Environmental Impact Assessment Report: Tongariro Alpine Crossing visitor sustainability project

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Te Papa Atawhai

Te Kāwanatanga o Aotearoa
New Zealand Government

Cover: Pristine Emerald Lakes Photo: *Credit to Rodolpho Mafei*

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Executive summary

This environmental impact assessment report for the Tongariro Alpine Crossing uses new and existing data, including environmental-DNA sampling and records about waste management. It focuses on two areas:

1. potential visitor impacts on flora, fauna and waterways
2. limits of visitor infrastructure (toilets and tracks) to manage impacts.

The report finds that the main environmental impacts of visitors to the Tongariro Alpine Crossing are from human waste, rubbish and the potential spread of weeds. The impact of current visitor numbers is low to moderate and mainly localised around the track. However, further monitoring is needed to confirm the status of native and exotic species identified through baseline sampling.

Installation of new toilets on the Tongariro Alpine Crossing has been the main way to mitigate and manage the impact of human waste. However, the increased frequency of removing toilet waste using helicopters creates higher carbon emissions and increases costs and the risk of spillage. More work is needed to determine the carrying capacity of the visitor and toilet facilities.

Most track damage arises from weather events and natural erosion, which will be accelerated by climate change. Visitor numbers can also speed up track erosion, and higher activity levels affect track standards over time. Sustainable funding for track maintenance in this situation is an ongoing challenge.

The report findings do not provide a definitive carrying capacity limit based on the current evidence. The work done so far provides a baseline dataset and further monitoring is needed over several years to establish robust trends and greater insights.

1 Purpose

This report provides an assessment of the environmental impacts of visitor numbers to the Tongariro Alpine Crossing (TAC). It will inform decisions on any future limits on tickets in the Department of Conservation (the Department) booking system for the TAC.

2 Introduction

The TAC sits in the dual World Heritage Tongariro National Park, recognised for its cultural and natural heritage values. One of only three World Heritage sites in Aotearoa New Zealand, it was the first in the world to be given dual World Heritage status. This recognises the park's important Māori cultural and spiritual associations as well as its outstanding volcanic features.

Over the past 20 years, the Department has been contending with sustainable management issues on the TAC as the track's popularity has grown. A steady increase has occurred in visitor numbers, which is putting consistent pressure on the conservation and cultural values of the area, as well as the infrastructure. These pressures include congestion, waste management, environmental damage, and lack of respect for the cultural significance of Tongariro.

Ngāti Hikairo ki Tongariro and the Department want to ensure the experience of walking the TAC protects the fragile environment, is safe, respects the cultural significance of the area, and is sustainable. Therefore, through better managing these challenges we will better protect Tongariro for future generations.

The Tongariro National Park Management Plan 2006–2016 gives clear direction regarding the determination of the TAC carrying capacity and implementing restrictions.[1]

1. The department will monitor visitor numbers and the social, cultural, and environmental impacts of those visitors on the Tongariro Crossing.
2. The department will identify the carrying capacity of the Tongariro Crossing having regard to the effects of guided and non-guided visitors on the natural resources, and historical and cultural heritage of the Tongariro Crossing and other visitors' benefit, use, and enjoyment of the park.
3. If limits on visitor numbers become necessary to achieve the objectives identified above, the department will impose controls to manage visitor flows, visitor impacts, and/or visitor numbers.

This obligation was further enforced through an amendment to the Tongariro National Park Management Plan in 2011[2] describing the use of concessioned transport operators to achieve such restrictions:

> **Transport Amend Policy 10**
>
> The department will recommend to the Minister a maximum daily number of passengers for transport operators on the Tongariro Alpine Crossing.
>
> Insert: "Concessions may include conditions to manage adverse effects for example addressing crowding by restricting drop off times. Passenger numbers may be set by the Minister following consultation with concessionaires.

Due to this statutory obligation and, with concerns about the impact of a return to pre-pandemic visitor demand and growth, the Department and Ngāti Hikairo ki Tongariro developed a management framework based on Limits of Acceptable Change[3] and the values of manaakitanga and kaitiakitanga. This approach seeks to protect known values, identify limits relating to adverse effects on the TAC and, ultimately, test and determine the TAC's carrying capacity. This work was used to draft management objectives in 2022,

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1 Department of Conservation. 2006. Tongariro National Park Management Plan 2006–2016. Tūrangi: Department of Conservation. Section 4.3.2.13 Policy 2 and Policy 3, page 157.

