



*Mt Baw Baw Alpine Resort:  
Integrated Water Management Plan (Final)*

*May 2025*



Three  
Seeds



## Traditional Owners

We acknowledge Gunaikurnai as the Traditional Owners of Country that includes Baw Baw Alpine Resort. Gunaikurnai language, knowledge and concepts referenced in this document remain the cultural and intellectual property of Gunaikurnai Peoples.

## Document Management

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Mt Baw Baw Resort. Source: Mt Baw Baw Alpine Resort (LinkedIn)

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## Executive Summary

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This Integrated Water Management (IWM) Plan establishes a framework for managing water and water systems at Mount Baw Baw Alpine Resort over the next 20 years. It has been prepared to support the economic viability and ecological and cultural values of the resort in a changing climate.

The plan addresses water supply (including snow making), stormwater management, wastewater treatment, and the downstream environment. It has been developed in consultation with resort stakeholders and informed by ARV's ongoing engagement with Traditional Owners. While Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) was not directly involved in this plan due to capacity constraints, cultural values outlined in key Gunaikurnai planning documents have guided the IWM approach.

### Resort Context

Mt Baw Baw Alpine Resort is located in Gunaikurnai Country, specifically the Country of the Brayakaulung clan. It sits at 1,565 metres elevation on the western edge of the Baw Baw Plateau, bordered by Baw Baw National Park and Tanjil State Forest. The resort encompasses 355 hectares, of which 37 hectares are developed, with capacity for around 2,600 visitors per day and 466 accommodation beds across 34 sites. It is a year-round destination for snow sports, hiking, cycling and nature-based recreation.

Water is essential to resort operations – particularly for snowmaking infrastructure that supports reliable winter visitation and for maintaining guest services, food preparation, cleaning and environmental sustainability. Skiing, with extensive day-visitor facilities but no on-mountain overnight accommodation.

### Water Context

Mt Baw Baw Alpine Resort is located within the Tanjil River catchment, part of the Latrobe River Basin that flows into the Gippsland Lakes. It holds a licence

to extract up to 18ML of water per year from the Tanjil River East Branch, with diversions occurring at two key weirs: the Dam Valley catchment and the ski bowl/Maltese Cross weirs. Water is directed via gravity through a 150mm ductile iron-concrete-lined pipe to two 200,000 L concrete tanks for village use and to three open storage tanks, including a 1ML tank on Big Hill, to supply snowmaking operations.

Raw water is treated through a multibarrier system including filtration, UV, hypo disinfection and pH correction. Wastewater is treated on-site using a state-of-the-art membrane bioreactor system, capable of achieving near Class A recycled water standards. Overflow from water tanks is returned to the Tanjil River East Branch helping maintain environmental flows.

While water availability is generally sufficient, the resort faces operational challenges related to limited storage, ageing infrastructure and snowmaking's reliance on narrow weather windows – pressures that are compounded by climate change and growing visitation.

### Climate Context

Current and projected future climate change impacts are affecting water management and the long-term viability of Mt Baw Baw Alpine Resort. Key changes include:

- Declining snowfall and snow depth
- Decreasing annual precipitation
- Rising temperatures
- Reduced hours suitable for snowmaking due to warming temperatures
- Increased reliance on snow factories
- Increased risks of bushfires, flash flooding and infrastructure damage

These changes are placing pressure on water systems, infrastructure and the visitor experience. Without proactive adaptation, Mt Baw Baw risks

significant declines in winter visitation, increased operational costs and long-term impacts on the surrounding environment.

### **Cultural Context**

Gunaikurnai strategies, including the Whole-of-Country Plan and Joint Management Plan, outline holistic perspectives on land, water and cultural responsibilities. This IWM plan draws on those principles to support future partnerships and embed Traditional Owner perspectives in water-related decision-making. While direct co-design was limited in this planning phase, the foundations have been laid for deeper collaboration as part of ARV's Traditional Owner Engagement and Self-Determination Strategy.

### **Water Management Options**

The IWM plan evaluated 21 options across five categories, with stakeholder input and analysis refining these to 15 priority recommendations:

#### Good Water Management

1. Leak detection and pipe mapping
2. Improved metering and SCADA for real-time water use insights
3. Strengthening cultural awareness and partnerships with Gunaikurnai
4. Supporting Traditional Owner-led land and water initiatives

#### Environmental Management

5. Erosion control measures around car parks
6. Monitoring the impact of wastewater discharges on the Tanjil River East Branch

#### Integrated Water and Energy Strategy

7. Feasibility study into mini-hydro power generation using treated wastewater discharge infrastructure

#### Future Water Resilience

8. Rainwater harvesting for toilets and green-season equipment washing
9. Feasibility of increasing snowmaking capacity through pump upgrades
10. Long-term exploration of alternative water sources (e.g. groundwater, wastewater reuse)

Snow making is a complex issue in the context of climate change and future water resilience options. One of the options has explored how a hybrid option of water use to support both more efficient snow fan guns and snow factories may be more resilient compared to a traditional approach to snow making. Options analysis did find that access to water was less of a constraint compared to climate impacts.

### **Action Plan**

The implementation timeline is structured in phases:

#### **Immediate (Current):**

- Continue engaging with Gunaikurnai Traditional Owners
- Maintain snowmaking and monitoring systems
- Monitor wastewater discharges to protect waterway health

#### **Short-term (1-3 years):**

- Implement leak detection and water efficiency upgrades
- Deploy car park stormwater erosion controls
- Conduct a feasibility study for a mini-hydro project
- Install rainwater harvesting for toilet flushing

#### **Medium-term (4-10 years):**

- Upgrade snowmaking pump capacity to maximise output during short favourable weather windows

**Long-term (10+ years):**

- Reassess options for wastewater recycling, groundwater use and expanded snowmaking as conditions change

**Benefits and Alignment**

The recommended options align with both ARV's strategic objectives (investment, environment, visitors, reform, progress, and people) and IWM outcomes. Key outcomes include:

- Strengthened water security and resilience
- Protection of downstream ecosystems and cultural values
- Enhanced visitor experience through reliable services
- Integration of Traditional Owner values and self-determination
- Reduced pressure on natural systems through efficient use and alternative water sources

Implementation is contingent on resource availability and external funding. With support, Mt Baw Baw Alpine Resort can be a demonstration of integrated alpine water management, balancing recreation, investment, cultural heritage and climate resilience for future generations.

# 1 Introduction

## 1.1 Purpose of this plan

The purpose of this plan is to provide a comprehensive framework for managing water resources at Mt Baw Baw Alpine Resort (referred to in this report as Mt Baw Baw) in a way that balances environmental sustainability, social needs, and economic considerations. By integrating diverse aspects of water use—supply, wastewater, stormwater, and environmental flows—the plan seeks to optimize the overall performance of water systems while addressing challenges like climate change, visitation growth, and resource scarcity. It promotes collaboration among stakeholders to align goals and actions. Ultimately, this plan aims to ensure the long-term availability and quality of water, protect ecosystems, enhance resilience, and support resort function in a coordinated and efficient manner over the next 20 years.



## 1.2 Overview of Mt Baw Baw Alpine Resort

Mt Baw Baw is in Gunaikurnai Country (Brayakaulung clan). Baw Baw village and ski runs are situated on the west side of Mt Baw Baw and includes the headwaters of Tanjil River East Branch and its tributaries. Water from the resort flows through Gunaikurnai Country along Durt'Yowan (Latrobe River Basin) and into the Gippsland Lakes before entering the Tasman Sea near Lakes Entrance.

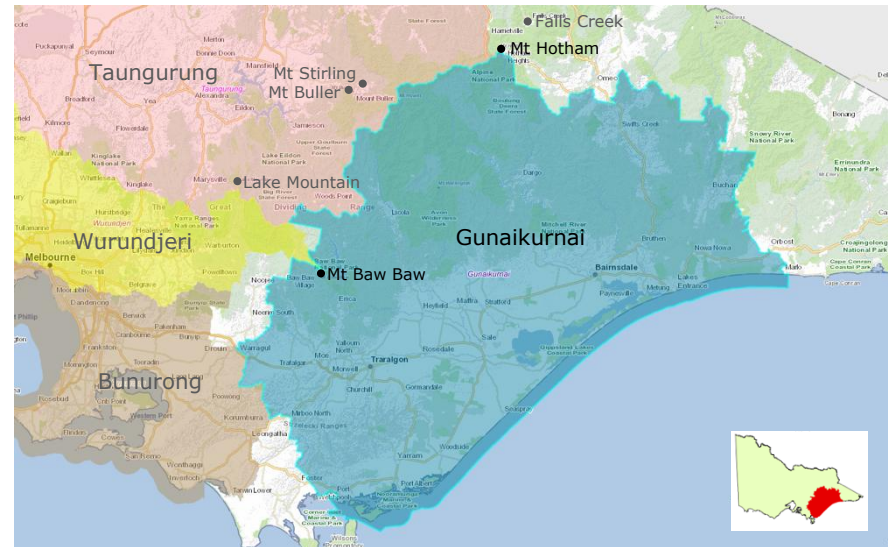


Figure 1. Gunaikurnai Country and Victorian Alpine Resorts (Source: Victorian Aboriginal Heritage Register and Information System, annotated with Victorian Alpine Resorts)

*For many thousands of years Gunaikurnai have lived in the valleys, on the fertile plains and up in the mountains of our traditional Country. Our Country was created by the spirits — the ancestors who link us to the land and bestow on us identity, rights and responsibilities. They defined our relationship with the land — how it should be used, how to move through it safely and how to care for it. In return, Country provided physical and spiritual nourishment for our people, with plentiful food, medicine, water and natural resources for survival.*

*Extract from 'Our Story,' Gunaikurnai Whole-of-Country Plan (GLaWAC 2015)*

Gunaikurnai connections to alpine landscapes, including Mt Baw Baw, are described in *Integrated Water Management in Gunaikurnai Wurruk*.<sup>1</sup>

Wurundjeri RAP area extends to the headwaters of the Tanjil River West Branch immediately to the north of Baw Baw Alpine Resort. Wurundjeri likely also have cultural connections to Mt Baw Baw.

Located on the south-west face of the Baw Baw Plateau and just two and a half hours east of Melbourne, Mt Baw Baw Resort sits at a summit elevation of 1,565 metres and is bordered by Baw Baw National Park to the north and east and Tanjil State Forest to the west and south. Baw Baw National Park is one of four additional parks now under joint management by Gunaikurnai and the Victorian Government.<sup>2</sup>

Of the resort's 355 hectares, only 37 hectares are developed. This includes groomed downhill ski runs and ski lifts, groomed cross-country trails, toboggan runs and a seasonal terrain park. The village comprises 34 developed, leased,

<sup>1</sup> Three Seeds (2025). *Integrated water Management in Gunaikurnai Wurruk – Mt Baw Baw | Mt Hotham*.

<sup>2</sup> GTOLMB (2024). Gunaikurnai and Victorian Government Joint Management Plan: The Next Five Years 2025 – 2030.

or licensed sites (of a total 43 surveyed sites), with 466 accommodation beds across a range of budgets. The resort accommodates up to 700 cars (around 2,600 visitors) and at least 20 buses.<sup>3</sup>

In the white season, the resort operates seven surface lifts, catering to beginners, intermediate, and advanced skiers. It features two toboggan parks, two magic carpets, a dedicated beginner's area, and a small terrain park.

Green season activities include road cycling, mountain biking and walking. The resort also serves as a gateway for many green season activities in the surrounding national park.

Table 1. Mt Baw Baw Profile

<b>Statistics</b>	<b>Values</b>
Winter Visitation (2022-24 av.) <sup>4</sup>	93,447 visitor days
Summer Visitation (2022-24 av.) <sup>4</sup>	30,694 visitors
Resort Area <sup>3</sup>	355 hectares
Resort Altitude (Summit) <sup>3</sup>	1,565 metres
Snowmaking Area <sup>5</sup>	2.5 hectares
Distance from Melbourne <sup>3</sup>	176 km
Food establishments <sup>5</sup>	3
Accommodation (visitor beds) <sup>3</sup>	466
Groomed trails (cross-country) <sup>3</sup>	10 km (7 trails)
Snowmaking terrain <sup>5</sup>	12 ha
Downhill skiable terrain <sup>5</sup>	35 ha (18 runs)
Ski lifts (tows + carpets) <sup>3</sup>	8
Road cycling*	13 km
Mountain biking*	8 km
Walking*	30 km

\* including sections of road / trails beyond the resort.

