



NEW ZEALAND
Society on Large Dams

Workshop on Consequence Assessment and Potential Impact Classification

Online Webinar

2nd to 3rd November 2020

An Introduction to Consequence Assessment and Potential Impact Classification

Peter Lilley

Assessing Consequence

Fundamental Dam Safety Objective

*People, property and the environment, present and future, should be **protected** from the harmful effects of a dam failure or an **uncontrolled release of the reservoir contents**.*

If there was an **uncontrolled release of the reservoir contents**, it is appropriate to assume that there would be adverse **consequences**.



Assessment of Consequence

New Zealand Dam Safety Guidelines

Module 1, Principle 1

The consequences of a dam failure should be understood so that appropriate design, construction and management actions can be applied to protect people, property and the environment.



Consequence, the effect, result or outcome of something occurring earlier.

Assessment of Consequence



Overview of the Dam Classification Process

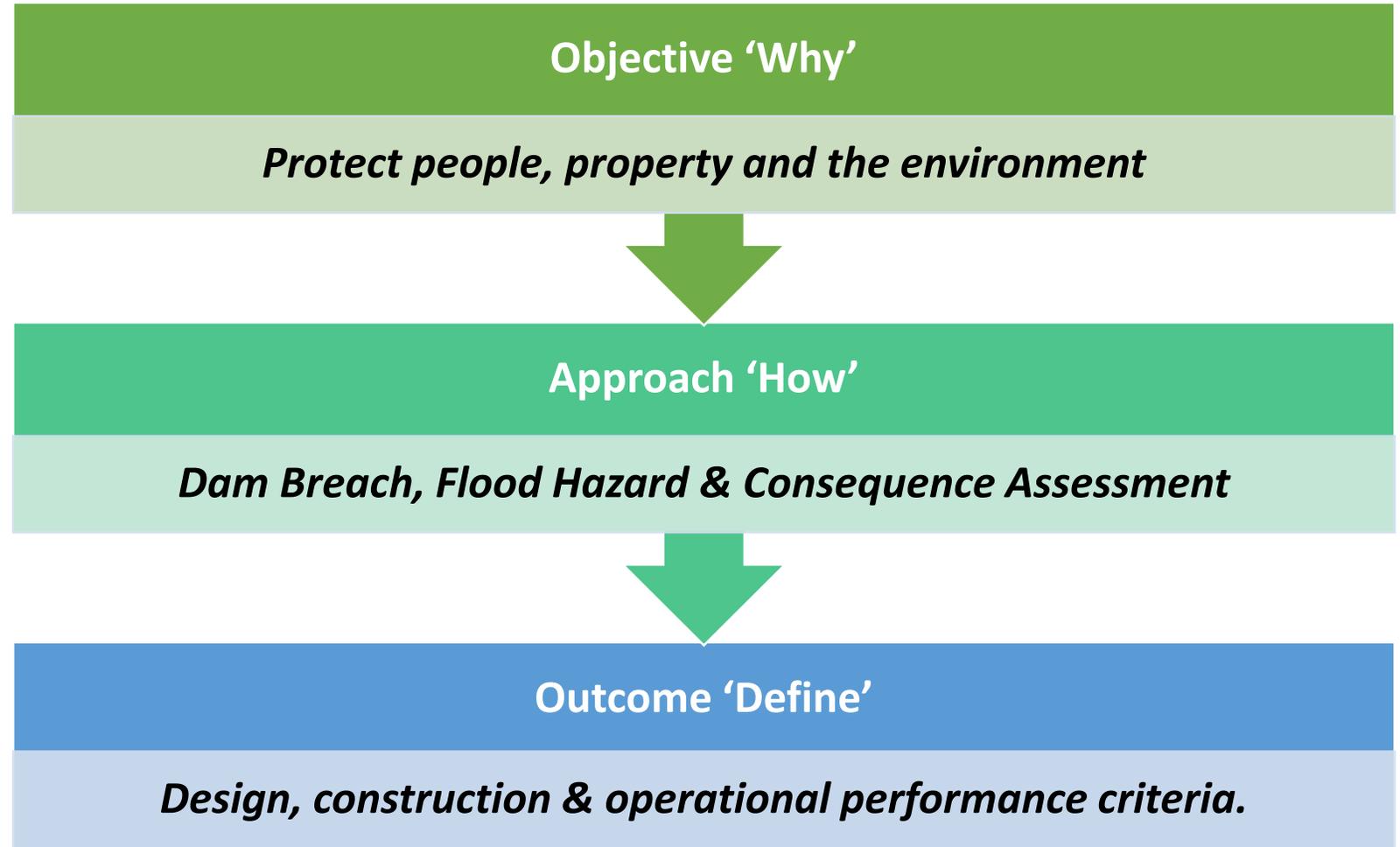
Provides an overview of the process. The guidance provided is however more relevant to dam practitioners than non-technical people.

