REPORT

Tonkin+Taylor

Private Plan Change Request

Geology and Geotechnical Hazards Report

Prepared for
CCKV Maitai Dev Co LP and Bayview Nelson Ltd
Prepared by
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1 Introduction

This report has been prepared to support the application for the proposed Private Plan Change Request (PPCR) for the Maitahi and Bayview land, at the request of CCKV Maitai Dev Co LP and Bayview Nelson Ltd (the applicant).

This report summarises the work undertaken by Tonkin & Taylor Ltd (T+T) for the assessment of geology and geotechnical hazards within the area being considered for the PPCR.

1.1 Background

1.1.1 Plan Change area

The proposed Plan Change area (PPCA) to enable new residential, rural - small holdings, and open space zonings, along with indicative road linkages is shown on T+T Figure 1012397-F1 which contains the proposed Structure Plan. It consists of land that is owned by either CCKV Maitai Dev Co LP or Bayview Nelson Ltd. The land extends from the Bayview subdivision in the north to Ralphine Way in the Maitai Valley to the south, from the west facing undeveloped slopes and ridgeline upslope of the existing residentially developed land from Bayview subdivision to Walters Bluff (Davies Drive), and the Kaka Valley catchment including Kaka Hill in the Maitai Valley, Nelson.

The land is currently accessed from Bay View Road and Ralphine Way, Nelson.

1.2 Scope of work

The scope of work carried out for production of this report has included the following:

- Desktop review of our files for relevant information to the proposed Resource Management Plan change sourced from various subdivision assessments.
- Review of published geological maps of the PPCA.
- Review of aerial photographs and digital terrain models based on LiDAR.
- Field mapping of surface features and subsurface investigations.
- Preparation of this report, which assesses the geotechnical hazards within the area of the PPCR, while acknowledging the relevant provisions of the Nelson Resource Management Plan (NRMP).

2 Geomorphology and land use

Our assessment of existing geomorphology is based on a review of aerial photographs, LiDAR digital terrain model and a walkover by an experienced Engineering Geologist. For the purpose of summarising the geomorphology, we have divided the Site broadly into four areas, being Atawhai hill slopes, Bayview ridge, Kaka Valley hill slopes and Kaka Valley floor as shown on T+T Figure 1012397-F2, attached in Appendix A).

- The Atawhai hill slopes are moderately inclined (generally between 16^{o} and 30^{o}) north-west facing slopes. Gully slope areas generally contain hummocky ground, terracettes and landslide backscarps indicative of previous deep seated slope mass movement.
- The Bayview ridge is a broad gently inclined north-east to south-west trending ridge. Ancient, denuded landslide headscarps predominate the western flank of the ridge.
- Moderately to steeply inclined Kaka valley hillslopes (generally between 22^{o} and 40^{o}) form the upper slopes of the Kaka Valley and gently to moderately inclined (generally between 5^{o} and 22^{o}) west and east facing slopes form the lower slopes of the Kaka Valley. The lower slopes contain gently inclined ridges and ancient debris fans that have been truncated by the flood plain. The presence of debris fans, sporadically placed boulders and hummocky ground contained within the gully slope areas of the lower slopes indicate previous and ancient mass movement, but there is little evidence of recent instability.
- The Kaka Valley floor is a sub-horizontal gently inclined area with numerous abandoned channels from the Matai River and Kaka tributary. The Kaka Valley floor is bound to the north-east and north-west by river terraces.

There is no evidence of significant, recent slope instability within the PPCA, however localised small landslip scarps are present on some steeper slopes, mainly within gullies and on steep slopes flanking spur lines, as is typical of Nelson hillside terrain.

The Site is pastoral farmland predominantly covered in grass with some areas of mulch following clearance of scrub and local areas of immature trees and scrub. There are several pockets of native scrub and trees along the margin of the Kaka Stream and on the higher slopes within Kaka Valley. Numerous areas of concentrated reed grass and greener vegetation indicate poorly drained conditions or natural springs, particularly in the gully floors, on the flood plains and within the hummocky gullies on the Atawhai hill slopes.

3 Geology

The New Zealand Geological survey, Dun Mountain 1:50,000 scale geology map[1] shows five basement rock types ***Marybank Formation, Botanical Hill Formation, Wakapuaka Phyollonite, Grampian Formation and Kaka Formation*** predominate across the site. Excluding the Wakapuaka Phyollonite, these basement rocks are principally strong to very strong breccia, tuff and tuffaceous sandstone. However, Kaka Formation is noticeably stronger. The weaker nature of the Wakapuaka Phyollonite has led to more subdued topography and more evidence of ancient slope instability.

