



Date: 7th August 2023

To: Tinaka Mearns, Acting Operations Director Hauraki / Waikato / Taranaki

CC: Dan Heinrich, Cat Wilson

From: Andy Roberts, Cyclone Gabrielle Taskforce

Subject: Summary re geotech advice for beach at Cathedral Cove

Context

Cyclone Gabrielle caused significant damage to DOC's tracks and structures at Cathedral Cove Recreation Reserve, including the DOC track from Hahei Beach to Cathedral Cove and on the foreshore area at Cathedral Cove and the nearby bays and coves.

A Natural Hazard Risk Assessment (NHRA) has been provided by Tonkin and Taylor Ltd to analyse landslide (includes landslide rockfall, and creep landslides) risk to visitors and staff on the track from Hahei beach to Cathedral Cove beach and the side tracks to Stingray Bay and Gemstone Bay. The report from T&T was received on 28 July 2023, and had undergone independent peer review.

This paper provides advice on interpreting and implementing the NHRA for landslides, and gives a summary of the report findings. Note that the Visitor Safety Team is providing additional comments to you on this topic.

Background

There are 3.8 km of DOC tracks across the site from Hahei to Cathedral Cove, the overall site covers both Recreation Reserve (managed by DOC) and the beaches (some of the beaches are outside of DOC management).

At its busiest (pre COVID), the site had over 250,000 visitors annually. The site is highly significant as an attraction in the regional tourism economy.

The predominant visitor type ("Day Visitors" - in the DOC system) are generally low skilled at dealing with natural hazards, therefore the site is managed by DOC for visitors expecting a lower level of risk.

The NHRA methodology is a standardised approach, developed by GNS for and in collaboration with DOC, for assessing natural hazard risks to visitors using DOC assets on public conservation lands and waters. Although applicable for other natural hazard risks, the focus is on landslide and rockfall.

Landslides and rockfalls have been a long-identified issue for Cathedral Cove and the weather events of February 2023 caused many of them to activate. These landslides are the focus of the T&T report.

Since 2009 T&T have carried out geotechnical investigations regarding Cathedral Cove for DOC.

DOC provided T&T with relevant information about the site and experience such as visitor type, visitor numbers and temporal use patterns. Standardised metrics have then been used:

- annual probability of an event (e.g., landslide / rockfall),
- probability of an event reaching an asset such as a track,
- amount of time a visitor may spent in the hazard area during a visit, and
- their vulnerability to that event

The information helps provide a quantitative figure that can then be compared with risk threshold levels that have been developed for DOC sites. The risk thresholds range from lower, to medium, to higher risk thresholds depending on the predominant type of visitor or experience (e.g., this site has a lower risk tolerance as it is managed for Day Visitors)

Risk calculations are provided for:

- individual visitor risk (per visit),
- annual risk for a DOC staff member working on the track,
- and societal risk of a multiple fatality event.

Based on these metrics we can determine the natural hazard risk to visitors at a site and then determine interventions or controls that might be required to manage the risk to an appropriate level.

Key Points

- Damage to the track is severe and makes the track impassable to visitors without reinstatement.
- A total of 180 landslides (historic and recent) were identified in the vicinity of the 3.8 km track. These included rockfall, landslide and creep events. The February 2023 weather has have triggered a larger number of landslides than were identifiable from previous large rainfall events.
- T&T assessed the overall site in 21 landscape sections and 4 specific locations.
- The risk assessment considered the risks of the site in a “pre-Cyclone damage” state, and they conclude the risks are greater than the risk assessment figures they provide due to the current damage.
- T&T advise the damaged track areas should be avoided or mitigated prior to opening the track.
- Much of the site has a history of landslides of various sizes.
- Landslides / rockfalls are primarily triggered due to elevated groundwater (i.e. soil / rock saturation) as result of prolonged and/or intense rainfall.
- No landslide / rockfall events in the period were known to have been triggered by earthquakes (this does however remain a possibility).
- Landslides could impact the track or users through debris falling from above the track onto users, an/or slip away beneath the track causing a fall risk for users.

Landslide Size and triggers

The report provides information on the maximum credible event (e.g. the largest landslide if the slope were to fail) and estimates it would potentially cover 10,000m². There are locations where an event of this scale would reach the track and facilities.