2 Department of Conservation. 2011. Addendum to the Tongariro National Park Management Plan 2006–2016 as required by the Partial review 2011. Tūrangi: Department of Conservation. Page 3 (Section 4.4.2.5 Policy 9 and Policy 10, page 177).

3 Limits of Acceptable Change is a value-based framework that sets limits to protect agreed values. It uses indicators and measures and can help determine and test carrying capacity settings (McCool, 2013).

which outline the future desired state. Ongoing monitoring of progress towards these objectives supports adaptive management.

Fundamental to the above framework is measuring and minimising the impacts of visitors on the environment. This is aligned with the Department's Tongariro National Park Management Plan and World Heritage obligations, and the mana whenua responsibilities of Ngāti Hikairo ki Tongariro to care for the environment.

This report has three main sections covering:

1. methodology
2. biodiversity context for the TAC
3. visitor infrastructure carrying capacity and limits.

It sits alongside social, economic and cultural impact assessment reports to contribute to identifying a potential carrying capacity for the TAC.

3 Methodology

The TAC is of prime cultural, environmental, social and economic importance to mana whenua, local communities and the region. Along with this, the TAC is located within the Tongariro National Park, which carries dual World Heritage status. To operate in this context, the chosen framework needed to be flexible and responsive to interactions between different dimensions of wellbeing.

The Living Standards Framework (LSF) was selected because of its flexibility, ability to prompt system thinking across different domains, and recognition of long-term issues and policy implications.[4] The LSF depends on a mix of objective and subjective measures to help users understand the interdependencies and trade-offs across the different dimensions of wellbeing (Figure 1).

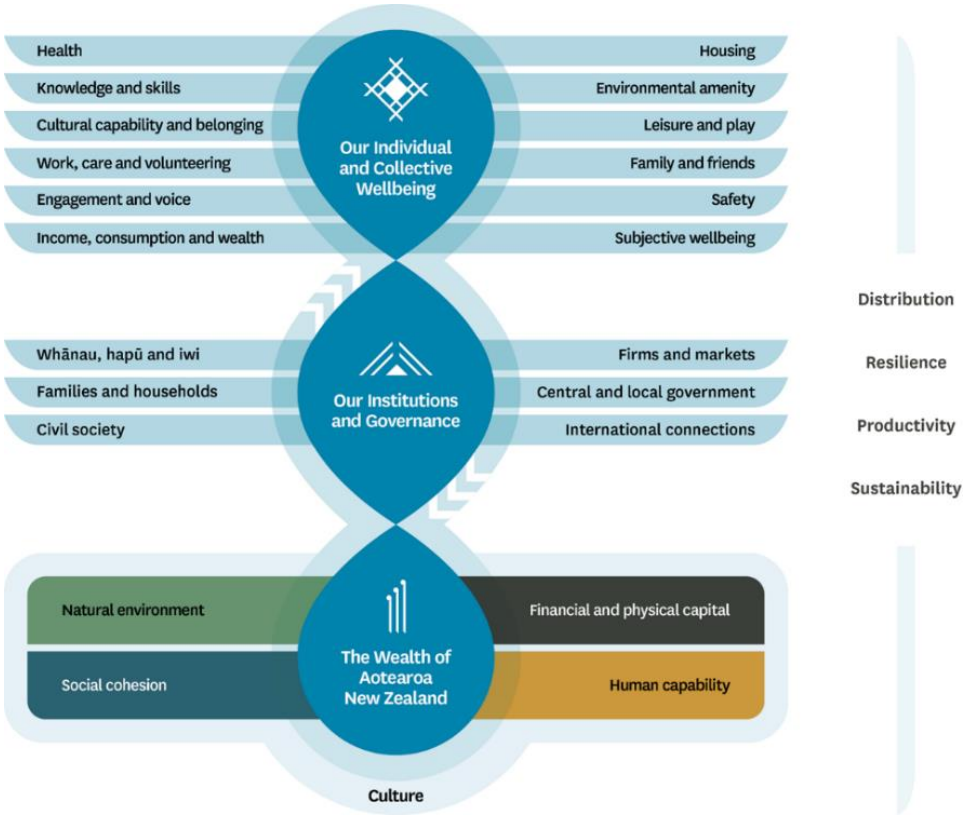

Figure 1. The Treasury's Living Standards Framework

The focus here is on the intended environmental impacts of any interventions on the wealth of Aotearoa New Zealand. The main domain covered in this report is the natural environment with its clear connection to Papatūānuku health and nature's mana. The definition provided by LSF of the natural environment domain is "All aspects of the natural environment which support life and human activity, whether valued for spiritual, cultural or economic reasons".[5] The indicators provided by the LSF in this domain relate mainly to an urban context, so the assessment for the TAC focuses on biodiversity impacts, infrastructure limits and contributions to greenhouse gas emissions.

