‘Stuff happens’ - A case history of a safety incident while assessing slopes in Waioeka Gorge

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ABSTRACT

Field inspection of steep slopes adjacent to transport corridors can pose serious safety hazards. An accident that occurred on one such project highlights the risks and safety considerations posed for geotechnical fieldwork. Geomorphic evaluation of slopes was undertaken in the Waioeka Gorge to assess the risk to the highway from large landslide events. The gorge is a hazardous environment for field work, characterised by very steep bush covered slopes up to 500m high, no cellphone coverage and numerous small rock fall events affecting the road on a daily basis. The investigation methodology used sought to minimise risk exposure to staff by utilising remote techniques such as assessment of GoogleEarth and LiDAR data, helicopter inspections, followed by field mapping to ‘ground truth’ selected slope features. Due to the hazardous nature of the site a rigorous health and safety plan was developed for the off-road slope inspections. The safety plan was severely tested by a serious incident during field inspection of a steep remote slope 100m above the highway. This paper presents a case history of the accident that occurred and provides a number of valuable lessons that were learnt which reinforce the importance of safety planning and the establishment of robust safety procedures when working in remote slope areas.

Keywords: Safety Incident, Waioeka Gorge, landslides, field mapping

1 INTRODUCTION

1.1 Outline

During field work while carrying out inspections on a steep slope in the Waioeka Gorge in May 2013 one of a field party of two slipped (on a tree root) and fell on a steep slope and dislocated a shoulder. Despite being only 100m from a highway this event resulted in rigorous testing of the project safety plan including an emergency rescue under trying conditions. This paper presents this incident as a case history of safety planning and incident response and considers the various elements of the process and provides lessons learnt for future such site inspections.

1.2 Background

A large landslide occurred in the Waioeka Gorge in March 2012 which resulted in State Highway 2 being closed for 6 weeks (Read, 2013). The impact on the region of this closure prompted the NZ Transport Agency (the Agency) to investigate the risk of similar large failures elsewhere in the Waioeka Gorge. Aurecon proposed and carried out a slope risk rating and assessment process for NZTA in order to identify high risk slopes. The process and findings of the slope study are presented in a separate paper (O’Loughlin, Stewart and Roh, 2015).
The work was carried out in two stages; Stage 1 involved a trial of two slope risk rating systems in order to rapidly identify the highest risk slopes and Stage 2 involved a more detailed study of the highest risk slopes. Both stages involved desk study and field components. The field components of Stage 1 involved observations from the highway only, whereas Stage 2 proposed field checks of selected features on the slopes to verify inferences made from desk studies.

1.3 The Site

The Waioeka Gorge is a 48km long section of highway between Opotoki and Gisborne (Figure 1. The terrain is typically very steep (Figure 2) with slopes rising to up to 600m above the highway and covered in (largely native) forest (mini Fiordland). The highway was built in the 1960's and was a very challenging engineering feat given the proximity of the river to the very steep sided hills. Some of the three fatalities which occurred during construction may have been attributable to rock fall as this was the greatest risk to building. The highway is prone to continuous rockfall events such that the maintenance contractor travels the road twice a day to clean up rock and slip debris. The highway has a low traffic volume (approx. 1300 vpd). The gorge has a high annual rainfall. Cellphone coverage is not available through most of the gorge.

Figure 1. Location of Waioeka Gorge

Figure 2. Typical steep slope in Waioeka Gorge

2 FIELD MAPPING

2.1 Sites

The field work for Stage 2 of the project proposed visits to four potential landslide sites including the 150m high slopes adjacent to the 2012 Sandy Slip site (Figure 3) and three others slopes of 200 to 500 m height (including Figure 2).

2.2 Challenge

The major challenge at this site related to the steep bush country which makes field mapping inherently inefficient and hazardous. The thick native bush-covered slopes prevent being able to easily identify actual or incipient landslide features or to get a thorough 'over-view' of the slope geomorphology.
The initial estimate gave at least ten days field work, even to visit only representative slope features.

