NEW ZEALAND
Society on Large Dams

Symposium on Advances in New Zealand and International Dam Practice

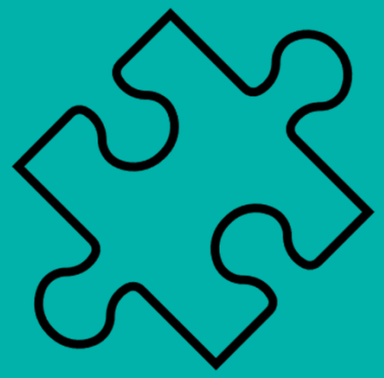
Online, 22 to 23 March 2022

# Public Safety Around Dams

Hanna Aung

Dam Safety Analyst, Watercare Services Limited.

# What is Public Safety?



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# What is Public Safety?

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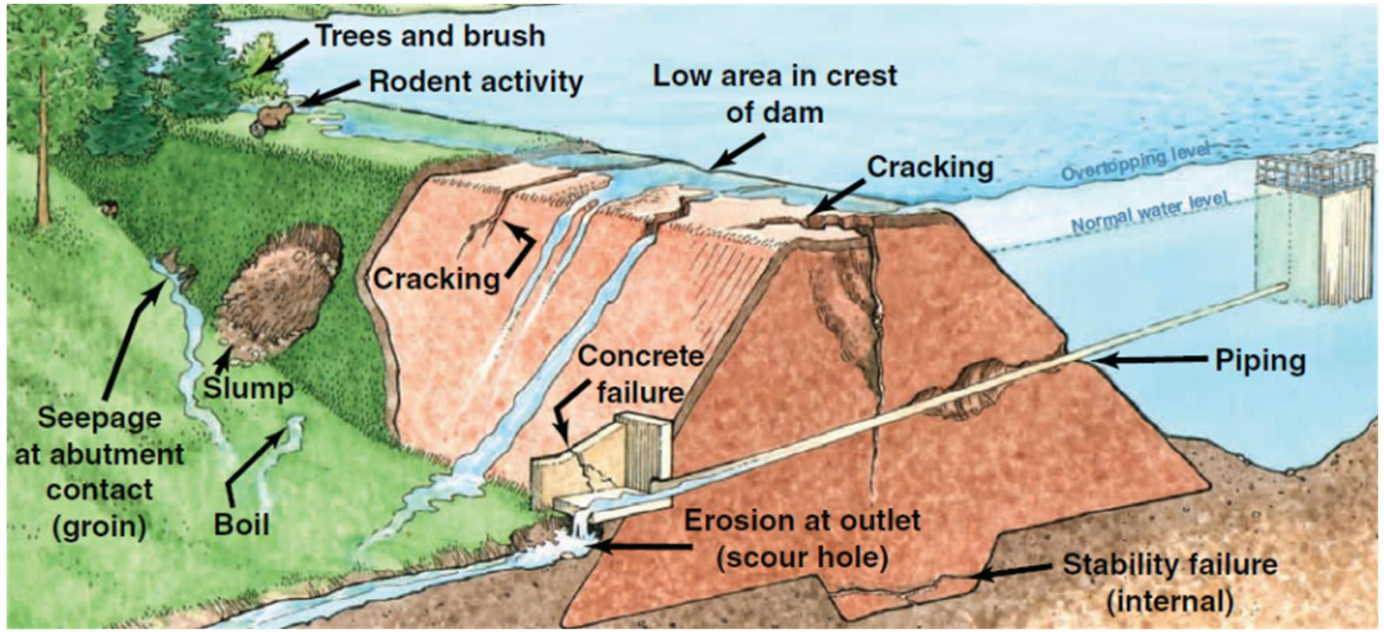
NEW ZEALAND
Society on Large Dams

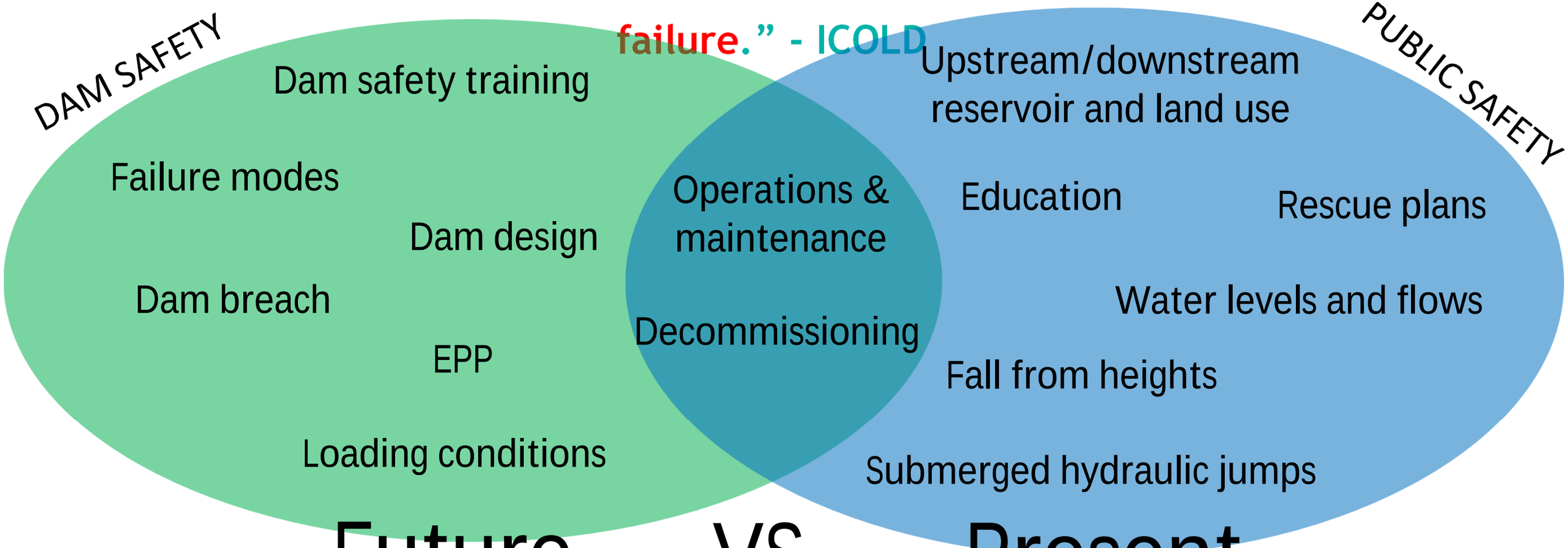
# Dam Hazard and Risk

"Dam Safety: The safe operation and management of dams and their reservoirs for all stages of the dam's lifecycle"

"Necessary to protect people, property and the environment from the potentially catastrophic impacts of a dam failure or unexpected release from the impounded reservoir."