[4] The Treasury. Our Living Standards Framework. [accessed 17 September 2024]. www.treasury.govt.nz/information-and-services/nz-economy/higher-living-standards/our-living-standards-framework

[5] The Treasury. The Living Standards Framework (LSF) 2021. [accessed 17 September 2024]. www.treasury.govt.nz/publications/tp/living-standards-framework-2021#analytical-prompts

4 Biodiversity context

Two sources provide baseline information about existing species in the vicinity of the TAC. The first is a recent assessment of environmental effects (AEE) for the TAC realignment, Ketetahi end[6] performed in April 2024. While this only covers part of the TAC it gives a good indication of the species present. The second is environmental-DNA[7] (e-DNA) testing in late April 2024, which gives a more comprehensive view of the presence of species either native or invasive around sampling locations. The samples were taken by Department staff in two lakes (Emerald Lakes and Blue Lake) and from water bodies in four basins (Mangatepopo, Mangatipua, Oturere and Upper Whanganui). These results build certainty about existing information on biodiversity in the area traversed by the TAC.

4.1 Native fauna

The e-DNA testing confirmed the presence of invasive bird species, such as Mallard duck/rakiraki, common chaffinch/pahirini, blackbird/manu pango and song thrush/manu-kai-hua-rakau (highlighted in yellow in Table 1). It also showed the presence of native bird species, such as blue duck/whio, black shag/kawau pū, and the New Zealand fernbird/matata also shown in Table 1.

Table 1. Native and invasive (highlighted) bird species and their location within the Tongariro Alpine Crossing

ScientificName	CommonName	Native/Invasive	Blue Lake	Emerald Lake	Mangatepopo	Whanganui	Mangatipuia	Oturere
Hymenolaimus malacorhynchos	Whio; blue duck; whio	Native	Absent	Absent	Present	Present	Absent	Present
Phalacrocorax carbo	Black Shag; kawau pū	Native	Absent	Absent	Absent	Present	Absent	Present
Anas platyrhynchos	Mallard duck; rakiraki	Invasive	Absent	Absent	Invasion	Invasion	Absent	Absent
Zosterops lateralis	Silvereye; pihipihi; tauhou; hiraka	Native	Absent	Absent	Present	Present	Absent	Present
Fringilla coelebs	Common chaffinch; pahirini	Invasive	Absent	Absent	Absent	Absent	Invasion	Absent
Anthornis melanura	Bellbird; korimako	Native	Absent	Absent	Absent	Absent	Present	Absent
Poodytes punctatus	New Zealand fernbird	Native	Absent	Absent	Present	Absent	Absent	Absent
Microcarbo melanoleucos	Little shag; kawaupaka	Native	Absent	Absent	Absent	Absent	Absent	Present
Hemiphaga novaeseelandiae	Kereru; kererū	Native	Absent	Absent	Absent	Absent	Present	Absent
Gerygone igata	Grey warbler; hōrirerire; riroriro	Native	Absent	Absent	Absent	Absent	Absent	Present
Rhipidura fuliginosa	Fantail; pīwaiwaka; pīrairaka; pīwakawaka	Native	Absent	Absent	Absent	Absent	Absent	Present
Turdus merula	Blackbird; manu pango	Invasive	Absent	Absent	Invasion	Absent	Absent	Absent
Turdus philomelos	Song thrush	Invasive	Absent	Absent	Invasion	Absent	Absent	Absent

It is possible *Galaxias brevipinnis* (kōaro) and unidentified galaxias species or eels (tuna) are present, however, little data could be found from the Mangatipua stream or surrounding waterways. According to e-DNA, rainbow trout and brown trout are both present in the waterways within the crossing, and these are considered invasive species.