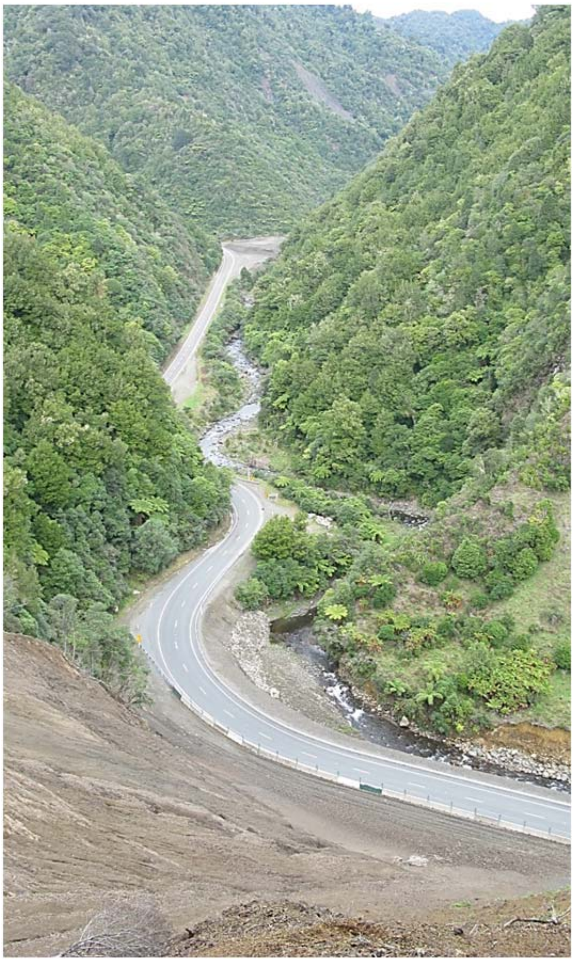

Figure 3. Waioeka Gorge looking down the March 2012 landslide scar. May 2013 photo.

2.3 Safety Strategy

The strategy for dealing with the hazards on this project was as follows:

- Maximise desk based (remote) mapping including aerial photo and 3D GoogleEarth viewing,
- Acquire LiDAR data of site to facilitate detailed ‘remote’ mapping
- Helicopter Inspection of key features and slope access routes to facilitate minimal targeted field slope visits
- Engage specialist outdoors rope access contractor (‘the guide’) to look after safety of geotechnical inspector(s)
- Undertake pre-trip Safety Workshop to confirm key risks, controls and responsibilities and communication plan
- Complete comprehensive Safe Work Method Statement (Safety Plan) – including engaging with all stakeholders
- Adhere to Safety Plan

2.4 Specific Hazards

In addition to more generic hazards for road based inspections and for utilising helicopters, specific hazards and consequences related to the project were identified and refined during the Safety Workshop. The hazards, associated consequences, and risk controls developed are outlined in Table 1.

Table 1: Summary of project specific Hazards, potential consequences and proposed risk controls

Hazard	Consequence	Controls
Very steep terrain (averages 45 degrees)	Slips, trips, falls	Experienced outdoor staff, tramping boots with good tred, rope and harnesses for inspections where precipice falls could occur, first aid kit
Thick bush	Navigation errors (becoming lost, separated)	Two types of GPS and navigation Smartphone apps; Radio Telephones (RT’s)
Winter – short daylight hours,	Stuck out overnight	Headlamps, extra food, warm clothes, extra batteries, communications plan
Cold/wet conditions	Hypothermia	Warm weatherproof clothes, snacks and drinks
No cellphone coverage	Inability to call for help	Satellite phone, Eperb, note on dashboard of our car on road
Hunters	Shot	Call DOC; Wearing Hi-Vis clothes

These elements were worked into a Safe Work Method Statement for the use of site staff and provided to all affected parties.

2.5 The team

The engineering geologist carrying out the inspection was an experienced outdoors person. The abseil support person (the guide) was responsible for determining safe routes in the steep terrain and facilitating rope assisted inspections in localised very steep terrain where required to ground truth specific features. The guide was a qualified outdoor first aid instructor, and highly experienced in the outdoors. The project manager (engineering geologist) based in Tauranga was involved in the first day helicopter and road based overview inspections of the sites on 24 May, and was the safety call-in point of contact at the start and end of the field days.