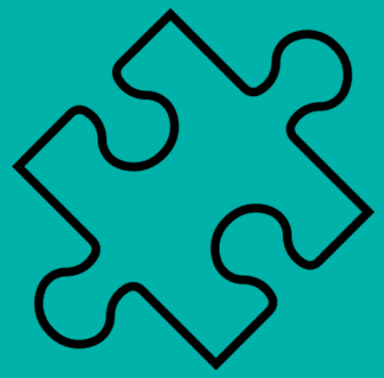


"Public Safety Around Dams encompasses all risks to the public created by the presence of the dam and its operation excluding those that result from a dam failure." - ICOLD



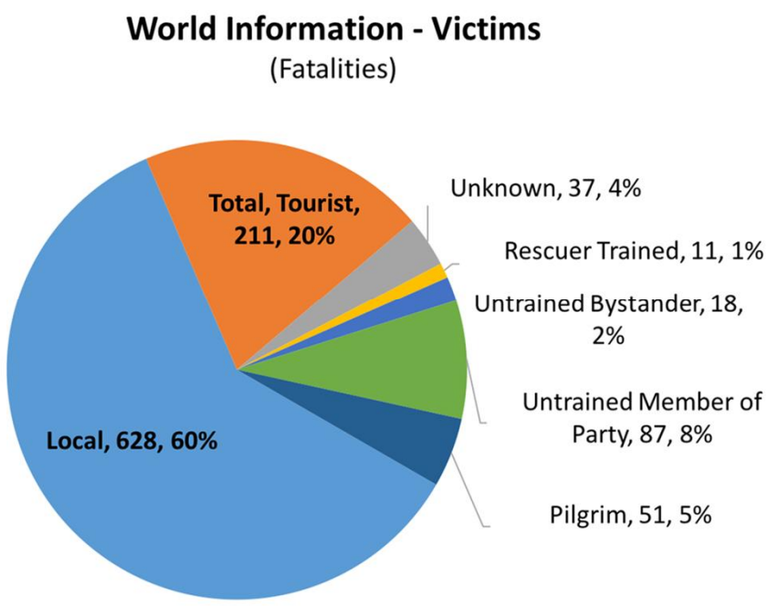

Future VS Present

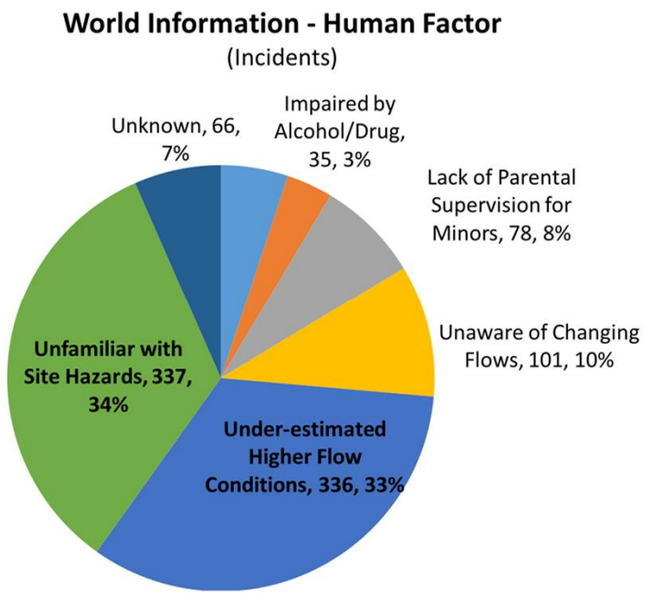
# Why is Public Safety Important?



# Global Known Statistics

| Area | Incidents in database | Fatalities in database |
|---|---|---|
| Africa | 5 | 15 |
| Asia | 49 | 180 |
| Australia/NZ | 23 | 17 |
| Canada | 343 | 29 |
| Europe | 50 | 97 |
| Latin America | 4 | 13 |
| United States | 530 | 431 |
| Total | 1004 | 1043 |




PennLive.com

Low-head dam where 11-year-old boy drowned is demolished

Such dams are known as “drowning machines” because of their effectiveness at drowning anyone unfortunate to end up in the circulating waters...

25/06/2021

SAPeople

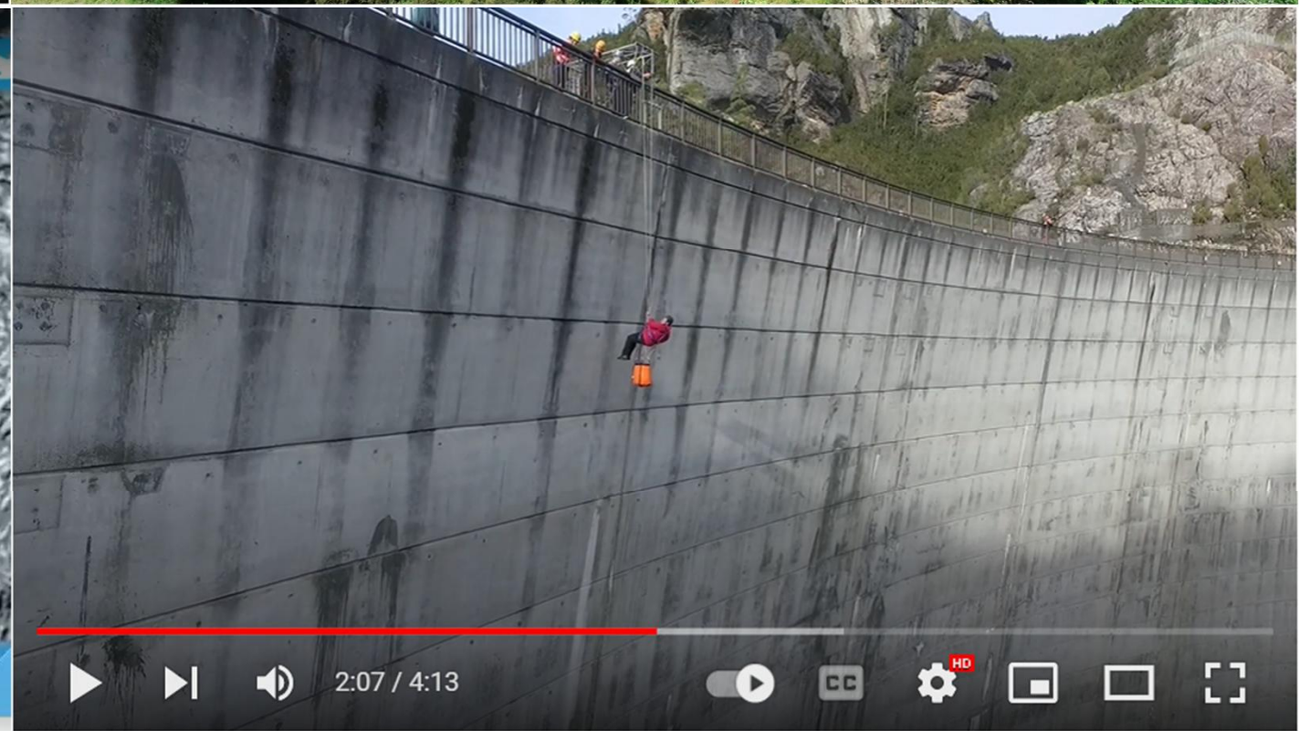
UPDATE: 26-Year-Old’s Body Retrieved from Silvermine Dam in Table Mountain National Park

The South African National Parks (SANParks) has announced that the Silvermine Dam is again closed until further notice, due to a drowning which...

