – the Tier III boundary was updated to incorporate the area at the rear of the property that was inundated with debris during the August 2022 event.
- Atawhai - The Tier III boundary was updated to incorporate an area with a mapped headscarp in the post-August 2022 datasets.
- Marie Place, Bishopdale – the Tier III boundary was updated to incorporate an area of observed slope failure and to incorporate an area of run-out observed downslope following the August 2022 event.

Map Outputs

Map outputs incorporating the above updates to the Slope Instability Overlay are included in Attachment A. The changes to the overlay were undertaken in accordance with the methodology previously set out in the 2021 and 2023 assessments. These reports should be referred to for full details of the methodology applied.

Applicability

This report has been prepared by Beca Limited (Beca) on the specific instructions of Nelson City Council (Client). It is solely for our Client's use for the purpose for which it is intended in accordance with the agreed scope of work. Any use or reliance by any person contrary to the above, to which Beca has not given its prior written consent, is at that person's own risk. Should you be in any doubt as to the applicability of this report, it is essential that you discuss these issues with the authors before proceeding with any work based on this document. In preparing this report Beca has relied on key information supplied as part of PC29. Unless specifically stated otherwise in this report, Beca has relied on the accuracy, completeness, currency and sufficiency of all information provided to it by, or on behalf of, the Client, including the information listed above, and has not sought independently to verify the information provided. This report should be read in full, having regard to all stated assumptions, limitations and disclaimers. No part of this report shall be taken out of context and, to the maximum extent permitted by law, no responsibility is accepted by Beca for the use of any part of this report in any context, or for any purpose, other than that stated herein.

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References

Beca (2021). NCC Slope Instability Overlay Report, Report prepared for Nelson City Council, Nelson, New Zealand.

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GeoSolutions and Baseline Geotechnical (2024). Plan Change 29 – Review of Geomorphic Inputs to Slope Instability Susceptibility Overlays, Letter report to Bayview Nelson Limited, GP Investments Limited, Nelson North Limited, dated 22 November 2024, Nelson, New Zealand.