Module 2, Figure 1.1: Overview of the Dam Classification Process

Assessment of Consequence



Dam Safety Objective Process
Overview of the consequence assessment 'thought process' to achieve the overall objective.



Assessment of Consequence

New Zealand Dam Safety Guidelines. Principle 1

The **consequences** of a dam failure should be understood so that appropriate design, construction and management actions can be applied **to protect people, property and the environment.**

So the reason **why** we need to establish consequences, is to determine...

the potential impact of a dam failure on;

- **people,**
- **property and**
- **the environment.**



Assessment of Consequence

Potential Consequence on

People, Injury or loss of life.

Property, damage to property and infrastructure (reinstatement considerations).

Environment, damage (magnitude & recovery time)

Social & Economic, disruption (limited guidance).



Assessment of Consequence

New Zealand Dam Safety Guidelines. Principle 1

The **consequences** of a dam failure should be understood so that appropriate design, construction and management actions can be applied **to protect people, property and the environment**.

So we now know **why** we are seeking to determine the consequences, but **how** do we determine those consequences?



The short answer: *We assume the dam fails releasing its contents. Often referred to as a **Hypothetical Dam Breach**. From this we determine the downstream flood hazard and subsequently **who and what is impacted** by such a flood, and **the magnitude of that impact**.*

Assessment of Consequence

Objective 'Why'

Protect people, property and the environment



Approach 'How'

Dam Breach, Flood Hazard & Consequence Assessment



Outcome 'Define'

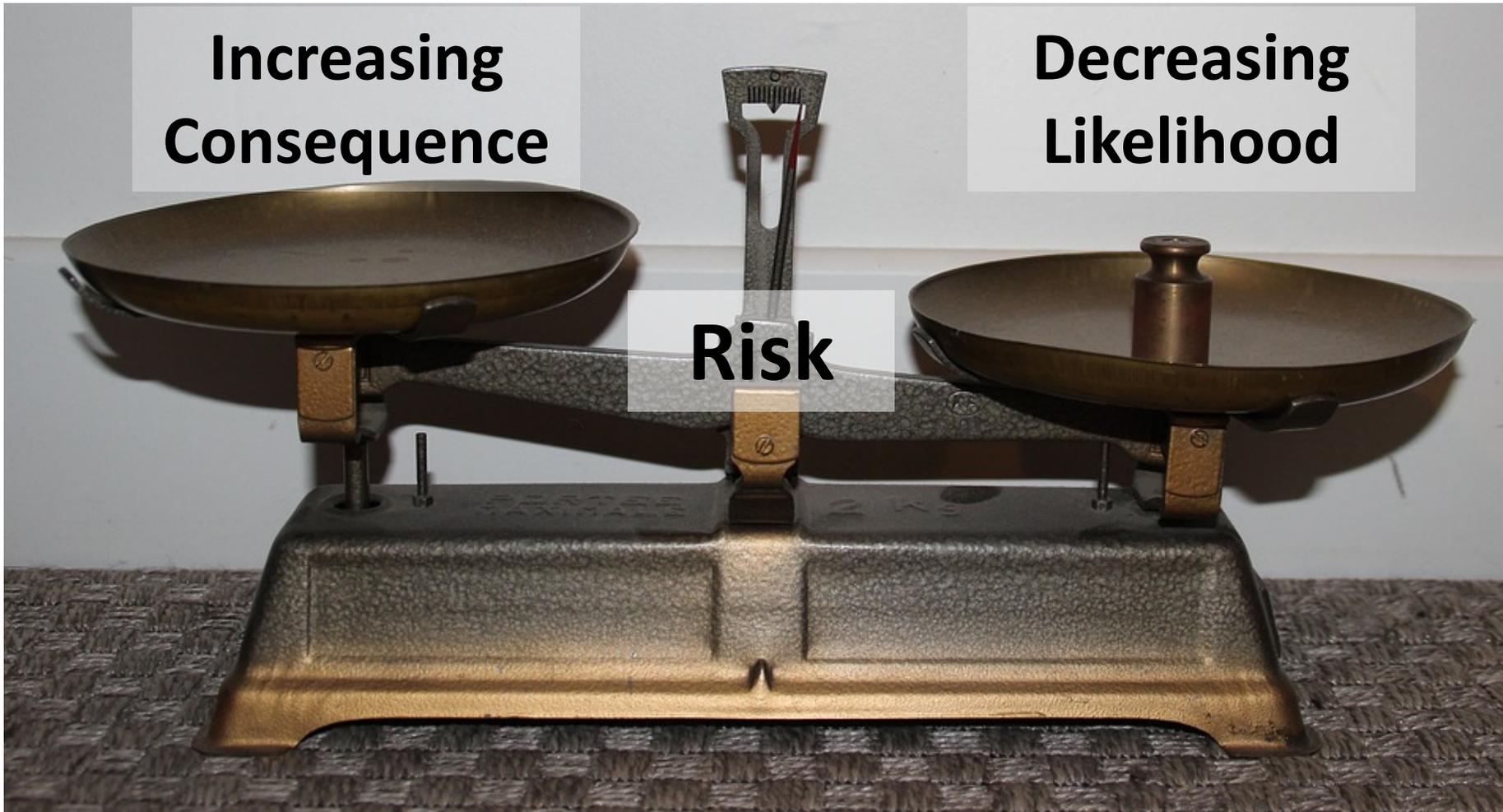
Design, construction & operational performance criteria.

