West Gippsland
Catchment Management Authority

Water for rivers

Seasonal watering proposals for the Latrobe, Thomson, and Macalister rivers

2023-24

Acknowledgement of Country

The West Gippsland Catchment Management Authority (WGCMA) would like to acknowledge and pay our respects to the Traditional Landowners and other Indigenous people within the catchment area: the Gunaikurnai people.

Traditional Owner input and guidance on objectives and values was received from GLaWAC (Gunaikurnai Land and Waters Aboriginal Corporation) via the Gunaikurnai Cultural Water Team.

We also recognise the contribution of Aboriginal and Torres Strait Islander people and organisations in land and natural resource management.

Cover photo credit: Elly Harrington – Swing Bridge Drive

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List of Acronyms and terms

AHD	Australian Height Datum
BoM	Bureau of Meteorology
DEECA	Department of Energy, Environment and Climate Action
DELWP	Department of Environment, Land, Water and Planning
EE	Environmental Entitlement
ENSO	El Niño/La Niña Southern Oscillation
EWAG	Environmental Water Advisory Group
GL	Gigalitre

LEWRI	Latrobe Environmental Water Requirements Investigation
ML	Megalitre
MW	Melbourne Water
PAG	Project Advisory Group
SRW	Southern Rural Water
VEWH	Victorian Environmental Water Holder
Water year	Year starting on the 1st of July through to 30 June
WGCMA	West Gippsland Catchment Management Authority

Executive Summary

The purpose of the document is to present the proposed watering actions and priorities for the four environmental water entitlements in West Gippsland for the 2023-2024 water year. Namely, the Latrobe River environmental water entitlement held in Bluerock Reservoir, the Thomson River environmental water entitlement held in the Thomson Reservoir, the Macalister River environmental water entitlement held in Lake Glenmaggie. The Lower Latrobe Wetland environmental water entitlement (covering Dowd Morass, Heart Morass and Sale Common) will be addressed in a separate proposal.

The objectives, scenarios and associated potential watering actions in this proposal take into consideration the best available ecological and natural resource management science and the long-term environmental objectives for the rivers and wetlands. Also considered are the past and forecast seasonal conditions, and ongoing environmental monitoring which inform adaptive management. Various stakeholders including landholder and community group representatives, Traditional Owners, Southern Rural Water, Melbourne Water, Parks Victoria, Field and Game Australia, and the Victorian Environmental Water Holder have been engaged during the preparation of these proposals. The risks associated with implementing the proposal have been identified and reviewed through consultation with various stakeholders and appropriate mitigation strategies have been identified. Only one risk was identified pre-mitigation as “high” risk, and with mitigation actions in place the working group assessed the residual risk as “low”.

The expected water availability for each system and the associated storage operator and land managers are shown in Table 1.

Table 1 Summary of the expected water availability at the beginning of 2023-24 water year and the waterway, storage and land managers for each environmental water entitlement

System Name	Latrobe River	Thomson River	Macalister River
Expected water availability. (July 1st, 2023)	18.9 GL*	10.7 GL*	17.4 GL*
Waterway Manager	West Gippsland Catchment Management Authority		
Storage Operator(s)	Southern Rural Water & Melbourne Water		
Land Manager(s)	N/A		

*values are estimates based on a 3rd March 2023 assessment.

Landscape scale objectives

The broad, landscape scale objectives identified for the Lake Wellington catchment (i.e., the Latrobe River, Thomson River, and Macalister River) are summarised in Table 2. With three years of high flows and flooding across the region, the priority flows for all systems are targeted at flows that continue to support native fish communities, from baseflows to freshes allowing for continued opportunities for migration, dispersal and survival of previous year recruits.

Table 2 Summary of the landscape scale environmental objectives

Symbol	Value	Landscape scale Objectives
	Fish	Increase the abundance and distribution of native fish communities (migratory, resident and estuary)
	Macroinvertebrates	Increase abundance and diversity of macro- and micro-invertebrate communities
	Birds, turtles, frogs and reptiles	Maintain populations of water birds, frogs and turtles
	Platypus and rakali	Increase the abundance of platypus and rakali
	Vegetation	Maintain or enhance in-stream, fringing and riparian vegetation species, zonation and structural diversity
	Geomorphology	Maintain or improve instream geomorphic diversity/physical habitat
	Connectivity	Maintain or improve in-stream habitat diversity and connectivity. Provide freshwater to the Latrobe estuary and lower Latrobe wetlands

Symbol	Value	Landscape scale Objectives
	Water quality	Avoid adverse water quality conditions

Potential Watering Actions

Table 3 summarises the highest priority watering actions for each of the river systems for the upcoming water year. The objective for the year is to capitalise on the previous wet years, delivering flows that support native fish communities, particularly with watering actions targeting migration, spawning and recruitment of native species.

Table 3 Summary of the highest priority watering actions for each environmental water entitlement

River/Wetland	Flow Component	Primary Ecological Objectives
Latrobe River	Summer-Autumn low flow	Providing longer durations of freshwater to the upper part of the water column in the estuary
	Summer-Autumn fresh (fish and vegetation)	Reduce terrestrial vegetation encroachment and flush sediments from pools Coinciding with flows in the Thomson and Macalister to maximise benefits for fish migration, provide environmental benefit in the Latrobe Estuary, and provide freshwater for the lower Latrobe Wetlands
Thomson River	Autumn fresh	Provides a trigger for downstream migration and spawning of Australian grayling
	Spring fresh	Encourages recruitment of juvenile migratory native fish species from estuarine/marine habitats, particularly Australian grayling.
	Autumn-Winter fresh	Provides a trigger for fish migration, specifically for species such as tupong and Australian bass
	Summer-Autumn fresh	Provide fish passage during the dry season to enable movement of fish and other fauna into available habitats.
	Winter-Spring low flow	Winter-Spring low flows provide important longitudinal connectivity and enable fish and other fauna to move freely between habitats. This is particularly important during this time as it is considered the juvenile recruitment period for native diadromous species, such as Australian grayling and tupong
	Autumn-Spring deliveries to Heyfield Wetlands	Provides growth and establishment opportunities for aquatic vegetation, and habitat for wetland bird and frog species.
Macalister River	Autumn fresh	Provides a trigger for downstream migration and spawning of Australian grayling.
	Autumn-Winter low flow	Provides fish passage for migratory species completing (i.e. Australian grayling) or about to complete (i.e. Tupong, Australian bass) migration
	Spring-Summer low flow	Provides complete longitudinal connectivity, allowing for aquatic biota to move between different habitats
	Winter fresh	Provides a flow trigger for the downstream migration of fish species, such as Tupong and Australian bass
	Spring fresh	Provides a flow trigger for the upstream migration of adult and juvenile migratory fish species.

Risk Assessment and Management

Potential risks arising from the implementation of the seasonal watering priorities were assessed and risk tables developed during the Gippsland Risk Planning Workshop in February 2023. Risks and mitigation strategies for each system are provided in section 5.

Engagement

Table 4 summarises the engagement that has occurred in the development of the West Gippsland Seasonal Watering Proposal. An example of engagement methods include:

- Formal advisory groups (Macalister, Thomson and Latrobe EWAGs)
- Partnership meetings, direct engagement / one-on-one and specific issue engagement
- Irrigator advisory groups (Macalister Customer Consultative Committee; CMA Irrigator Reference Group)
- E-flows subscriber notifications and newsletters (email, SMS)

Table 4 Partners and stakeholders engaged by West Gippsland CMA in developing seasonal watering proposals and annual deliveries

Category	Stakeholder	IAP2 level
Community and Environment Groups	• Friends of Bellbird corner (Macalister EWAG) • Field Naturalists (Macalister EWAG) • Friends of Tyers Park (Latrobe EWAG) • Friends of Latrobe Water (Latrobe EWAG)	Collaborate
	• Birdlife Australia • Greening Australia	Involve
	• Field Naturalists • Latrobe Landcare Network • 'Friends of' groups	Inform
Government agencies	• VEWH (Latrobe, Thomson and Macalister EWAGs) • DEECA (Thomson EWAG) • Gippsland Water (Latrobe, Thomson and Macalister EWAGs) • Southern Rural Water (Latrobe, Thomson and Macalister EWAGs) • Melbourne Water (Thomson EWAG)	Collaborate
	• East Gippsland Catchment Management Authority • Arthur Rylah Institute	Inform/Consult
Landholders/farmers	• Landholders and Irrigators on the Latrobe EWAG • Irrigators on the Macalister EWAG • Irrigators on the Thomson EWAG	Collaborate
	• Irrigators and landholders	Involve/consult
Recreational users	• Whitehorse Canoe Club (Thomson EWAG • VR Fish (Latrobe, Thomson and Macalister EWAGs) • Native Fish Australia (Thomson and Macalister EWAGs)	Collaborate
	• Recreational users (individuals and organisations)	Inform
Traditional Owners	• Gunaikurnai Land and Waters Aboriginal Corporation (Latrobe, Thomson and Macalister EWAGs)	Collaborate
Land managers	• Heyfield Wetlands committee of management (Thomson EWAG)	Collaborate

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1. Introduction

This seasonal watering proposal outlines the West Gippsland Catchment Management Authority's (WGCMA) proposed priorities for use of environmental water within the Lake Wellington catchment. This is as per the requirements under section 192A of the *Water Act 1989* and is a priority of the West Gippsland Waterway Strategy (WGCMA, 2014). This proposal covers the three of the four environmental entitlements managed on behalf of the Victorian Environmental Water Holder (VEWH), by the WGCMA. These entitlements are for the Latrobe River, Thomson River, and Macalister River.

Potential watering actions and environmental objectives for the Latrobe, Macalister and Thomson rivers are informed by flow recommendations and objectives, derived from the Latrobe Environmental Water Requirements Investigation (LEWRI)(Alluvium, 2020), the Macalister River Environmental Flows Review (Alluvium, 2015) and the Thomson River Environmental Flows and Management Review (Streamology, 2020). Where meaningful, this proposal also includes watering requirements specific to the Latrobe Estuary. Although the estuary does not have a specific entitlement, it benefits from all river flows of the Thomson, Macalister, and Latrobe.

This proposal will be used by the VEWH to inform the development of the state-wide Seasonal Watering Plan. The plan will outline the full scope of state-wide priorities for use of environmental water, including the West Gippsland catchment environmental entitlements. Environmental water in the Latrobe, Thomson and Macalister rivers will be used to protect and enhance the ecological health of their respective waterways. Where applicable, coordinated management of the three river entitlements will also be used to protect and enhance the Lower Latrobe Wetlands and the Latrobe Estuary. The extent to which this is achieved will be governed by the amount of water available and the relevant climatic scenario.

Climatic conditions and system regulation strongly influence river flows, and thereby the opportunities and need to actively manage environmental water. Flexibility is built into this proposal to enable adaptive management.

Landscape overview – Lake Wellington catchment

The Lake Wellington catchment extends from Lake Wellington to the slopes of the Great Dividing and Strzelecki Ranges. It includes almost 1.2 million hectares of land in the catchments of Latrobe, Thomson, Macalister and Avon Rivers and runs from Noojee and Warragul in the west to Stratford in the east. Lake Wellington is the most westerly of the Gippsland Lakes and forms part of the Gippsland Lakes Ramsar site, a wetland complex of international conservation significance. Three of the four major rivers in the catchment are regulated (Latrobe, Thomson, and Macalister rivers) and each have an environmental water entitlement. A fourth environmental water entitlement is held to divert water to the lower Latrobe wetlands (Dowd Morass, Heart Morass and Sale Common) (Figure 1).

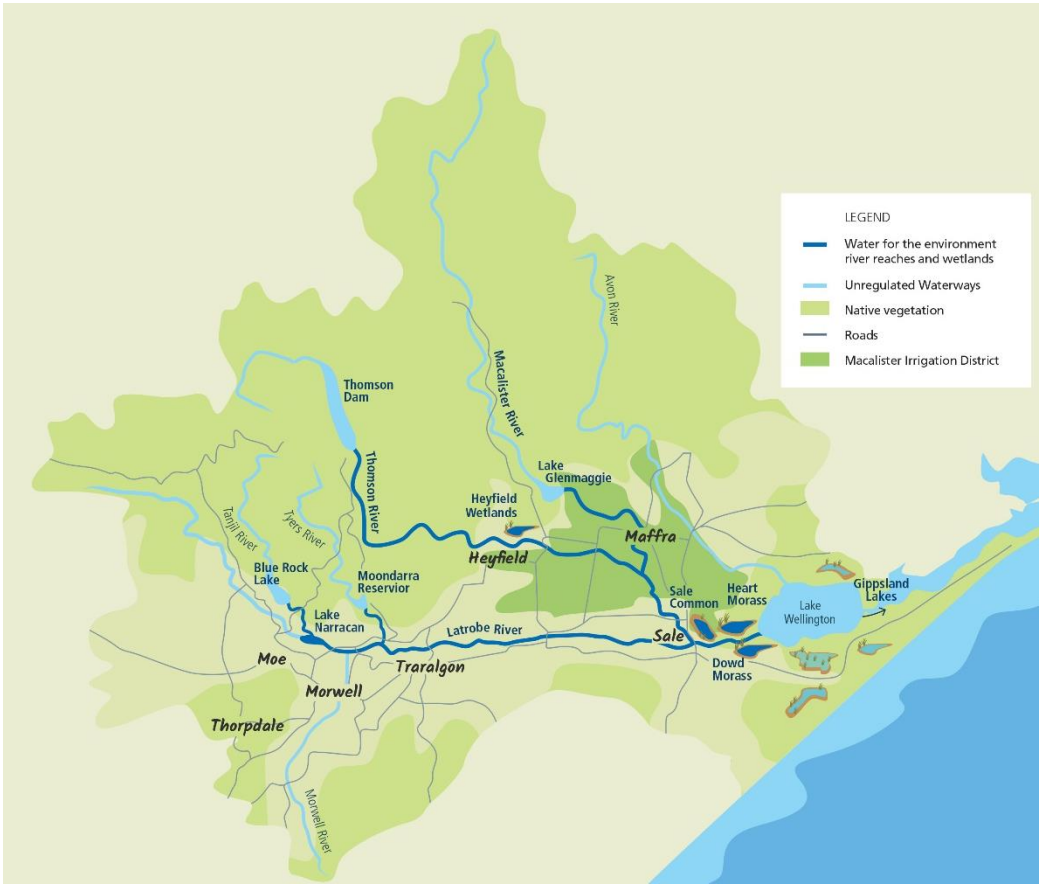


Figure 1 Map of the Lake Wellington Catchment, with environmental water receiving rivers and wetlands highlighted (dark blue)

With a continued connection to Country spanning more than 27,000 years, the Gunaikurnai are the Traditional Owners over much of Gippsland with approximately 1.33 million hectares extending east-west from near Warragul to the Snowy River and north-south from the Great Dividing Range to the coast and sea country (GLaWAC, 2015). This area includes the Lake Wellington catchment and the Macalister River (*Wirn wirndook Yeerung*), Thomson River (*Carran Carran*), Latrobe River (*Durt- Yowan*) and the lower Latrobe Wetlands.