20/11/2021

4:10 / 6:39

Video shows boat with 4 women hanging over dam
JUNE 11, 2021 / 00:36
@ATCEMS
BOATERS RESCUED AFTER CLOSE CALL AT TEXAS DAM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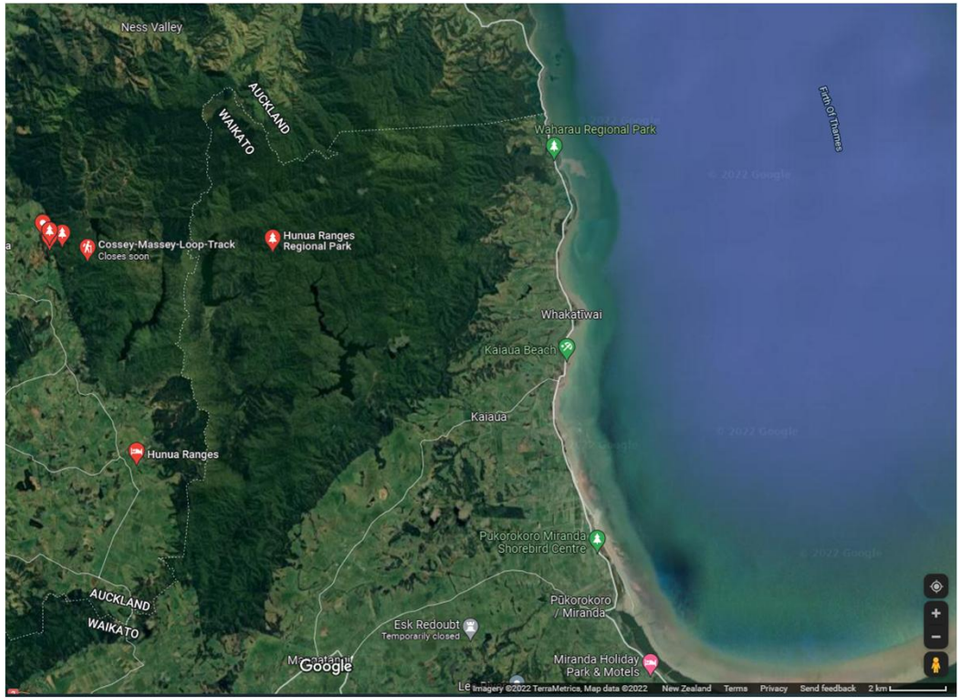
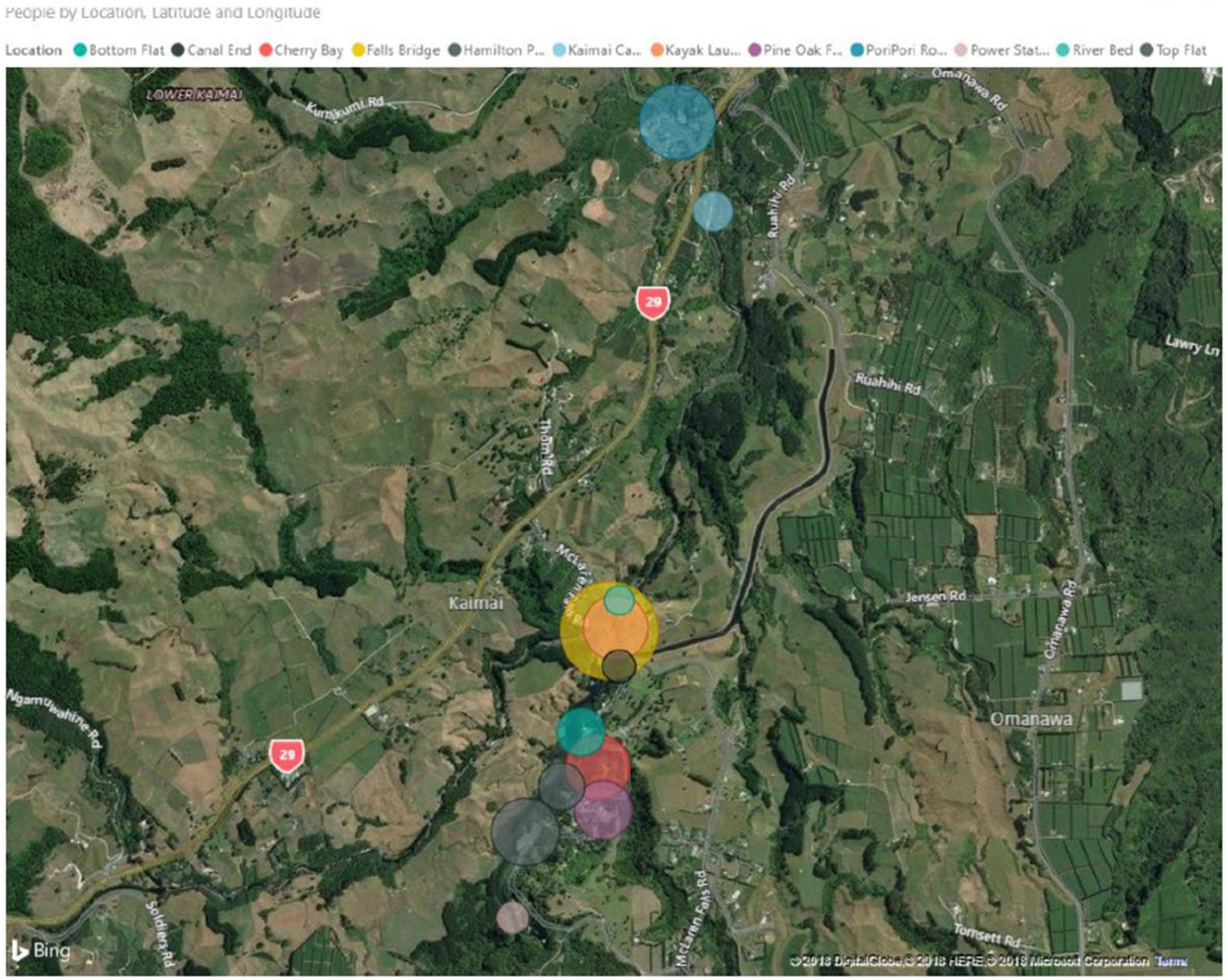
# Southern Regional Parks Visitor Numbers