3 THE INCIDENT

3.1 Description

The inspections were planned for early May 2013. These were delayed until the last week of May due to lack of continuous fine weather for the helicopter inspection and field work. The helicopter inspection occurred on 24 May with the first full field day on 25 May in the vicinity of the 2012 Slip. The weather was fine but cool with light rain forecast for late in the day.

The inspection started mapping along the base of the slope from the road and then climbing up bushed slope to the west of the 2012 slip (Figure 4) inspecting features of interest identified from the LiDAR assessment. Inspections of the top of the slip were made at the slip crest while roped to the abseil support person (Figure 5). The inspection continued down the eastern flank of the slip in the bush toward road level. Approximately 1/3 of the way down (100m above road level), the guide (the abseil contractor) slipped on a tree root and fell heavily on his shoulder. It became clear that he wasn't able to continue as he was in severe pain and had dislocated his shoulder. We concluded that he was unable to continue and that help was needed.

The sequence of events and the various factors (both negative and positive) that influenced the outcomes and decisions at each stage of the rescue are outlined in Table 1. The slip occurred at 3.30pm, the first police car on the scene at 6.30pm, and the casualty extracted by lowering to the road on long ropes at 10.30pm.

Rain and lowering cloud levels set in within an hour of the incident, preventing helicopter rescue, with darkness descending about 5.30pm.

Figure 4. Sandy Slip site in April 2012 partway through debris clearing, showing route of 25 May 2013 inspection and incident site (x). GDC photo. Figure 5. Set-up for short roped inspection of landslide head scarp prior to descending toward road.

Table 1: Sequence of events, and factors that influenced the outcomes of the incident (May 2013)

Stage	**Commentary / Actions**	**Negatives**	**Positives**
Immediately Post Accident (3.30pm to 4.30pm)	• First aid implemented under direction from the injured Guide (the casualty) • Mutual decision that needed external help, either by activating EPERB or uninjured personnel climbing down to road to raise alarm	• The wrong (safety) person was injured! • Unstable slope - largely steep scree with isolated trees • Casualty was unable to move on the steep slope • No way of communicating other than EPERB (cellphone and satellite phone were ineffective)	• The casualty's experience in First aid and Incident response • Warm and weatherproof outdoor clothes • Good footwear (boots) • Good first aid kit • Had rope and harness's available • Had EPERB
	• Decided that climbing down to road would get better information to emergency services and was faster way to get help compared to EPERB • Geologist climbed to road maintaining Radio Telephone contact • Flagged down two motorists to call police when in cellphone reception (which they did about 5.30pm) • Climbed back to casualty to await help	• Risk of slipping on route to road • Totally reliant on members of public to alert authorities	• Non-injured person had good outdoor skills • Non-injured person was confident of route to road bypassing bluffs to raise help having reconnoitred base of slope from road in morning • Had operational RT's to maintain comms during separation • Two cars stopped decreasing risk of message not getting through
Awaiting Rescue (5pm to 7.30pm)	• Put warmer clothes and wet weather clothes on casualty • Had sufficient food and drinks • *Following no contact from field staff project Manager Ben O'Loughlin initiated comms plan, contacted field staff accommodation and police)* • Signalled police with headlamp	• Dark approaching • Low cloud ruling out helicopter rescue • Onset of steady rain • Lost glasses	• Both had powerful headlamps • Adequate food and snacks • Had spare pair of glasses • Hot sweet drinks (both had thermous') • Wearing hi-vis clothes
Rescue (7.30pm to 11pm)	• Emergency services arrive at road • Threw Radio Telephone (RT) down slip in protective lit case to make contact with rescuers (*unsuccessful)* • Firemen arrived at 7pm • USAR and pain relief arrived at 8.30pm • Lowered by long ropes to road level	• No means of communicating with rescue staff on road below (their generator didn't help) • Protracted process of extraction • Poorly equipped initial rescuers (fire fighters) • Labour Dept rules on allowable rope access equipment slowed evacuation process	• Innovative idea to get RT to road • Snacks, hot drinks • Warm clothes • Someone to talk to once rescuers arrived to site (morale) • Experience of USAR staff, taking control
Post Rescue (11pm onwards)	• Casualty by ambulance to Whakatane Hospital - • Geologist drove back to Opotiki (fighting sleep)	• Have to drive out • Very tired and late • Heavy rain	• All survived • Valuable lessons learnt