The Macalister River (*Wirn wirndook Yeerung*), Thomson River (*Carran Carran*), Latrobe River (*Durt- Yowan*) and the lower Latrobe Wetlands are part of the Country of the Brayakaulung people – whose clan area extends from the current site of Sale, Providence Ponds, Avon and Latrobe rivers; west of Lake Wellington to Mounts Baw Baw and Howitt.

The Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) is the Registered

Aboriginal Party (RAP) for the Gunaikurnai community, the Traditional Owners of Country encompassing the WGCMA, as determined by the Victorian Aboriginal Heritage Council under the Aboriginal Heritage Act, 2006 (GLaWAC - Who we are, 2022).

Latrobe River

The Latrobe River catchment drains the Baw Baw Plateau (1,500 m elevation) and flows into Lake Wellington. The Latrobe River itself extends 242 km from just east of Powell Town in west Gippsland to just east of Sale in central Gippsland. Notable tributaries include the Tanjil River and Narracan Creek, Morwell River, Tyers River, Traralgon Creek and the Thomson River (Figure 2).

The Latrobe River system is one of the most significantly modified river systems in Victoria outside of major urban areas (EarthTech, 2005). It is viewed as a working river, reflecting the significant past, present and future pressures and expectations placed upon it along its length (Alluvium, 2009). Large areas of the catchment have been cleared for agriculture, and major industrial, mining and power generation activities heavily impacting the Latrobe River and some of its tributaries. The Latrobe River channel has undergone significant de-snagging and straightening, resulting in a loss of about 25% of its length in the mid and lower reaches (Reinfelds & Rutherfurd, 1995). This has caused accelerated bank erosion, deepening and widening of the river channel and associated loss of ecological function (Sinclair Knight Merz, 2009). Other major changes include: floodplain drainage, channelisation of the lower reaches of the Moe and Morwell Rivers, incision of some tributaries, regulation of major tributaries (EarthTech, 2005), and ongoing stock grazing and water extraction (33% of average annual flows, including the Thomson River) (Tilleard, 2009; Tilleard & Ladson, 2010). The estimated environmental flow shortfall in the Latrobe River ranges between 7.5 GL/yr in reach 5 to 88.9 GL/yr in reach 3 (annual average under full uptake and baseline climate conditions (Alluvium, 2020a), based on providing the environmental flow recommendations.

Despite extensive modification, the Latrobe River system does retain many significant environmental values: the upper Latrobe River is ecologically healthy and listed (endangered and vulnerable) riparian vegetation communities exists in all but the most modified reach (reach 4) flowing through the Latrobe Valley; the river supports numerous fauna species of high conservation significance including fish and birds; and it provides an essential source of freshwater to the Ramsar listed Gippsland Lakes system (44% of annual average inflows, including the Thomson River), of which the lower Latrobe wetlands are an important part.

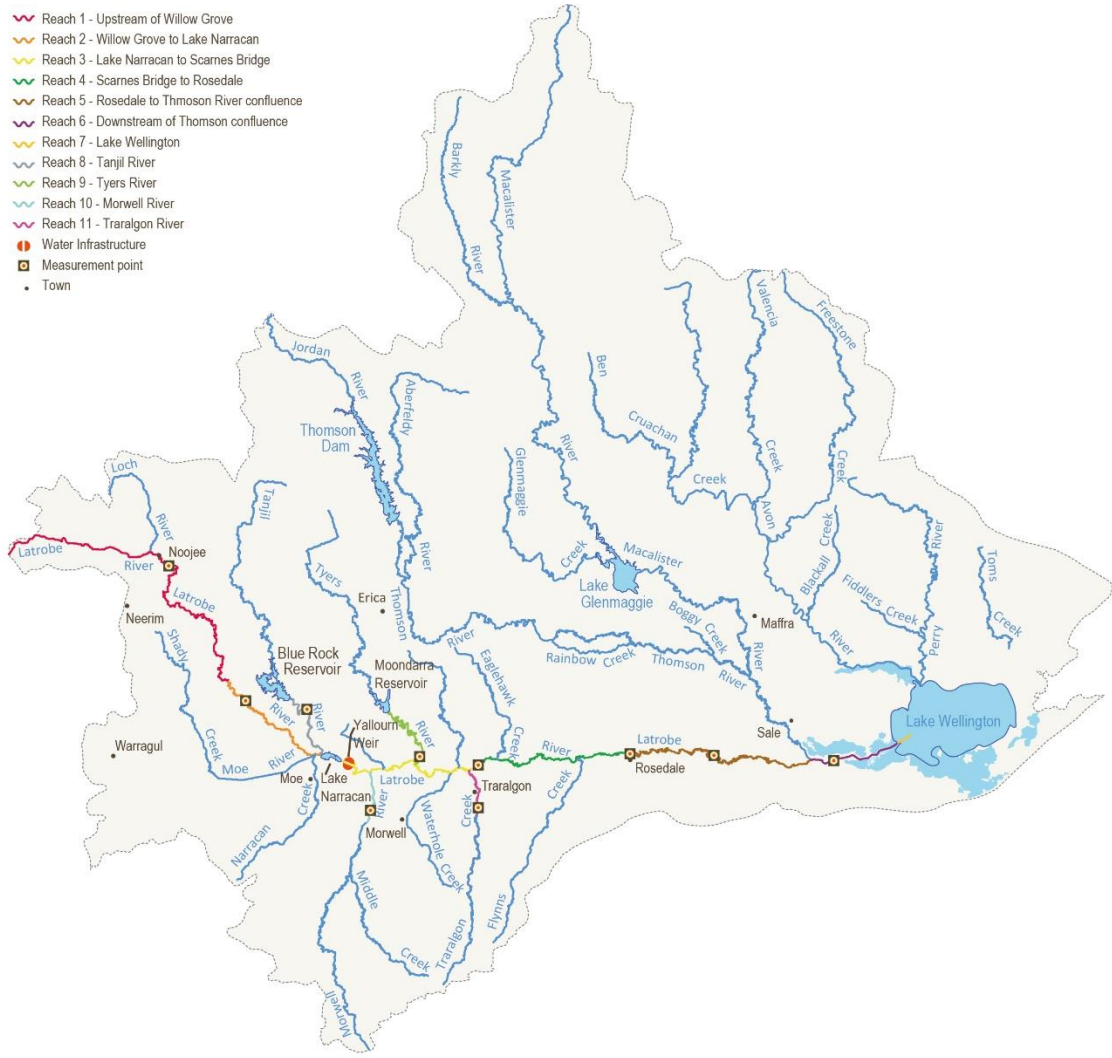


Figure 2 Map of the Latrobe River and tributaries with associated reach numbers

Thomson River

The Thomson River catchment drains an area of 1,522 km^2 extending from Mt Gregory (1,011 m) to Sale, where it joins the Latrobe River. It receives inflows from the Aberfeldy River and Jordon River in the upper reaches, and the Macalister River in the lowest reach. Two major structures exist on the Thomson River: Thomson Reservoir (the major potable water storage for metropolitan Melbourne) and Cowwarr Weir (a regulating structure providing irrigation water to the Macalister Irrigation District). Environmental water is managed via water holdings held in the Thomson Reservoir.

The Thomson River has been divided into 6 management major reaches (Figure 3). Hydrologic compliance is assessed at two locations: Reach 3 at Coopers Creek gauge (225208) and Reach 6 at Bundalaguah gauge (225232). From Reach 3, the Thomson passes through Cowwarr Weir. This marks a major regulation point, with flows divided between Reach 4a and 4b (the 29 km Thomson channel, and the shorter 14 km anabranch of Rainbow Creek) and an irrigation channel off-take. Rainbow Creek and the Thomson River converge again near Heyfield (Reach 5). Reach 6 represents the section of river below

the Macalister confluence and upstream of the confluence with the Latrobe River, downstream of Swing bridge.

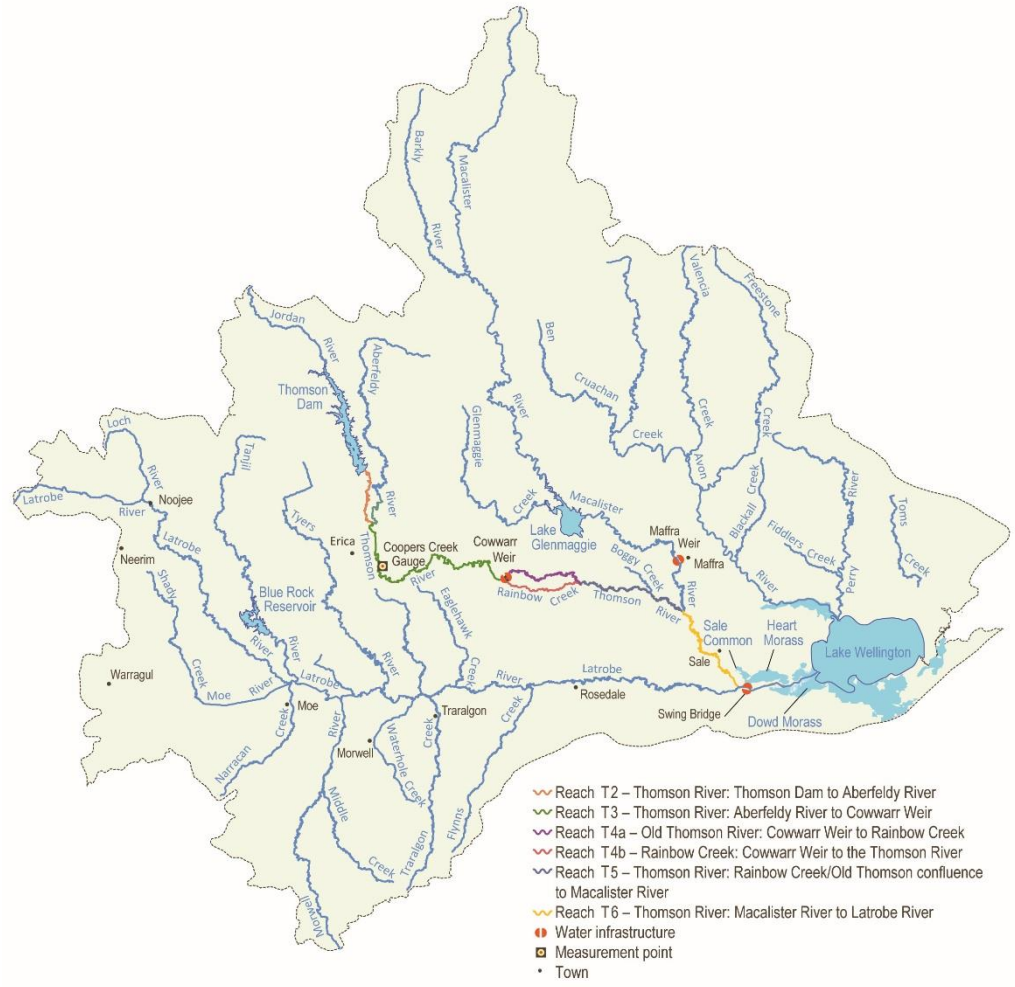


Figure 3 Map of the Thomson River and tributaries with associated reaches

The Thomson River is one of a network of coastal rivers across Gippsland and south-eastern Australia that sustains populations of nationally significant migratory fish species, including the Australian grayling (EPBC-listed), tupong and Short- and Long-finned eel.

Reach 3 (from Aberfeldy River to Cowwarr Weir) has heritage river status, with largely intact native riparian vegetation communities and fish populations, including the protected Australian grayling. Reach 6 is also used to assess the continuity of environmental flow releases down the system and is a known spawning location for Australian grayling.

The recent completion of the Horseshoe Bend fishway reconnects the Thomson with upstream reaches in the Victorian Alpine bioregion, unlocking an additional 22 km of waterway to fish passage, as well as access to an additional 64 km of the Aberfeldy River (Figure 4).

Figure 4 Aerial view of the Thomson Fishway at Horseshoe bend

Located adjacent to the Thomson River is the Heyfield wetlands, a site jointly managed by DELWP and the Heyfield Wetlands Committee of Management (HWCOM). After being used for multiple recreational purposes, the land has been converted to a functioning wetland complex.

The initial objective of re-establishing Heyfield wetlands was to filter stormwater and agricultural run off before it entered the Thomson River. This initiative assisted in decreasing the levels of turbidity and reducing the nutrient load entering the River and ultimately entering the Ramsar-listed Gippsland Lakes. As the site has been developed, it now hosts walking trails, interpretative signage, a visitor information centre, and extensive areas of native plantings (both terrestrial and aquatic).

The wetlands are deemed an important environmental feature of the area as the surrounding land is used for industrial and agricultural purposes with nearby rivers harvested for irrigation. The Heyfield wetlands serve as a refuge for wetland and migratory bird species, a feature which is lacking in the immediate surrounding landscape. Since 2019, this site has received environmental water deliveries to support vegetation and habitat objectives (Figure 5).

Figure 5 Aerial view of Heyfield Wetlands

Macalister River

The Macalister River drains from a catchment area of 2,330 km^2, beginning in the southern slopes of the Great Dividing Range below Mt Howitt, through to its confluence with the Thomson River upstream of Sale. It receives inflows from Wellington River and Glenmaggie Creek. The river is regulated by two in-stream structures: Lake Glenmaggie (190 GL at full capacity) and Maffra weir (~ 500 ML diversion weir).