Consequence Assessment Informs the Selection of Performance Criteria.

The higher the potential consequence the more rigorous the performance criteria.

Consequence and Likelihood

Consequence & Likelihood = Risk



Selecting Performance Criteria based on consequence is a risk management concept.

Consequence & Likelihood = Risk



+



+

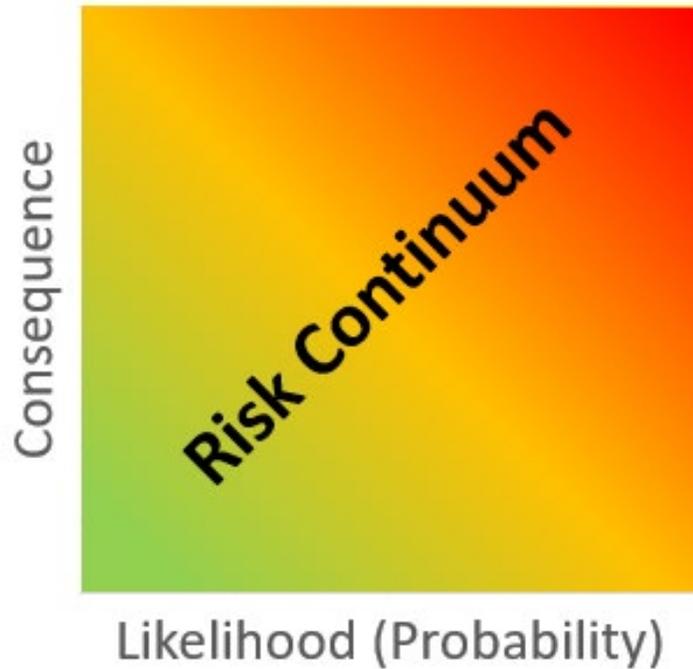


+



The combination of Consequence & Likelihood means that very different situations could ultimately represent a similar level of risk and hence require similar performance criteria.

