SLR Consulting

AusIMM NZ Branch Annual Conference 2026

# Water Resource Management in Mining

## Integrating Multi-Criteria Decision Analysis (MCDA) with Probabilistic Water Balance Models to Assess Strategic Outcomes

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SLR

# Why is water management important in mining?




Image sources: ai

# The growing challenge of water management

## CLIMATE

- Increasing variability and extremes
- Droughts and floods impact water availability
- Uncertainty drives risk and complexity

## REGULATION

- Consents and limits
- Compliance and reporting obligations
- Evolving policy and standards
- Reputational and legal risk



## ENVIRONMENT

- Protect ecosystems and biodiversity
- Maintain water quality and flows
- Support long-term environmental outcomes

## COMMUNITY

- Shared water resources
- Cultural values and expectations
- Social license to operate
- Transparency and engagement

## OPERATIONS

- Water is critical to production
- Infrastructure capacity
- Reliability and cost efficiency
- Operational flexibility and resilience

Image sources: ai

# What is a water balance?

A water balance quantifies all inflows and outflows and storage changes within a defined system

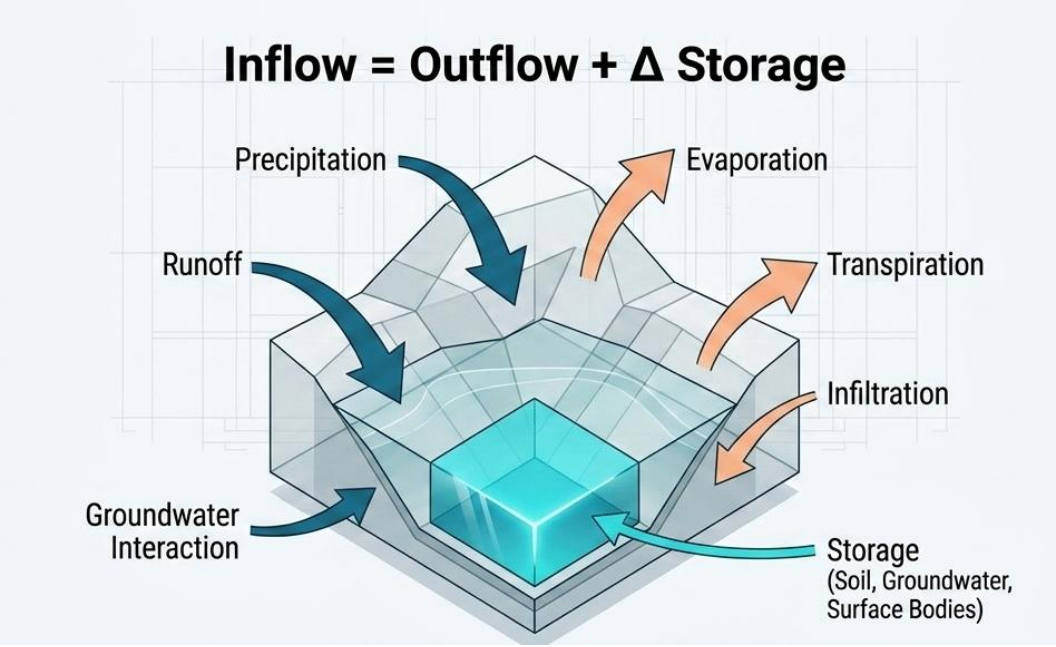



Image sources: ai

# Water balance modelling

## Why do we make Water Balance Models for Mining Operations?

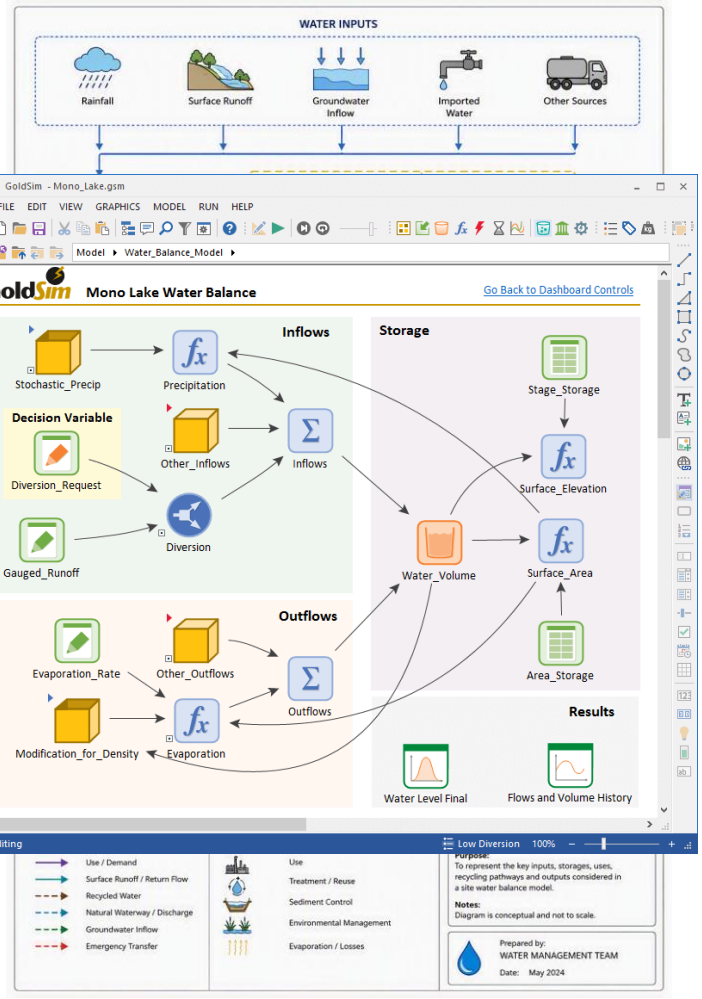
For mining, it helps operations understand water resources management

- Determine the amount of storage available
- Predict water use and help with annual reporting
- Understand risk of water scarcity or overflows
- Determine water management options