The cleared floodplains surrounding the lower Macalister River are part of the Macalister Irrigation District (MID). This is a 53,000 hectare irrigation district; the largest south of the Great Dividing Range. Over half of the MID is irrigated land, with 90% dedicated to pasture. The Macalister River is the main source of irrigation water for the MID, as well as a potable water supply for Gippsland Water.

The Macalister River has been divided into 2 major management reaches (see Figure 6); downstream of Lake Glenmaggie to Maffra weir (Reach 1); downstream of Maffra weir to the Macalister-Thomson River confluence (Reach 2). The *Macalister River Environmental Entitlement 2010* (herein, the Macalister River EE) utilises storage capacity in Lake Glenmaggie. Hydrologic compliance is monitored at three locations: Lake Glenmaggie tailwater (225204), Maffra weir tailwater (225242A) and Riverslea (225247). The compliance point selected is dependent on the underpinning target ecological objective. Streamflow at these locations is also considered during the annual planning process.

Reach 2 contains a greater abundance and diversity of fish species compared to Reach 1, particularly for the six migratory species, including Australian grayling, tupong and Common galaxias. This is attributable to the presence of Maffra Weir, and its downstream knife-edge weir, which limit movement and act as a block to fish passage both into and out of Reach 1 for most of the year. Reach 1 offers high quality habitat, with a relatively continuous riparian zone, improved water clarity, sand-cobble substrate, and riffle-pool sequences. As such, re-establishing connectivity at Maffra Weir is expected to greatly improve the existing abundance, distribution, and diversity of native fish species in the lower Macalister River.

Figure 6 Map of the Macalister River and tributaries with associated reaches

Latrobe Estuary and the Lower Latrobe wetlands

The lower Latrobe wetlands are situated along the Latrobe River between its confluence with the Thomson River and Lake Wellington (Figure 7) and form part of the Gippsland Lakes Ramsar Site. The wetlands include: Sale Common (230 ha) and Heart Morass (1,870 ha) on the northern floodplain, and Dowd Morass (1,500 ha) on the southern floodplain. Sale Common and Dowd Morass are wholly Crown land reserves managed by Parks Victoria (PV). Heart Morass is comprised of Crown land (managed by PV) and private land. Nearly 60% of the Heart Morass is owned by the Wetlands Environmental Taskforce (WET) Trust.

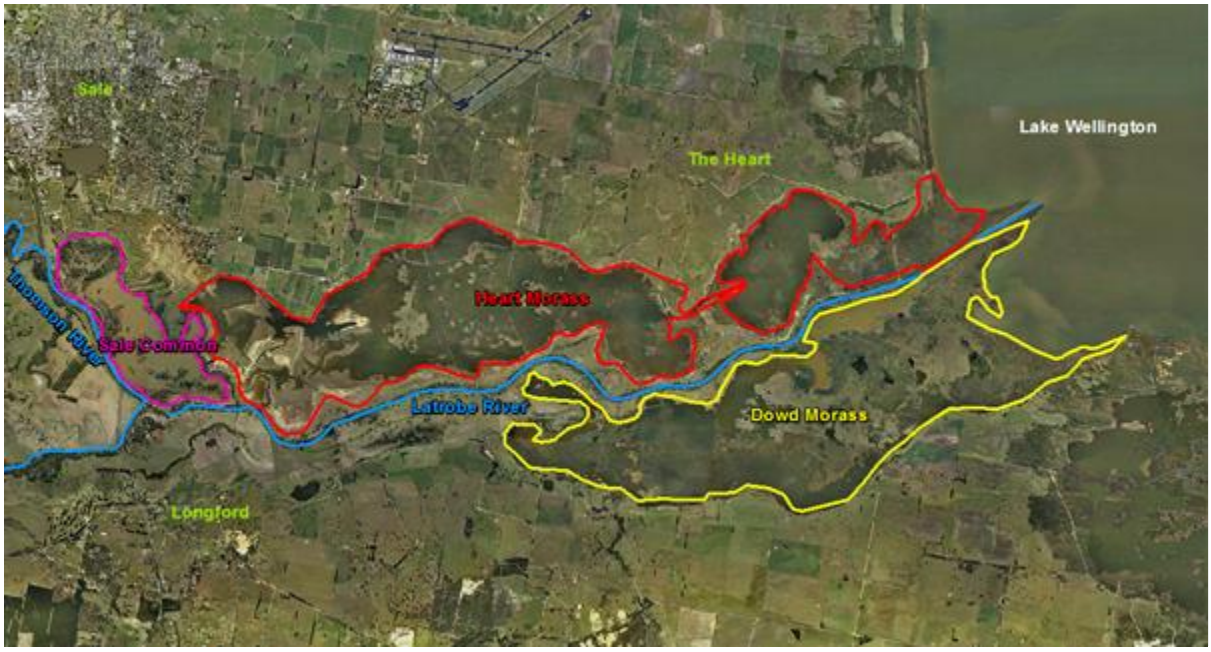


Figure 7 Satellite image showing the extent of Dowd Morass, Heart Morass and Sale common.

Together, the lower Latrobe wetlands provide habitat for a diverse range of water-dependent species, especially plants, waterbirds and frogs, including threatened species and communities. Individually, each wetland provides a range of ecological benefits.

Sale Common is one of only two remaining freshwater wetlands in the Gippsland Lakes system and provides sheltered feeding, breeding and resting habitat for a very diverse range of waterbirds for its relatively small size, particularly species that prefer densely vegetated freshwater and fish/frog feeders.

Culturally, the lower Latrobe wetlands were an important resource for the Gunaikurnai people. Dowd Morass is of high cultural significance with over thirty registered indigenous cultural heritage sites such as scarred trees, artefact scatters, earth features and shell deposits.

Environmental water delivery in all three river systems consider impacts to the estuary and lower Latrobe wetlands to maximise environmental benefits at a landscape scale.

Climate review and Climate outlook

2022-23 Climate review

Following a very wet 2020 and 2021, rainfall for 2022 continued above average in West Gippsland. Autumn rainfall was average to above average, with warmer than average temperatures. Winter rainfall was also above average for many parts of West Gippsland, particularly during June and August (see Figure 8). Mount Baw Baw received its highest total rainfall for June in 24 years, recording 295 mm more than the usual monthly average. During mid-august rain fell heavily over several days leading to minor flooding at Traralgon. Morwell (Latrobe Valley Airport gauge) had its highest total winter rainfall for over 20 years (previous maximum total 75mm in the winter of 1991).

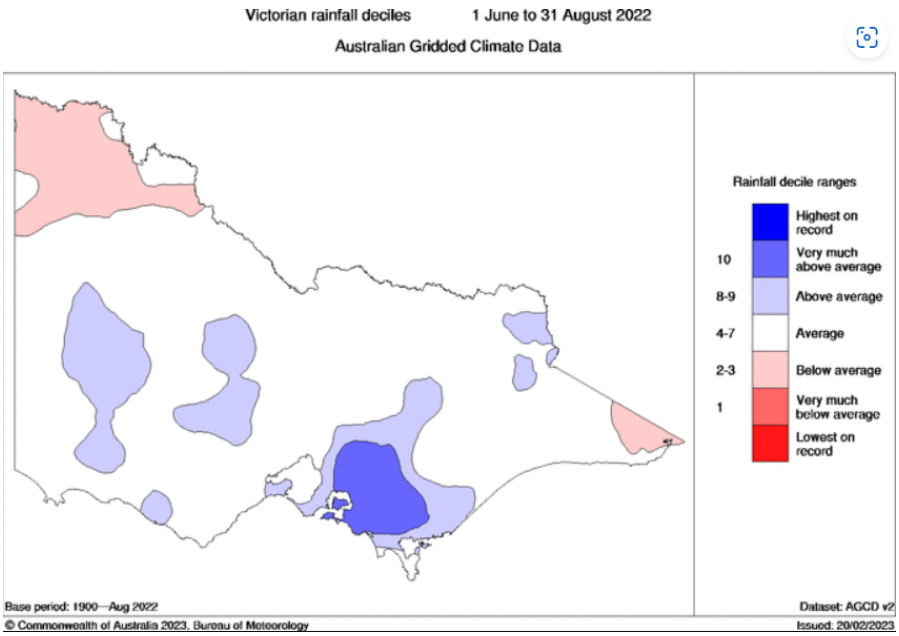


Figure 8 West Gippsland rainfall deciles from 1 June to 31st August 2022 (Source: BoM Victoria in Winter 2022, bom.gov.au)

Spring was much wetter than average across the State. The West Gippsland region saw higher than average spring rainfall, with some areas (e.g., Traralgon EPA station) showing the highest rainfall on record for November (see Figure 9 below). Notably, due to the high volume of rainfall in the Thomson catchment, in October the Thomson Dam spilt for the first time since 1996.

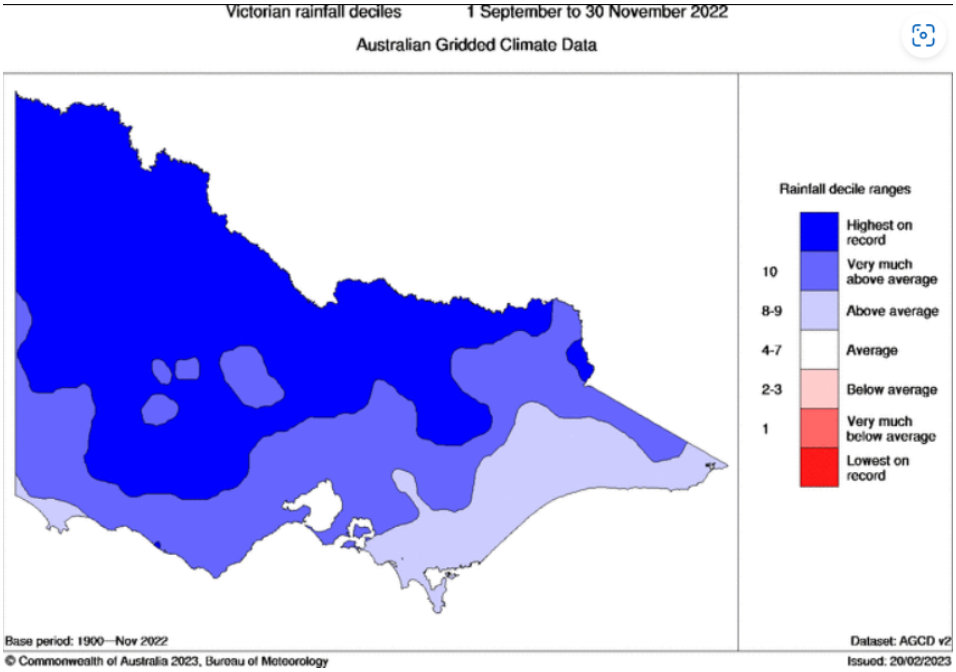


Figure 9 West Gippsland rainfall deciles from 1 September to 30th November 2022 (Source: BoM Victoria in Spring 2022 (bom.gov.au))

These natural rain events, subsequent storage releases and unregulated river flows across winter and spring provided flushing flows in the Latrobe, Macalister and Thomson rivers, with flows remaining elevated throughout the year.

Between January and February 2023, temperatures have been above average, and rainfall has been below average signalling a warm, dry start to summer.

2023-24 Climate Outlook

Available forecast information from the Bureau of Meteorology (BoM) indicates that La Niña continues but is slowly weakening. While models predict that there is an increased risk of El Niño developing in mid-late 2023, the accuracy of forecasting so far ahead is low so should be considered cautiously.

From March to June, the Macalister, Latrobe and Thomson River catchments are likely to have average rainfall (Figure 10). Most parts of West Gippsland are likely to get totals of 50 – 200 mm rainfall for the March to May and April to June quarters. There are very low chances of unusually wet or dry weather across West Gippsland during this time.

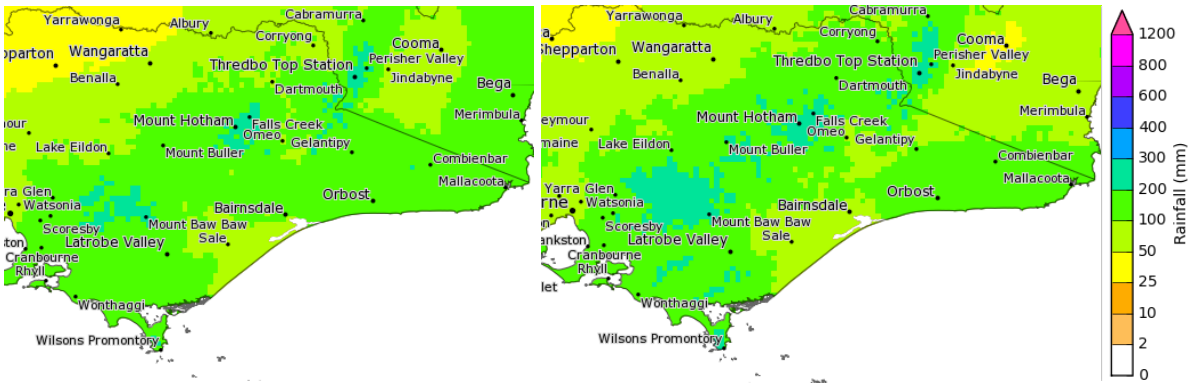


Figure 10 Rainfall totals that have a 75% chance of occurring for March to May (left) and April to June (right) (Source: www.bom.gov.au)

Long range forecasts also predict warm weather across many parts of West Gippsland (Figure 11). Temperatures are likely to very likely (60% to 80%) to be warmer than median from March to June 2023. Minimum median temperatures are also very likely (75%+) to be exceeded from March to June.