Consequence & Likelihood = Risk



In Seeking Risk Informed Decision Making

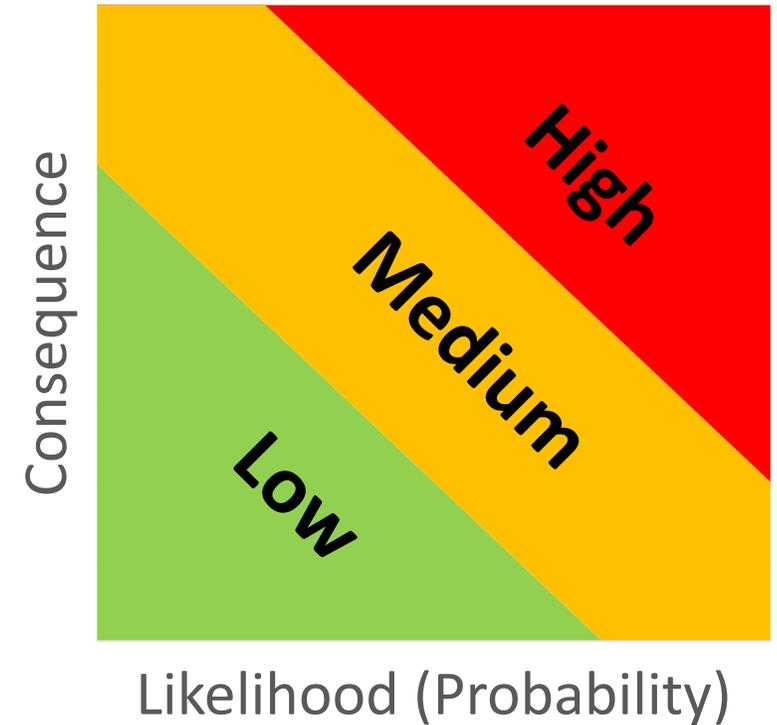


To provide a simple and consistent framework for design, construction and operation, the risk continuum is banded in to Low, Medium and High.



Known as

Potential Impact Classification (PIC)



Potential Impact Classification

Potential Impact Classification

New Zealand Dam Safety Guidelines. Principle 1

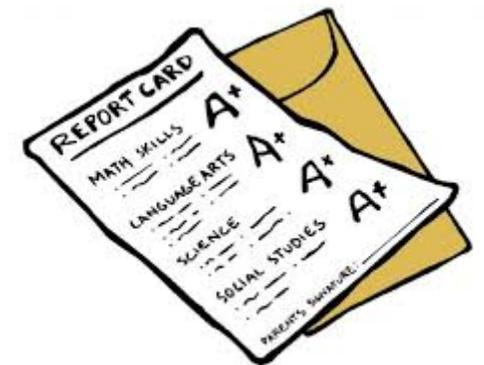
The **consequences** of a dam failure should be understood so that **appropriate design, construction and management** actions can be applied to protect people, property and the environment.

Broad Performance Criteria for.

Design, including investigation.

Construction, including commissioning.

Management, including operation, monitoring maintenance, rehabilitation and decommissioning.



Potential Impact Classification

New Zealand Dam Safety Guidelines. Principle 1

The **consequences** of a dam failure should be understood so that **appropriate design, construction and management** actions can be applied to protect people, property and the environment.



Has direct relevance to all aspects of dam safety and links to other principles.



Principle 2 All natural **hazards, loading conditions, potential failure modes** and any other **threats to the safe design, construction, commissioning, operation and rehabilitation** of a dam should be **identified**.

Principle 3 Dams and appurtenant structures should be **designed, constructed, commissioned, operated and rehabilitated** in a manner which ensures they **meet appropriate performance criteria**.

Principle 5 A **dam safety management system, commensurate with the consequences of dam failure** and incorporating policies, procedures and responsibilities, should be **in place for all dams**.

Potential Impact Classification

A fundamental aspect of a PIC is that it is **Applicable to any dam....**



Type

- Earth, Rock, Concrete, Other
- Instream, Off channel
- Single, Multiple, Linear (stopbanks).



Use

- Water, Tailings, Waste etc.
- Permanent, temporary, intermittent.
- Storage, flood protection.



Life Stage

- Design/Construction
- Operation
- Rehabilitation / Decommissioning

Potential Impact Classification



Internal to the Organisation/Dam Owner

- Systems, policies and procedures
- Advisors, reviews, upgrades
- Training, knowledge management.



External to the Organisation/Dam Owner

- Emergency Services.
- Regulatory Authorities
- Lifeline Requirement.