The Department's Arc Reader kiwi database (last updated October 2021) has only one record of kiwi present in the Ketetahi area, with no other records on that side of Mount Tongariro. However, kiwi records are incomplete unless specific monitoring at night is performed. A list of the bird life that likely exists near the Ketetahi side of the crossing, based on information in the AEE, is shown in Table 2.

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6 Department of Conservation. 2024. Assessment of Environmental Effects for the Tongariro Alpine Crossing realignment, Ketetahi end, Tongariro National Park. Ohakune: Department of Conservation.

7 Environmental DNA: "Genetic material that is shed by organisms as they move in, through, and around their environment. By isolating this material from different reservoirs such as waterways, we can gain valuable insights into the distribution of species through time and space, more sensitively monitor biosecurity threats, and better understand and track fluctuations in ecosystem health". Source: Wilderlab: www.wilderlab.co.nz.

Table 2. Bird species, breeding habits and status within the Tongariro Alpine Crossing (particularly the Ketetahi side)

Species	**Status**	**Egg laying period**	**Ecological breeding habits**
North Island robin (toutouwai)	Declining	September to January	Woven cup in trees
New Zealand pigeon (kereru)	Not threatened	July to June	Raised platforms
Parson bird (tui)	Not threatened	September to January	Bulky cup-shaped nest
Bellbird (korimako)	Not threatened	September to January	Woven cup in trees
New Zealand falcon (kārearea)	Recovering	August to January	Scrape on ground under a log, bush or small rock stack, on ledge of small bluff, or in epiphyte within emergent tree
North Island kākā	Recovering	November to March	Tree holes
Red-crowned parakeet (kākāriki)	Relict	November to January	Nest in cavities
Yellow-crowned parakeet (kākāriki)	Declining	November to January	Nest in cavities
North Island rifleman (titipounamu)	Not threatened	August to December	Nest in cavities
Grey warbler (rirorirori)	Not threatened	August to December	Hanging, enclosed nest in dense vegetation
Fantail (piwakawaka)	Not threatened	August to January	Woven cup in trees
Tomtit (ngirungiru)	Not threatened	September to January	Woven cup, sometimes in cavities
Morepork (ruru)	Not threatened	September to February	Nest in cavities
New Zealand pipit (pihoihoi)	Naturally uncommon	August to January	Woven cup in grass
Western brown kiwi	At risk, declining	May to January	Burrows

The AEE notes limited information is available about gecko and skink species in this area of Tongariro National Park. Table 3 provides a list of lizard species likely to be present based on habitat, probably in low numbers.

Table 3. Status of lizards and gecko species at the Ketetahi side of the Tongariro Alpine Crossing[8]

Barking gecko *Naultinus punctatus* (at risk, declining) Elegant gecko *N. elegans* Could be either of these two.
Forest gecko *Mokopirirakau granulatus* Ngahere gecko *M.* "southern North Island" Could be either of these two.
Pacific gecko *Dactylocnemis pacificus* – range extremity
Raukawa gecko *Woodworthia maculata* – range extremity
Northern grass skink *Oligosoma polychroma*
Crenulate skink *O. robinsoni* – unlikely
Kupe skink *O. aff infrapunctatum* "southern North Island" – but more likely to be *O. robinsoni*

[8] Department of Conservation. 2024. Assessment of Environmental Effects for the Tongariro Alpine Crossing realignment, Ketetahi end, Tongariro National Park. Ohakune: Department of Conservation. Page 14.

Small-scaled skink *O. microlepis*
Striped skink *O. striatum* – range extremity
Kakerakau skink *O. kakerakau*
Copper skink *O. aeneum*
Ornate skink *O. ornatum*

Several best practices can be applied to minimise harm from track realignment to lizard habitats, such as micro-siting, hand-clearing vegetation and sensitive construction mechanisms. Leaving cut vegetation in place to allow individual lizards to escape if they survive removal and gradual, staged clearing of vegetation (especially rank grass or tussock) are recommended to maintain the lizards' sensitive habitats.

4.2 Native flora

The only native plants found to be of significance in the AEE for track alignment work near Ketetahi were 11 individual juvenile mountain toatoa (*Phyllocladus trichomanoides var. alpina*). A full list of native flora is given in Table 4.