<sup>3</sup> SARMB (2022). Annual Report 2022.

<sup>4</sup> ARV (2024). 2024 end of season visitation report.

<sup>5</sup> Urban Enterprise (2021). *Victorian Alpine Resorts Visitor Economy Development Plan*.



Water plays a critical role at Mt Baw Baw Alpine Resort, particularly in supporting the resort's operations and environmental sustainability. The resort relies on water for snowmaking, an essential part of ensuring reliable skiing conditions throughout the winter season when natural snowfall is insufficient. This helps maintain the resort's ski terrain, attracting visitors and ensuring a consistent ski experience. Water is also vital for the resort's broader infrastructure and various recreational and operational purposes, including water supply for visitors, food preparation, and cleaning.

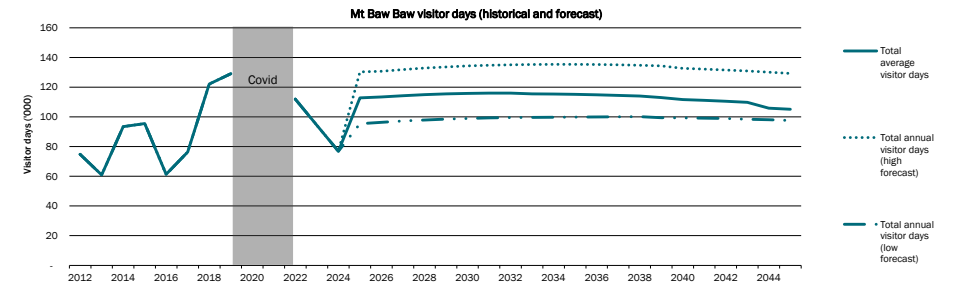


Figure 2. Historic and Projected Total Number of Visitor Days Under Different Snow Scenarios (data provided by Centre for International Economics, 2024).



The economic viability of Mt Baw Baw Alpine Resort is under pressure as a result of climate change and increasing climate variability. Without adaptation, shorter snow seasons and reduced winter visitation will likely impact revenue and make diversification and year-round operations increasingly important. Figure 2 shows historic and projected visitor days under different scenarios (average, high and low visitation and snow depth trajectories), assuming an adaptation scenario where half of the natural snow

reduction from climate change is alleviated through snowmaking.<sup>6</sup> With snowmaking, visitor days may remain somewhat similar to historic numbers in an average snow scenario and high snow scenario but start to decline significantly in a low snow scenario around 2048.

The alpine environment surrounding Mt Baw Baw is recognized as a site of national ecological significance. Wet alpine heathlands with sphagnum moss beds are interspersed with extensive sub-alpine woodlands dominated by snow gums. Higher elevations support tall forests of Alpine Ash, Shining Gum, and Tingaringy Gum, while lower slopes transition to Mountain Ash, Messmate, and Silver Wattle forests. In the Thomson and Aberfeldy River valleys, dry forests of Silvertop, Messmate, and Peppermints thrive, characterized by an open understory of shrubs, grasses, and bracken.<sup>7</sup>

The fauna of Mt Baw Baw includes several significant species, some of which are of conservation concern. The critically endangered Baw Baw frog relies on subalpine wetlands for breeding. Another notable species includes the Leadbeater's Possum, which live in small numbers in sub-alpine woodland. More common species present include the Common Wombat, Swamp Wallaby, Greater Glider, Yellow-bellied Glider, Sugar Glider, Mountain Brush-tailed Possum, Brown Antechinus, Burrowing Crayfish and Platypus.<sup>8</sup>



Figure 3. Mt Baw Baw alpine forest

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<sup>6</sup> CIE (2024). *Carrying Capacity of Victorian Alpine Resorts: Preliminary Draft Report*.

<sup>7</sup> Australian Alps National Parks. (n.d.). *Baw Baw National Park*.

<sup>8</sup> Ibid.

### 1.3 History of natural snow depth at the resort

Snow depth data has been recorded since 1993 at the resort, on a daily basis, providing an excellent basis for considering changes in climate and their impact on water management. The chart below shows the depth for each season, and the long-term trend for natural snow depths. Snowmaking has been recorded since 2006 (but not every year) and supplements the natural snow at the resort. It is rare to get more than 1 metre of snow depth on the mountain, and it would normally only remain on the mountain for a few weeks or up to a month, due to rain and warmer weather melting the snow.

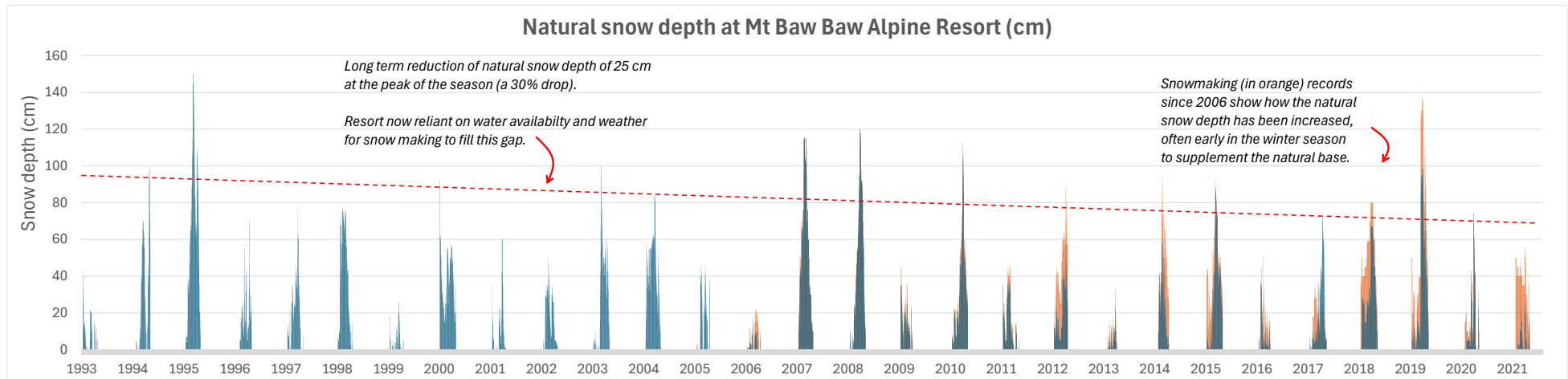


Figure 4. Snow depth at Mt Baw Baw Alpine Resort since 1993.

Snow depth records for this resort are available between 1993 and 2021. Note the area that is covered by snowmaking has increased from 10 hectares to 61 hectares.

## 1.4 Water planning approach

An iterative process was used to understand the resort context, water and environment context, identify potential opportunities, and evaluate options (see figure to the right).

The consultant team worked with ARV and Mt Baw Baw stakeholders to understand and explore the resorts water-related context, aspirations and challenges through a series of informal interviews and two online workshops. The first workshop focused on understanding the role of water, as well as constraints and opportunities for better water management at the resort. The second workshop identified as well as critiqued potential options. Inputs from both workshops formed the basis of what options are presented in this plan. See the Appendix for summaries of the outcomes from each workshop.

Wave Consulting Australia and Three Seeds also visited the resort with ARV staff to assess existing infrastructure and ground-truth potential opportunities.

Multiple stakeholders participated in the workshops and were provided the draft plan for review, including DEECA, Baw Baw Shire, Southern Rural Water, Gippsland Water, Parks Vic, West Gippsland Catchment Management Authority, and several ARV staff.

ARV is engaging with Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) as part of the development of ARV’s Traditional Owner Engagement and Self-Determination Strategy. GLaWAC provided high-level direction and review of Integrated Water Management in Gunaikurnai Wurruk (Three Seeds 2025) but has not been directly involved in water planning Mt Baw Baw due to their current organisational priorities and capacity.



## 2 Water context

### 2.1 Waterway Catchments

The Resort is within the Tanjil River waterway catchment, part of the Latrobe River Basin that flows into the Gippsland Lakes. It is located south of the Great Dividing Range in the West Gippsland Catchment Management Authority region.

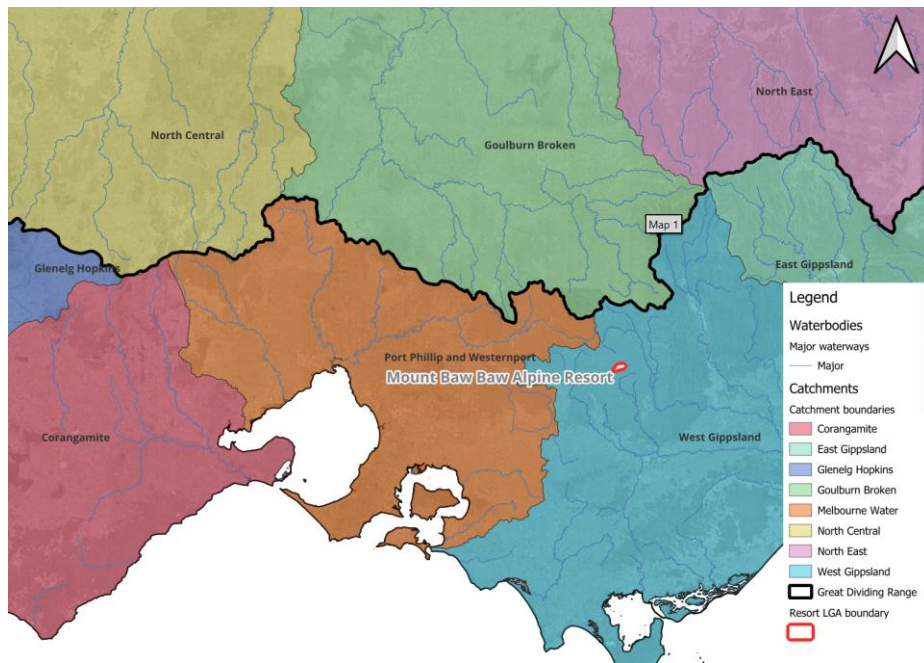


Figure 5. Mt Baw Baw Alpine Resort, within the West Gippsland and Thomson Catchment, south of the Great Dividing Range.

<sup>9</sup> SARMB (2021). 2020–21 Water Supply Annual Report.

### 2.2 Water Infrastructure

#### 2.2.1 Water Supply

The Resort’s water supply comes from the Dam Valley catchment in the headwaters of the Tanjil River East Branch, a protected area elevated above the village. The catchment is densely vegetated, with only a single access trail on its north-western side, keeping the environment largely pristine. Rainfall and snowmelt flows through sphagnum moss, providing natural filtration of suspended particles.<sup>9</sup>

A weir in the stream below Dam Valley captures this water and directs it to a draw-off pipe that supplies two 200,000-litre concrete storage tanks, servicing the village. Water flows by gravity from the weir through a 150 400mm ductile iron, concrete-lined (DACL) pipe, connecting to the village's treatment, distribution, and reticulation network. Any overflow from the tanks, consisting of untreated water, is discharged back into the headwaters of the Tanjil River East Branch. This overflow occurs frequently, indicating that water flow from the weir consistently exceeds the village's demand.<sup>9</sup>

*“There is a need to ensure that run off from paved surfaces do not negatively impact the surrounding environment or stream flow. Pollution and intense run off are key considerations.”*

*Workshop 2 participant*



Figure 6. Raw water storage tanks

### 2.2.2 Water Treatment

The Resort utilises a multibarrier approach to drinking water treatment which includes two methods of filtration, UV disinfection, hypo disinfection and pH correction, all within a containerised secure water treatment plant installed in May 2022.<sup>10</sup>



Figure 7. Inside the wastewater treatment plant

### 2.2.3 Wastewater

The Resort operates a state-of-the-art sewage treatment plant, commissioned in May 2023, to process wastewater from village lodges and public amenities. This facility employs a membrane bioreactor system that integrates membrane filtration with biological treatment. The treated sewage undergoes additional disinfection using ultraviolet light and chlorine, ensuring it meets Environmental Protection Authority (EPA) licensed quality parameters. While the treated wastewater is not used for any non-potable uses at the moment,

<sup>10</sup> Alpine Resorts Victoria (2022), Drinking Water Quality Annual Report, 2022 – 2023.

it is designed to achieve Class A recycled water standards, providing the opportunity for potential future reuse opportunities.