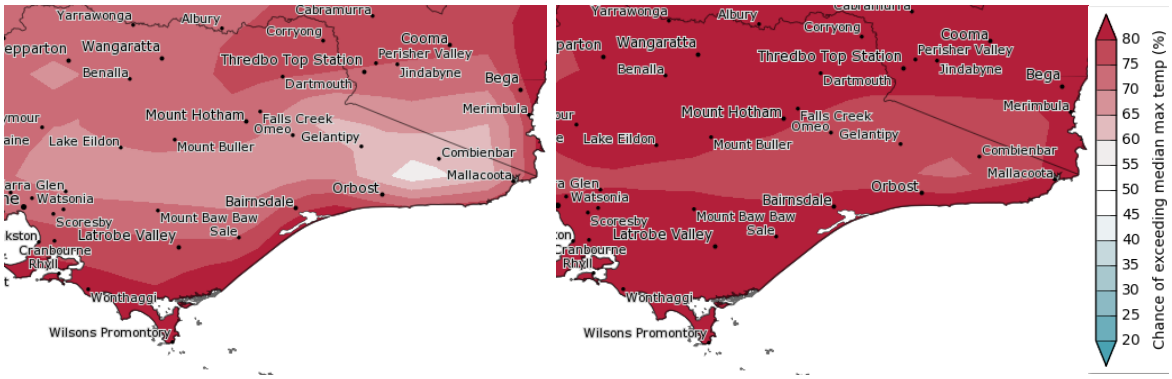


Figure 11 The chance of above median maximum temperature for March to May (left) and April to June (right) (Source: www.bom.gov.au)

Landscape scale objectives

To maximise the benefit of environmental water in the Lake Wellington Catchment landscape scale objectives are used. These overarching objectives across the three river systems are summarised in Table 5.

Following the wet conditions over the past 3 years and significant breeding and recruitment events of native fish species the highest priority objective for 2023-24 is to improve fish and eel populations. This will be done by prioritising and delivering watering actions that allow for continued opportunities for migration, dispersal and survival of previous years recruits.

Table 5 Overarching landscape scale environmental objectives for all three rivers

Symbol	Value	Landscape Objectives
	Fish	Increase the abundance and distribution of native fish communities (migratory, resident and estuary)
	Macroinvertebrates	Increase abundance and diversity of macro- and micro-invertebrate communities
	Birds, turtles, frogs and reptiles	Maintain populations of water birds, frogs and turtles
	Platypus and rakali	Increase the abundance of platypus and rakali
	Vegetation	Maintain or enhance in-stream, fringing and riparian vegetation species, zonation and structural diversity
	Geomorphology	Maintain or improve instream geomorphic diversity/physical habitat
	Connectivity	Maintain and improve in-stream habitat diversity and connectivity. Provide freshwater to the Latrobe estuary and lower Latrobe wetlands
	Water quality	Avoid adverse water quality conditions

Long-term objectives

The objectives set reflect the environmental values of the individual river systems considered important by both waterway managers, Traditional Owners and the community. Objectives were determined in the context of the current water resource management, likely environmental conditions, including the likely trajectory of the system over the next 50 years, and the social and economic values of the region. In any given year the level at which an objective can be met will vary depending on the extant weather and climate conditions. For this reason, the overarching goals for environmental water management varies over four climactic conditions. These goals are as follows:

- Drought — **Protect** high priority environmental assets, key functions, and priority refuges to ensure chance of future recovery and avoid catastrophic events such as low dissolved oxygen or algal blooms

- Dry — **Maintain** high priority environmental assets, key functions, and priority refuges to ensure chance of future recovery and avoid catastrophic events such as low dissolved oxygen or algal blooms
- Average — **Recover** by improving ecological health and resilience and enhance recruitment opportunities for key flora and fauna
- Wet — **Enhance** by maximising recruitment opportunities for flora and fauna species.

2. Latrobe River seasonal watering proposal

The following section provides details for the Latrobe River 2023-24 proposed watering actions.

Flow components and considerations

Target reach

Watering actions for the Latrobe River are aimed at meeting environmental objectives in all reaches from Lake Narracan to Lake Wellington, with flow recommendations for the estuary reliant on flows from the Thomson River. The compliance reach for Latrobe River flows is reach 5 (Kilmany)

Delivery

Environmental water deliveries are released from Blue Rock Lake on the Tanjil River where they travel to Lake Narracan on the Latrobe River. From here flows can be temporarily retained or allowed to flow through depending on the environmental objective or operational constraints at the time.

In designing environmental flow releases, while the target is Latrobe River out comes, Tanjil river outcomes are considered maximising the benefits of environmental water releases.

Options to deliver environmental water to the Latrobe River via the Tyers River are being considered for 2023-24 as was for 2022-23 (wet conditions mean no environmental water releases were required).

The Tyers River contains approximately 25 km of high-quality riparian and instream habitat downstream of Moondarra Reservoir. The Tyers River is a highly flow stressed river largely due to the retention of flows in Moondarra reservoir resulting in an average annual environmental water deficit of 32 GL/yr. Delivering water to the Latrobe via this river would support the Tyers River ecosystem, particularly vegetation and non-migratory fish (barriers to fish movement currently exist) of the Tyers. The delivery will also provide a proof of concept for potential future environmental or Cultural water flows.

Water for any delivery in the Tyers would be deducted from the Blue Rock environmental entitlement and would be transferred to Gippsland water either physically (through existing Gippsland Water infrastructure between Blue Rock Reservoir and Moondarra Reservoir) or as part of a temporary trade arrangement.

Operating arrangements will be developed with stakeholders including an assessment of risks and benefits.

Temporary trade

Temporary trade of environmental water is proposed for consideration in the 2023-24 water year. Historical under use of the environmental entitlement is largely a result of the delivery constraint in reach five. While this constraint remains, the ability to effectively use the full entitlement and benefit additional reaches of the river (including the estuary) will continue to be compromised.

It is proposed that between 2-5 GL could be made available for temporary trade depending on the prevailing climate conditions. However, this should be reviewed throughout the year

to ensure base environmental needs are met. The WGCMA proposes that proceeds from any trade be made available for works aimed at addressing the constraint.

The inherent risk with this proposal is the perception that the VEWH hold to much environmental water in the Latrobe. This is not correct, and a significant deficit exists in the system. If the temporary trade is to proceed, appropriate community engagement should be undertaken.

Seasonality

Flow recommendations have been developed and expressed as either “Summer-Autumn” or “Winter-Spring” to reflect the expected climactic conditions. The “Summer-Autumn” recommendations cover the period from December to May which are typically drier and hotter months. The “Winter-Spring” period covers June to November which is typically cooler and wetter (Table 6). Flow frequencies expressed as ‘per season’ denote the number of events in the “Summer-Autumn” or “Winter-Spring” expression (i.e. a six-month period). For example, a Summer-Autumn fresh with a frequency of six per season would occur a total of six times across the December – May period.

Flow components

Flow recommendations for each “season” have two components: low flows and freshes. The former are long sustained flows aimed at maintaining instream habitat while the latter are short events and are aimed at creating migration or breeding opportunities as well as maintaining water quality in pools.

Table 6 Hydrological description of each of the flow components and the seasons they are aligned with (Alluvium, 2020).

Flow component	Hydrological description
Summer-Autumn low flows	Summer-Autumn low flows are the natural dry period flows or ‘low flows’ that maintain water flowing through the channel, keeping in-stream habitats wet and pools full
Summer-Autumn freshes	Summer-Autumn freshes are frequent, small, and short duration flow events that last for one to several days because of localised rainfall during the low flow period. There are two types of Summer-Autumn fresh for the latrobe system. A shorter more frequent fresh aimed at maintaining or improving water quality and a longer less frequent fresh with flora and fauna outcomes.
Winter-Spring low flows	Winter-Spring low flows refer to the persistent increase in low or low flow that occurs with the onset of the wet period
Winter-Spring Freshes	High flow freshes refer to sustained increases in flow during the high flow period because of sustained or heavy rainfall events
Bankfull flow	Bankfull flows fill the channel, but do not spill onto the floodplain More common in the wet period but can occur in the dry period
Overbank flow	Overbank flows are higher and less frequent than bankfull flows and spill out of the channel onto the floodplain. More common in the wet period but can occur in the dry period

Scenario planning and prioritisation

Observations and provision of flow recommendations

As with all three river systems, the 2020-21, 2021-22 and 2022-23 water years were considered wet years in terms of planning scenarios, with rainfall and river flow being consistently high from July through to September (winter – spring). For most of the water year, increased unregulated flows in the river often achieved and exceeded the priority flow components. Flow peaks throughout the year exceeded bankfull levels providing lateral connectivity between the main channel and floodplain wetlands. Anecdotal evidence suggest that Australian Bass, Eel and Estuary Perch continue to benefit for the high river flows and floodplain inundation.

While peak flow rates are less than the major flood levels of June 2021, total annual flow for the 2022-23 year to date is comparable to the previous two years (Table 7). For overall context, Figure 12 illustrates the streamflow in Latrobe River (at the Reach 5) for the 2013 – 2021 water years, with the bankfull level indicated in brown.

Table 7 Estimated total flow in the Latrobe River (reach 5 Kilmany gauge). * as at 28th of February 2023

Water year	*Total estimated annual flow at Kilmany (GL)*
2014	596,722
2015	507,448
2016	404,850
2017	456,452
2018	351,406
2019	273,833
2020	653,706
2021	775,091
2022	767,768
*2023**	733,889

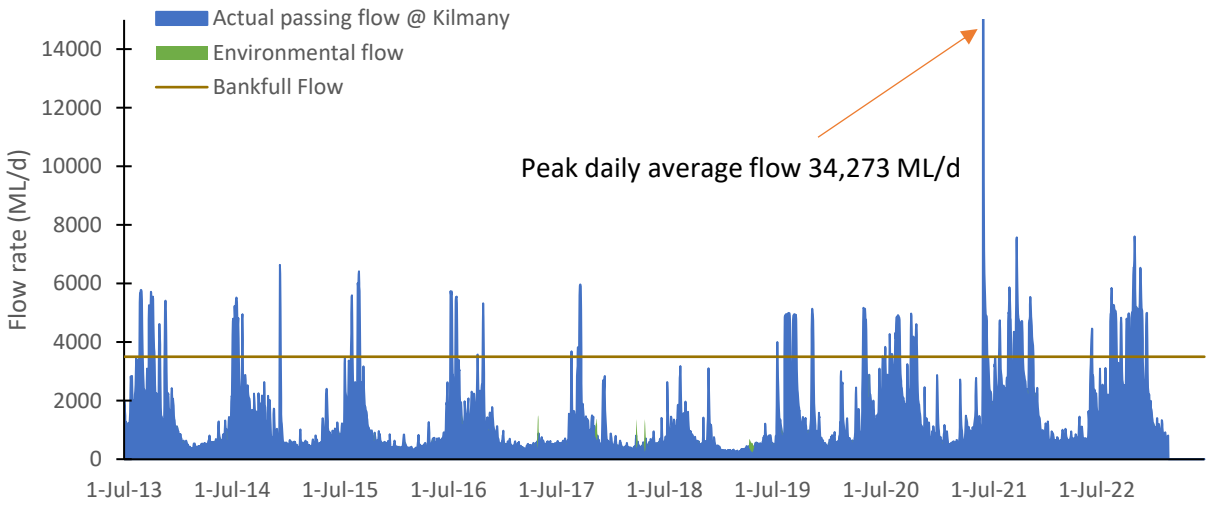


Figure 12 Hydrograph of managed and unmanaged flows occurring in reach five of the Latrobe River between the 2013 and 2022 water years.

As of the end of February no managed freshes or low flows have been delivered in the 2022-23 water year as they have been provided by unmanaged/natural river flows (Table 8 & Figure 13). The compliance assessment indicates that less than the recommended Summer/Autumn freshes have been observed. However, it is likely that the associated objectives have been met with high summer flows including bankfull and overbank events occurring in December 2022.

At the time of writing this proposal, urgent water releases from Blue Rock reservoir are being made for maintenance purposes. SRW have engaged with WGCMA to maximise the environmental benefit of these operational flows and they may meet the environmental flow recommendations. Conditions will be monitored, and the required number of remaining freshes will be delivered, if necessary, before the end of the season. If met, this will mark the fourth year in a row that all flow recommendations for reach 5 in the Latrobe River have been met.

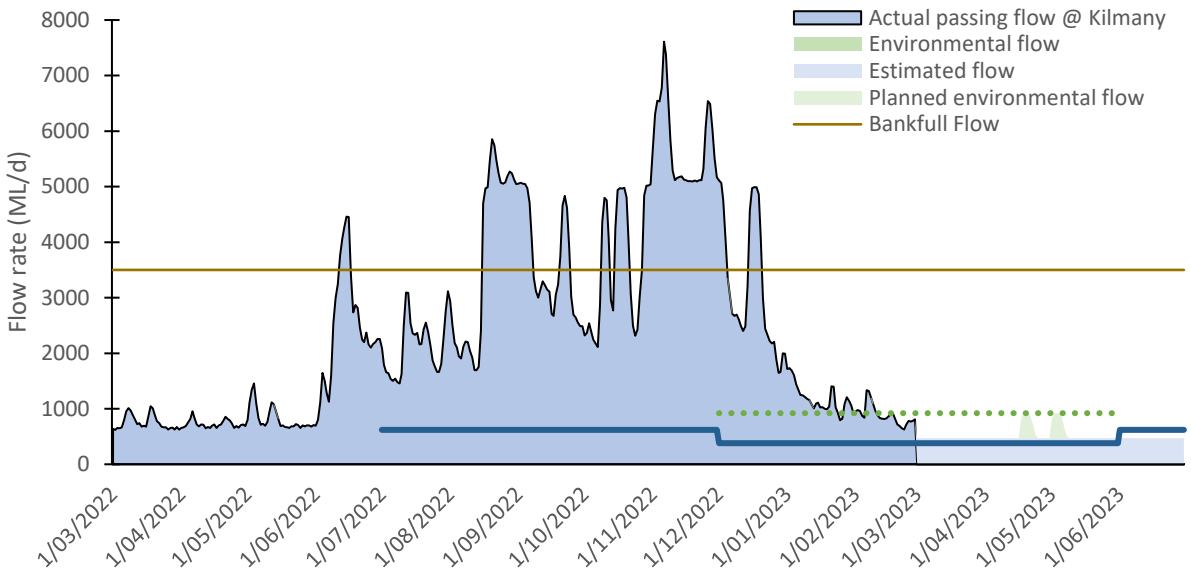


Figure 13 Hydrograph of flows occurring in reach five of the Latrobe River in the 2022-23 water year, as well as the estimated low flows and planned freshes for the remainder of 2022-23

Table 8 Hydrological achievement of flow components over time for the Latrobe River (reach five) against the average climactic condition flow recommendations. Numbers in each cell indicate the number of freshes observed, or, for low flows, the number of noncompliance days. E = managed environmental water release, * = includes planned environmental water deliveries, [a] = Assessment based on partial data set only; [b] = Flow component deemed undeliverable due to downstream flooding risk and capacity constraints. Bold line indicates commencement of Latrobe River Environmental Bulk Entitlement.