In addition, geologically young river alluvium and fan gravels are mapped within the Kaka Valley floor.

A summary of the distribution of geology bedrock is shown on T+T Figure 1012379-F3.

- The basement rock is highly weathered and moderately closely jointed in track cut batters formed across the PPCA. The weathered and closely jointed rock is susceptible to small, localised instability.
- Surface soil deposits, consisting of colluvium, alluvium, fan deposits and residual soil overlie bedrock. They are products of bedrock weathering, erosion and shallow mass movement formed predominantly during the Pleistocene epoch.
- The active Flaxmore Fault is mapped to the west, beyond the western boundary of the PPCA.
- The active Waimea Fault is mapped approximately 2 kilometres to the east of the PPCA.

Many slopes that occur within the existing Nelson residential area, notably the lower elevation Atawhai hill slopes, the Port Hills slopes and the Stoke foothills are underlain by “Soft Rock” geology, such as the Jenkins Group, and Port Hills Gravel Formation. These rock types, that have a high susceptibility to slope instability, do not occur within the PPCA.

[1] Johnston, M.R. 1981 Geological Map of New Zealand 1:50,000 Sheet 027 AS Dun Mountain. Lower Hutt: New Zealand Geological Survey.

4 Resource Management Plan Overlays

The Nelson Resource Management Plan identifies the subject site as within the Rural Zone and Rural – High Density Small Holdings Area, along with being located in part within the Landscape Overlay, Land Management Overlay, Services Overlay, Riparian Overlay, and Flood Overlay. Of importance to land development potential assessment, are the Land Management overlay, the Flood Overlay and the Fault Hazard overlay. These overlays are shown on T+T Figure 1012397-F4. The site is not located within the Fault Hazard Overlay and so the associated rules, such as REr.110, do not apply. Flood risk is assessed in a separate report as part of the PPCR.

The role of the Land Management Overlay is explained in AD11.3.8 of the NRMP as follows:

AD11.3.8 Land management overlay

Indicates land that is especially sensitive to activities that cause erosion and sedimentation, particularly vegetation clearance, soil disturbance and earthworks. The Overlay comprises mostly the land in Land Management Zone C in the NCC Land Disturbance Regional Plan, which is to be replaced by this Plan.

The activity of earthworks on land within the Land Management Overlay are regulated by rules such as REr.61. It is therefore at the time of earthworks/construction activity that the potential effects of earthworks would be assessed.

5 Geotechnical hazards

Existing residentially zoned land within the Nelson urban area is subject to a number of geotechnical hazards. These hazards include:

- Bedrock slope instability
- Shallow soil instability
- Ground rupture by Faulting
- Liquefaction and lateral spreading
- Soil Erosion

As a part of the structure planning process, we have considered the susceptibility of the land within the PPCA to these geotechnical hazards. These are described below.

5.1 Slope instability

Aerial photographs, LiDAR imagery and site observations indicate that the majority of land is not subject to slope instability. In the Kaka Valley, gully controlled translational soil slide/debris flows dominate slope instability forms, but these areas are limited in extent and mainly associated with slopes steeper than 30 degrees. In contrast, deep seated landslides and earthflows that extend into the underlying bedrock dominate slope instability on the Atawhai hill slopes adjacent to existing residentially developed land. The majority of the slope instability features noted on the site are associated with very old ancient, prehistoric slope instability that may be tens to hundreds of thousands of years old.

The is occasional, but generally rare, evidence of recent shallow soil instability, locally noted to be associated with slope angles >35^{o} in areas with pre-existing ancient slope instability features.

5.2 Ground rupture by faulting

There are no active faults mapped within the PPCA and the land is not susceptible to direct fault rupture.

5.3 Liquefaction and lateral spreading

Geologically young, Holocene alluvial deposits, consisting of clayey silts and gravels occurring within the Maitai River floodplain and high groundwater levels (1.4 m to 3 m depth below ground surface) indicate that this area is susceptible to liquefaction and lateral spreading. Such deposits would normally require moderate to major ground shaking (typically initiated by earthquakes that occur at roughly 150-400 year intervals) to trigger liquefaction. Experience elsewhere indicates that mitigation measures are readily available in such situations for residential development. Accordingly, with respect to residential infrastructure, a moderate risk level of geotechnical risk is assessed for the majority of the floodplain while a high risk is assessed for land immediately adjacent to the Maitai River. Further assessment to quantify the risk would be needed to support a resource consent application for residential development in areas of Holocene alluvial deposits as required by the fourth schedule of the RM Act 1991 and relevant rules of the NRMP.