#### 2.2.4 Snowmaking

Mt Baw Baw has a network of snowmaking infrastructure, included 14 snow guns and 26 snow making hydrants, to create consistent snow coverage and enhance the guest experience throughout the snow season.

Currently, raw (untreated) water for snowmaking is stored in two 200,000-litre concrete open storage tanks and one 1ML corrugated steel open storage tank on Big Hill. Water is sourced from the ski bowl weir and Maltese Cross weir, both fed by the Tanjil River East Branch.<sup>11</sup>

Filling of the snowmaking tanks is manually controlled by activating pump systems and occurs regularly during the white season to support snow production. In the green season, these tanks remain full as a backup supply for the village's pre-treatment system, and potentially as a firefighting resource.

There is an ongoing movement in the industry to adapt and transition snow making infrastructure in response to climate change. The use of more efficient snow fan guns, more sensors to calibrate and target snow production, and the installation of snow factories will continue to deal with a changing climate and a more consistent coverage of snow.

The future of snow making at Mt Baw Baw may well include a hybrid mix of more efficient snow fan guns, operating at slightly higher wet bulb temperatures, and snow factories, where snow produced lasts longer on the ground.



Figure 8. Snow gun on the Summit T Bar slope.

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<sup>11</sup> Alpine Resorts Victoria (2022), Drinking Water Quality Annual Report, 2022 – 2023.



Figure 9. Local stormwater infrastructure at Mt Baw Baw

### 2.3 Water Demand

An analysis of water demand patterns is based on estimates of water consumption as a function of visitation, and anecdotal evidence provided by resort staff. Metering of the wastewater treatment plant is a good reference point for estimating the seasonal and annual water demand as well.

Data on visitation figures to the resort, local rainfall records, nearby weather data (temperature, humidity, wet bulb, and wind direction and speed at an hourly interval), and river monitoring at a downstream station on the Tanjil River East Branch was used to input into a demand model to create a demand profile for the two main uses of water:

- Potable water for all accommodation, toilets, buildings, administration and workshop
- Snowmaking production

Year to year the water demand fluctuates based on weather, on visitation rates, leakage in the system, and other climate variables. The figure below represents a typical year, noting the pattern can vary significantly.

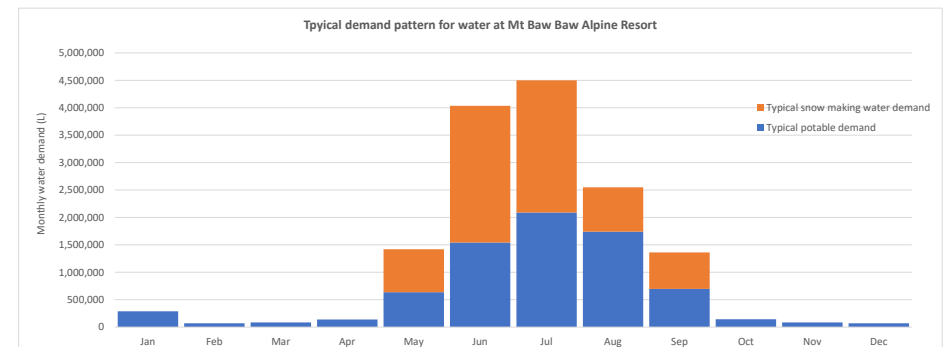


Figure 10. Monthly water demand pattern

## 2.4 Water Balance

A water balance represents the average flow of water through a geographic area and highlights the complexity of natural and constructed water systems in an alpine setting. For Mt Baw Baw, the water balance was calculated using a variety of models and data sets to create the best estimate of how much water flows through and is used at the resort.

The resort water balance includes access to a diversion from the Tanjil River East Branch (a diversion licence of up to 18 ML / year) with two separate diversion points and storages; wastewater treated to near Class A standard and discharged to the creek via the lagoon system; and all snow melt ultimately returning to the river.

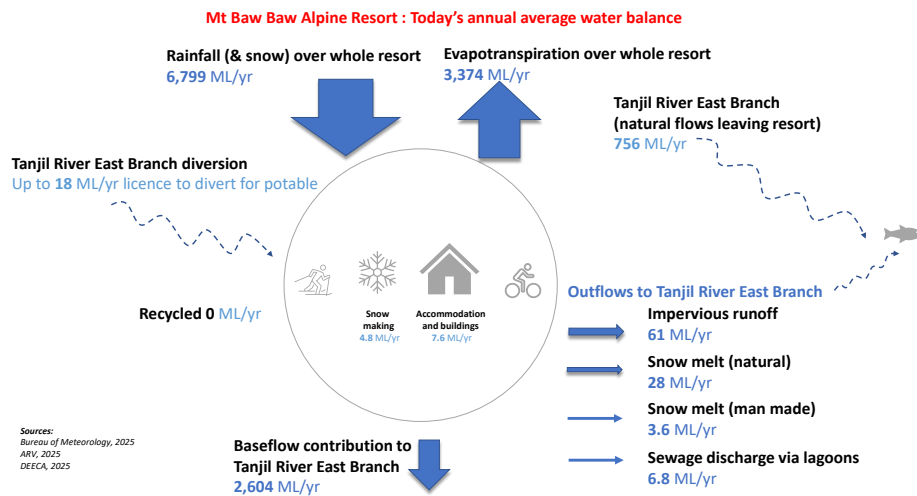


Figure 11. Mt Baw Baw water balance

On an average annual basis, most of the water falling on the resort (as rain and snow) is intercepted by the vegetation and evapotranspired. The resort is not constrained in terms of access to raw water but is constrained in terms of storage sizes and weather conditions to support snowmaking. Impervious runoff from the several car parks and natural snow melt are relatively large discharges from the resort, compared to wastewater.

## 2.5 Climate Context

Victoria's alpine resorts, including Mt Baw Baw Alpine Resort, face significant challenges from climate change, which is altering key environmental and economic conditions. Over the past 70 years, snowfall has decreased, with the snow season now starting later and ending earlier. Snowfall is projected to decline at Mt Baw Baw by around 78% by 2070-2099, relative to 2000-2010.<sup>12</sup>

*"The capacity of water storage for snowmaking is not currently an issue, but with climate change, the reliance on snowmaking may increase."*  
Workshop 2 participant

Snowmaking technology will be critical for sustaining winter operations, with its effectiveness dependant on future water availability and energy costs, and suitable weather conditions for making and retaining snow. An overall decline in Spring rainfall by 19% in 2040-2059 under high emissions scenarios in the Gippsland region may reduce water available for snowmaking.<sup>13</sup> Earlier snowmelt could also reduce water storage capacity, affecting both winter season operations and environmental water flows. Also, whilst average rainfall may decline, heavy rainfall events may increase in intensity, with projections suggesting a rise in daily rainfall intensity of up to 12% for events with a 20-

<sup>12</sup> Nation Partners (2024). *Summary of Climate Change Science and Impacts*.

<sup>13</sup> Ibid.

year recurrence interval.<sup>14</sup> These changes heighten risks of erosion, landslides, and infrastructure damage.

While average annual rainfall is expected to decrease in the Victorian alpine region, drought durations may decrease slightly at Mt Baw Baw. At the same time, average daily maximum temperatures for both summer and winter are projected to increase relative to the historic average. Minimum winter temperatures are modelled to increase by 1.2°C at Mt Baw Baw by 2050 under a high emissions scenario and summer average daily maximum temperatures are expected to increase by 2.7°C.<sup>15</sup> This warming accelerates snowmelt, shortens the snow season, and reduces snowmaking efficiency.

Access to and storage of water has the potential to become more important in the summer months as well, with the increased risk of bushfires.

## 2.6 Cultural Context

Gunaikurnai knowledge, responsibilities and aspirations for managing Country, including land, water and air, is documented Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) and Gunaikurnai Traditional Owner Land Management Board (GKTOLMB) plans and guidance. These include:

- Gunaikurnai Whole-of-Country Plan<sup>16</sup>
- Gunaikurnai and Victorian Government Joint Management Plan<sup>17,18</sup>
- Gunaikurnai Nation Statement - Water is Life.<sup>19</sup>

*All things come from Wurruk [land], Yarnda [waters] and Watpootjan [air] and they are the spiritual life-giving resources, providing us with resources and forming the basis of our cultural practices. We have a cultural responsibility to ensure that all of it is looked after.*

Gunaikurnai Whole-of-Country Plan (GLaWAC 2015)

<sup>14</sup> Nation Partners (2024). *Summary of Climate Change Science and Impacts*.

<sup>15</sup> Ibid.

<sup>16</sup> GLaWAC (2015). Gunaikurnai Whole-of-Country Plan.

<sup>17</sup> GKTOLMB (2018). Gunaikurnai and Victorian Government Joint Management Plan.

<sup>18</sup> GKTOLMB (2024) Gunaikurnai and Victorian Government Joint Management Plan: The next five years 2025—2030.

<sup>19</sup> GLaWAC (2022). Gunaikurnai Nation Statement - Water is Life.

## 2.7 Partnering with Gunaikurnai

ARV has obligations and aspirations to:

- build organisational cultural competence to engage with Traditional Owner groups with rights and interests in alpine resorts (Registered Aboriginal Parties and Traditional Owner groups without formal recognition)
- support Aboriginal self-determination and partner with Traditional Owners in the planning and management of alpine resorts.

*Integrated Water Management in Gunaikurnai Wurruk* informs this IWM plan and contributes to building ARV's water-related cultural knowledge and competence.<sup>20</sup>

ARV is also engaging with GLaWAC as part of the development of ARV's *Traditional Owner Engagement and Self-Determination Strategy*. The draft strategy identifies actions 'to champion Aboriginal self-determination through genuine partnerships with Traditional Owners, ensuring their rights and interests in Alpine Country are understood, supported and upheld'. These actions relate to three key focus areas: governance and accountability, culture and Country, and economic opportunities.<sup>21</sup>

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<sup>20</sup> Three Seeds (2025). *Integrated water Management in Gunaikurnai Wurruk – Mt Baw Baw | Mt Hotham*.

<sup>21</sup> ARV (2025). *DRAFT Traditional Owner Engagement and Self-Determination Strategy*.

### 3 Integrated Water Management Planning in an Alpine Environment

Integrated Water Management (IWM) is a collaborative approach to managing water resources that considers the interconnectedness of water systems, including supply, demand, wastewater, stormwater, and environmental flows. In alpine environments, IWM is particularly important due to the region's unique ecological, hydrological, and climatic characteristics. These areas are critical sources of freshwater for downstream communities and ecosystems, yet they face increasing pressures from climate change, seasonal variability, tourism, and development.

Effective IWM in alpine environments ensures sustainable water use, protects fragile ecosystems, and enhances the resilience of water systems against extreme weather events like droughts, fires, and floods. By integrating perspectives across stakeholders, IWM helps balance the needs of people, industry, and nature while preserving the alpine environment for future generations.

As discussed previously, the options for IWM management considered in this plan were sourced from conversations with ARV staff and stakeholders during the two workshops, as well as interviews and the site visit. The ideas and opportunities generated from this engagement were then analysed using available data and also were evaluated based on their alignment with ARV strategic objectives and IWM outcomes. This alignment is important as it addresses how each option supports ARV's organisational goals, as well as the broader outcomes IWM seeks to support.



Figure 12. IWM framework for alpine resorts

### 3.1 ARV Strategic Objectives, 2024 – 2027

Alpine Resorts Victoria (ARV) has six strategic objectives to guide activities between 2024 – 2027. These objectives were created to ensure ARV has clear direction to support sound decision-making. The alignment of these objectives with each individual IWM option will be discussed further later sections. The table below shows the connection between the ARV objectives and IWM planning.

ARV Strategic Objective	Relevance to IWM planning
<b>Investment:</b> Enable investment that drives sustainable businesses	Supports IWM through financing water infrastructure improvements and ensuring water-related services are resilient and sustainable
<b>Environment:</b> Protect and enhance the alpine environment and adapt to climate change	Reducing water use and improving water security mitigates environmental impacts on alpine ecosystems
<b>Visitors:</b> Enhance the visitor experience	Ensures water services meet visitor demand, maintaining quality and accessibility
<b>Reform:</b> Implement practical policy and regulatory reform	Facilitates the adoption of updated water management practices and regulations
<b>Progress:</b> Enhance organisational excellence and sustainability	Effective IWM planning depends on robust governance, resource allocation, and continuous improvements.
<b>People:</b> Build constructive culture and leadership capabilities	Developing expertise in IWM among ARV staff ensures long-term sustainability and informed decision-making.