Type of Event

- Dam Safety Event
- Natural Hazard Event
- Public/Community Stress Event

← Relevant to Dam Safety & Emergency Management →

Potential Impact Classification

Relevant to Legislative & Regulatory Processes:

- **Standards Based**
- **Alternative Solution**
- **Modification & rehabilitation works**

Building Consents



- **Effects based.**
- **Perception of PIC = Risk**
- **Many cycles during dam lifetime.**

Resource Consents



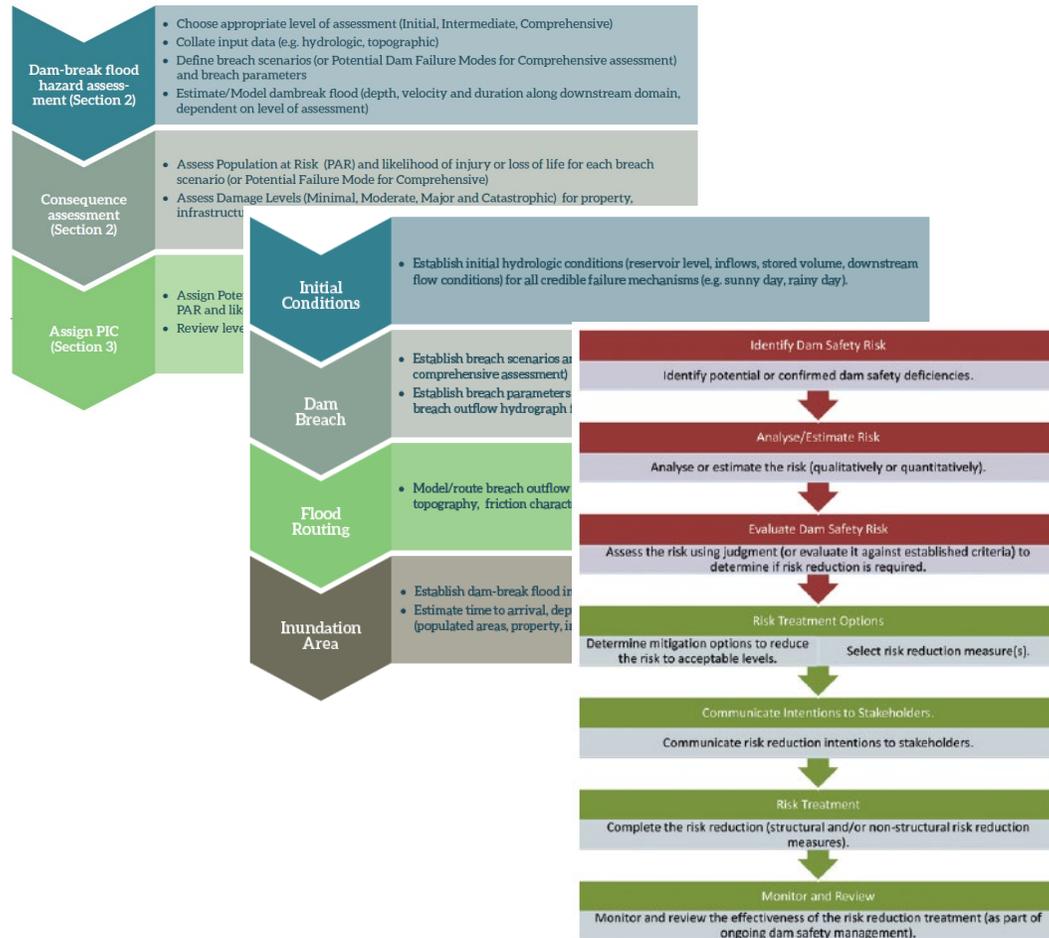
- **Compliance Based**
- **Role of Authority**
- **Role of Specialist**
- **Role of Owner**

Dam Safety Regulation



Systems Approach

Systems Approach: Future Considerations



Much of the guidance within the New Zealand Dam Safety Guidelines tends to imply a largely linear process.

This is however often more applicable to new dams (design and construction) rather than ‘all of life cycle’ dam management.

Systems Approach: Future Considerations



In a system-based approach;

Rather than reducing an entity (dam) to the properties of its parts or elements, a systems approach focuses on the arrangement of and relations (and influences) between the parts, which connect them into a whole.