The report also informs the most likely sized event as covering of an area up to 1,000m². This information is significant in planning for future options.

| | Part of the Site | Most Likely | Max Credible Size |
|------------------------|---------------------|----------------------------|----------------------------------|
| Landslides | All except CC Arch | <1000m ² (area) | 1000-10,000m ² (area) |
| Rockfall (except Arch) | All except CC Arch | <1000m ² (area) | 1000-10,000m ² (area) |
| Rockfall at Arch | Cathedral Cove Arch | ≤3m ³ (volume) | 4-5m ³ (volume) |

The report identifies:

Sections with higher risk where further action may be required are identified as:

- Section 1: Hahei Beach to Cathedral Cove carpark,
- Section 7: Part track to Stingray Bay,
- Section 11: Stingray Bay Beach,
- Section 14: Mare’s Leg Cove, Cathedral Cove Beaches,
- Section 15: Cathedral Cove Arch,
- Section 18: Stingray Bay Beach.

These sections of track generally have a higher density of landslides potentially affecting them.

Risk Calculations

The main risk calculations requested by DOC and provided by T&T are:

- I. Individual risk per visitor per trip
- II. Person most at risk (DOC worker)
- III. Societal risk of multiple fatalities

I. Individual risk per visitor per trip

This is the main metric that we focus on when determining the risk to a visitor, and DOC has defined thresholds against which risk tolerance can be assessed. The risk figures have been rounded to a range of approximately 1 in 670,000 to 1 in 2,174,000.

The calculated risk per visitor per trip is within the range for a lower risk site where the DOC management response is: “reduce risk to as low as reasonably practical (ALARP)” through to “continue (with operation of site) only after high level review”.

To note when considering this risk calculation:

- The figures should not be taken as absolute.
- There is a wider range the estimates will fit within.
- The upper range (e.g. highest risk figure) is based on the calculated maximum credible event/largest possible landslide, and is thus the most conservative figure.

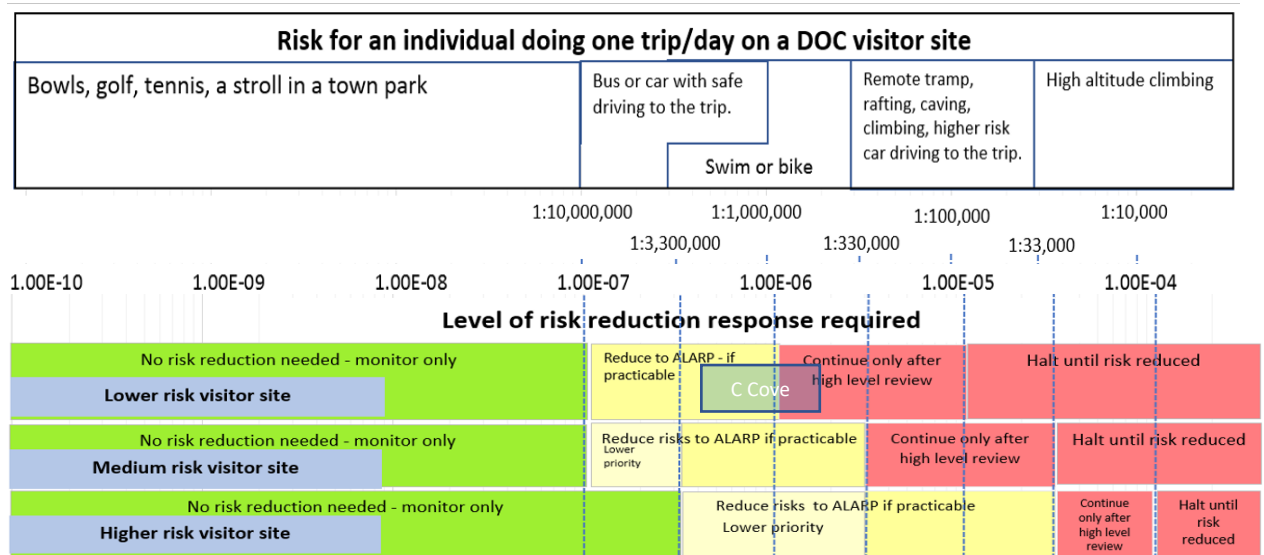


Figure 1 – individual visitor risk thresholds levels for Hahei – Cathedral Coves track. The location is a Lower Risk Visitor Site. (the blue bar indicates the calculated cumulative visitor risk range for the site)

An earthquake induced landslide event is still possible, from the report presented, T&T did not find evidence of any in their investigations. Earthquake induced landslide event at this site therefore have an unknown likelihood.