3.2 Epilogue / Wrap-up

What was the outcome? How did our safety management plan do? What could we have done better? The casualty made it to Whakatane Hospital and his shoulder was 'put back in' about 3am. The geologist made it back to his accommodation in Opotiki about 2am.
The rescue was reported in online news the next day, eg NZ Herald, and 3News and was the front page of the 'Opotiki News' on its next issue. No negative exposure was given for the Agency or the geotechnical profession (news referred to "surveyors"). The news reported the incident controller saying that the rescue organisations had "all worked well together".
The inspections continued with a one day delay, with a replacement abseil safety person, but from road level only. An incident review meeting was held with the client and Aurecon's H&S manager four days later. While no major shortcomings were identified, there were many learnings and points to note.

4 LESSONS LEARNT

This incident provided a rigorous test of safety procedures and provided many learnings:

- Get specialist help when dealing with hazardous conditions. Expert involvement reduced risk/consequences considerably
- Conducting a pre-trip safety planning meeting (hazard workshop) was invaluable in 'teasing out' where the risks and responsibilities were, and resulted in 'plugging some risk gaps' that proved invaluable when the incident occurred
- Remote mapping gives 'more bang for buck' and is much safer; enabling 'ground truthing' of limited sites only
- Have significant redundancy in risk controls – some of them will be ineffective!
- Don't compromise safety for project outcomes (temptation is to skimp on safety costs)
- Know how to use safety gear – during an incident is too late to learn, including satellite phone, radio telephones and EPERB's
- All party members should be first aid trained and able to provide care if needed and if in remote locations able to provide extended care
- Excess safety equipment can be a hazard in itself – dividing some of this amongst all party members can help to reduce size of the load carried
- Two man team was marginal – an additional person on site would have assisted eg. safety person at road level in radio telephone contact
- Tell emergency services in advance (Police and USAR) so they can mobilise faster in event of an incident
- Could use site road network contractor as part of communications plan
- This situation could occur in a far less remote area with similar significant consequences.

5 CONCLUSIONS

The steep and hazardous country characteristic of much of New Zealand poses safety challenges for those involved in maintaining and developing transportation and other facilities in such terrain. The May 2013 incident in the Waioeka Gorge highlights the need to carry out thorough safety planning when carrying out inspections in such areas.
Due to the significant hazards faced in such locations, the consequences of an incident need to be considered in detail as well as the range of scenarios that could occur. In order to Eliminate as much of the risk as possible, remote (desk study) inspections can be used to minimise hazardous slope inspections. In this case this involved assessment of aerial photographs, Google Earth and detailed topographic data from newly flown LiDAR. Low risk site inspections were carried out from the road and helicopter. Minimisation of the remaining risk was made by limiting the number of inspections on the steep slopes and a development and implementation of a detailed Health and Safety Plan.
The May 2013 incident resulted in a protracted rescue, which rigorously tested the safety plan.

Experience with the incident that occurred showed that a number of the risk controls were ineffective, highlighting the need for having back-up controls ('plan's B and C') to address such eventualities. Risk control procedures should be well rehearsed and equipment mastered <u>prior to</u> the inspection

commencing. Foolproof communication plans are critical; the presence of another person on site, eg. a stand-by person in RT contact at road level, would have aided the outcome in this instance; as would have including prior notification of authorities (Police, road maintenance contractor, and USAR) with expected and latest return times.
This incident has highlighted the importance of thorough pre-trip safety planning meetings, prior training of safety procedures for all team members and competent first aid skills. The big lesson is that in isolated steep terrain, 'stuff' can happen to anyone no matter how experienced, we need to be prepared for such eventualities and for adequately managing the risk.

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