- Used for impact assessments
- Determine climate risk

- Software:

GoldSim
a datacor company

Image reference : https://www.goldsim.com/Web/Products/GoldSim/GoldSimExamples/



# Integrated Framework for Water Management

*Turning many possible climate futures into one defensible water management strategy*




**CLIMATE DATA** → **PROBABILISTIC WATER BALANCE MODELLING** → **MODEL RESULTS** → **RISK ASSESSMENT (MCDA)** → **INFORMED DECISIONS ON WATER MANAGEMENT**

UNCERTAINTY → SIMULATION → RISK → TRADE-OFFS → DECISION

# 1. Climate Data

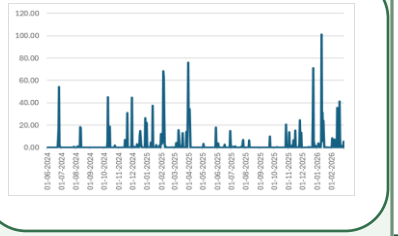
| Key Question | Approach | Outcome | Mining Water Applications |
|---|---|---|---|
| What has happened? | 📖 **Historical Climate** | Distribution of outcomes based on historical variability | 🏭 Operations planning<br>💧 Water balance calibration<br>📋 Compliance assessments |
| What could happen? | 🎲 **Probabilistic Climate** | Thousands of simulations that include wider wet and dry conditions, including events not observed in the past. | ⚠️ Drought risk<br>🌊 Flood risk/ Excess of water<br>🏗️ Storage and infrastructure design<br>📋 Compliance assessments/ Spill risk |
| What could happen under climate change? | 🌍 **Climate Change Scenarios** | Future water balance risks across multiple climate futures | ♻️ Closure planning<br>🛡️ Climate adaptation<br>📋 Compliance assessments<br>💰 Long-term investment decisions |



**Climate Risk**

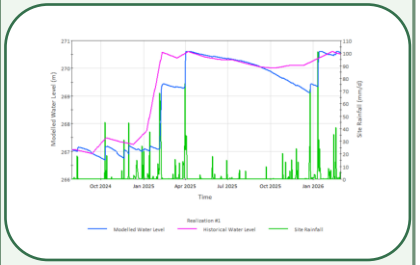
# 2. Probabilistic Water Balance Model

## 1 SITE DATA



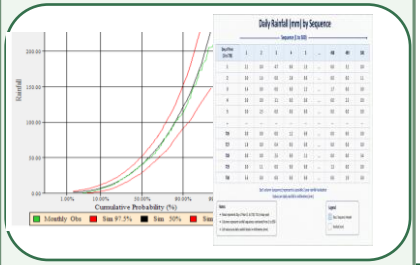
- Observed historical climate data and Climate change data
- Site management data
- Garbage in garbage out