5.4 Soil erosion

We have not identified large areas that show a significant susceptibility to soil erosion, and the dominant rock types do not weather to sandy or silty soils that are typically easily erodible by rainfall. However, we note that the steeper slopes (particularly those generally in excess of 30 degrees) may be susceptible to gully and sheet erosion if stripped of topsoil.

Locally, the Kaka Hill Tributary has eroded and undercut small sections of Quaternary gravel terraces immediately adjacent to the active stream channel. Such erosion if often common in hillside stream channels, particularly when natural vegetation has been removed by land management practises

Along the southern boundary of the PPCA the Maitai River is actively eroding the alluvial soils by avulsion and undercutting. This is a result of the north-ward migration of the Maitai River over the last seventy years and, in particular, over the last forty years largely due to construction of stop banks and dense planting of trees that has been undertaken on the southern side of the Maitai River floodplain.

5.5 Geotechnical risk to residential development

Based on the susceptibility to geotechnical natural hazards we have assessed potential geotechnical risk to residential development. Our assessment is based on evidence from desktop review of geological maps, a site walkover, historical aerial photographs and LiDAR digital terrain models.

We have assessed areas in general accordance with the Australian Geomechanics Society "Practise Note Guidelines for Landslide Risk Management 2007". We have assessed land to have either a low moderate or high geotechnical risk associated with residential development. These risk areas are shown on T+T Figure 1012397-F5.

This assessment does not remove the need for specific geotechnical investigations that would be required to support a resource consent application. In particular, further assessment to quantify the risk would be needed to support a resource consent application for residential development in areas of susceptible to natural hazards as required by the fourth schedule of the RM Act 1991 and relevant rules of the NRMP.

Areas of **low** geotechnical risk include flat to gently inclined slopes, principally within the elevated terrace and slope apron deposits in the Kaka valley and along the broad ridge crest separating Kaka Valley with the Brooklands and Atawhai residential areas. There are also isolated areas along ridge crests.

The areas of potential low geotechnical risk are likely to be able to be developed with standard best practise civil engineering for subdivisions. Geotechnical input should be carried out in conjunction with planning, designing and constructing earthworks. However, significant geotechnical mitigation works would not be required to improve the existing stability of land.

Areas of **moderate** geotechnical risk include moderately inclined slopes that do not display significant evidence of past slope instability or direct effects of other geotechnical hazards. This also includes the Kaka floodplain where liquefaction is possible. As part of any resource consent application geotechnical consideration of any proposed development may indicate that specific geotechnical hazard mitigation should be incorporated as part of the design and construction of any subdivision development. Following investigations some areas may be considered as not being feasible for residential development.

The **high** geotechnical risk areas include slopes that display evidence of recent or ancient (including Holocene) slope instability or evidence of other geotechnical hazards, or are underlain by geological materials that may be susceptible to natural hazard triggering by rainfall, earthquake or land development. This does not mean that some high risk areas cannot be developed but such areas would require a detailed geotechnical assessment as part of the planning for residential development, provision for mitigation works and more controls on the way the land is developed.

High geotechnical risk areas would not normally be feasible for residential development without geotechnical mitigation measures being incorporated into the development aimed at achieving levels of risk that are acceptable, or tolerable by the Consenting Authority.

It must be recognised that further geotechnical assessments will be required for any residential developments on any of the land and that T+T Figure 1012397-F5 is for resource management planning purposes only.

6 Conclusions

We have carried out an assessment of the geomorphology, geology and geotechnical hazards that may exist within the PPCA.

We have identified areas of low, moderate and high geotechnical risk. Areas of low geotechnical risk are generally suitable for residential development with geotechnical input to development. Areas of moderate geotechnical risk have some potential geotechnical constraints but, where present, specific risks can normally be mitigated with geotechnical input to planning, design and construction of residential subdivisions works. Areas of high geotechnical risk will generally have potentially significant constraints to residential land development that may or may not be feasibly mitigated.

Further geotechnical assessment will be required for specific subdivision development proposals.

7 Applicability

This report has been prepared for the exclusive use of our client CCKV Maitai Dev Co LP and Bayview Nelson Ltd , with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
	
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Appendix A: T+T Figures

- **Figure 1012397-F1 – Proposed Plan Change area and land ownership**
- **Figure 1012397-F2 – Geomorphology Plan**
- **Figure 1012397-F3 – Geological Plan**
- **Figure 1012397-F4 – Nelson Resource Management Plan Overlays**
- **Figure 1012397-F5 – Geotechnical Risk Rating for Land Development**

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