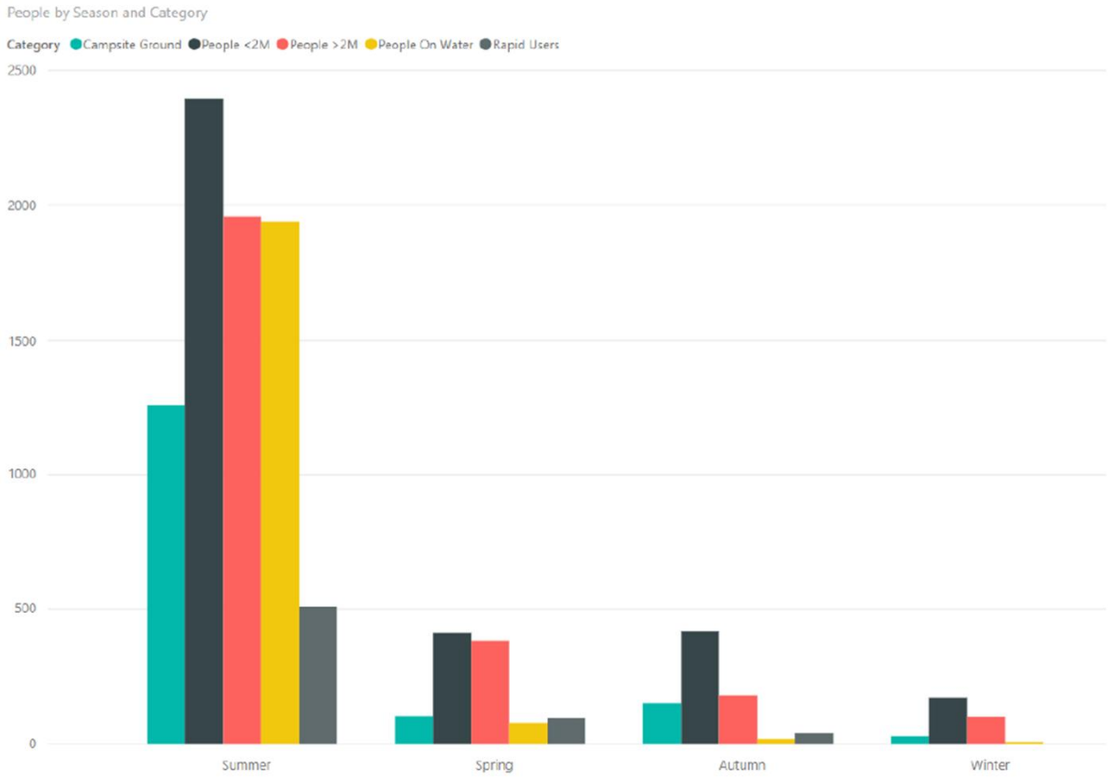

- Steady increase over the last five years, with approximately 250,000 visitors between July 2019 and June 2020
- Readings taken monthly via car counters (2.7 people per car)
- Car counters at entrances to Hunua Falls, Mangatawhiri Valley, Wairoa, and Cosseys
- Visitor satisfaction survey conducted annually – Hunua Falls included
- Deployment of network of counters on cycle/walking tracks in early 2021

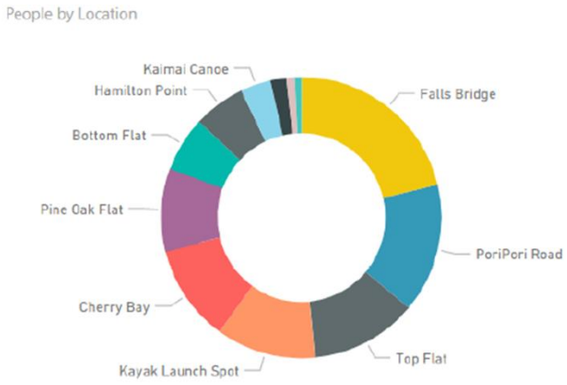
Auckland Council
Te Kaunihera o Tāmaki Makaurau

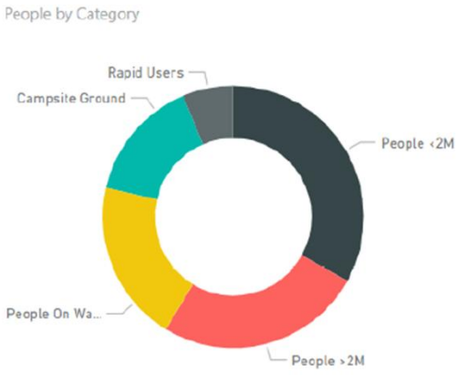
# Wairoa River Use Survey Report – UAV Services, July 2018




- 96 facility usage surveys carried out from September 2017 to June 2018
- Areas surveyed: Lake McLaren, Falls Bridge, Kaimai Canoe Club and Water Hole, and Poripori Road Carpark and Water Hole
- Survey timings varied slightly depending on day, weather, and happenings, but mostly based date and timing guides lines provided on the Trustpower schedule (10 am, 2 pm, 6 pm)
- Standard vs High Flow Survey



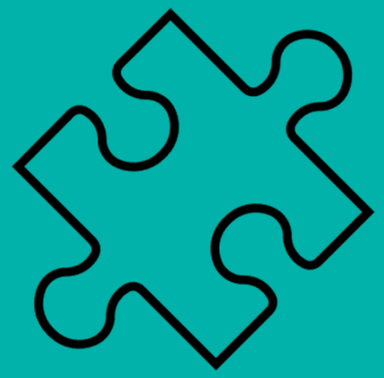

- Grand total of 10,256 facility users
- Majority on busy days from swimming activities in or around the water level at the Falls Bridge, Kaimai Canoe Club and Poripori Road swimming holes
- The numbers of people using the facilities was greatly dependant on the climate at the facility
- Several occasions where number of facility users arrived after an area survey had been completed or leaving before the area survey commenced
- Numbers during peak times fluctuated greatly depending on the time of day and whether it was the holiday period

# Implications of Public Safety Control Measures on Dam Safety

"Some controls considered necessary for the mitigation of public safety hazards may place constraints on dam operation which, in turn, may influence dam safety."