### 3.2 IWM outcomes and relevance to Mt Baw Baw

There are generally eight strategic outcomes of an IWM approach; each outcome addresses a different aspect of the water system. However, it is important to recognise that most IWM plans (and outcomes) are focused on urban environments and communities that are quite different from a resort or alpine environment. The following table displays the IWM strategic outcomes and their relevance to Mt Baw Baw Alpine Resort.

System Aspect	Outcome	Relevance to Baw Baw
Water sources	1. Safe, secure and affordable supplies in an uncertain future	Increase the amount of water conserved or alternative water volume supplied to meet demand.
Wastewater	2. Effective and affordable wastewater systems	Ensure environmental and public health standards are met while maximising resource recovery.
Drainage, stormwater, and flooding risks	3. Effective stormwater management to manage flood risks	Minimise environmental impacts of stormwater; ensure resilience to existing and future flood risks.
Waterways	4. Healthy and valued waterways and waterbodies	Improve ecological health of alpine bogs and riparian areas; improve hydrology and water quality.
Water in urban landscapes	5. Healthy and valued landscapes	Maximise the connectivity, accessibility, aesthetic, and recreational values of landscapes.
Traditional owners	6. Traditional Owner values, opportunities, and inclusion	Ensure that Traditional Owner values and priorities are acknowledged, respected, and enhanced.

System Aspect	Outcome	Relevance to Baw Baw
Community value of water	7. Community values reflected in place-based planning	Ensure that different communities are considered and included in planning and design. Consider how to increase water systems literacy of Baw Baw visitors.
Economic values	8. Jobs, economic opportunity and innovation	Recognition that water management is an integral part of sustainable business

### 3.3 Gunaikurnai considerations

As an interim step toward understanding Gunaikurnai values of alpine water systems, cultural considerations for integrated water management in Gunaikurnai Country are identified below. Gunaikurnai knowledge, aspirations and principles are drawn from the Gunaikurnai Whole-of-Country Plan,<sup>22</sup> Gunaikurnai and Victorian Government Joint Management Plan,<sup>23</sup> and *Wurruk na ingga ma* Returning to Country 5 Year Strategy 2021 - 2026.<sup>24</sup>

The capacity and capability of both ARV and Gunaikurnai to work together on water-related initiatives will evolve as the Baw Baw Alpine Resort IWM Plan is implemented. A focus on building relationships with Gunaikurnai will support identification, development and implementation of IWM options aligned with the responsibilities and aspirations of both ARV and Gunaikurnai. Engagement with Gunaikurnai through the development of ARV’s Traditional Owner Engagement and Self-Determination Strategy may also provide opportunities to review and refine cultural considerations and IWM options.

<sup>22</sup> GLaWAC (2015). Gunaikurnai Whole-of-Country Plan.

<sup>23</sup> GKTOLMB (2018). Gunaikurnai and Victorian Government Joint Management Plan.

## 1. Build relationships to care for Country

Gunaikurnai knowledge:

- Work together to learn from each other and incorporate Gunaikurnai knowledge and values.
- Look after waterways from source to sea, and manage for the animals, plants, water and people.

IWM Consideration:

*Work with Gunaikurnai – as part of broader ARV engagement and self-determination initiatives - to identify opportunities for two-way sharing of knowledge and skills in managing water in the landscape, including those linked to joint management of Baw Baw and Alpine National Parks.*

## 2. Recognise and respect Gunaikurnai cultural rights and obligations

Gunaikurnai knowledge:

- Gunaikurnai have cultural rights and obligations related to Country.
- Gunaikurnai Country possesses a rich Aboriginal culture. Gunaikurnai heritage is strong across our landscape, and Aboriginal cultural sites and artefacts can be found along our songlines, trade routes, mountain ridges and waterways.

IWM Consideration:

*Recognise and respect Gunaikurnai connections to alpine areas, the wide range of tangible and intangible values of alpine landscapes (including waterways) to Gunaikurnai, and how integrated water management options may impact on these connections and values.*

<sup>24</sup> GKTOLMB (2021). *Wurruk na ingga ma* Returning to Country 5 Year Strategy 2021 – 2026.

**3. Water is part of a cultural landscape; everything is connected.**

Gunaikurnai knowledge:

- Wurruk (Country) includes land, water, sea, sky, all life.
- All things come from land, waters and air and they are the spiritual life-giving resources.

IWM Consideration:

*Understand and minimise potential adverse impacts of water management decisions on the cultural landscape within and beyond alpine resorts.*

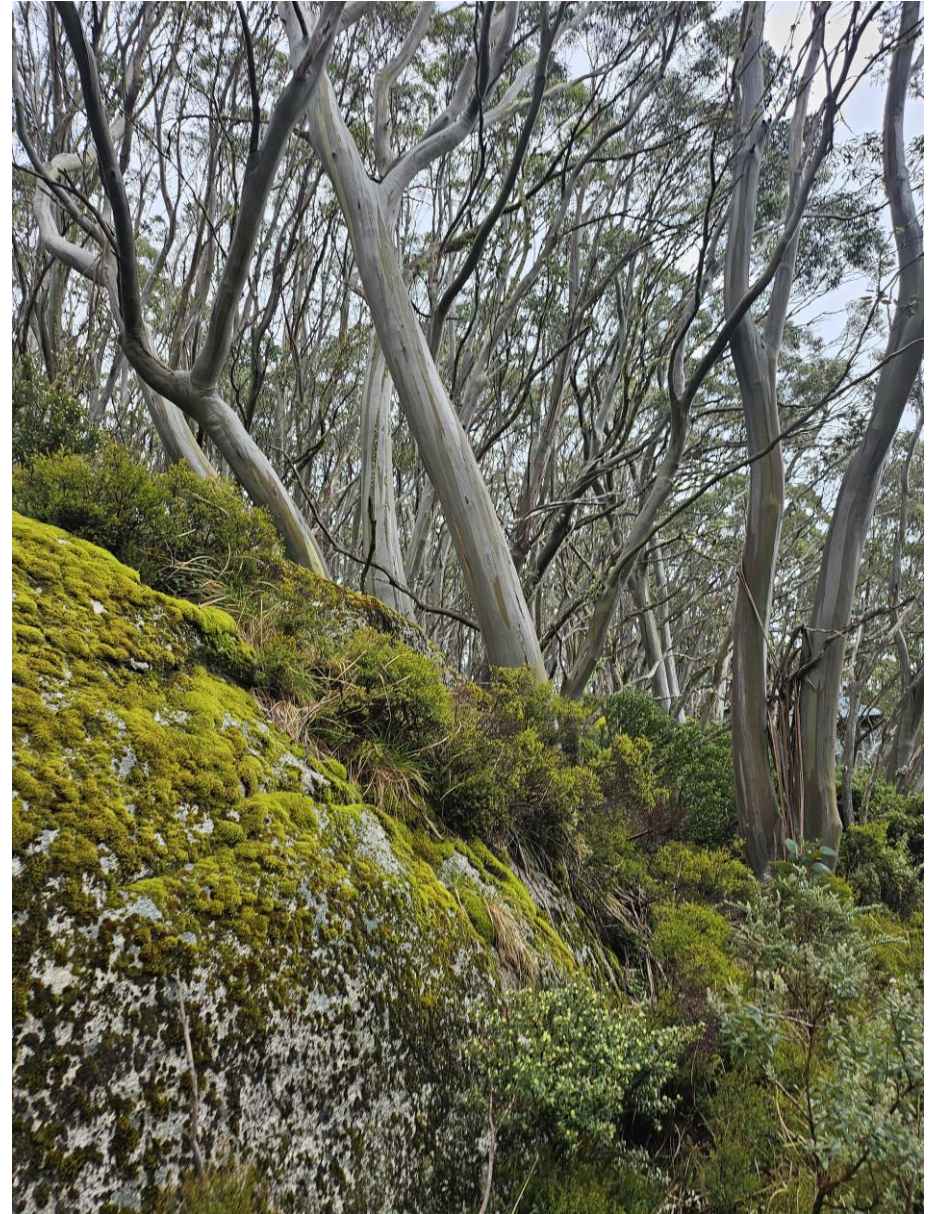


Figure 13. Snow gums at Mt Baw Baw

## 4 Water Management Options

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The options presented in this plan have been grouped into five categories.

- **Basic water management.** These options relate to getting the basics right. It is important, irrespective of what water is used for what purposes, that leaks are detected and fixed, assets are maintained at appropriate frequencies and service levels, and there is a good understanding of all water infrastructure and pipe connections throughout the resort. These options should be addressed as a priority.
- **Good water management.** These options relate to good asset management and managing water as a precious resource; they should be pursued irrespective of the long-term strategic plan for the resort. These options include partnerships and understanding with the Traditional Owners, and better reporting on water consumption, savings, end uses and discharges, for an overall increased water efficiency resort.
- **Environmental values.** These options relate to impacts of surface water systems on the downstream and surrounding environment. Options specific to reducing the impact of stormwater from the impervious surfaces (particularly car parks) are critical to these options. They focus on reducing diffuse source pollution, erosion, and in some instances wastewater discharges on the environment.
- **Integrated water and energy strategy.** Energy and water are both critical to the successful ongoing operations of the resorts. Energy and water are both significant issues in running the alpine resorts, and options that relate to increasing the opportunities for renewable energy production through the smart use of water storages and water discharges are noted in these set of options.
- **Future water resilience.** These options relate to augmentation of the water supply, storage and infrastructure system that support moves to create a more resilient water system that can cope with climate change

(and associated impacts such as bushfire) and forecast visitation at the resort.

The options under these themes are shown in Figure 14.

### 4.1 Refining options based on stakeholder feedback

Figure 14 has 21 unique options across a wide range of IWM issues and strategies. A useful IWM plan is one that is clear and prioritises action and investment in a few key areas that will support IWM and the resort's vision, rather than a long list of options.

To refine the 21 options and leverage stakeholder expertise, the project conducted multiple iterations to stress test feasibility and support levels. Two workshops, attended largely by the same representatives, played a key role in this process. In particular, the second workshop provided an opportunity for ARV staff and stakeholders to critique and refine options (see Appendix B). Through this process, some options were deemed infeasible, while others were refined or improved based on stakeholder insights.

This resulted in a priority set of 15 options deemed worthy of additional review and modelling, seen in bold. Of the 15, one of the options (increased water storage for snowmaking) did not pass the technical feasibility task and is not included in the action plan. Also, of the 15 options, three of these are in the 'basic water management' category, and a further five of these are in the category of 'good water management', which were agreed to be sound pieces of work to do at the resort, irrespective of the longer-term vision and operation of the resort.

To further expand on some of the reasoning and issues that were discussed in the workshops, Figure 15 captures how far each option got in terms of meeting various criteria that was raised and discussed in the workshops.

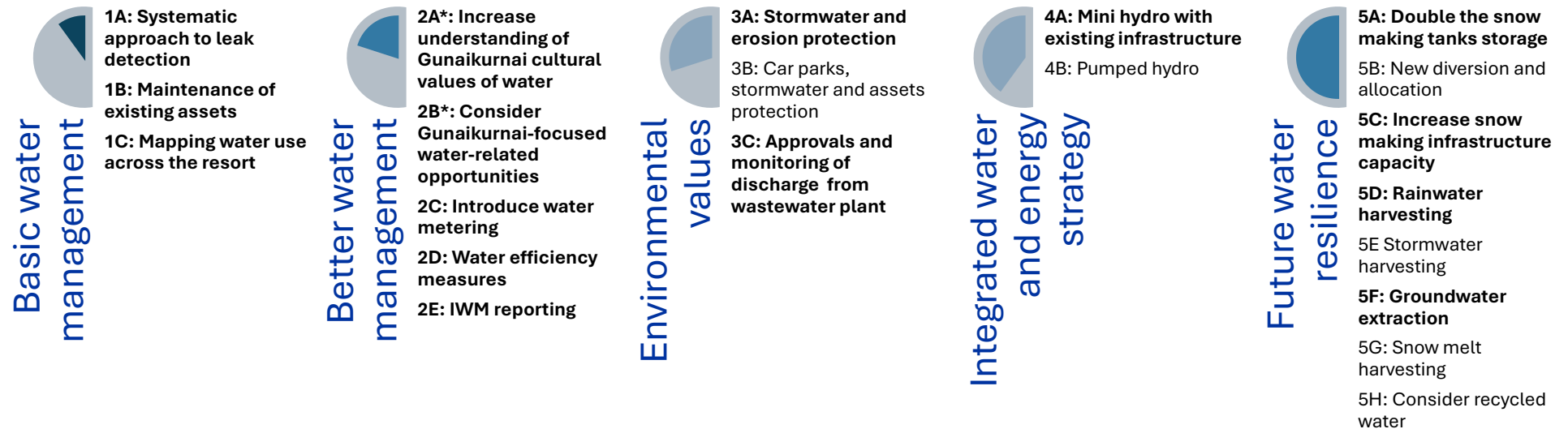


Figure 14. List of all IWM options

Options in **bold** in were presented to stakeholders involved in the second workshop and broadly supported and where necessary were subject to additional review and analysis.