Flow Component	Hydrologic characteristics	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21-22	22-23*
Summer-Autumn Fresh (fish and vegetation)	Dec-May; Up to 920 ML/d; 3-5 days; 1-3/yr	1 (E)	3 (1 E)	1 (E)	1 (E)	3 (2 E)	2	4 (2 E)	6	2	6
Summer-Autumn fresh (water quality)	Dec-May; Up to 920 ML/d; 1 day; 4-6/yr	1 (E)	4 (1 E)	1 (E)	3 (1 E)	4 (2 E)	2	3 (2 E)	6	3	4
Winter-Spring Fresh[b]	Jun-Nov Up to 2,200 ML/d; 2 days; 1-4/yr	5	2	3	4	2	3	4	4	1	3
Summer-Autumn Low flow (noncompliance days)	Dec-May; Up to 380- ML/d	0	0	0	0	0	14	0	0	0	0
Winter-Spring Low flow (noncompliance days)	Jun-Nov Up to 620 ML/d	0	3	24	27	62	43	0	0	0	0
Bankfull flow[b]	3,500 ML/d	3	2	2	3	1	0	4	5	5	6
Overbank flow[b]	>5,000 ML/d	3	2	2	2	1	0	3	1	4	3

Key	Low flow compliance level	Fresh compliance level
Flow component completely provided	80-100%	100%
Flow component partially provided	60-80%	>50%
No significant part of the flow component achieved	<60%	<50%

Potential watering actions

Potential watering actions for 2023-24 are focused on maintaining the benefits of the wet conditions over the past three years. In line with the Thomson and Macalister rivers, watering actions this year will be targeted at providing continued support to native fish communities, from baseflows to freshes allowing for continued migration, dispersal, and survival of the 2021 and 2022 new recruits. As such, Summer/Autumn fish and vegetation

freshes and Summer/Autumn low flows are high priority flow components. The watering actions are also aimed at preventing catastrophic reduction in water quality resulting in fish kills and algal blooms if drought or dry conditions arise. Prioritised potential watering actions for 2023-24 are shown in Table 9.

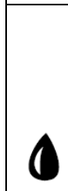
Updates/changes from 2022-23

The maximum flow rate for Summer/Autumn low flows has been increased from 380 ML/d to 440 ML/d to meet the requirements of all reaches downstream of Lake Narracan.

Additionally, the maximum flow rate for Summer/Autumn freshes has been increased from 920 ML/d to 980 ML/d in line with the highest fresh magnitude recommendation for the Latrobe River. This will ensure the benefits from these freshes is being seen throughout the regulated river system.

Table 9 Prioritised potential watering actions for the Latrobe River and Latrobe Estuary in 2023-24.

<table>
<tr><th>Potential Watering Action</th><th>Expected Watering Effects</th><th colspan="2">Environmental Objectives</th><th>Flow Details</th><th>Prioritisation rationale</th><th>Priority</th></tr>
<tr><td rowspan="6">Summer-Autumn low flow –440 ML/d (December – May)</td><td rowspan="6">Support healthy country, fishing (Bunjil Tambun) / hunting (Woorngan) and platypus (Balagen), by:
• providing pool habitat (adequate depth up to 2 m) to support migratory and resident freshwater fish, macroinvertebrates, aquatic mammals, turtles, and submerged vegetation.
• Limit terrestrial vegetation encroachment to support emergent macrophyte vegetation.
• Maintain dissolved oxygen levels in pools</td><td>  </td><td>Improve fish (migratory, resident and estuary) and eel populations</td><td rowspan="6">The flow recommendation is to provide low flows on a continuous basis. However, if dry conditions eventuate, shorter pulses may be utilised to meet some environmental objectives and conserve water. Pulses should be no shorter than 10 days.
.
Under most climate conditions, these flows are met naturally or with passing flows, however under drought conditions, managed release may be required.</td><td rowspan="6">Summer Autumn low flows are critical to meeting the long-term objectives for the Latrobe Rivers and maintains a high priority. They ensure flora and fauna have adequate water depth to prevail in dryer conditions between freshes.
Likely water availability for 2023-24 means it is unlikely that pulses will need to be utilised to conserve water.</td><td rowspan="6">High</td></tr>
<tr><td>  </td><td>Improve extent of platypus and rakali populations</td></tr>
<tr><td>  </td><td>Improve abundance of all macro- and micro-invertebrates</td></tr>
<tr><td>  </td><td>Maintain abundance of freshwater turtle populations</td></tr>
<tr><td>  </td><td>Improve condition, extent and diversity of submerged, emergent, and riparian vegetation or control invasive species</td></tr>
<tr><td>  </td><td>Avoid adverse water quality conditions</td></tr>
<tr><td rowspan="2">Summer/Autumn water quality fresh - 980 ML/d for one day
(December – May)</td><td rowspan="2">Supporting healthy country by:
• flushing sediment (sands) from pools and velocity for pool turnover.
• Provide flows that maintain pool depth and abrade algae on riffles and large wood through by scouring fine sediment from bed of pools.
• Flush pools to maintain dissolved oxygen levels, low salinity, and low nutrients in the water column to support aquatic ecosystems (e.g. fish, macroinvertebrate populations and zooplankton)</td><td>  </td><td>Maintain or improve instream geomorphic diversity</td><td rowspan="2">These are short duration freshes with a high frequency designed to maintain water quality conditions. They are particularly important in drought and dry conditions where natural flows may not be adequate, and the “fish and vegetation” freshes are less likely to be observed. The objectives of this event may be met during delivery of summer/autumn fish and vegetation freshes or estuary freshes however this proposal suggests they be delivered independently if required until this can be confirmed.

Climate | Frequency | Duration (days)
Drought | 4 | 1
Dry | 5 | 1
Average | 6 | 1
Wet | 6 | 1</td><td rowspan="2">The focus of 2023-24 is to enhance the benefits seen after the high flows and floodplain inundation of the past couple of years. This means a higher priority is given to fish and vegetation freshes required to maintain or improve fish populations and vegetation diversity. Water quality freshes may still be required if drought or dry conditions are experienced.</td><td rowspan="2">Medium</td></tr>
<tr><td>  </td><td>Avoid adverse water quality conditions</td></tr>
<tr><td rowspan="4">Summer/Autumn fish and vegetation fresh – 980 ML/d - 3 to 5 days
(December – May)</td><td rowspan="4">Supporting healthy country, fishing (Bunjil Tambun) / hunting (Woorngan) and platypus (Balagen) by:
• inundating benches to maintain habitat, support growth of emergent macrophyte vegetation and sustain macroinvertebrate and zooplankton communities, and breeding substrate for Blackfish.
• Longitudinal connectivity for aquatic mammals, migratory fish, and estuary residents; including depth over benches for Grayling.</td><td>  </td><td>Maintain or improve fish (migratory, resident and estuary) and eel populations</td><td rowspan="4">These are longer duration freshes designed to support fish migration and breeding as well as support vegetation growth on instream benches. They are particularly important in drought and dry conditions where natural flows may not be adequate. The objectives of this event can be met during delivery of summer/autumn estuary freshes or may be delivered independently if required.

Climate | Frequency | Duration (days)
Drought | 1 | 4
Dry | 2 | 3
Average | 3 | 4
Wet | 3 | 5</td><td rowspan="4"></td><td rowspan="4">High</td></tr>
<tr><td>  </td><td>Maintain or improve extent of platypus and rakali populations</td></tr>
<tr><td>  </td><td>Improve abundance of all macro- and micro-invertebrates</td></tr>
<tr><td>  </td><td>Improve condition, extent and diversity of submerged, emergent, and riparian vegetation or control invasive species</td></tr>
</table>

<table>
<tr><th>Potential Watering Action</th><th>Expected Watering Effects</th><th colspan="2">Environmental Objectives</th><th>Flow Details</th><th>Prioritisation rationale</th><th>Priority</th></tr>
<tr><td></td><td></td><td>  </td><td>Avoid adverse water quality conditions</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>  </td><td>Maintain or improve instream geomorphic diversity</td><td></td><td></td><td></td></tr>
<tr><td>Estuary Summer-Autumn fresh (980 ML/d) for up to 10 days to meet estuary requirements (assuming adequate flow in the Thomson to meet 2200 ML/d at Swingbridge) (December – May))</td><td>Summer/Autumn fish and vegetation fresh effects plus freshening of Latrobe estuary</td><td>  </td><td>Summer/Autumn fish and vegetation fresh effects plus provide access to freshwater for the lower Latrobe wetlands</td><td>This watering action is an extension of the Summer/Autumn fish and vegetation fresh aimed at providing access to fresh water for the lower Latrobe Wetlands by freshening the Latrobe Estuary.
The action relies on the contribution of Thomson flow to meet the recommended flow rate of 2,200 ML/d Swingbridge.

<table><tr><th>Climate</th><th>Frequency</th><th>Duration (days)</th></tr><tr><td>Drought</td><td>2</td><td>7</td></tr><tr><td>Dry</td><td>2</td><td>10</td></tr><tr><td>Average</td><td>3</td><td>10</td></tr><tr><td>Wet</td><td>3</td><td>10</td></tr></table></td><td>Fresh conditions throughout the Lower Latrobe wetlands over the past few years mean this watering action is a medium priority as most of the objectives have been met. This is still an important action particularly if the support of bird breeding events is required or to avoid catastrophic conditions as per the Lower Latrobe Wetlands Seasonal Watering proposal.
Potential water availability for 2023-24 will allow these events to be delivered under all scenarios.</td><td>Medium</td></tr>
<tr><td>Winter-Spring low flow – 620 ML/d (June- November)</td><td>Supporting healthy country by providing Summer / Autumn low flow functions plus flushing of sediment (sands) from pools.</td><td>  </td><td>Maintain or improve instream geomorphic diversity</td><td>This flow is designed to provide low flows on a continuous basis. However, if dry conditions prevail, shorter pulses may be utilised to meet environmental objectives. Pulses should be no shorter than 10 days.
Under most climate conditions, these flows are met naturally, however under drought conditions, managed release are likely to be required.</td><td>Winter-Spring low flows are an important flow component for protecting critical habitat and water quality, particularly in drought conditions. These flows have been met in each the last ten years naturally and are likely to be met naturally this year unless drought conditions arise. Accordingly, these flows are a low priority for 2023-24</td><td>Low</td></tr>
<tr><td></td><td></td><td>  </td><td>Maintain or improve fish (migratory, resident and estuary) and eel populations</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>  </td><td>Maintain or improve extent of platypus and rakali populations</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>  </td><td>Improve abundance of all macro- and micro-invertebrates</td><td></td><td></td><td></td></tr>
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<tr><td></td><td></td><td>  </td><td>Avoid adverse water quality conditions</td><td></td><td></td><td></td></tr>
</table>

Delivery constraints

Competition for, and total, outlet capacity as well as risk of downstream flooding are the key operating constraints in the Latrobe River (Table 10). Operating constraints have been considered in the development of this proposal, and in the operating arrangements for the Environmental Entitlement. These will be further considered as required in the implementation of the seasonal watering plan. Effective implementation will require coordination by the storage managers (SRW and GW) and cooperation/negotiation with other entitlement and land holders.

Table 10 Delivery constraints for carrying out the watering regime for the Latrobe River

Potential constraints	Impact on priority watering action
Available outlet capacity share (e.g. during periods of high electricity demand)	Limits release volume/timing. Most likely to impact freshes but may also impact low flows.
Total available outlet capacity	Limits release volume. Most likely to impact freshes.
Flooding risks of private land in Tanjil River reach	Limits ability to release larger volumes from Blue Rock reservoir
Inundation of private land in reach five of the Latrobe River	Existing constraints to water delivery limit peak flows to less than approximately 1,100 ML/day. Water heights in the lower portion of this reach are influenced by tidal and backwater effects from Lake Wellington and the Thomson River. As a result, flows above approximately 1,100 ML/day have the potential to inundate private landholders (depending on river heights). This constraint leads to significant environmental water deficit for upper reaches of the regulated Latrobe River (reach 3 and reach 4) as well as the Latrobe Estuary (Alluvium 2020).
Maintenance of water levels in Lake Narracan during ski season (January – March) (impact on other entitlement holders)	Reduces capability to charge Lake Narracan with releases from Blue Rock to allow for larger releases into Latrobe River (related to previous constraint).

Triggers for action

A regular evaluation will be undertaken of past, current, and projected seasonal conditions against the seasonal watering plan to inform actual watering decisions throughout the year. The evaluation will use recent data on storage inflows and flows in the target reach, seasonal outlooks for rainfall and streamflow, environmental water availability, environmental conditions and other relevant information and observations.

The trigger for the augmentation of low flows is water availability, river conditions and seasonal outlook at the end of April. Triggers for the provision of Summer/Autumn low flows would ideally be based on water quality (e.g., dissolved oxygen), but the cost of

implementing a monitoring system to support a water quality trigger is not considered to be warranted at this time.

Scenario planning

Four climatic scenarios are used to plan environmental water usage in Latrobe River system: drought, dry, average, and wet. In 2023, these scenarios were reviewed and updated to promote consistency in approach across the CMA's four environmental entitlements where appropriate, and to reflect best practice more broadly.

From this review the following indicators, shown in Table 11, are now used for each of the scenarios for the Latrobe River.