- Notification to downstream users – the alert wave
- Ramping rates
- Specific control periods
- Pre-spill, to "prime" river prior to floods
- Stepped discharge changes

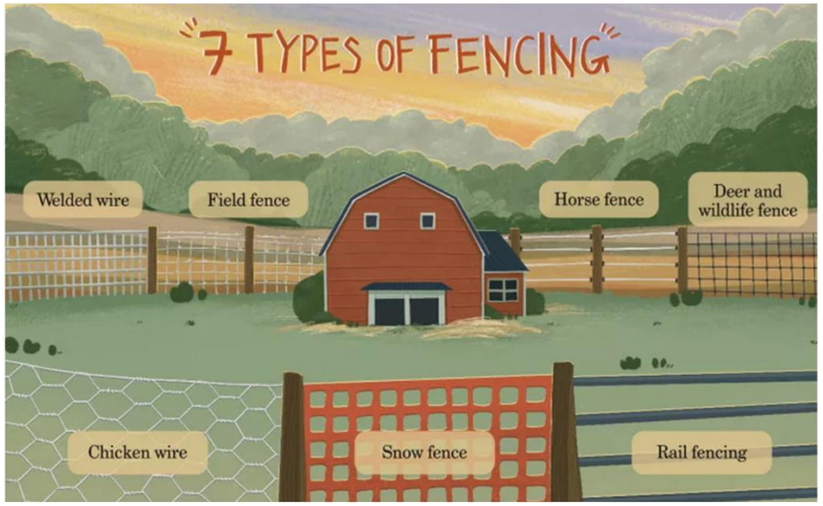
# How do we improve?

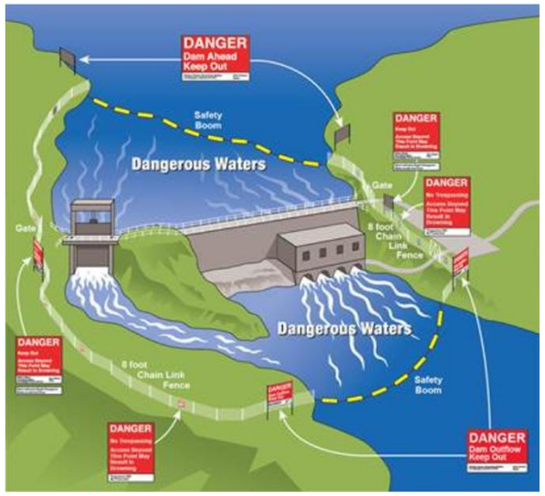


# “The simple existence of a water body attracts the public.”

It’s easy!

- Signage
- Barriers
- Booms and buoys
- Alarms



# ICOLD Public Safety Maturity Matrix

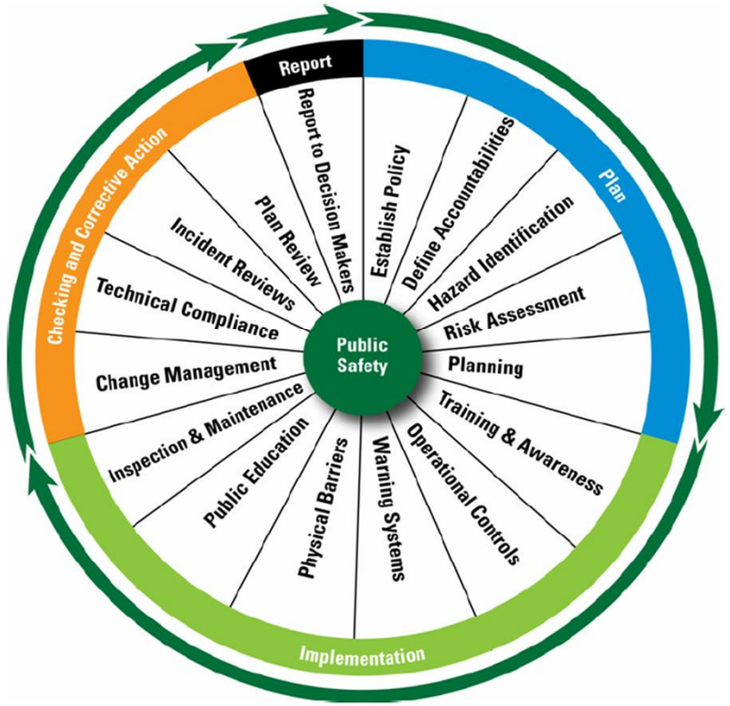
| Level 1: Inital | Level 2: Intermediate | Level 3: Good | Level 4: Advanced | Level 5: Comprehensive |
|---|---|---|---|---|
| • Significant development required. | • Some aspects addressed | • Most aspects addressed | • Aspects addressed to a good level | • All areas consistently addressed to at least a good level |

## How does New Zealand compare?

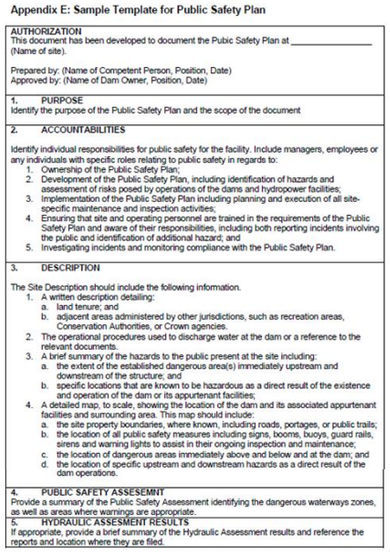
| | | | | | |
|---|---|---|---|---|---|
| *Regulatory Framework* | A Few Countries | Majorityof Countries | Some Countries | A Few Countries | No Countries |
| *Education* | Many Countries | Many Countries | A Few Countries | A Few Countries | No Countries |
| *Incident Management* | Many Countries | Majority of Countries | Some Countries | A Few Countries | No Countries |
| *Physical Measures* | A Few Countries | Many Countries | Many Countries | A Few Countries | No Countries |
| *Operational Measures* | Several Countries | Majority of Countries | A Few Countries | A Small Few Countries | No Countries |

# International Practices

**Figure 1 – The Public Safety Wheel: A Managed System Approach to Public Safety Around Dams**




(Source: Canadian Dam Association – Technical Bulletin: Public Safety Around Dams)



**Appendix E: Sample Template for Public Safety Plan**

**AUTHORIZATION**
This document has been developed to document the Pubic Safety Plan at _____ (Name of site).

Prepared by: (Name of Competent Person, Position, Date)
Approved by: (Name of Dam Owner, Position, Date)

**1. PURPOSE**
Identify the purpose of the Public Safety Plan and the scope of the document

**2. ACCOUNTABILITIES**

Identify individual responsibilities for public safety for the facility. Include managers, employees or any individuals with specific roles relating to public safety in regards to:

1. Ownership of the Public Safety Plan;
2. Development of the Public Safety Plan, including identification of hazards and assessment of risks posed by operations of the dams and hydropower facilities;
3. Implementation of the Public Safety Plan including planning and execution of all site-specific maintenance and inspection activities;
4. Ensuring that site and operating personnel are trained in the requirements of the Public Safety Plan and aware of their responsibilities, including both reporting incidents involving the public and identification of additional hazard; and
5. Investigating incidents and monitoring compliance with the Public Safety Plan.