\* Cultural initiatives should align with ARV's Traditional Owner Self-Determination and Engagement Strategy (in-development) as part of long-term relationship building and caring for country.



Figure 15. Summary of support for options

Water management options supported by ARV and resort stakeholders, perceived to represent value (from a cost-benefit perspective), and considered technically viable are presented in Section 5.2. Options that were initially considered but not pursued are listed below (Table 2).

Table 2. Options not pursued

Option Name	Description	Reason not pursued
Wastewater recycling	Option to filter and reuse treated wastewater for snowmaking.	There are adequate supplies for snowmaking, and other options are preferable to find additional water for snowmaking over this one, that would require significant capital expenditure and ongoing maintenance.
Stormwater harvesting	Harvesting of stormwater from the two main car parks for reuse in toilet flushing and/or snowmaking	Rainwater harvesting to potable was considered to be a better option, but in the future stormwater harvesting could be explored with the potential of between 25 and 60 ML / year of available water (with appropriate treatment and a location to store collected stormwater).

## 5 Options analysis

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### 5.1 Modelling method

Water management options for Baw Baw have been modelled where possible to identify benefits, costs, uncertainties, and risks. Several recommended options were unable to be modelled due to lack of available data; these options are discussed in Section 6.

A custom water system model was developed to simulate all water demands, fluctuations in storages and diversions, and snowmelt. Weather and rainfall data (10 years at an hourly time-step), together with visitation and snowmaking data was used to calibrate the model. A modelled base case scenario was used to better understand the impacts of proposed options.

To assess water options, the following assumptions and method were used:

- The resort uses in total 15 to 20 ML / year of water (7 ML / year of potable water for the buildings and operations, and 10 to 12 ML / year of non-potable water for the snowmaking).
- Resort maximum daily visitation is 5000 people.
- The resort uses snowmaking at the Summit T-bar, Tank Hill, Magic Carpet and Hut-Run, a total area of 25,600 m<sup>2</sup>.
- The resort in theory could expand snowmaking to cover more toboggan and snow play areas, an additional area of 2,000 m<sup>2</sup>.
- Snowmaking requires 500 L / cubic metre of snow.

- Water is diverted from the Tanjil River East Branch to three storage tanks (total capacity of 1.5 ML), noting the extraction point for pumping is downstream of the potable diversion point.
- The diversion has an upstream area of 5 hectare (all forested).
- Modelling of rainwater patterns was based on the rainfall records at Baw Baw, with daily rainfall data; pluviometer data was available for a 3-decade period at Tanjil Bren.
- Mean annual rainfall at the Baw Baw rain gauge for the period used for modelling is 1,596 mm / year.
- Hourly temperature, humidity, wind and wet bulb data for Baw Baw was used to model snowmaking conditions. This was the closest weather station with hourly data and provides a good basis to identify appropriate weather conditions for snowmaking, and melting.
- Snowmaking was modelled to occur every time the wet bulb temperature is less than '-3 degrees'.
- It is assumed that up to 125 cm of snow would be made in the peak of winter if the weather were conducive, there was available water, and the volume of water did not exceed the pump capacity.
- Snow melt was modelled using a 'degree days' function, which varies with temperature (i.e. a higher Degree Days Factor for a higher temperature). The following function was used to determine the melting factor (and applied every time step):  $y = 0.2415 e^{-.1004x}$  (where  $y$  = cm of snow melt, and  $x$  = temperature).<sup>25</sup>

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<sup>25</sup> Muhammad Fraz Ismail, H.-u.-R. W. (2015). *Degree day factor models for forecasting the snowmelt runoff for Naran watershed*. Science International Lahore, 1951-1959.

Figure 16 shows the trend in ‘weather window for snow making’ suitable for snowmaking with snow guns, noting not all factors that influence the optimum time and duration for snow gun use are represented.

Favourable conditions for snowmaking with snow guns (dark blue band) reflect temperatures less than -1 degree, wind less than 5 km/h and relative humidity less than 90. Between 2024 and 2023, there were between 10 and 80 hours per year of favourable conditions for snowmaking. Since 2013, there have been less than 40 hours per year (except for 2022).

A warming climate reduces the time where temperature, relative humidity and wind speed are suitable for snowmaking with snow guns.

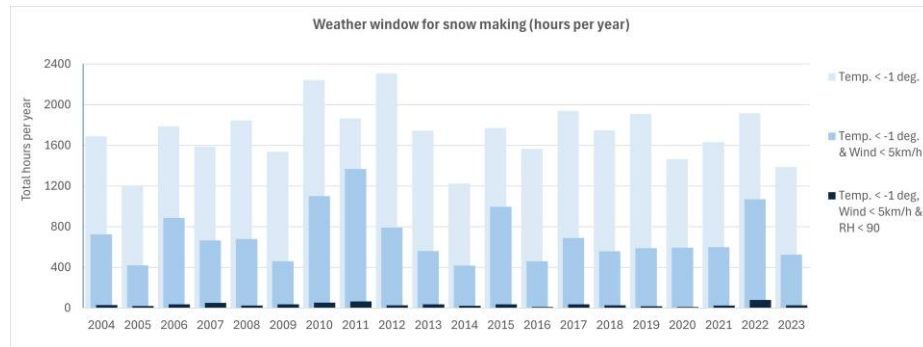


Figure 16. Weather window for snow making (Baw Baw weather station data 2004 - 2023).

## 5.2 Options detail

### 5.2.1 Option 1A, 1B and 1C: Basic water management

Basic water management options include a group of actions focused on leak detection (through regular flow monitoring to identify when typical demands are significantly exceeded); reducing leaks and pipe cracking in the potable network; and, mapping all pipes and connection across the resort (to be added into the ARV asset management database).

An increase in sewage treatment volume may indicate a toilet leak; unseasonal or unusual wet patches or springs may indicate a cracked pipe.

**Category:** Basic Water Management

**Who benefits:** ARV, all visitors (through a more resilient water system)

**Costs:** Ongoing



Maintenance of pits and pipes is important.



Monitoring of pumps and consumption, and protection of pipes to avoid cracking is critical.



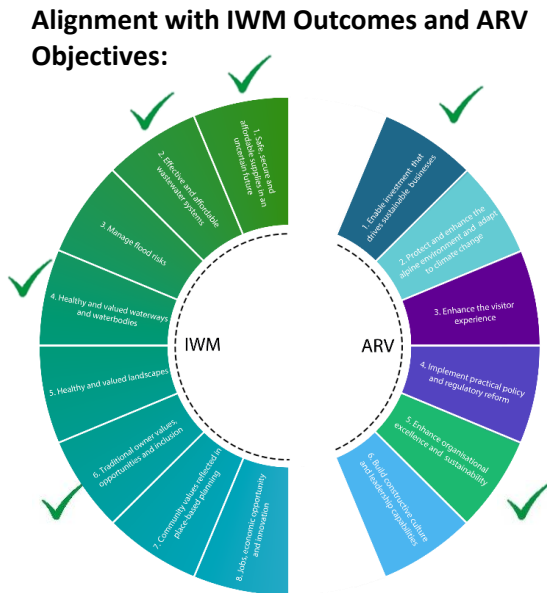
Without better management of stormwater assets and upstream flows, erosion risks will increase.

#### Risks / Uncertainties:

- The existing risk/uncertainty of not knowing the location of some pipes and how they connect are addressed by these options.

#### Summary:

System losses can account for 3 to 15% of overall water consumption when not proactively monitored and maintained<sup>26</sup>. Ongoing monitoring, maintenance and repair of existing water infrastructure is critical for the resort.



<sup>26</sup> Bureau of Meteorology, 2024. Urban national performance report 2023-2024 raw dataset for small and medium sized utilities. Accessed at <http://www.bom.gov.au/water/npr/index.shtml>

### 5.2.2 Option 2A: Increase understanding of Gunaikurnai cultural values of water (building cultural understanding)

This option supports broader and deeper understanding of Gunaikurnai cultural values of water in alpine landscapes, including physical, spiritual and cultural connections to Gunaikurnai Country beyond the resort via Durt'Yowan (Latrobe River Basin) and its tributaries. Initiatives should:

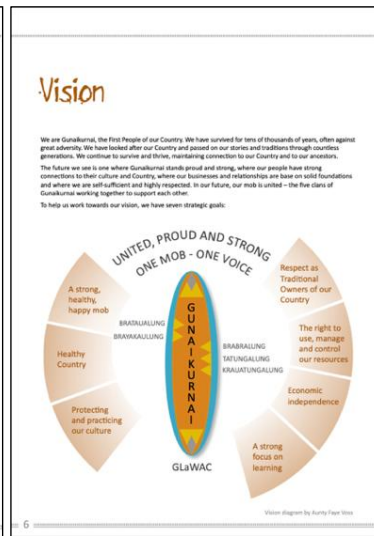
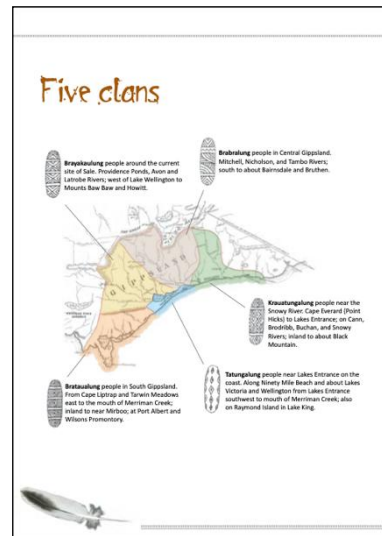
- focus on building the cultural awareness and competence of resort staff and visitors,
- align with ARV's Traditional Owner Engagement and Self-Determination Strategy (in-development),
- be delivered in partnership with Gunaikurnai Land and Waters Aboriginal Corporation – subject to Gunaikurnai self-determined priorities and capacity.

**Category:** Good Water Management

**Who benefits:** ARV, resort visitors.

**Costs:** To be determined (dependent on the scope of specific initiatives and level of Gunaikurnai involvement)

**Alignment with IWM Outcomes and ARV Objectives:**



**Risks / Uncertainties:**

- Gunaikurnai involvement will be self-determined, informed by their priorities and capacity.

**Summary:**

Greater awareness of cultural values of water in alpine landscapes supports ARV obligations and aspirations to work in partnership with Traditional Owners.

### 5.2.3 Option 2B: Gunaikurnai-focused water-related opportunities (supporting cultural land and water management)

This option relates to cultural land and water management opportunities – Identified and developed as part of an ongoing relationship with Gunaikurnai – to support:

- implementation of the Gunaikurnai and Victorian Government Joint Management Plan, and
- planning and implementation of the Gunaikurnai water strategy (in-development).

Opportunities may include, for example, data sharing (ecological/biodiversity/water monitoring data) and two-way knowledge sharing (alpine bogs, waterway management). Initiatives should align with ARV's Traditional Owner Engagement and Self-Determination Strategy (in-development).

**Category:** Good Water Management

**Who benefits:** ARV, Gunaikurnai, resort visitors.

**Costs:** To be determined (dependent on specific initiatives identified and developed with Gunaikurnai)

**Alignment with IWM Outcomes and ARV Objectives:**



**Risks / Uncertainties:**

- Gunaikurnai involvement will be self-determined, informed by their priorities and capacity which may vary over the life of this plan.
- Identification of specific initiatives was not possible at the time this plan was prepared

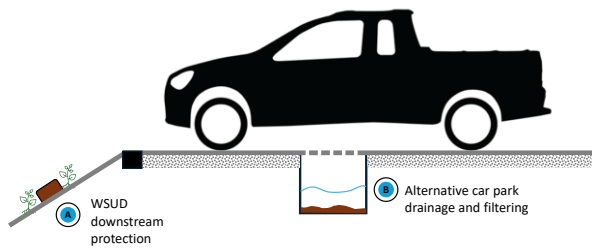
**Summary:**

Working with Gunaikurnai on cultural land and water management initiatives supports ARV obligations and aspirations to work in partnership with Traditional Owners.