Table 4. Native and invasive plant species in the Ketetahi area

Species	**Common name**	**Status**	**Source of information**
Dactylanthus taylorii	Woodrose	Nationally vulnerable	iNaturist, Bioweb
Thismia rodwayi	Thismia	At risk, naturally uncommon	iNaturist, Bioweb
Gentianella grisebachii	Forest gentian	Not threatened	iNaturist
Phyllocladus trichomanoides var. alpina	Mountain toatoa	Not threatened	iNaturist
Hymenophyllum peltatum	One-side filmy fern	Not threatened	iNaturist
Microsorum p.p.		Not threatened	iNaturist
Pterostylis sp.	Greenhood orchid	Not threatened	iNaturist
Hymenophyllum nephrophyllum	Kidney fern	Not threatened	Sara Treadgold, pers. comm (April 2024).
Podocarpus totara var. totara or nivalis	Totara or snow totara	Not threatened	Sara Treadgold, pers. comm (April 2024).
Tupeia antartica	White mistletoe	At risk, declining	Bioweb
Prumnopitys ferruginea	Miro	Not threatened	Singers, N.J.D. (2007)
Prumnopitys taxifolia	Matai	Not threatened	Singers, N.J.D. (2007)
Manoao colensoi	Silver pine	Not threatened	Singers, N.J.D. (2007)
Dacrydium cupressinum	Rimu	Not threatened	Singers, N.J.D. (2007)
Kunzea ericoides	Kānuka	Not threatened	Department species lists
Leptospermum scoparium	Mānuka	Not threatened	Department species lists
Beilschmiedia tawa	Tawa	Not threatened	Department species lists
Pseudopanax arboreus var. arboreus	Five finger	Not threatened	Department species lists
Pseudopanax crassifolius	Lancewood, Horoeka	Not threatened	Department species lists
Coprosma sp.		Not threatened	Department species lists
Hebe sp.		Not threatened	Department species lists
Geniostoma rupestre var. ligustrifolium	Hangehange	Not threatened	Department species lists

Species	Common name	Status	Source of information
Metrosideros colensoi, diffusa, perforata	Climbing rātā, White rātā	Not threatened	Department species lists

4.3 Weeds and rubbish

The presence of the TAC means that the environment close to the track has already been modified by ongoing human disturbance, but some impacts have the potential to grow with increased use. A recent experience plan for the Tongariro Northern Circuit Great Walk is a useful resource for the TAC because they share a section of track between Emerald Lakes and Mangatepopo Hut.[9] The plan states that the "ongoing disturbance to and resulting erosion, littering and human waste around the tracks plus the potential spread of invasive weed are currently the most significant negative impacts on ecosystem values in the area".

If visitor numbers to the TAC remain at current levels, the human waste and rubbish effects should remain localised. However, the spread of exotic species has the potential to become a widespread issue in the Tongariro alpine area. Visitors create opportunities for the introduction and spread of invasive species by bringing the seeds of weeds on boots and clothing. High use likely increases this risk, which needs further monitoring.

A recent example is the spread of Juncus weed in the culturally valued Emerald Lakes (its spread on the banks of the lakes is shown in photo 1. This infestation has taken multiple efforts and significant resources over several years to retain the health and pristine look of the lakes as shown in photo 2.

Photo 1. Effect of Juncus weed on Emerald Lakes (before treatment)

Photo 2. Emerald Lakes free of Juncus weed (after treatment)

Overall, advice from biodiversity experts in the Department and the evidence set out above indicate that effects on ecosystem types and threatened species from human waste, rubbish, and potential spread of exotic species remain low to moderate at current visitor numbers. The experts also recommend ongoing surveillance of the weed population and spread of any exotic species, so these can be managed in a timely manner to protect the fragile alpine ecosystems. A surveillance programme should be included in the environmental monitoring for the TAC, and potential effects on species and ecosystems should be considered before any changes are made to the management of the TAC.

[9] This analysis can be easily replicated from the Great Walk to the Day Hike because they are connected ecosystems and lie within neighbouring ecological management units used by the Department for biodiversity management.

5 Visitor infrastructure limits

The TAC infrastructure carrying capacity is finite. Most track damage arises from weather events and natural erosion, which will be accelerated by climate change. Visitor numbers can also speed up track erosion, and higher activity levels affect track standards over time. In theory, the track surface can support any number of visitors provided maintenance can be funded and carried out regularly enough. However, maintaining the track to standard, given its high use and hostile alpine environment is extremely challenging. Pressure on all infrastructure affects visitors, management costs and cultural values, as well as the environment and climate. Track maintenance limits have been set aside in the rest of this report because thresholds for toilet maintenance are much lower and so are reached first.