## 2 CALIBRATED WATER BALANCE MODEL



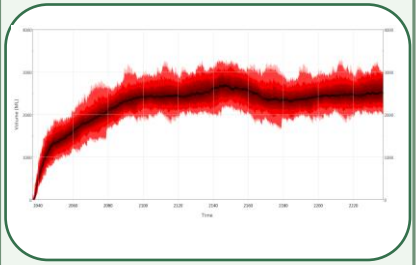
- Create a Water Balance Model in GoldSim
- Estimate runoff with AWBM, and add in the WMP
- Add in all the data and match the operational water levels to historic

## 3 PROBABILISTIC DATA



- Fit statistical models to historical data
- Generate multiple probabilistic sequences
- Provides many possible futures (equally likely) and preserves statistics of historical climate

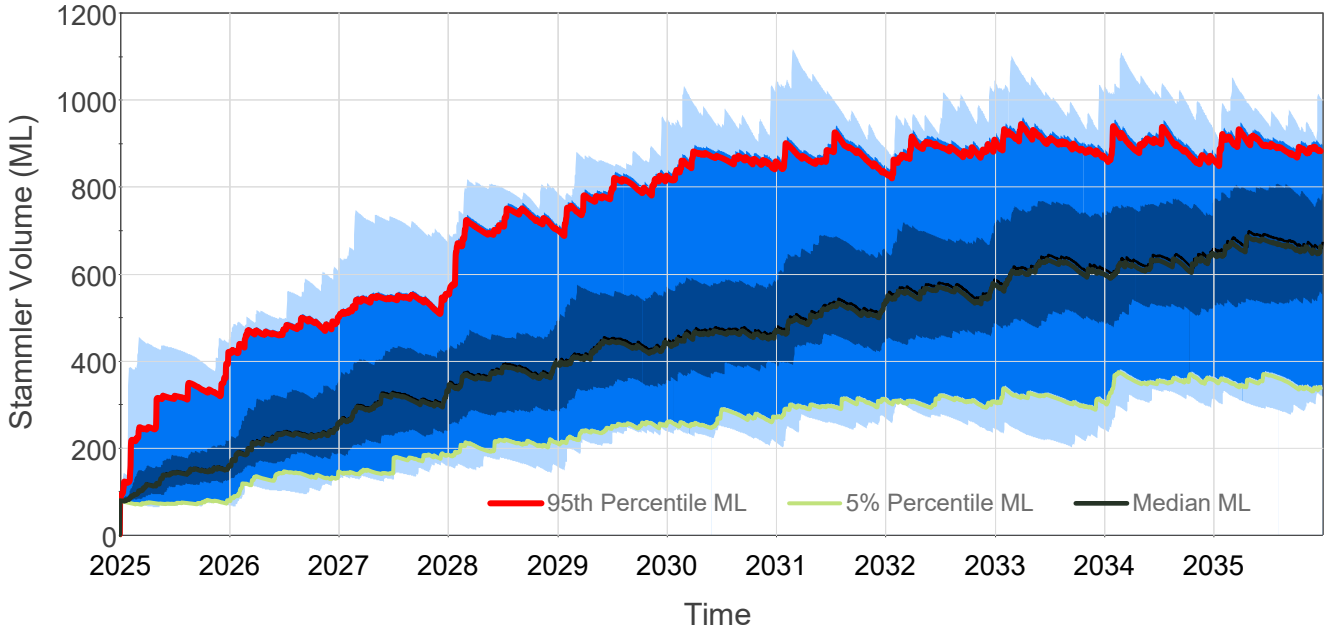
## 4 PROBABILISTIC WATER BALANCE MODEL



- Run model for all realisations
- Quantify range of possible outcomes as probabilities

# 3. Water Balance Model Results

How do we visualize the results?