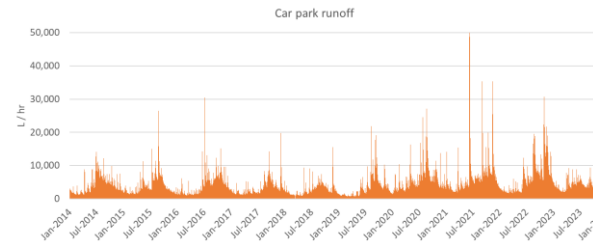
### 5.2.4 Option 3A: Stormwater and erosion management

Stormwater runoff from car parks impact downstream environments through stormwater pollution and erosion. These impacts can be mitigated through the re-design/upgrade of car park edges, for example, by:

- (1) introducing diversions and berms to manage runoff on slopes below the car park, and/or
- (2) installing a strip trench and grate system set two meters back from the edge (to allowing snow clearing) while capturing and filtering stormwater pollutants through a sump pit and sand filter.



Mt Baw Baw Car park #1



Runoff from the 2.5 ha of car parks generates significant stormwater flows, leading to erosion, asset damage, and pollution. In alpine environments, snow, salt (used to improve safety), and machinery used to clear snow and debris introduce additional challenges to managing these issues.

#### Summary:

Innovative options are needed to reduce the risk of stormwater pollution and erosion. This will require re-design/upgrade of carparks and may involve changes to snow clearing processes.

#### Risks / Uncertainties:

- Potential impacts of car park stormwater management on current snow clearing processes will need to be considered as part of further investigation/design.
- Maintenance of proposed trench drains (process and frequency) will need to be considered as part of further investigation/design.

**Category:** Environmental values

**Who benefits:** Downstream environment, Traditional Owners

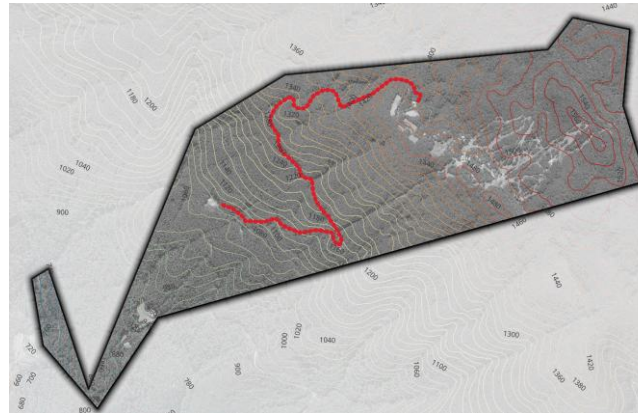
**Costs:** Variable

**Alignment with IWM Outcomes and ARV Objectives:**

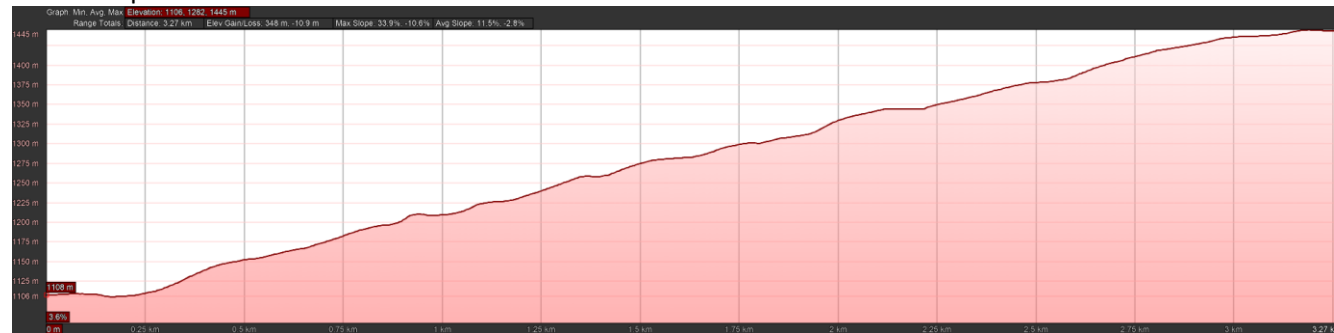


### 5.2.5 Option 4A: Mini hydro with reused wastewater network

Use existing pipe from WWTP to lagoon ponds, to generate power 365 days a year, and use the waste water system and existing infrastructure to generate renewable electricity and compliment other renewable energy strategies and infrastructure. Existing pipe has a 10% grade and 340 metre elevation difference and runs for 3450 metres.



Elevation profile



#### Risks / Uncertainties:

- Longer term licencing and management of wastewater will influence this option.
- Uncertainty as how the quality of water (Class A) will impact on the mini-hydro turbine over the long term.

#### Summary:

Possible power from this mini hydro with a 340-metre head, could be between 5kw and 50kW and in peak season could contribute around 1MWh of energy to the resort.

**Category:** Integrated water and energy strategy

**Who benefits:** ARV and power project.

**Costs:** Dependent on feasibility work.

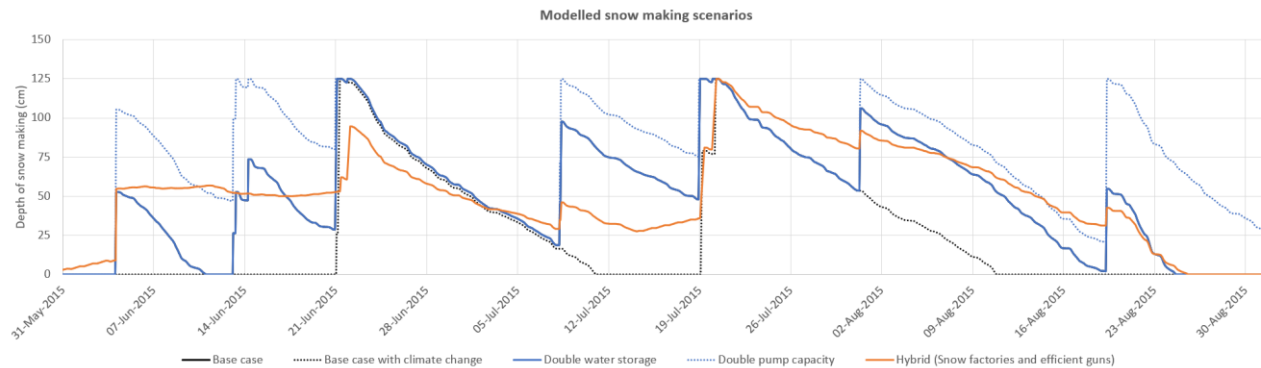
**Alignment with IWM Outcomes and ARV Objectives:**



- Maintenance and power connection to main supply is uncertain.

### 5.2.6 Option 5A & 5C: Increased snowmaking with more storage and or pumps

This option evaluated increasing water storage and pump capacity to enhance snow production during favourable ‘weather windows’ and also tests the use of snow factories that operate outside of these weather windows. Analysis, based on an indicative winter season (2015), demonstrated that doubling pump capacity (blue dotted line) increases snow production capacity but doubling the water storage volume (blue line) has minimal impact. The base case with climate change scenario indicates a 2°C temperature rise would result in approximately 75% less snowmaking opportunities (noting snow factories operate at higher temperatures and avoid this impact of climate change but are an expensive new piece of infrastructure). A hybrid option (orange line) is modelled that illustrates the use of snow factories that may produce an overall smaller depth, but don’t melt in the same fashion, so in conjunction with efficient guns could be an option to further investigate (noting the increased costs of a snow factory should be considered as well).



#### Risks / Uncertainties:

- Climate change will impact snow making with snow guns and snow melt irrespective of increases in snowmaking capacity.
- Uncertainty as to the power load required for future snow factory and pumping.
- Snow factories as an alternative to increasing snow guns and pump capacity has not been investigated.

#### Summary:

Modelling shows that any investment to increase snowmaking capacity should consider upgrades to the water distribution system and pump infrastructure (adjacent to the Tank Hill storage). Greater pump capacity over shorter duration favourable weather conditions was shown to increase snow production using snow guns by approximately 20%.

**Category:** Future water resilience

**Who benefits:** ARV, visitors

**Costs:** \$950k (based on \$250k pump station and 14 x \$50k per snow gun). Snow factories typically \$2M.

**Alignment with IWM Outcomes and ARV Objectives:**



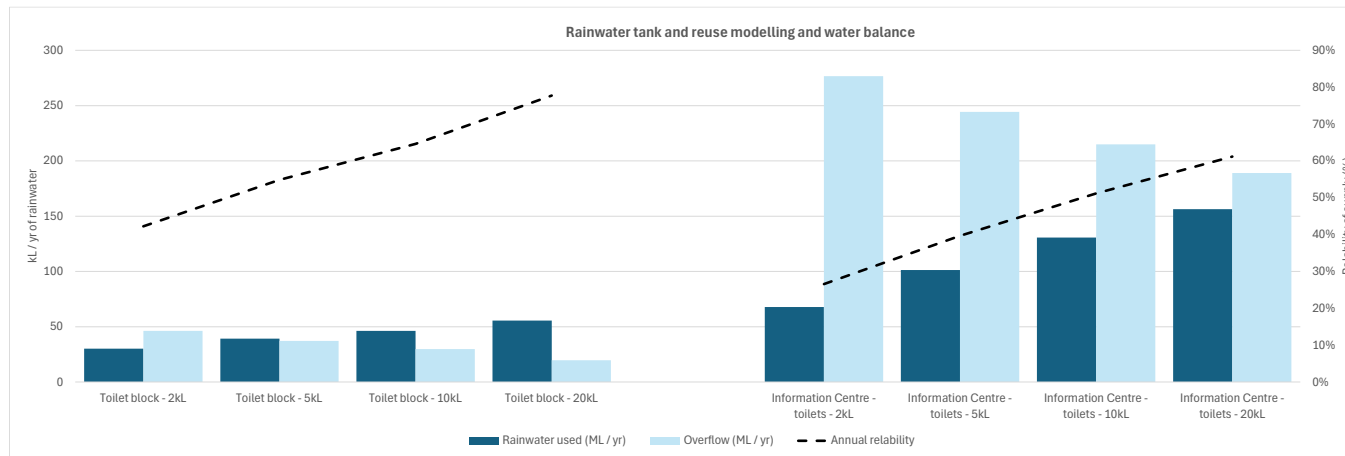
### 5.2.7 Option 5D: Rainwater harvesting

Adding rainwater tanks to supply toilet flushing (and irrigation and hot water where appropriate) to public buildings would reduce potable water demand while also reducing stormwater runoff and erosion. The existing potable system can provide a back-up supply allowing tank size to be optimised without rainwater needing to provide 100% reliability. Tanks of varying capacity were modelled at the toilet block and administration building. 10kL tanks were identified as sufficient to provide a 50% to 60% reliability of supply, with greater thermal mass relative to smaller tank sizes reducing the risk of the water freezing.

**Category:** Future water resilience

**Who benefits:** ARV

**Costs:** 25k to 35k per tank (10 kL)



**Alignment with IWM Outcomes and ARV Objectives:**



#### Risks / Uncertainties:

- Detailed planning and costing (including guttering, plumbing and power) is required to reduce potential risks/uncertainties associated with rainwater harvesting in alpine environments
- Regular maintenance is required to ensure well-functioning system and minimise operational risks.

#### Summary:

Rainwater harvesting is a well-developed technology that could reduce potable supplies by up to 150-kL per year where installed on buildings with large roofs and appropriate water demands (e.g. toilet flushing). Rainwater tanks could potentially also meet appropriate green season demands (e.g. bike / outdoor equipment washdown).

### 5.2.8 Option 5F: Groundwater extraction for potable

This option explores the potential of sourcing groundwater for potable water use and assumes groundwater would be used as a primary source, instead of the diverted surface water from the Tanjil River East Branch.