5.1 Toilet facilities and volumes of waste

Twenty-eight toilets are available on the TAC, as listed in Table 5. The table shows high use of the toilets located at Blue Lake, Mangatepopo Road end and hut, as well as those in the South Crater. Figure 2 shows the location of the toilets along the track.

Table 5. Toilets available on the Tongariro Alpine Crossing with their capacity and frequency of use

Location	**Number of toilets**	**Capacity per toilet (cubic metres)**	**Frequency of use**
Mangatepopo Road end	4	3.7	High
Ditch track junction	2	3	Low
Mangatepopo Hut	2	3	High
Soda Springs	4	3	Medium
South Crater	3	3	Medium to high
Blue Lake	3	3	Very high
Ketetahi (old hut site)	4	3	Medium
Bush-line	4	3	Low
Ketetahi Road end	2	4	Medium to high
TOTAL	**28**		

Figure 2. Map showing the location of toilets on the Tongariro Alpine Crossing

Figure 3 outlines statistics about waste management for the TAC since 2015/16. These are based on data from activity counters on the track and records of helicopter trips and waste removal. All numbers are estimates to be treated with caution and some gaps exist (2021/22 and 2022/23) where records for TAC toilets are aggregated with other work or counter data is not accessible. Overall, the available information suggests, on average, around 0.5 litres of waste removal is required per visitor. The data for 2017/18 and 2020/21 are outliers, and it is possible it is inaccurate or that visitor behaviour varied for unknown reasons. Until more data is available, a rate of less than 0.4 litres per visitor in any year should raise concerns about whether the facilities are meeting visitor needs, to ensure they are not toileting in nature.

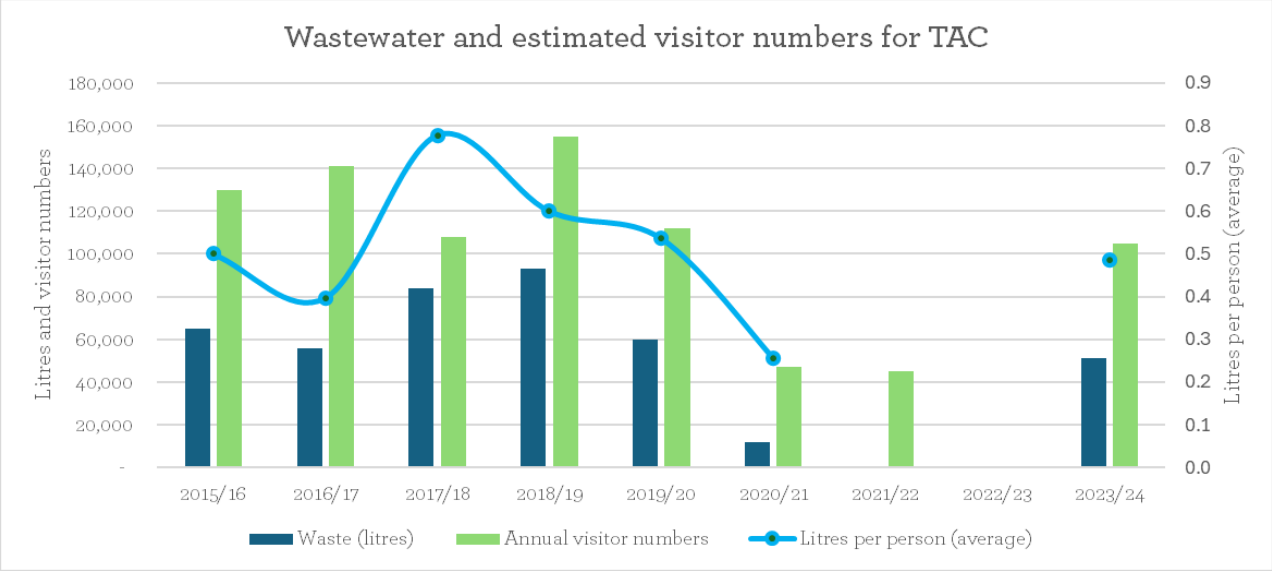

Figure 3. Comparison of wastewater data and estimated visitor numbers for the Tongariro Alpine Crossing (TAC)

5.2 Sewerage management risks, issues and emissions

Installing toilets on the TAC is contentious and comes with risk. The storage capacity for human waste was increased in 2016 and again in 2018 to support the six additional toilet pans. Although this responded to the increasing volume of people, it increased risks of contamination and other accidents while shifting sewage or due to earthquakes. It also increased management costs.