# What to do with these WBM results?

Gap between complex model results and clear decisions for water management

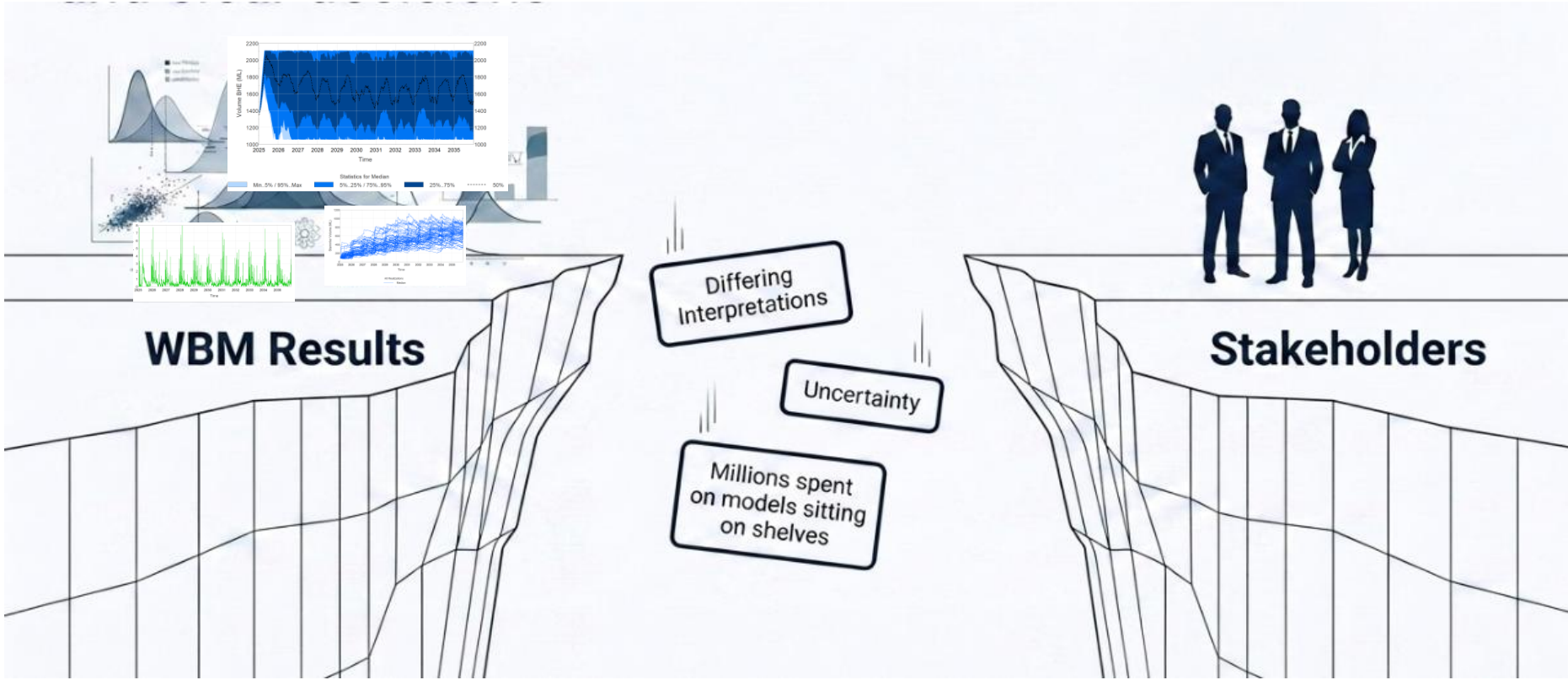



Image sources: ai

# Multi- Criteria Decision Analysis Bridges the Gap

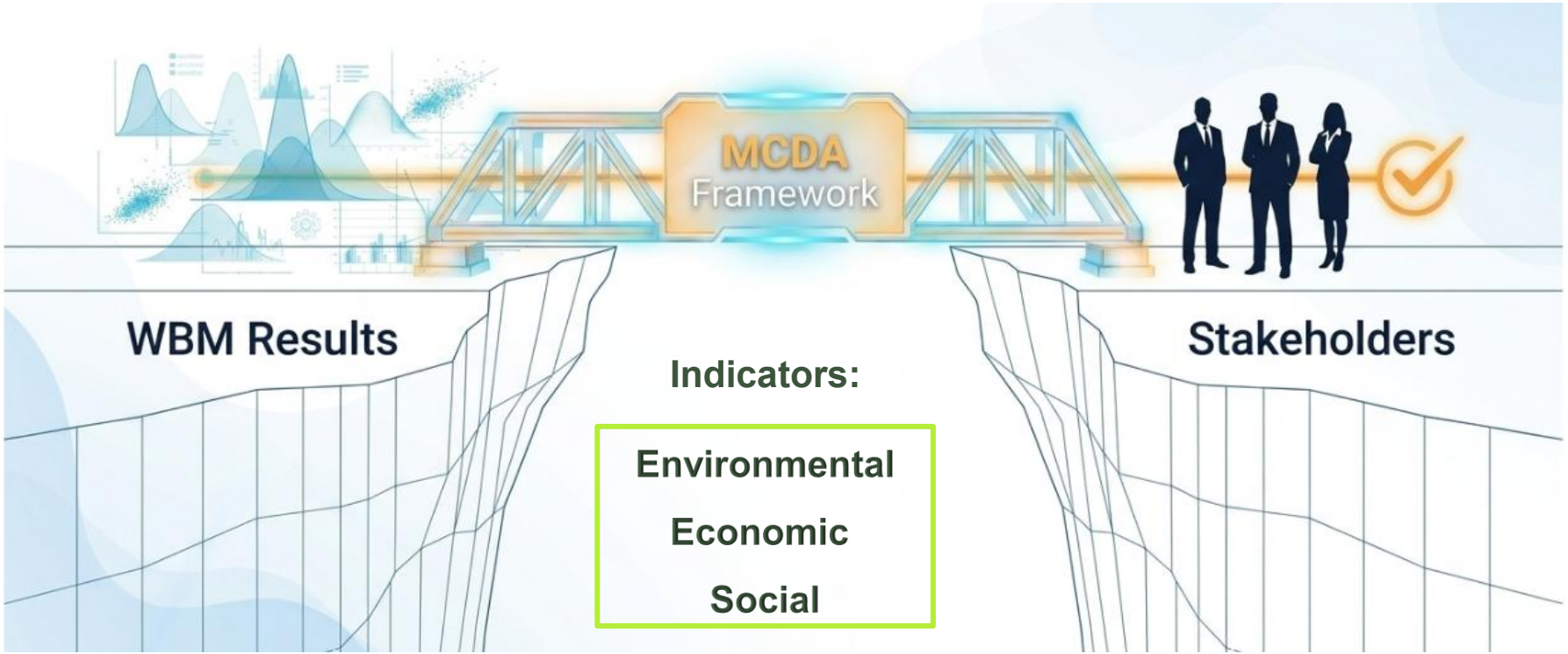



Image sources: ai

# 4. Risk Assessment Using MCDA Framework

Structurally translate the outputs into risk-based outcomes

**1. Define Scenarios** → **2. Evaluation Criteria (Indicators)** → **3. Scoring Scale**

## Scenarios:

- **Current Condition (Historical Climate)**
- **Increase water supply to landholders**
- **Increase water recycling (P95)**
- **Dry Conditions (P5)**
- **Additional storage capacity**