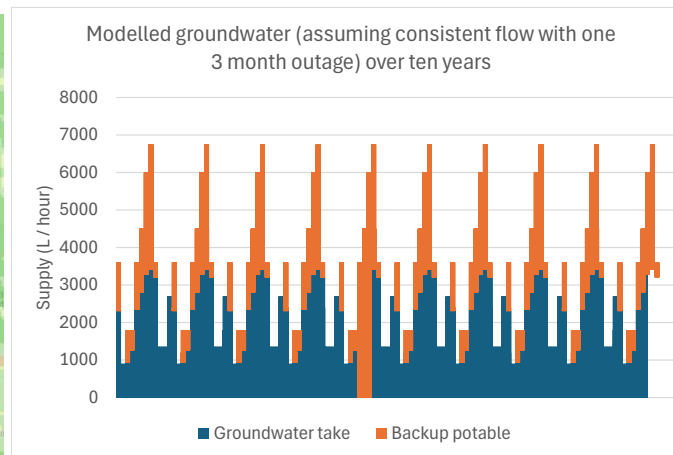
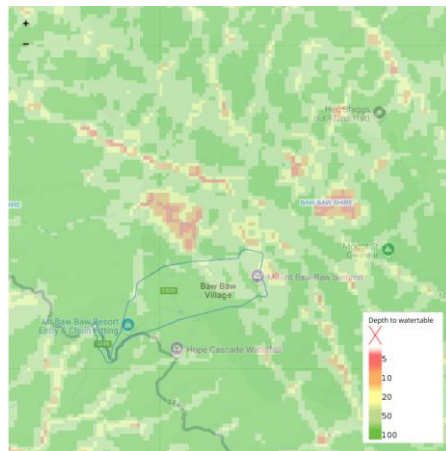
There is no Groundwater Management Unit or Permissible Consumptive Volume at Baw Baw, and therefore no regulatory framework groundwater extraction. However, DEECA’s Groundwater Resource Report (a 3 page report on basic groundwater parameters) for Baw Baw Village indicates there is a groundwater resource in the 0 – 200 metre depth range with estimated salinity < 500 mg/L. The report states that the geology of this region is “BSE Mesozoic and Palaeozoic Bedrock (basement) sedimentary (fractured rock): Sandstone, siltstone, mudstone, shale. Igneous (fractured rock): includes volcanics, granites, granodiorites.”

From a water supply / demand perspective, a bore could supply between 55% and 78% of all potable water, assuming there is an uninterrupted (seasonal) supply of between 0.5 and 1 L / second and assuming a 5% downtime to account for asset failure or water quality issues.

**Category:** Future water resilience

**Who benefits:** ARV resort and surface water system.

**Costs:** \$100k for feasibility study and test bores.



**Risks / Uncertainties:**

- Groundwater regulation and licencing must be addressed prior to any investigations.
- There are considerable uncertainties as to groundwater availability, and quality, even when exploring availability of groundwater over a 25-metre distance.

**Summary:**

Engagement with Southern Rural Water is required to discuss the licence and regulatory framework, noting there is no Groundwater Management Unit or Permissible Consumptive Volume at Baw Baw. If this can be resolved then an in-depth feasibility report is required to assess this option.

**Alignment with IWM Outcomes and ARV Objectives:**



## 6 Recommendations

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Through the engagement process and modelling of water issues and options, it has emerged that a suite of options are worthy of pursuing, though some require additional studies and investigations to ensure there is a sound business case for investment, by ARV or associated stakeholders. Options presented below but not shown in Section 5.2 were unable to be modelled due to lack of available data.

### 6.1 Recommended

These options are recommended as they will collectively meet the ARV and IWM objectives and align with the vision of an integrated water management approach. The recommendations prioritise doing the basics well before progressing to more complex / advanced water management options.

#### Basic Water Management

- **# 1. Systemic approach to leak detection and mapping water infrastructure** [ Option 1A, 1B and 1C ]

It is recommended that ARV / Mt Baw Baw address the simple things first: water infrastructure maintenance including leak detection and rectification. The use of real time alerts (particularly overnight) will assist in identifying potential leaking in real time. Ongoing mapping and documentation of all assets is also part of basic water management.

#### Good Water Management

- **#2. Gunaikurnai cultural values of water and water-related opportunities.** [ Option 2A and 2B ]

It is recommended that ARV / Mt Baw Baw build relationships with Gunaikurnai Traditional Owners to increase understanding of cultural

values of water, and to develop longer term partnerships and shared opportunities.

- **#3. Water metering and water efficiency.** [Option 2C and 2D]  
Progressive implementation of water metering across the resort supports short and long-term water management. SCADA or other control system will enable a clear understanding of system operation and performance including timely leak detection.

#### Stormwater and environment

- **#4. Stormwater and erosion protection.** [Option 3A]  
Design and build a car park stormwater retention/filtering trial (for one whole car park) to reduce the stormwater volume and associated pollutants entering local creeks. This trial should be monitored and assessed to inform future stormwater-related environmental initiatives and could support two-way knowledge sharing partnerships with Traditional Owners [Option 2B]. This will protect local car park assets as well.
- **#5. Wastewater discharge monitoring.** [Option 3C]  
Monitor and report on wastewater impacts, to enable an evidence based approach to having minimal impact on the downstream environment and to gather water quality data for future investigations for an option of wastewater recycling for resort operations and snowmaking.

#### Integrated water and energy

- **#6. Mini Hydro** [Option 4A]  
Undertake a feasibility of a potential mini-hydro scheme attached to the existing wastewater discharge pipe from the treatment plant to the lagoons (using the 340 metres difference in elevation), to create renewable energy all year round and offset the importing of fossil fuels.

### Integrated water and energy

- **#7. Increasing snowmaking capacity.**[Option 5C]  
Complete a feasibility study into a hybrid option for snowmaking that uses snow factory technology, combined with increased efficiency of snow fan guns, with the existing water allocation and storage, and an option for increased pump capacity to make snow in shorter weather windows. The study should consider power implications for the resort and the findings from the mini-hydro option [Option 4A].  
make more snow, on the basis that there will be a reduced number of favourable weather windows for snow making.
- **#8. Rainwater harvesting for toilets [Option 5D]**  
Undertake a retrofit rainwater harvesting project at one toilet block or admin building (with at least 250 m<sup>2</sup> roof area), with the intention that this harvested rainwater be plumbed into internal toilet flushing from a minimum 10 kL tank. Monitor and evaluate the system to determine the indicative potable water reduction from the pilot, and any other additional benefits, to better understand the potential of expanding rainwater harvesting to other buildings and link with Option 3A to monitor benefits to downstream environments.

### 6.2 Not recommended.

Analysis of options to create more snow through additional water storages has little or no benefit to the ability to create snow, at this altitude and with this climate pattern. **Therefore Option 5A (double the capacity of the snowmaking tanks) is not recommended.**

Groundwater bores (**Option 5F**) could potentially be explored in the future, in consultation with Southern Rural Water in relation to regulatory and licencing considerations, should surface water supplies become constrained.

## 7 Action plan

The delivery of this plan is contingent on available resources and grant funding to support ARV to upgrade the resort and create an integrated water management demonstration site.

The following table lays out the broad set of tasks and staging of projects that is recommended to meet the IWM and ARV objectives of the site.

Table 3. Action plan and staging of projects

Timing	Name / Option	Task(s)	Link to objectives	Theme	Indicative cost	Lead	Water savings (ML / year)
Immediate	Option 1A to 1C – leaks and data mapping	<ul style="list-style-type: none"> <li>Ongoing maintenance work to ensure integrity of the system, stop leaks, and map the existing water network and end uses.</li> </ul>	Water efficiency and sustainable asset management	Basic water management	Ongoing opex	ARV, EPA	> 0.5 ML / year
Immediate	Option 2A & 2B - TO	<ul style="list-style-type: none"> <li>Continue to explore how to engage with the Gunaikurnai.</li> </ul>	Cultural and community values	Good water management	TBC	ARV	NA
Immediate	Option 3C – wastewater monitoring	<ul style="list-style-type: none"> <li>Continue ongoing approval process for discharge of Class A water to local creek, and ongoing monitoring of the impacts of the discharges on Tanjil River East Branch.</li> </ul>	Environmental management	Environmental management	Ongoing opex	ARV, EPA	NA
Short term (1 to 3 years)	Option 1D & 1E - metering	<ul style="list-style-type: none"> <li>Efficiency and leak detection. Systematically review every single tap, toilet, hose and water outlet to ensure all units are very water efficient (as per WELS rating) and water efficient flow restrictors in place, over a 3-year period.</li> </ul>	Water efficiency and sustainable asset management	Good water management	\$10,000	ARV	0.17 ML / year
Short term (1 to 3 years)	Option 3A – stormwater management	<ul style="list-style-type: none"> <li>Identify specific areas where the placement of old logs or coir logs would be useful to retain sediment and leaf litter, and reduce erosion risk, around car park 1 and 2. Locations must be below the edge of the asphalt, to ensure</li> </ul>	Environmental management and sustainable	Environmental management	\$10,000	West Gippsland CMA, ARV	NA

Timing	Name / Option	Task(s)	Link to objectives	Theme	Indicative cost	Lead	Water savings (ML / year)
		<p>graders are not affected when clearing snow from the car park.</p> <ul style="list-style-type: none"> <li>Monitor effectiveness of these stormwater interventions.</li> </ul>	asset management				
Short term (1 to 3 years)	Option 4A: mini hydro	<ul style="list-style-type: none"> <li>Conduct a feasibility study, as part of the Mt Baw Baw Power Strategy, the option of introducing a mini-hydro on the end of the wastewater discharge to the lagoons, a fall of 340 meters in elevation.</li> </ul>	Jobs, economic opportunity and innovation	Integrated water and energy strategy	\$50,000	ARV	0 * (But possible energy savings)
Short term (1 to 3 years)	Option 5D- rainwater tanks	<ul style="list-style-type: none"> <li>Engage a plumber to design and build rainwater tank system with potable back up.</li> </ul>	Safe, secure, affordable water supplies	Future water resilience	\$25,000	ARV	0.1 ML / year
Medium term (4 to 10 years)	Option 5C – pump upgrades for snowmaking	<ul style="list-style-type: none"> <li>Investigate the option to increase pump capacity and the impact this has on snow production, on the basis it can add 20% more snow to the resort, in a reduced weather window, and recognises that the existing storages will provide enough water for upgrade.</li> </ul>	Safe, secure, affordable water supplies	Future water resilience	\$950,000	ARV, DEECA, Dept of Health	1.3 ML / year
Long term (10+ years)	-	<ul style="list-style-type: none"> <li>Revisit the option for stormwater harvesting, wastewater recycling, and groundwater bores to create alternative supplies for potable and snowmaking demands.</li> </ul>	Safe, secure, affordable water supplies	Future water resilience	NA	NA	NA
Long term (10+ years)	-	<ul style="list-style-type: none"> <li>Revisit the need for increased snowmaking at the resort, especially if there is a need to increase the area that snowmaking covers.</li> </ul>	Safe, secure, affordable water supplies	Future water resilience	NA	NA	NA

## 8 References

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## Appendix A. Workshop 1 summary report

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## Appendix B. Workshop 2 summary report