Table 11 Seasonal watering scenarios for the Latrobe River including representative years beginning in July for each seasonal watering scenario (ranked from wettest to driest within each scenario)

Indicator		Drought	Dry	Average	Wet
Blue Rock Lake inflow probability of exceedance, x (%)		≥90%	<90 x ≥66%	<66 x ≥33%	<33%
Blue Rock Lake inflow (GL/yr)	Min	67	79	117	152
	Average	73	101	133	183
	Max	79	117	152	233
Representative years (Reference period July 1955 to June 2020 under post-1975 climate conditions)		1972, 2002, 2018, 1967, 2006, 1982	1981, 1980, 1998, 2015, 2007, 1966, 1999, 2000, 2009, 2017, 1979, 2008, 2005, 1997, 1965	1996, 1986, 1994, 1968, 1971, 2019, 1962, 1975, 2001, 1988, 1957, 2004, 1983, 2014, 1963, 2003, 2016, 2013, 1987, 1961, 1973	1995, 2011, 1992, 1960, 1993, 1991, 1989, 1959, 1978, 1985, 1974, 1976, 1977, 1984, 1990, 1969, 2010, 1964, 1958, 2012, 1970
Likelihood of spills from Blue Rock Lake in July-June when Blue Rock Lake volume ≥ 88% of full supply level on preceding 1 Feb		Unlikely	May or may not occur	Likely	Almost certain
Likelihood of spills from Blue Rock Lake in July-June when Blue Rock Lake volume < 88% of full supply level on preceding 1 Feb		Unlikely			Likely
Likelihood of industrial return flows		Almost certain (with volumes based on number of industrial users returning water in any given year)			

Operating constraints were factored into the selection of priority watering actions for the four climatic scenarios (see the scenario descriptions below). Delivery of priority flow components is most problematic in dry and drought years, and potentially also in average years in some instances, due primarily to competition for outlet capacity. This is especially so for low flows.

The 2023-24 priority watering actions under each scenario are shown in Table 12 and Table 13. Watering actions are divided into two categories, Tier 1 and Tier 2. Tier 1 priorities are those which can be achieved within the current physical constraints of the river system and Tier 2 are those which cannot be met due to these constraints (e.g. landholder inundation).

Tier 1 priorities are further spilt into two categories, “a” and “b”. Tier 1a priorities are those which are achievable with estimated water availability. Tier 1b priorities are those which currently are not achievable with the estimated water availability but will be delivered if water becomes available.

Table 12 Environmental objectives and expect river conditions for scenario planning

	Drought				Dry				Average				Wet			
Environmental objectives	PROTECT Protect high priority environmental assets to ensure chance of future recovery. Protect key functions of high priority refuges Avoid catastrophic events such as large-scale fish kills or toxic blue green algae blooms and critical loss				MAINTAIN Maintain high priority environmental assets to ensure chance of future recovery. Maintain river functioning with reduced reproductive capacity. Maintain key functions of high priority refuges. Avoid catastrophic events such as large-scale fish kills or toxic blue green algae blooms and critical loss				RECOVER Improve ecological health and resilience. Enhance recruitment opportunities for key flora and fauna species. Maximise opportunities for natural inflows to meet in-channel environmental objectives (i.e. piggybacking)				ENHANCE Maximise recruitment opportunities for key flora and fauna species. Restore key floodplain and wetland linkages. Maximise opportunities for natural inflows to meet in-channel, floodplain, and wetland objectives			
Blue Rock inflows probability of exceedance	≥90%				<90% ≥66%				<66% ≥33%				<33%			
Median seasonal conditions @ Rosedale	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring
Flow (ML/d)	349	468	831	599	482	473	989	990	521	519	1,315	1,658	621	572	2,051	1,973
Minimum Passing flows	modified natural	modified natural	500 ML/d	500 ML/d	modified natural	modified natural	500 ML/d	500 ML/d	500 ML/d	500 ML/d	500 ML/d	500 ML/d	500 ML/d	500 ML/d	500 ML/d	500 ML/d

Table 13 Scenario planning for watering actions for the Latrobe River 2023-24. [1] Based on current account volume and forthcoming planned watering events. [2] The estimated annual share of inflows is discounted by 50% because no inflows or internal spills are accounted to the EE when it is full. [3] Passing flow used for Summer-Autumn estimated volume calculations. [4] Passing flow used for Winter-Spring estimated volume calculations. [5] Estuary summer/autumn freshes may meet the objectives of the Summer/autumn fish and vegetation freshes

		Drought				**Dry**				**Average**				**Wet**			
Estimated water availability	Likelihood of spills from Blue Rock Lake in July-June	Unlikely				May or may not occur				Likely				Almost certain			
	Starting Volume	18.9 GL				18.9 GL				18.9 GL				18.9 GL			
	Share of inflows	6.9 GL				9.5 GL				12.6 GL				17.3 GL			
	Internal spills	Unlikely				May or may not occur				Likely				Almost certain			
	Annual total:	25.8 GL				28.4 GL				31.5 GL				36.2 GL			
Tier 1a potential watering actions	**Watering action**	**Magnitude**	**Frequency**	**Duration**	**Estimated volume**	**Magnitude**	**Frequency**	**Duration**	**Estimated volume**	**Magnitude**	**Frequency**	**Duration**	**Estimated volume**	**Magnitude**	**Frequency**	**Duration**	**Estimated volume**
	Summer-Autumn low flow	440 ML/day	-	Continuous	0.3 GL	440 ML/day	-	Continuous	Met naturally	440 ML/day	-	Continuous	Met naturally	440 ML/day	-	Continuous	Met naturally
	Estuary Summer-Autumn fresh	980 ML/day	2	7 days	8.8 GL	980 ML/day	2	10 days	10.6 GL	980 ML/day	3	10 days	15.8 GL	980 ML/day	3	10 days	12.2 GL
	Summer-Autumn fish and vegetation fresh[5]	980 ML/day	1	4 days	0-4.2 GL	980 ML/day	2	3 days	0-5.2 GL	980 ML/day	3	4 days	0-7.5 GL	980 ML/day	3	5 days	0-19.8 GL
	Summer-Autumn water quality fresh	980 ML/day	4	1 day	7.2 GL	980 ML/day	5	1 day	6.3 GL	980 ML/day	6	1 day	6.9 GL	980 ML/day	6	1 day	3.6 GL
	Winter-Spring low flow	620 ML/day	-	Continuous	0.1 GL	620 ML/day	-	Continuous	Met naturally	620 ML/day	-	Continuous	Met naturally	620 ML/day	-	Continuous	Met naturally
Tier 1b potential watering actions		Nil				Nil				Nil				Nil			
Tier 1 estimated environmental water demand		16.4-20.6 GL				16.9-22.1 GL				22.7-30.2 GL				15.8-35.6 GL			
High priority carryover		5 GL				5 GL				0-3 GL				0 GL			

	Drought	Dry	Average	Wet
Potential water available for temporary trade	0GL	2 GL	3 GL	5 GL
Estimated remaining carryover	0.2-4.4 GL	1.3-6.5 GL	1.3-5.8 GL	0.6-20.4 GL

3. Thomson River seasonal watering proposal

The following section provides details for the Thomson River 2023-24 proposed watering actions.

Figure 14 Thomson River at Bruntons Bridge, November 2022

Flow components and considerations

Target reach and delivery

The Thomson River itself is viewed as a connected system, from the headwaters in the mountains through to the Gippsland Lakes, and finally into the ocean. The long-term vision for the River is:

A living river, from mountains to sea, that sustains social, cultural and ecological values, contributing to the health and prosperity of the Gippsland lakes and broader region.

Operationally, environmental flows are ordered from Thomson Reservoir to meet volume targets at the Coopers Creek gauge in reach 3 (from Aberfeldy River to Cowwarr Weir) 23 kms downstream of Thomson Reservoir, as this is a compliance point for Melbourne Water. The upper section of reach 6 is also a compliance point for Southern Rural Water (SRW) and is used to assess the continuity of environmental releases down the system.

Flows at Cowwarr Weir

Flows at Cowwarr Weir can be split between the Thomson River (T4a) and Rainbow Creek (T4b). Unless notified otherwise, passing flows are split 2/3 in the Thomson River channel and 1/3 in Rainbow Creek (TMEFTF, 2004). Environmental flow releases under section 5.2 shall preferentially be passed through the Thomson River channel, except for autumn and spring freshes which will be split as per passing flow arrangements.

Heyfield Deliveries

The long-term vision for Heyfield Wetlands is:

Provide a watering regime that will ensure Heyfield wetlands is a functional and resilient wetland ecosystem supporting diverse habitat niches and abundant flora and fauna including aquatic, terrestrial and culturally significant species.

Deliveries to Heyfield Wetlands are ordered to meet target volumes at the Coopers Creek gauge in reach 3, as the Melbourne Water compliance point. Water is extracted from the Thomson River via the Gippsland Water raw water pump station at Heyfield. Meter readings are taken at the Rose Street pump by Gippsland Water. Water is delivered to the receiving wetlands (Figure 15) via underground pipework.

Figure 15 Heyfield Wetlands – "Donut" pond, January 2023

Environmental objectives

The environmental objectives and related flow recommendations used in this proposal are detailed in the Thomson River Environmental Flows and Management Review (Streamology, 2020) and the Heyfield Wetlands Environmental Water Management Plan (Boon, 2022), and the watering actions evaluated and prioritised in this proposal are consistent with those in this study. The Thomson River objectives were refined through direct consultation with stakeholders associated with the Thomson River, GLaWAC, landholders, urban and rural water suppliers and environmental interest groups through a Project Advisory Group (PAG). Traditional Owner guidance on objectives and values was received from GLaWAC via the Gunaikurnai Cultural Water Team.

The overarching environmental objectives for the flow components are summarised in Table 14.

Table 14 Thomson River & Heyfield Wetlands environmental values and objectives, as per Thomson Flow study and Heyfield EWMP

Symbol	Value	Overarching objective
Thomson River		
	Fish	Maintain/enhance native fish community structure
	Macroinvertebrates	Restore or maintain the natural macroinvertebrate and microinvertebrate community
	Birds, turtles, frogs, reptiles	Maintain populations of birds, turtles, frogs and reptiles

	Platypus	Increase the abundance of platypus
	Vegetation	Maintain or enhance in-stream, fringing and riparian vegetation species, zonation and structural diversity
	Geomorphology	Maintain or enhance physical form and functioning of the stream bed
	Connectivity	Maintain and improve in-stream habitat diversity and connectivity
Heyfield Wetlands		
	Water-dependent birds	Maintain/improve the diversity of water-dependent bird species
	Frogs	Maintain/improve the diversity and quality of fauna habitats associated with the wetlands
	Vegetation	Maintain/improve the condition of water-dependent vegetation growing in and around the wetlands. Enhance the resilience of semi-aquatic species.

Flow components & Seasonality

The proposed flow regime for the Thomson has been categorised into three components - low flows, freshes and sub-bankfull flows, each of which are important for maintaining ecosystem health, functions, and processes. Each of the flow components are broken down into relative season; Summer/Autumn (December - May) and Winter/Spring (June - November) to align with natural, pre-regulation, conditions more closely.

Scenario planning and prioritisation

Observations and provision of flow recommendations

The 2022-23 water year has continued the trend of the previous two water years, with rainfall and river flow being consistently high. In terms of planning scenarios, this has seen most of the 2022-23 water year as falling in the “wet” scenario for management.

Flows were high throughout October to December, significantly October 28th saw the spillway at Thomson Reservoir activated, for the first time since 1994 (Figure 16). Some pre-releases were planned for prior to spill, however these were cancelled after storage space was freed up in Cardinia Reservoir following the cancellation of the desalinisation order. Highest river flows occurred in November 2022, with magnitudes remaining consistently above 3,000 ML/d for most of the month, with two peaks in flow reaching >4,000 ML/d (volumes that are considered to achieve bankfull objectives in Reach 3 (>3,000 ML/d)).

Interestingly, from December onwards there have been drier conditions, in terms of rainfall, but river flow has continued to be above average. For the majority of the water year, increased unregulated flows in the River often achieved and exceeded the priority flow components.

For overall context, Figure 17 illustrates the streamflow in Reach 3 of the Thomson River (at the Coopers Creek gauge) from July 2017 – Feb 2023, with low flow, fresh and bankfull recommendations overlain.

Figure 16 Thomson River - active spillway in November 2022

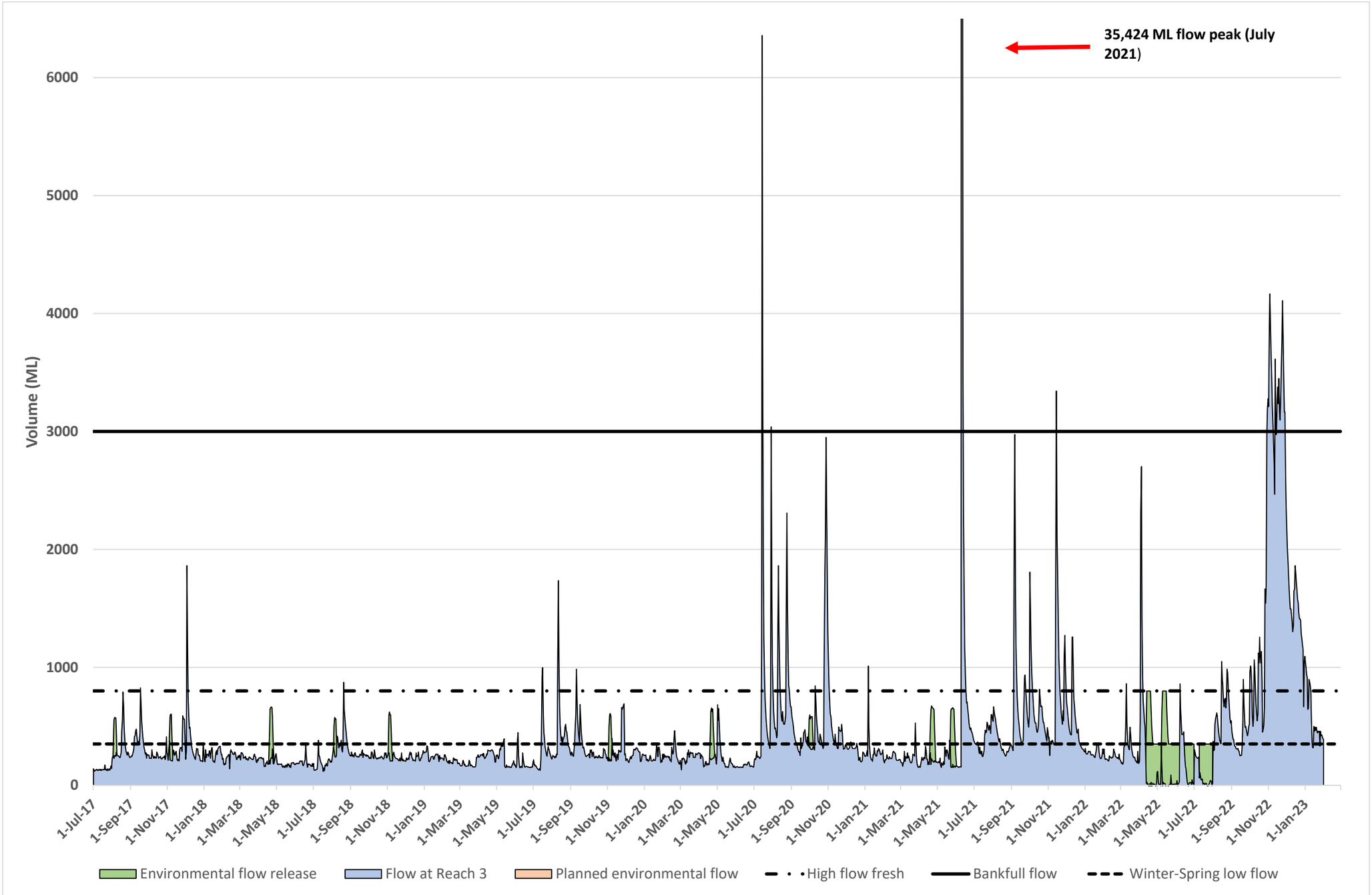


Figure 17 Hydrograph of managed and unmanaged flows occurring in the Thomson River (at Coopers Creek gauge) from July 2017-Feb 2023.