Systems Approach: Future Considerations

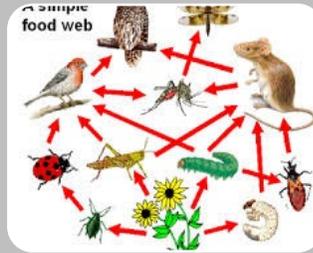


Why is a systems approach relevant to the consequence of dam failure?



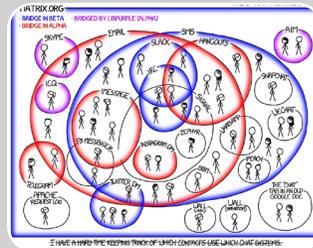
Consequence is Not Constant

- Physical changes over time, deterioration, operational.
- Change in natural hazards (eg Climate change)
- Societal expectations, acceptable risk.



Interrelationship between components

- Inter-reliance and resilience. Component failure
- Differing life-cycle for separate but related components.
- Inconsistent evolution in industry knowledge.



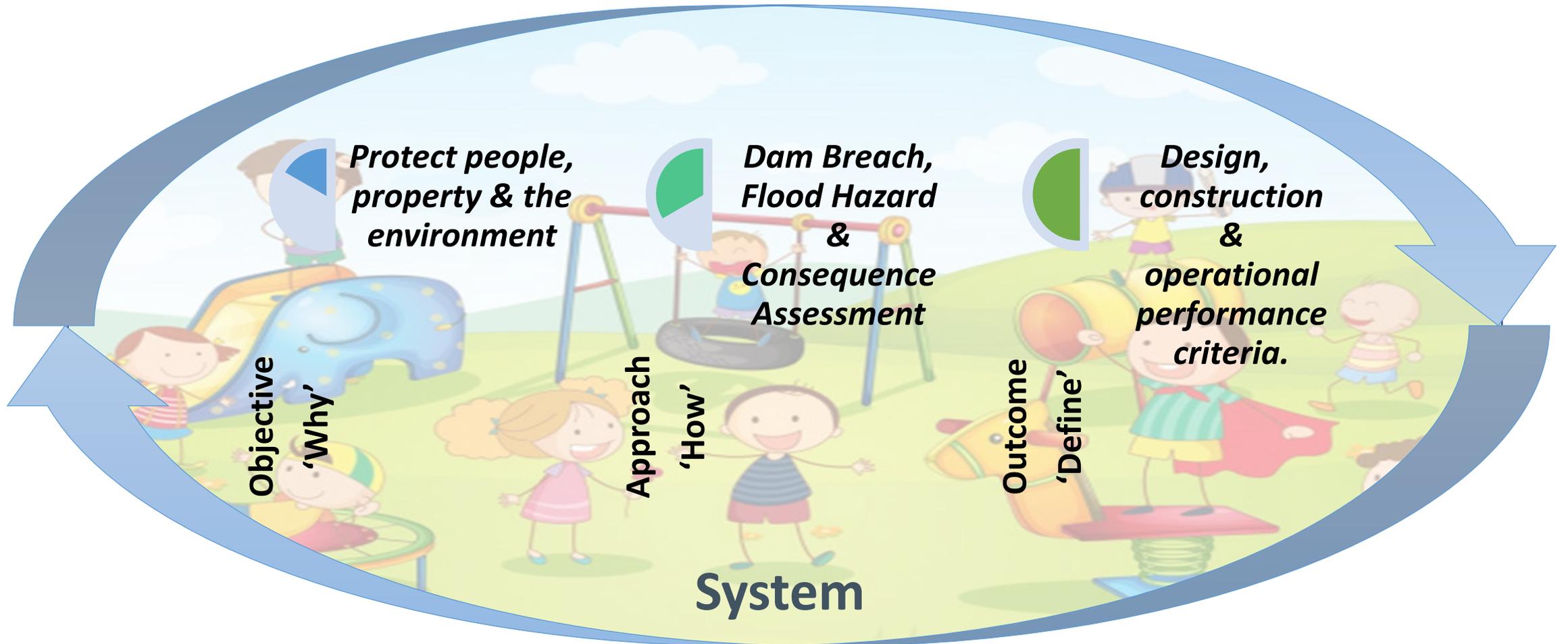
Multiple Overlapping Systems

- The dam and its components as a system.
- The use of the dam as part of a system
- The dam and use within a societal system

Summary



Overview Summary





NEW ZEALAND

Society on Large Dams