II. *Person most at risk (DOC worker)*

The figure is calculated using the average visitation of a DOC worker to the track and beaches for longer periods (3 x per week for 40 weeks pa). The risk calculation figure is 1 in 5,560 – 1 in 18,200. In terms of actions required this figure straddles both the actions of ‘continue only after high level review’ and ‘halt until risk reduced’ – refer to table below. Practical options to further reduce risk involve work at site only in dry conditions, etc. This information will need to be factored into work site planning for DOC staff and other who might work at the site.

III. *Societal Risk*

Societal risk has been calculated based on the probability of either:

- At least 1 person getting killed annually.
- At least 5 people getting killed annually.
- At least 30 people getting killed annually.

This is then provided as a cumulative risk figure which has a range of 1 in 365 to 1 in 14,500. This straddles the actions of ‘explore practical risk reduction options’ and ‘continue only after high level review’ – refer to table below.

| Person most at risk (DOC worker) - calculation | Societal Risk - calculation | Action |
|--|-----------------------------|---|
| | | Halt until reduced. |
| | | Continue only after high level review. |
| | | Explore practical risk reduction options. |
| | | Explore practical risk reduction options (lower priority). |
| | | Monitor situation. |

Table 1 – representation of calculated risk figures for DOC workers and societal risk against suggested actions

Conclusions

The report reaches several conclusions and recommendations. The points below outline DOC comments on the considerations outlined in the report.

1. The Hahei to Cathedral Cove track and beach access is a lower visitor risk site, i.e. day visitors are not expecting a high risk site.
2. The cause of landslides and rockfall are prolonged / high intensity rainfall events, and landslides have been recorded during and after such events.
3. The hazard risk calculations trigger the DOC risk management responses of “reducing risk to as low as reasonably practical” through to “continue only after high level review”.
4. The greatest level of risk is for those visitors who use the whole site, i.e. tracks and beaches, as they are exposed to all risk sites. Mitigation of risk should focus on reducing risk at key parts of the overall site and at supporting visitor decision making for people visiting the site during or after heavy / prolonged rainfall events.
5. DOC should continue to review the site and explore practical risk reduction options (hazards, & exposure, etc) so the wider site can be available for visitors within an acceptable risk profile. The risk profile of the Cathedral Cove visitor site sits outside the risk threshold for a lower risk visitor site. The risk assessment notes the current actual level of risk may be higher than the report identifies as a reflection of increased site damage.
6. Review of the site should include a risk mitigation approach that reduces risk to as low as reasonably practicable, allows visitors to make informed risk decisions about visiting the site, and is cost effective.
7. The combination of damage / increased risk on the tracks and beaches is greater than the damage / risk in parts. It is possible to manage the site in parts until a longer-term solution is found. (i.e. manage beach access separate to management of track use).
8. Visitor access to the beaches should be possible, but will require increased risk management. Spending time on the beaches, (under the cliffs) during or in the days after heavy rainfall is carries some risk. Some of these areas are not DOC managed land. Renewed beach access will require a collaborative risk reduction exploration and effort between all stakeholders. Effort in communicating risk to visitor prior and as part of their visit will be important.
9. An option to consider would be to enable visitors to access the site at the beach, with the addition of provision of information to visitors about the hazards and risks, and any transport providers should ensure visitors are aware of the hazards and risks.
10. DOC should monitor the number of active landslides on the site and establish a record of landslides, including date, location, a sketch or photograph and approximate size/volume. This information should be shared with various stakeholders.

11. Closure of the site based on rainfall events may not be a workable solution, such solutions can be costly to manage when there are multiple stakeholders and not all the area is managed by one entity. The use of public weather forecasts, hazard mapping and a coordinated effort across stakeholders may provide effective risk information to visitors (as an example).

12. Practical mitigation measures to reduce risk for workers (DOC and others) could include reducing exposure during and after rainfall events, and reducing time spent directly under landslide/rockfall source areas such as the beach cliffs as well as track investigations. This support actions of 'continue only after high level review' and 'halt until risk reduced.' (*employee safety and visitor safety have differing rules and obligations*).

| Recommendations | | Accept |
|------------------------|--|---------------|
| 1 | Accept the findings of the geotechnical report for Cathedral Cove. | Yes/no |
| 2 | Note the risk to visitors falls outside acceptable risk threshold limits. | Yes/no |
| 3 | Note the conclusions in this report including consideration of renewed beach access along with increased risk at the whole site. | Yes/no |
| 4 | Accept the requirement to undertake further investigation into longer term solutions for visitor access from Hahei to Cathedral Cove | Yes/No |





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