At the writing of this proposal, there has only been one environmental flow delivery in the Thomson for the 2022-23 water year. A 350 ML/d continuous winter low flow was delivered in July 2022, lasting 23 days and using 1755 ML, to maintain longitudinal connectivity for fish recruitment and providing increased access to habitat for other aquatic fauna. As outlined above, natural flows and storage releases, particularly over the winter-spring period met, and often exceeded, planned watering actions for the water year. No water for the environment was delivered to the Heyfield wetlands in 2022-23 as significant rainfall and runoff filled and maintained the wetlands in winter and throughout spring.

The spilling of Thomson Reservoir had implications for the environmental allocation in 2022-23, with remaining carryover held in airspace being lost to spill. With Thomson Reservoir spilling from October through to February, this resulted in a reduction of ~20 GL to the held environmental allocation.

Three planned deliveries remain for the 2022-23 water year, from April through to June 2023, an autumn-winter low flow and two freshes, with flows intended to provide connectivity between habitats, fish passage (autumn-winter low flow), and important spawning and migration cues for native fish species in April 2023 (Autumn fresh) and May 2023 (Winter fresh). As December onwards has been drier, it is still considered a priority to deliver these flows, and there is currently no expectation of unregulated or spill flows meeting the watering actions. With the significant reduction in held water available to deliver the remaining watering actions, the planned 350 ML/d continuous baseflow was reviewed with the Thomson EWAG. Following consultation with the EWAG it was decided that this flow was still a priority to deliver and that a modified flow magnitude of 250 ML/d would be adopted. This will also mean a smaller than proposed carryover volume into 2023-24.

Figure 18 illustrates the streamflow in reach 3 of the Thomson River (at the Coopers Creek gauge) from 1 July 2021 – 30 June 2023. Flows post March 2023 reflect the upcoming planned flow deliveries remaining for 2023.

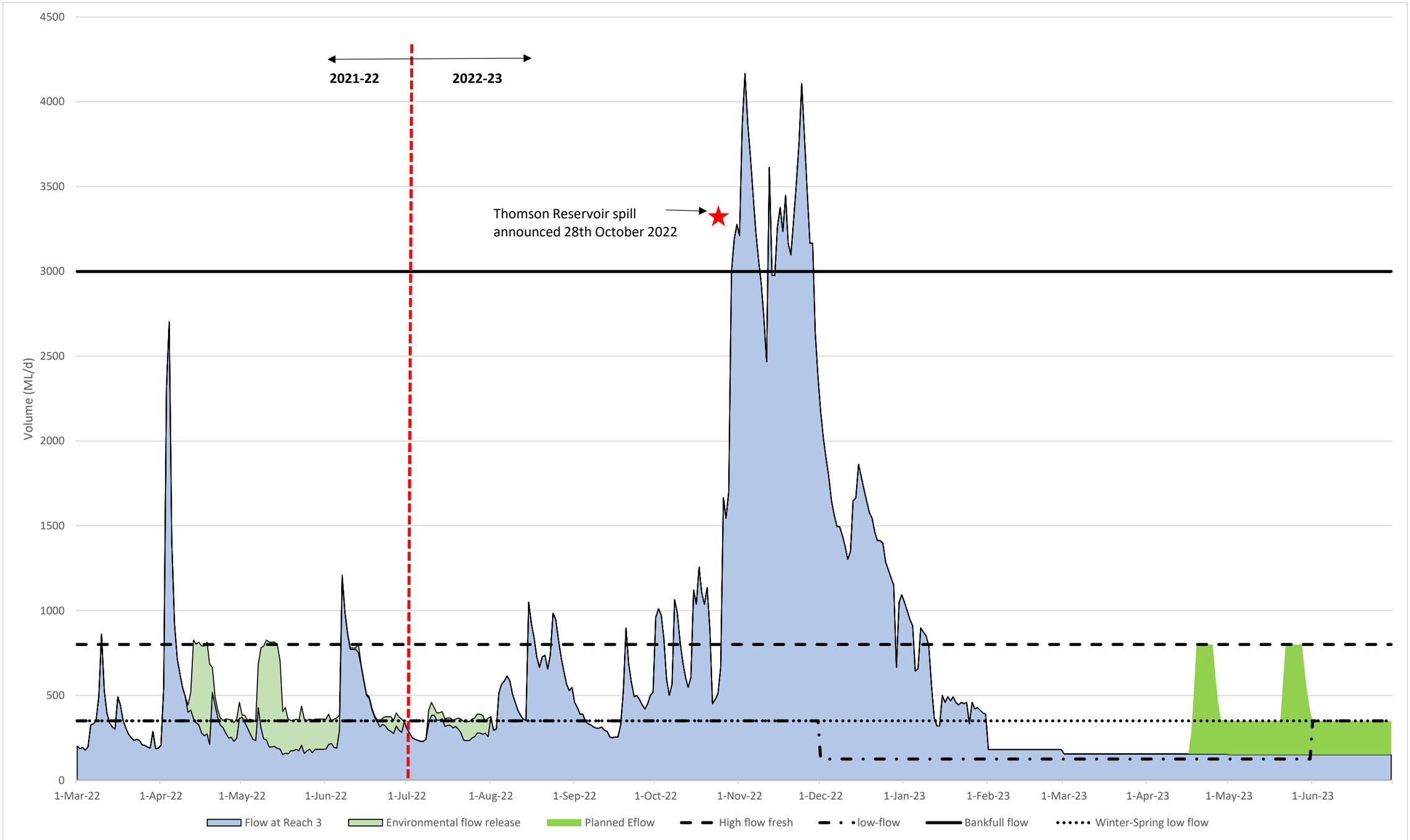


Figure 18 Thomson River Hydrograph (at Coopers Creek gauge) March 2022- June 2023. Flow data as of Feb 2023, with passing flows and planned environmental deliveries through to the end of June (Note: Red star indicates 28th October, official start date of Thomson Reservoir spilling

Assessment of hydrologic compliance involved assessing the provision of flow events based on a set of specified rules – these rules correspond with the flow recommendations for the Thomson River (Streamology, 2020). The rules include the target magnitude, minimum duration and time of year of each flow event. The compliance table has been updated to reflect the current flow recommendations (updated in 2020) the past historical flow compliance tables can be found in previous proposals.

Streamflow was assessed at two hydrologic compliance points in the Thomson River (i.e., Coopers Creek confluence and Bundalaguah). Table 15summarises the results from the Coopers Creek confluence assessment, indicating the extent to which the flow recommendations have been delivered via managed and natural flows. Table 16 summarises the delivery results for Heyfield Wetlands.

Preliminary survey results from the annual Thomson River fish population surveys (February 2023), showed continued high numbers of Tupong, with catch rates higher than found in 2021, including individuals captured at sites above the Horseshoe bend fishway. Strong numbers of River Blackfish were also captured, with the highest catch rate since the program began in 2005. Brown trout distribution has increased and now includes all but one of the sites sampled, with maximum catch rates as well. Carp numbers in the lower reaches were also high. There was only a low catch-rate of Australian Grayling, the lowest since 2005, with trout and Australian bass numbers possibly contributing to this, either through direct competition for resources or predation (*pers comm.* F. Amtstaetter). Other species captured include: Southern Pygmy Perch, galaxiid, Pouched Lamprey, Australian Smelt and Australian Bass (Figure 19).

Figure 19 ARI Feb 2023 Thomson River annual fish population surveys. Top left Tupong, top middle Australia Grayling, top right River Blackfish, bottom left Pouched Lamprey, bottom middle Australian Bass and a Galaxiid species, bottom right Southern Pygmy Perch.

Table 15 Environmental flow compliance in reach 3 (Coopers Creek gauge) of the Thomson River

Note: Updated flow recommendations were adopted from 20/21 water year onwards. A portion of past water years have been reassessed based on the 2020 flow recommendations. Details of previous compliance can be found in the 2019-20 seasonal watering proposal.

Name	Detail	17/18	18/19	19/20	20/21	21/22	22/23*	Ecological outcomes/observations 2022/23
Autumn high flow fresh	Apr-May; 800 ML/d; 7 days. 2/yr	E	1	E	E	E	E	These are planned environmental water deliveries, the first in April and the second in May 2023. The timing of the April delivery is to trigger downstream migration and spawning of Australian grayling. The May delivery provides these migration cues for Tupong and Australian bass. Recent fish surveys (undertaken in Feb 2023) reported continued good numbers of tupong. Tupong were also captured above the Horseshoe bend fishway.
Winter-Spring low flow	June - Nov;350 ML/d; continuous	E/O/U	E/O/U	E/O/U	E/O/U	U	E/U	Low flow delivered in July 2022 and flows met through unregulated flow mid-July – November 2022 Planned environmental delivery for June 2023
Summer-Autumn low flow	Dec – May; 125 ML/d; continuous	O/U	O/U	O/U	O/U	O/U	O/U	Fully provided through passing flow arrangements
Spring fresh	Sep-Nov: 800 ML/d; 7 days. 2/yr	E	E	E	E	E	O/U	Fully provided through unregulated/spillway flows
Summer fresh	Dec-Jan; 350 ML/d; 7 days; 1/yr	O/U	O/U	O/U	O/U	E	O/U	Fully provided through unregulated/spillway flows
Summer-Autumn low flow fresh	Feb-Mar; 230 ML/d; 7 days; 1/yr	O/U	O/U	O/U	E	O/U	O/U	Fully provided through unregulated/spillway flows
Bankfull/ sub bankfull	Anytime; 3,000 ML/d; 1 days	2	2	U	U	U	O/U	High flow peaks in November 2022 at and above 3000 ML/d Although considered an ecologically important flow, providing this bankfull event is considered a low priority, as delivering it would preclude the delivery of other higher priority watering actions due to its large volumetric demand. Delivery of this event would also elevate the risk of personal injury or damage to property. This flow event was achieved through unregulated flows in 2022-23.

Key	
	Flow component has been fully provided
	Flow component has been partially provided
	No significant part of the flow component provided either naturally or through managed flows
	Planned environmental delivery
E	Managed environmental water release
O	Consumptive water enroute/other managed flows
U	Unregulated flows

Footnotes

*Note: This assessment is as of 3rd March 2023
1This flow was not delivered in 2018-19 due to the construction of the Thomson fishway
2 Due to flooding risks, only unregulated flows are able to provide for this flow component

Table 16 Heyfield Wetlands Historical environmental delivery compliance

Heyfield Wetlands (Western Ponds)	**17-18**	**18-19**	**19-20**	**20-21**	**21-22**	**22-23***	**Ecological outcomes/observations**
Winter Watering	N/A*	N/A*	E	U	U	U	With significant rainfall and runoff widespread across the catchment, no environmental deliveries were required to meet the 2022-23 fill and top-up watering actions. Water levels held very well across the autumn and spring, again providing habitat for water birds, frogs, and turtles. Both receiving ponds are now undergoing natural summer drawdown
Spring Watering	N/A*	N/A*	E	U	U	U	
Key							
	No significant part of the water regime provided naturally or through environmental deliveries						
	Water regime partially provided						
	Water regime completely provided						
N/A	No watering						
U	Unregulated flows						
E	Managed environmental delivery						
Footnotes	*These wetlands were constructed in 2017 and remained dry until receiving environmental water in 2019-20						

Potential watering actions

Potential watering actions for the Thomson River in 2023-24 have been detailed in Table 17, based on the recent historical streamflow, latest known condition of target ecological values, the likelihood of achieving the ecological objectives and the potential for the watering action to be provided via other water sources (e.g., unregulated flows, consumptive water delivery).

As the Latrobe, Thomson and Macalister all contribute to flows in the estuary (and the lower Latrobe wetlands), there are times when high flow releases for river objectives across all systems can be delivered in a coordinated approach to have benefits for both the river systems and the estuary. Where flows have benefits for the estuary and/or lower Latrobe wetlands, this has been included in the rationale for priority watering actions.

Heyfield Wetlands priority watering actions are presented separately in Table 18.