The six new pans were temporary summer toilets, installed at high altitude, close to sacred sites and routinely removed in the winter season when use is low. Visitor toileting in these ecologically fragile and wāhi tapu locations is considered particularly offensive. Ngāti Hikairo ki Tongariro reluctantly supported this intervention to prevent impacts on the cultural and natural environment. Anecdotally, it appears the additional toilets are managing visitor impacts at present-use levels, but more work is required to confirm this and better understand the true carrying capacity of the facilities.

A further consideration is that the Department must meet its climate change obligations and reduce the use of fossil fuels especially aviation and diesel fuel, which is the highest contributor to the Department's carbon dioxide emissions profile. Reducing waste removal from TAC toilets to 60,000 litres would stabilise carbon use and reduce the frequency of its removal to less than monthly. The Department is developing a TAC carbon use plan to verify this reduction strategy. The plan will also consider longer term options to dewater the waste through evaporation before its removal.

5.3 Carrying capacity for toilet infrastructure

The carrying capacity of toilet facilities is the product of their ability to meet demand and the Department's capacity to maintain service levels to avoid visitors toileting in nature. Research and data from 2016/17 suggest that "1000 – 1100 counts per day might represent a state or a target where adverse impacts could be managed in more defined and sustainable ways".[10] This proposed limit, while primarily based on ability to manage visitor congestion and satisfaction, provides good guidance for management of visitor flow and wait times for facilities.

For management of toilet tank levels and removal of waste, it is useful to consider historic wastewater data and its relationship to annual visitor volume and daily averages. At the peak of visitor growth in 2018/19, when over 150,000 visitors completed the TAC, 93,000 litres of black water were removed from facilities, putting a strain on resources. The annual daily averages of visitors that season were around 800 per day,[11] which suggests a sustainable average for waste management could be lower than the 1,000 to 1,100 per day rate suggested above for visitor flow and wait times. In 2016, when pressure on facilities management was lower, the summer and autumn daily averages were around 650 visitors per day. Based on all the above, the carry capacity for infrastructure could be within the range of 700 to 1,000 visitors per day.

It is important to note that further increasing the supply of toilets is not an option because:

- fundamentally toileting and human waste on the TAC is offensive to iwi
- risks exist from leakage while waste is contained and through spillage during its removal
- constructing facilities has significant environmental and cultural impacts
- waste removal requires intensive carbon use to transport it (helicopter/tanker).[12]

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10 Keyes, H. 2016. Tongariro Alpine Crossing – where to from here. Tongariro Journal 2016. December 2016: 61.

11 Annual (summer autumn) day averages provide a useful measure because they allow for adverse weather days and reflect a visitor model that aims to spread demand from peak days (weekends and holidays).

12 In 2018, around 93,000 litres of human waste were flown out over the season, with monthly service flights completed over the season to manage the volume.

Therefore, the future strategy for human waste management on the TAC is to:

- ensure the existing facilities meet demand
- reduce the need for temporary summer toilets at sacred sites
- reduce carbon emissions from transporting human waste.

Achieving this strategy will require accurate monitoring and determining the carrying capacity of the existing TAC toilet facilities. This will inform objectives for visitor wait times at facilities, annual targets for total volume and frequency of removed waste, and ensure total containment of human waste.

6 Conclusion

This report outlines available baseline data on biodiversity in the area surrounding the TAC. It identifies the main impacts of TAC visitors as coming from human waste, rubbish and the potential spread of exotic species. It estimates the biodiversity impact at current visitor numbers to be low to moderate. Further survey work would increase our understanding of that baseline and enable closer monitoring of the spread of any invasive species. The limitations of the existing toilets, and challenges in removing sewerage and waste management in an alpine environment are highlighted. While no environmental carrying capacity is established in this report, infrastructure limits are noted as the most pressing consideration, particularly given the cultural significance of the TAC's location.

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