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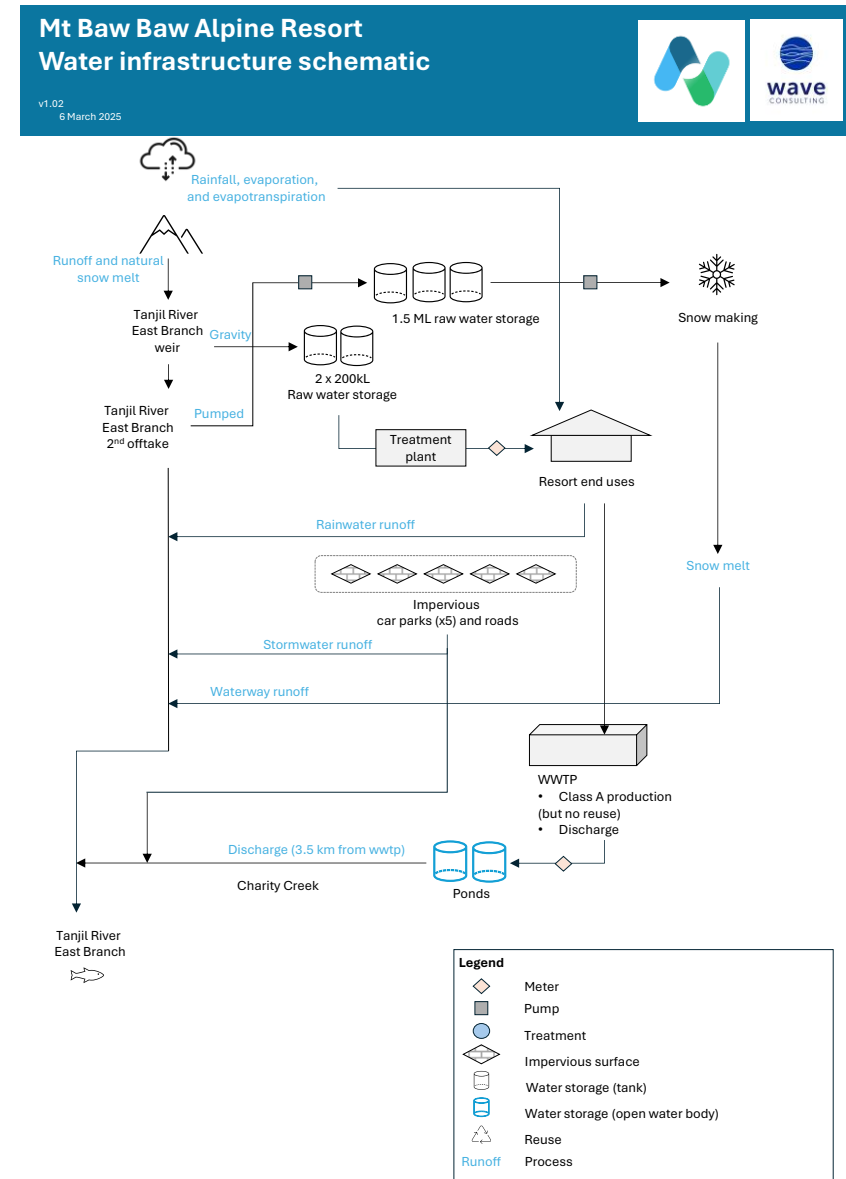
## Appendix C. Available data

Data for this project came from a variety of sources. These are listed below, with reference to the time period that the data covers.

Table 4. Data sources and records

Variable	Source	Start	End
<b>Snow (natural)</b>	ARCC_DailySnowDepthRecordsMtBawBaw_from_1993	1993	2023
<b>Snow (making)</b>	MBB Daily reporting.xls	2019	2023
<b>Potable consumption</b>	Water & Wastewater data 2024.xls	-	-
<b>Recycled water</b>	NA	-	-
<b>WWTP discharge</b>	Water & Wastewater data 2024.xls	-	-
<b>Rainfall</b>	Mt Baw Baw - 85291	1998	2024
<b>River levels</b>	TANJIL @ TANJIL JUNC	1960	2024
<b>Temperature (min and max)</b>	BOM - MT BAW BAW station 085291	1997	2024
<b>Temperature (hourly)</b>	BOM - Mt Baw Baw (085291)	1994	2024
<b>Humidity (hourly)</b>	BOM - Mt Baw Baw (085291)	1994	2024
<b>Wet bulb (hourly)</b>	BOM - Mt Baw Baw (085291)	1994	2024
<b>Wind (hourly)</b>	BOM - Mt Baw Baw (085291)	1994	2024
<b>Visitor days - winter</b>	ARCC_Annual_Winter_VisitorDays_Historical_Records_from_1985.csv	1985	2024
<b>Visitor days - summer</b>	ARCC-Summer-18.19-vis-nos-and-vehicle-countB.csv	2007	2024
<b>Assets - tanks etc</b>	ARV geospatial data	-	-
<b>Assets - stormwater</b>	ARV geospatial data	-	-
<b>Assets - impervious</b>	ARV geospatial data	-	-

## Appendix D. Water schematic



## Appendix E. Traditional owner's summary

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## Appendix F. Stormwater modelling

Modelled was undertaken to assess the capacity of pipes at Mt Baw Baw, and the potential erosion risk. A complete summary of this work is in a related report “Review of Stormwater Infrastructure at Alpine Resorts” (Wave Consulting Australia, 2025). Some of the main results from this report are shown below, but it should be noted that the input data on the stormwater networks (i.e. the location and detail of all stormwater assets in Mt Baw Baw was not mapped or available.”

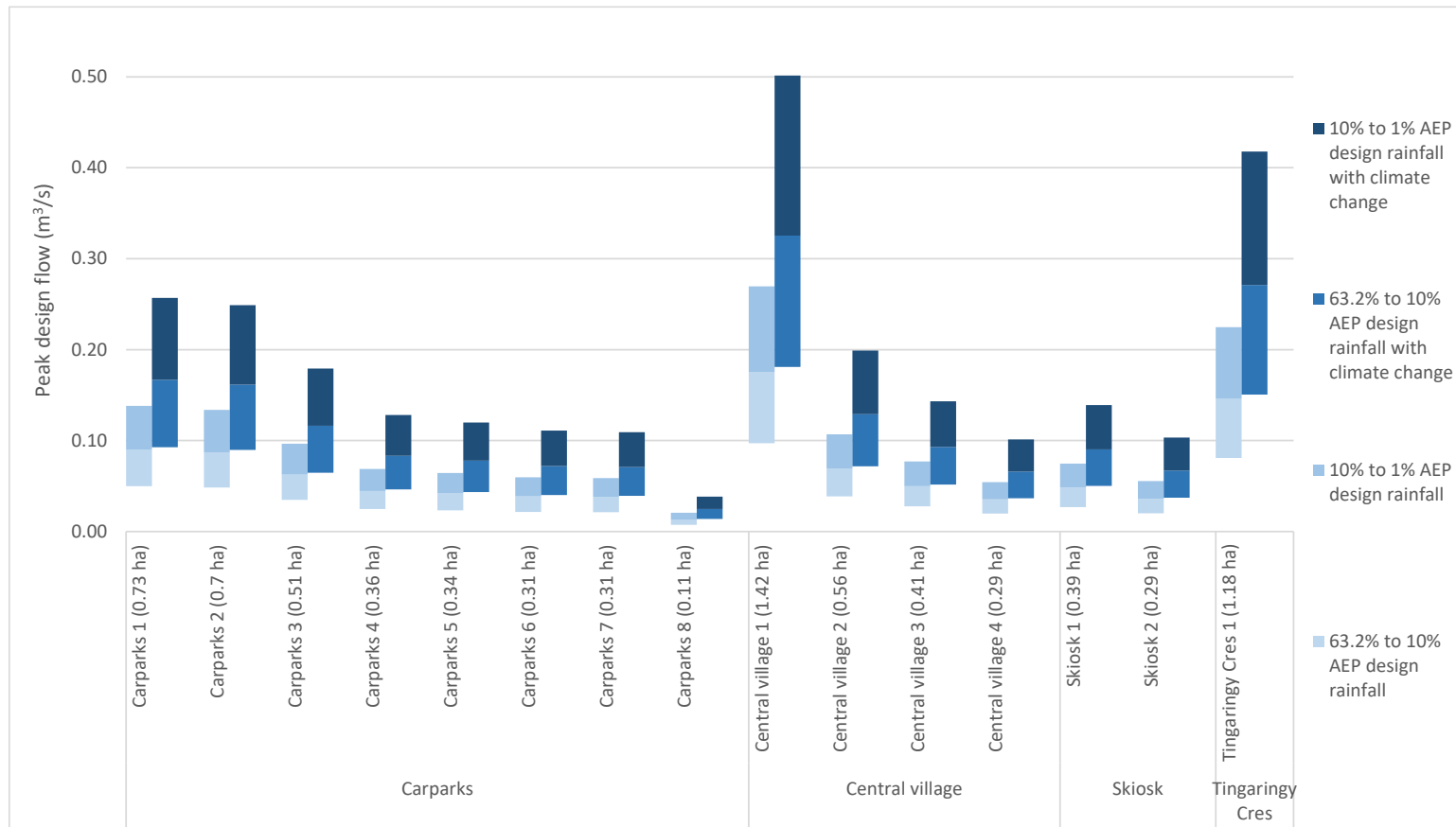


Figure 17. Stormwater capacity issues highlighted across Mt Baw Baw resort (now and with climate change).

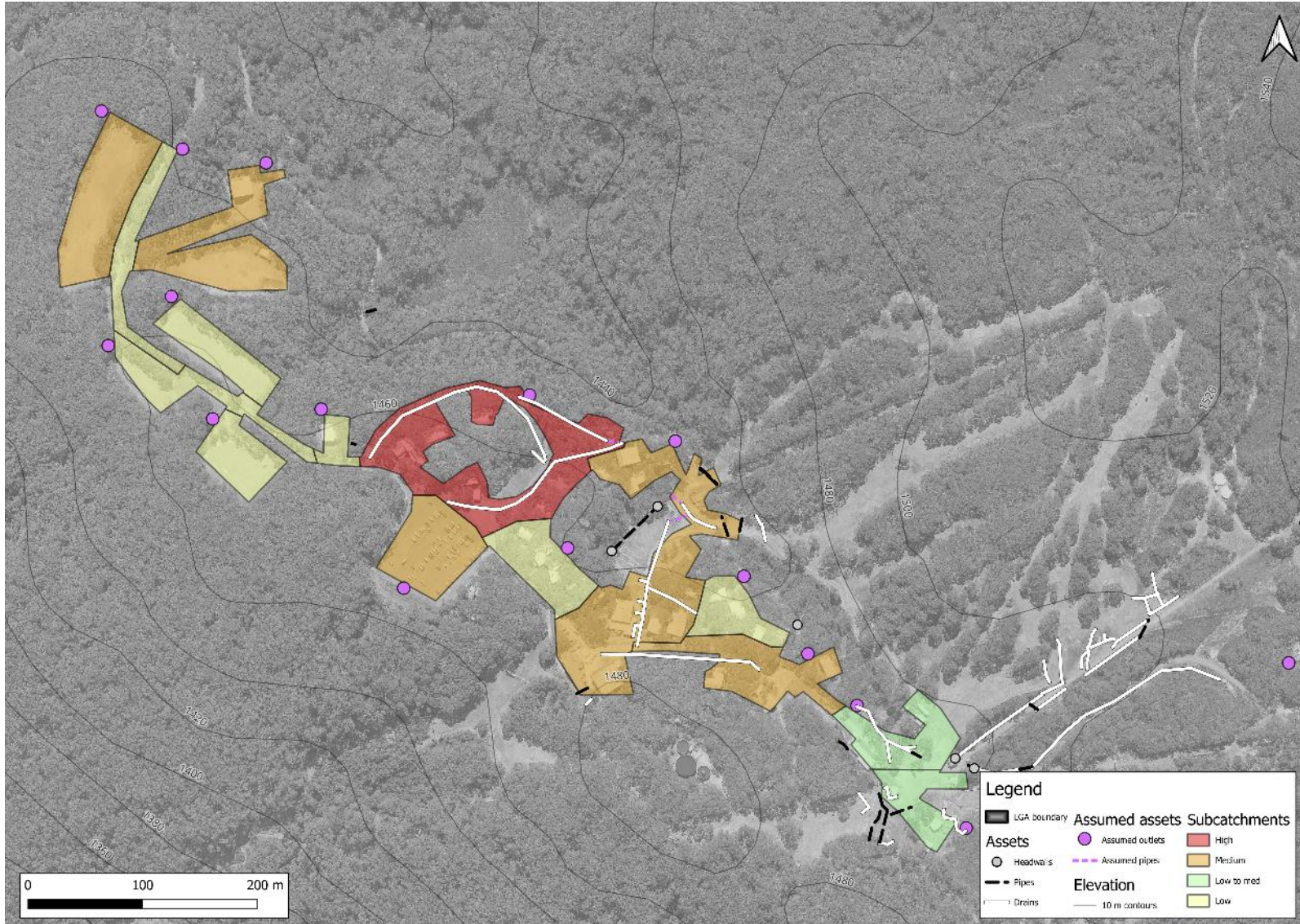


Figure 18 illustrates the erosion risk across Mt Baw Baw, showing many regions with medium to high risk that may require a more detailed analysis as the lack of stormwater infrastructure makes it difficult to determine eroding surface. Tingariny Cres has been marked as a high risk as observed from an on-site visit where significant erosion is occurring during wetter periods, and thus should be a key area of improvement

Figure 18. Indicative erosion risk using slope across Mt Baw Baw Alpine Resort.