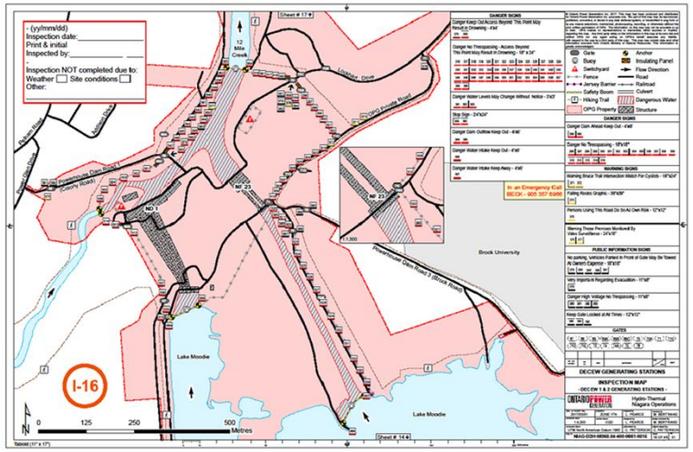
**3. DESCRIPTION**

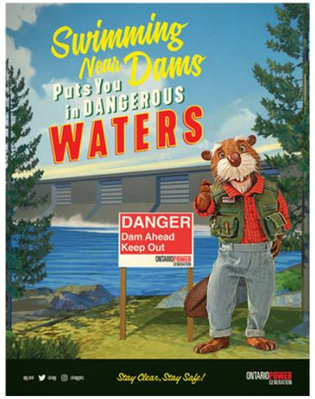
The Site Description should include the following information.

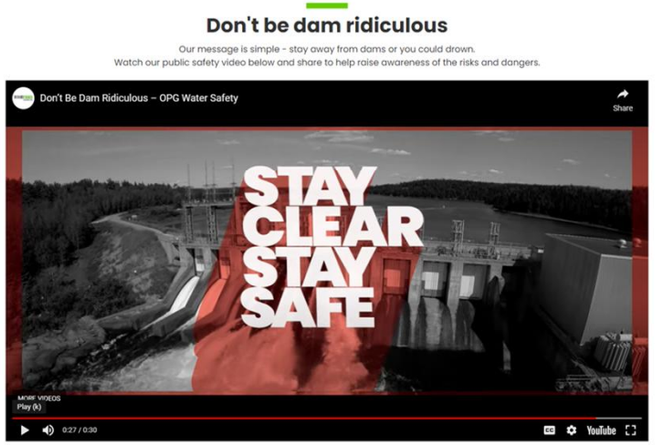
1. A written description detailing:
   a. land tenure; and
   b. adjacent areas administered by other jurisdictions, such as recreation areas, Conservation Authorities, or Crown agencies.
2. The operational procedures used to discharge water at the dam or a reference to the relevant documents.
3. A brief summary of the hazards to the public present at the site including:
   a. the extent of the established dangerous area(s) immediately upstream and downstream of the structure; and
   b. specific locations that are known to be hazardous as a direct result of the existence and operation of the dam or its appurtenant facilities;
4. A detailed map, to scale, showing the location of the dam and its associated appurtenant facilities and surrounding area. This map should include:
   a. the site property boundaries, where known, including roads, portages, or public trails;
   b. the location of all public safety measures including signs, booms, buoys, guard rails, sirens and warning lights to assist in their ongoing inspection and maintenance;
   c. the location of dangerous areas immediately above and below and at the dam; and
   d. the location of specific upstream and downstream hazards as a direct result of the dam operations.

**4. PUBLIC SAFETY ASSESEMNT**
Provide a summary of the Public Safety Assessment identifying the dangerous waterways zones, as well as areas where warnings are appropriate.

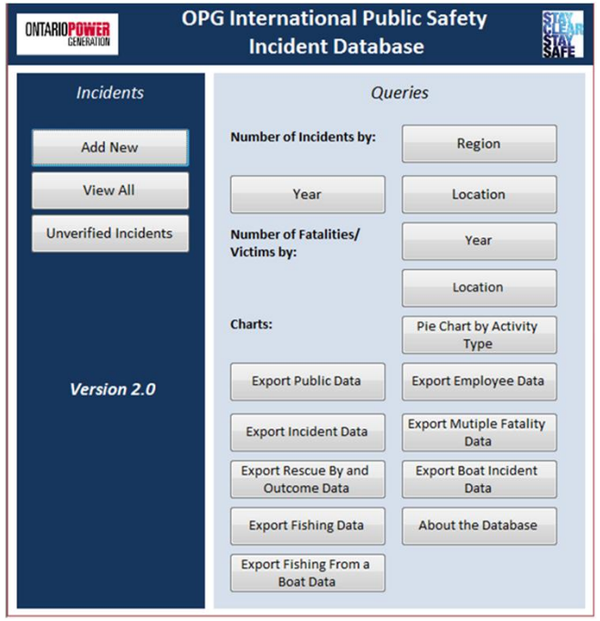
**5. HYDRAULIC ASSESMENT RESULTS**
If appropriate, provide a brief summary of the Hydraulic Assessment results and reference the reports and location where they are filed.