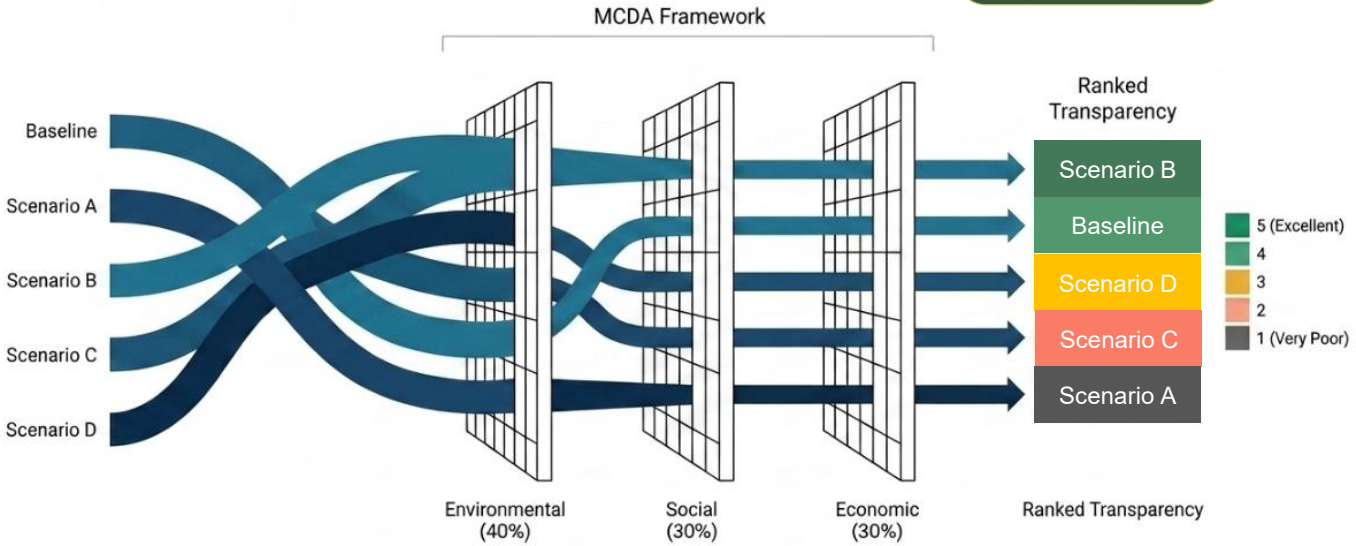



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# Multi-Criteria Decision Analysis (MCDA)

Structure inside of MCDA cascades high-level priorities into specific and quantifiable performance indicators (Example)

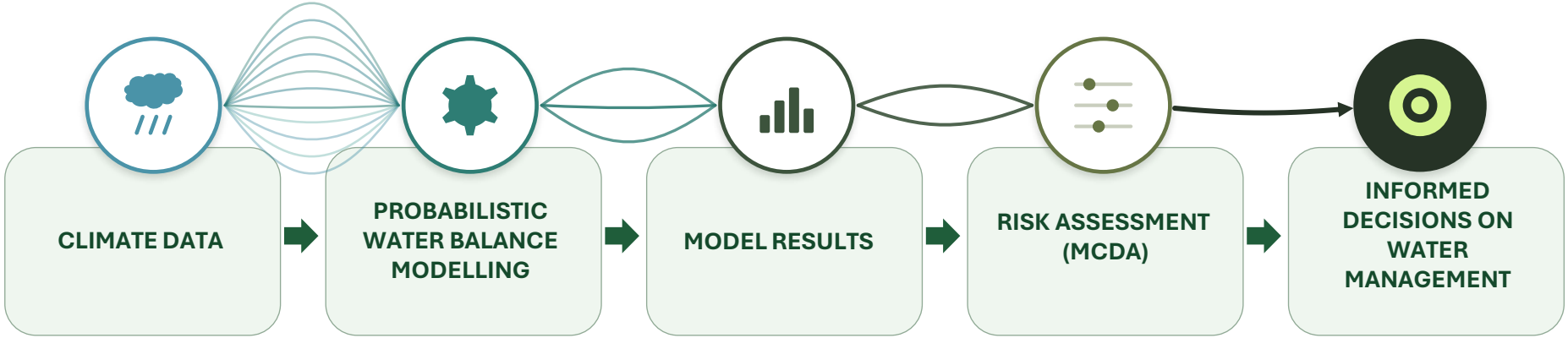
| **Environmental (40%)** | | **Social (30%)** | | **Economic (30%)** | |
|---|---|---|---|---|---|
| Water Availability: 15% | Environmental flow: 10% | Water Security 20% | | Capital Cost (CAPEX): 15% | Operational Cost (OPEX): 10% |
| Water Quality Deterioration: 10% | Climate Resilience 5%: | Transparency & Understanding 5% | Public Health and Safety: 5% | Dewatering efficiency in Pit (5%) | |

# 5. Informed Decisions on Water Management




Image sources: ai

# Conclusion




**Quantify uncertainty —** Probabilistic water balance modelling turns climate variability into a measurable range of outcomes rather than a single guess.

**Translate results —** The MCDA framework converts complex model outputs into transparent and understandable risk-based outcomes.

**Decide with confidence —** Together they give mining operations a defensible, stakeholder-ready basis for strategic water management decisions.

# Kia ora, thank you

Questions and discussion welcome

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