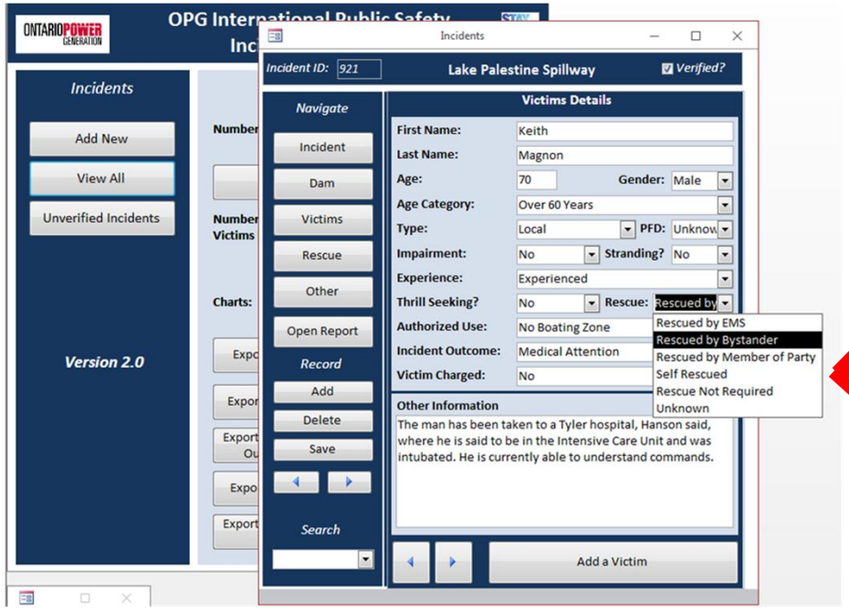


# International Practices

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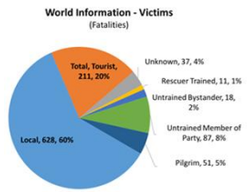
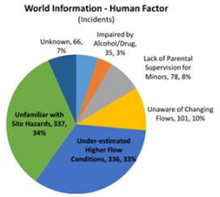
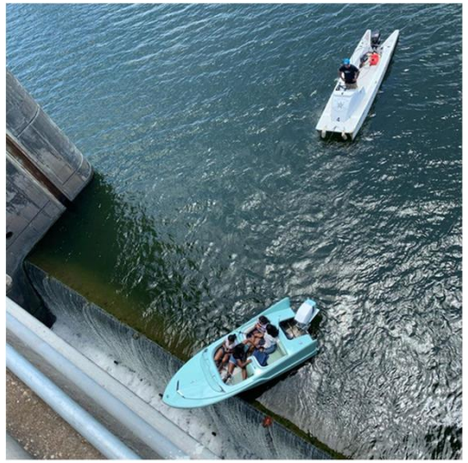
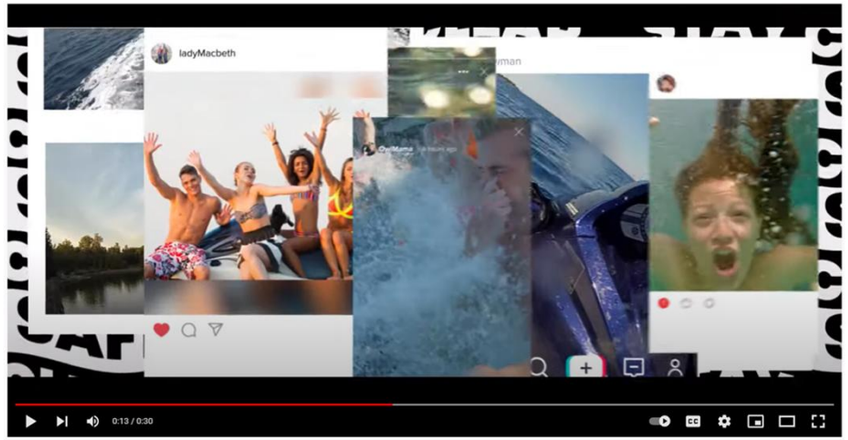
| Asia | 49 | 180 |
| Australia/NZ | 23 | 17 |
| Canada | 343 | 29 |
| Europe | 50 | 97 |
| Latin America | 4 | 13 |
| United States | 530 | 431 |
| **Total** | **1004** | **1043** |






Don't Be Dam Ridiculous – OPG Water Safety

NEW ZEALAND
Society on Large Dams

# New Zealand Practices

## 2. Public Safety Around Dams

### 2.1 Introduction

Beyond the hazard associated with the potential uncontrolled release of the reservoir, dams, their reservoirs and their associated hydraulic structures can incorporate a wide variety of other hazards that can affect public safety. The simple existence of a water body attracts the public. The construction of a dam often facilitates easier public access through the provision of roads and access points directly to the river or water body, and the provision of improved public access is often a consent condition for the construction of a dam. In addition, the demand for public access is increasing over time as is the range and nature of water-based recreational activities.

Public safety hazards that are typically encountered at, and in the vicinity of, a dam and reservoir include:

- Hazards associated with reservoir operation – changing water levels, submerged intakes, submerged structures which may be located just beneath the reservoir surface, and floating debris.
- Hazards associated with discharges from spillway and sluice facilities, or climbing on or traversing these facilities – physical drops, high water velocities and turbulence, unsecured deck gratings over sluice gate openings, and automatic or remote operation of spillway and sluice facilities.
- Hazards associated with approaching the spillway or intake facilities from the reservoir.
- Hazards associated with intake and conveyance facilities – physical drops, high water velocities, steep and slippery canal side slopes, and high undercurrents associated with inlets to conduits, tunnels, drop inlet structures and inverted siphons.
- Hazards associated with other discharge sources including power stations and surge relief facilities, sudden increases in flow, high water velocities, turbulence and vortices, and slippery shoreline surfaces at low tailwater levels.

While not directly related to the safety of a dam, the protection of the public and operating personnel from hazards associated with the presence of a dam, an appurtenant structure and a reservoir, and the operation of a dam and its associated hydraulic structures is an important component of dam safety management. Some controls considered necessary for the mitigation of public safety hazards may place constraints on dam operation which, in turn, may influence dam safety. For example, a constraint on the rate of spillway gate opening to reduce the risk to downstream river users could reduce the Owner's ability to safely manage a large flood event.

Owners are obligated under the Health and Safety in Employment Act to ensure that dam workplaces are safe for operational employees and persons who enter the site.

The following subsections outline a recommended approach for the management of public safety at dams. The approach includes:

- Identifying and assessing potential hazards.
- Controlling the hazards by changing operational procedures, installing physical controls, or installing warning signs and devices.
- Managing the hazards through a documented public safety plan, inspection and maintenance activities, and continual review and improvement processes.

The material largely reflects recommended practices included in the Canadian Dam Association publication "Dam Safety Guidelines" (2007) and their associated "Guidelines for Public Safety around Dams" (2011).

### 2.2 Hazard Identification and Assessment

The initial step in the development of a site-specific public safety plan is the identification and assessment of hazards.

Unlike dam safety hazards, public safety hazards associated with dam operation may have little to do with the size of the dam and/or the volume of the stored fluid. Similarly, downstream populations that may be at risk from a dam failure may have little relevance to public safety hazards associated with the operation of the dam. For example, the public safety hazard of a small Low PIC weir, which is utilised by the public for recreational activities, may be much greater than the dam safety hazard.

The identification and assessment process should include:

- Consideration of the physical extent, both upstream and downstream, to which dam operation introduces potential hazards to the public and operating personnel.



- A discussion with site operating personnel to determine areas visited by the public, determine the nature of the visits, discuss hazards, and discuss past incidents or 'near misses' which may have occurred at the site.
- A site inspection with operating personnel to identify and assess hazards, and the appropriateness of existing barriers, warning signs and warning devices.
- A review of existing operating procedures for the safe management of hazards associated with the operation of hydraulic structures (e.g. spillway gates, sluice gates, generation plant).
- Consideration of any differences in the identified hazards that may arise through automatic, remote and local operation.
- A qualitative assessment of the identified hazards and a ranking of the hazards according to their potential to result in loss of life or injury.

In addition, it may be appropriate to meet with local authorities and recreational groups to obtain an improved understanding of public access to water bodies that are affected by dam operation.

### 2.3 Hazard Controls

A variety of measures are available for the control of hazards. In a limited number of cases it may be practicable to eliminate the hazard (e.g. a stilling basin could be designed or modified to eliminate back eddies that could trap swimmers). In some cases hazards may be able to be mitigated by the adoption of alternative operating procedures while, in other cases, hazards may be best controlled by the installation of barriers, warning signs, rescue equipment or alarms.

Operating procedures which minimise sudden rates of change in water levels and flows can be very effective in the mitigation of hazards associated with the discharge of water from spillway, sluice and generation facilities. Wherever possible, operating procedures should include requirements for:

- Visual observation prior to operation.
- Audible and/or visual alarms prior to operation.
- Incremental gate or valve openings, or machine discharges to avoid sudden large increases in water levels and flows.

In some situations it may be appropriate to include time-specific operational controls. For example, a tighter constraint on the rate of change in a discharge may be appropriate during the summer months when numerous recreational activities are present in the downstream river.

If hazards cannot be eliminated or mitigated, physical control measures such as lake booms, barriers, fences, warning signs and warning alarms should be considered. Lake booms are usually installed upstream of spillway and intake facilities, barriers and fences are usually provided to protect against vertical falls (e.g. from the crest of a concrete dam) and prevent unauthorised operation of gate facilities, and warning signs and alarms are usually installed in areas where physical barriers are impractical (e.g. downstream of spillway and sluice gate facilities).

### 2.4 Hazard Management

Where operation poses a risk to public safety, hazard management should include the preparation of a site-specific public safety plan, periodic inspection and maintenance activities, periodic review and updating of the plan to reflect any changes in the hazards, and a system of incident reporting.

Where warranted, a site-specific public safety plan should outline:

- The objectives of the plan.
- Individual responsibilities for public safety, the development and implementation of the plan, the training of operating personnel in the requirements of the plan, and the reporting of public safety incidents.
- A summary of the identified hazards and the results of the hazard assessment.
- A description of the physical control measures installed at the site and a plan showing their locations.
- A reference to the operational procedures for spillway and sluice gate operation, surge facility operation and machine start-up.
- Procedures for the inspection of hazards and the maintenance of physical control measures.
- Procedures for the reporting and evaluation of public safety incidents, including both 'near miss' and actual events.

Records should be kept of all inspection and maintenance activities and all incident reports.



Guidelines and upcoming regulations?

Who is responsible?

Who sets the standard?

# New Zealand Practices

## OUR COMMUNITY

Mercury

Our stations are located around many recreational areas accessible by the public. We're committed to keeping people safe near our hydro dams, geothermal stations and other sites. We work closely with local authorities and communities to continually assess and improve safety around sites.

- Radio & newspaper campaigns
- Public Safety audits/review
- Staff interviews – local knowledge, near misses
- Public education – local school visits, open days
- Public Safety Management System
- Documentation – near misses, control measures, hazards, etc.
- Removing Public Safety from H&S umbrella

## Have a hmmm...

We're starting by asking New Zealanders to do something easy: Take a moment and think of others before acting.

Find out more

**He Kaupare. He Manaaki. He Whakaora.**

**prevention. care. recovery.**

Water Safety NEW ZEALAND

## A family of websites.

Water Safety New Zealand delivers information and resources that are specific, and made relevant, for various audiences.

Kia Maanu Kia Ora – Stay Afloat Stay Alive

Under5 – Water Safety for Little People

Water Skills for Life

NEW ZEALAND WATER SAFETY SECTOR STRATEGY 2025

Alcohol.org.nz | Help & advice | Alcohol & its effects | In your community | Management & laws | Resources & research

## Welcome to alcohol.org.nz

Information, advice, research and resources to help prevent and reduce alcohol-related harm and inspire New Zealanders to make better decisions about drinking alcohol. This website is run by Te Hiringa Hauora/Health Promotion Agency.

### Need help with your drinking?

Call the Alcohol Drug Helpline on 0800 787 797, visit their website, or free txt 8681.

SAY YEAH, NAH AND EASE UP ON THE DRINK

slido

# What are other ways we can improve?

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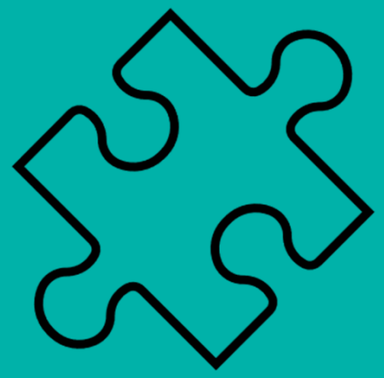
# What is Public Safety?



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# What is public safety?

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# Conclusions

- What is public safety?
- Why is it important?
- How can we improve?

# What next?

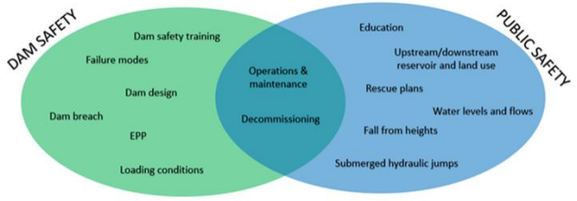
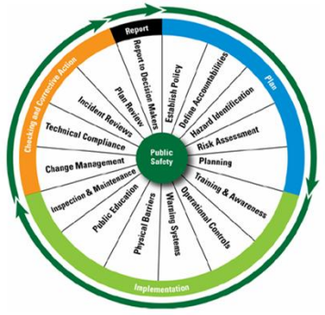
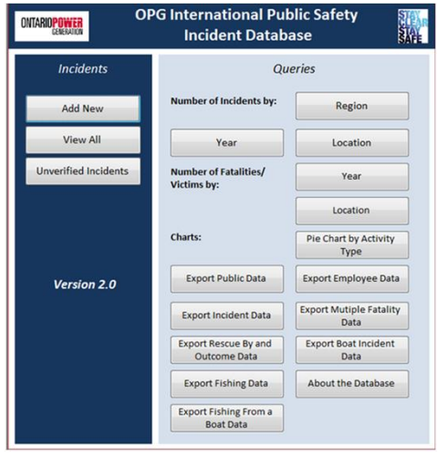
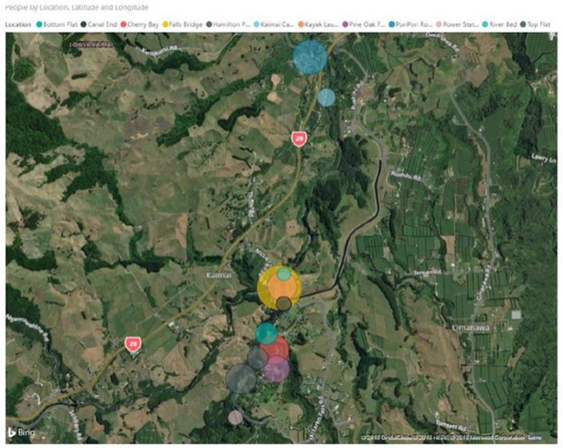



Figure 1 – The Public Safety Wheel: A Managed System Approach to Public Safety Around Dams




(Source: Canadian Dam Association – Technical Bulletin: Public Safety Around Dams)





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