Table 17 Potential watering actions in the Thomson River for 2023 - 24

Thomson River – Site Details	
Environmental Watering Reach	Operationally, environmental flows are ordered to meet volume targets at the Coopers Creek gauge in Reach 3 (from Aberfeldy River to Cowwarr Weir) 23 kms downstream of Thomson Reservoir, as this is a compliance point for Melbourne Water. The upper section of Reach 6 is also a compliance point for Southern Rural Water (SRW) and is used to assess the continuity of environmental releases down the system.
Measurement Point	Thomson River @ Coopers Creek (#225208B), Thomson @ Wandocka (#225212A)

The overall priority of the proposed flows in 2023-24 are targeted at supporting native fish populations following successive breeding and recruitment events. Priority ranking is also based on the assumption of an “average” scenario for climate and allocation.

Potential Watering Action	***Expected Watering Effects***	***Environmental Objectives***		***Flow Details***	***2023-24 Rationale***	***Priority (H/M/L)***
Autumn fresh 800 ML/d for 7 days (April)	Flow cue for downstream migration for Australian grayling, adult Short-finned eel, adult Long-finned eel, adult Australian bass, and adult Common galaxias. Flow cue for upstream migration for juvenile Long-finned eel and spent Australian grayling. Adequate volume and flow of water to maintain submerged water dependent vegetation, biofilms, and non-woody fringing vegetation Higher flows to permit downstream dispersal of seeds and propagules of native non-woody fringing vegetation, submerged plants and other water-dependent species in the riparian zone. Flows to provide opportunities for scouring of existing biofilms and generate new colonisation sites Mobilising fine sediments, turnover of sediment, preventing infilling of pools, and depositing sediments on existing bars and benches		Maintain/enhance the structure of native fish communities Maintain or enhance physical form of the channel to provide a variety of channel features and habitats for aquatic animals Maintain or enhance river function by maintaining substrate condition and enabling carbon cycling Maintain and restore the structural diversity (zonation) of streamside vegetation and reduce terrestrial encroachment/invasion Increase the recruitment and growth of native in-stream, fringing and streamside vegetation	This flow is considered a high priority in all scenarios (**drought-dry-average-wet**). In a **drought-average scenario** the duration can be reduced to 5 days rather than 7, to reduce the delivery volume. In a wet scenario, the duration is 7 days.	The primary objective of this PWA is to provide a flow cue for native fish migration, particularly for Australian Grayling. Timing and provision of these flows provides continued support for grayling and the broader migratory native fish population, particularly for Australian Bass which are showing signs of significant recruitment over the last two years. As grayling are an EPBC listed species, and regarded a significant value in the Thomson, it is a high priority to deliver flows in 2023-24 that support their migration, spawning and recruitment. At a catchment scale, the provision of this flow would also have secondary benefits, particularly when timed to coincide with Macalister River delivery, as it provides a full flushing flow to the upper Thomson estuary. This will provide freshwater to sustain macroinvertebrate communities and flush sediments. This estuary flow requirement would be **partially, if not fully achieved** during the combined Macalister and Thomson rivers Autumn fresh deliveries in Apr-May.	**H**

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2023-24 Flow Details*	*2023-24 Rationale*	*Priority (H/M/L)*
Spring fresh 800 ML/d for 5-7 days (Oct – Nov)	Flow cue for upstream migration of juvenile Australian grayling, adult lamprey species, juvenile Short-finned eel, juvenile Tupong, adult and juvenile Australian bass, juvenile Common galaxias, and Broad-finned galaxias. Flow cue for downstream migration of juvenile Short-headed lamprey and adult Short-finned eel. Providing flows that disturb biofilms and maintain habitat quality Providing flow variability to maintain zonation of vegetation, and periodic higher flows to permit downstream dispersal of seeds and propagules (of submerged, woody and non-woody plant species) Turnover of sediment, mobilising fine sediment, prevention of pool infilling, and deposition of sediment on existing bars and benches		Maintain/enhance the structure of native fish communities	This flow is considered a high priority in all scenarios (**drought-dry-average-wet**). In a **drought-average scenario** the duration can be reduced to 5 days rather than 7, to reduce the delivery volume. In a wet scenario, the duration is 7 days.	Spring freshes are considered important for the recruitment of juvenile migratory native fish species from estuarine/marine habitats, particularly Australian Grayling and Tupong. Monitoring in Feb 2023 detected high numbers of Tupong and Australian Bass in the Thomson River. Delivering flows that support migration, spawning and recruitment are of high priority for 2023-24, as they continue to provide opportunities for native migratory fish species. This flow also fits with the overall priority to support native fish populations following successive breeding and recruitment events. At a catchment scale, the provision of this flow would have a secondary benefit for the upper Thomson estuary, providing a full flush. This flow would help to improve water quality by displacing the salt wedge and contributing freshwater flows to the lower Latrobe wetlands. This estuary flow requirement would be **partially achieved, if not fully**, in 2023-24 during combined Macalister and Thomson rivers Spring fresh deliveries in Sept-Nov.	**H**
			Maintain the natural invertebrate community			
			Maintain and restore the structural diversity (zonation) of streamside vegetation and reduce terrestrial encroachment/invasion Increase the recruitment and growth of native in-stream, fringing and streamside vegetation			
			Maintain or enhance physical form of the channel to provide a variety of channel features and habitats for aquatic animals Maintain or enhance river function by maintaining substrate condition and enabling carbon cycling			

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2023-24 Flow Details*	*2023-24 Rationale*	*Priority (H/M/L)*
Autumn – Spring low flow 125 – 350 ML/d continuous (May – Nov) Proposed partial delivery: **125 - 350 ML/d, continuous (July)**	Provides flows that support diversity of instream habitat for macroinvertebrates and the whole native fish assemblage Provide adequate water quality (DO and temperature) through pools and riffles to facilitate respiration of macroinvertebrates Maintain continuous connectivity for localised movement of native small-bodied fish species and platypus.		Maintain the natural invertebrate community	Partial delivery of this action: In a **drought and dry scenario**: 125 – 230 ML/d (July): 350ML/d, 7 days (Oct-Nov) 230 ML/d, continuous (May – June)	Providing the full continuous baseflow from May – Nov would preclude the delivery of other priority flows given the volumetric demand. Proposed here is a partial delivery of this action, comprising 3 targeted flows. Passing flows from March – June are 150 – 155 ML/d, the lowest magnitudes throughout the year, at a time when flows would have naturally been a lot higher. This period is extremely significant for both migratory fish species and platypus. The minimum magnitude (125 ML/d) would provide localised movement opportunities for small-bodied fish and platypus, but not the same extensive longitudinal connectivity.	**H**
			Maintain and improve in-stream habitat diversity and connectivity			
			Maintain/enhance the structure of native fish communities			
			Increase the recruitment and growth of native in-stream, fringing and streamside vegetation Maintain and restore the structural diversity (zonation) of streamside vegetation and reduce terrestrial encroachment/invasion			

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2023-24 Flow Details*	*2023-24 Rationale*	*Priority (H/M/L)*
350 ML/d, 7 days (following Oct-Nov fresh) **230 - 350 ML/d continuous (April - June)**	Extended connectivity to allow upstream migration of adult Short-headed lamprey and adult Pouched lamprey. Extended connectivity for downstream migration of Australian bass, Tupong, juvenile lamprey (Short-headed and Pouched), and Common galaxias. Adequate volume and flow of water to maintain submerged water dependent vegetation, biofilms, and non-woody fringing vegetation Higher flows to permit downstream dispersal of seeds and propagules of native non-woody fringing vegetation, submerged plants and other water-dependent species in the riparian zone. Periodic inundation of low-lying benches and lower parts of the riparian zone to prevent encroachment of inundation intolerant terrestrial weed species.		Increase the abundance of platypus	**Average-Wet scenario**: <u>230 – 350 ML/d (July)</u> <u>350ML/d, 7 days (Oct-Nov)</u> <u>300-350 ML/d, continuous (April – June)</u>	Winter-Spring baseflows provide important longitudinal connectivity and enable fish and other fauna to move freely between different habitats. This is particularly important during this time as it is considered the juvenile recruitment period for native diadromous species, such as Australian grayling and tupong. Providing this flow also provides a dominant attractant flow for fish connectivity, encouraging them up the Old Thomson channel where there is fish passage, rather than up the Rainbow Creek. By adding a 7 day 350 ML/d tail to the Spring fresh, the opportunity for migration is extended providing that increased longitudinal connectivity for any stragglers. Increased flows during this time provides greater connectivity and feeding opportunities for platypus, while also reducing the risk of individuals being predated upon during the pre-breeding season. Providing the upper magnitude of this flow also prevents encroachment by terrestrial vegetation and inundates fringing native vegetation, particularly in reach 3 and 6. <u>Additional benefits for Reach 6 (upper Thomson estuary)</u>: This flow would also partially flush the upper portion of the water column, providing freshwater above the halocline for fish. It would also reduce the salinity enough to support emergent macrophyte vegetation. Baseflows from the Thomson and Macalister may **partially** meet the volumes and duration required for this estuary flow. Full provision of this baseflow is currently considered a low priority, as delivering it would preclude the delivery of other higher priority watering actions due to its large volumetric demand	

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2023-24 Flow Details*	*2023-24 Rationale*	*Priority (H/M/L)*
Summer-Autumn fresh **230 ML/d for 7 days** **(Feb – Mar)**	Flow cue for downstream migration of adult Short-finned eel, adult Long-finned eel. Flow cue for upstream migration for juvenile Short-finned eel, juvenile long-finned eel, juvenile Australian bass, juvenile common galaxias. Connectivity to facilitate localised movement between habitats for large-bodied fish species		Maintain/enhance the structure of native fish communities	This flow is considered a priority in all scenarios (**drought-dry-average-wet**).	Summer freshes provide fish passage during the dry season to enable movement of fish and other fauna into available habitats and refuge habitats. They also improve habitat for macroinvertebrates and plants by scouring out sediment that has deposited in riffles.	**H**
			Maintain or enhance physical form of the channel to provide a variety of channel features and habitats for aquatic animals Maintain or enhance river function by maintaining substrate condition and enabling carbon cycling			
			Increase the recruitment and growth of native in-stream, fringing and streamside vegetation			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2023-24 Flow Details	2023-24 Rationale	Priority (H/M/L)
	Maintain physical form and functioning of the channel through mobilisation of fine sediments Adequate volume and flow of water to maintain submerged water dependent vegetation, biofilms, and non-woody fringing vegetation		Maintain and improve in-stream habitat diversity and connectivity			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2023-24 Flow Details	2023-24 Rationale	Priority (H/M/L)
Summer fresh, 350 ML/d for 7 days (Dec – Jan)	Adequate volume and flow of water to maintain submerged water dependent vegetation, biofilms, non-woody fringing vegetation, and water-dependent taxa of existing EVCs in the riparian zone Maintain physical form and functioning of the channel through mobilisation of fine sediments		Increase the recruitment and growth of native in-stream, fringing and streamside vegetation	In a drought scenario this flow would be considered a high priority. In a dry-average-wet scenario this is considered a medium priority.	The objective of this flow is to wet vegetation during the seasonally dry December - January summer months, as without a fresh the fringing vegetation is likely to undergo a 3-month period over summer without inundation.	**M**
			Maintain or enhance physical form of the channel to provide a variety of channel features and habitats for aquatic animals Maintain or enhance river function by maintaining substrate condition and enabling carbon cycling			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2023-24 Flow Details	2023-24 Rationale	Priority (H/M/L)
Autumn fresh 800 ML/d for 7 days (May)	Flow cue for the upstream migration of juvenile Australian grayling, adult lamprey (Pouched and Short-headed), juvenile Short-finned eel, juvenile Tupong, adult and juvenile Australian bass, juvenile Common galaxias, and Broad-finned galaxias. Flow cue for downstream migration for juvenile Short-headed lamprey,		Maintain/enhance the structure of native fish communities	This flow is considered a medium priority in the **drought-dry-average** scenarios In a **drought scenario** the duration can be reduced to 5 days rather than 7, to reduce the delivery volume.	The primary objective of this flow is to act as a cue for fish migration, specifically for species such as tupong and Australian Bass. This flow also fits with the overall priority to support native fish populations following successive breeding and recruitment events. It also has benefits for vegetation, macroinvertebrates and geomorphic objectives. With the loss of carryover water in 2022-23, the estimated allocation for the Thomson is lower than it has been in previous years. At the time of planning, estimated allocation for the 2023-24 water year is	**M**
			Maintain the natural invertebrate community			
			Maintain and restore the structural diversity (zonation) of streamside vegetation and reduce terrestrial encroachment/invasion Increase the recruitment and growth of native in-stream, fringing and streamside vegetation			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2023-24 Flow Details	2023-24 Rationale	Priority (H/M/L)
	adult Short-finned eel, and adult tupong. Providing flows that can disturb biofilms and maintain habitat quality Providing flow variability to maintain zonation of vegetation and downstream dispersal of seeds and propagules (of submerged, woody and non-woody plant species) Maintaining physical form and functioning through the turnover of sediment, mobilising fine sediment, prevention of pool infilling, and deposition of sediment on existing bars and benches		Maintain or enhance physical form of the channel to provide a variety of channel features and habitats for aquatic animals Maintain or enhance river function by maintaining substrate condition and enabling carbon cycling	In all other scenarios, the duration is 7 days.	insufficient to provide all of the watering actions. Although still considered significant flow for supporting native fish populations, the highest priority migration flows are the April and Oct-Nov freshes as they cover spawning and recruitment timing for several species. In terms of prioritisation this delivery has been given a medium priority across the drought-average scenarios, and if allocation allows this flow may still be delivered (Tier 1b).	

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2023-24 Flow Details	2023-24 Rationale	Priority (H/M/L)
Winter-Spring Fresh, 800 - 900 ML/d for 7 days (Sept)	Providing flows that can disturb biofilms and maintain habitat quality Providing flow variability to maintain zonation of vegetation according to elevation and flow requirements, and periodic higher flows to permit downstream dispersal of seeds and propagules		Maintain the natural invertebrate community	In a **wet scenario,** when not delivered via unregulated flow**, and** where appropriate to do so, this flow can be increased to 900 ML/d to reach higher up the bank.	As there are no direct fish objectives associated with this September fresh, and with volumes greater than this being achieved through unregulated flows over the last three years, it has been given a lower priority, to only be considered under a wet scenario (where allocation allows). At a catchment scale, the provision of this flow also has secondary benefits for the upper Thomson estuary providing a full flush. This flow will improve water quality by displacing the salt	**L**
			Maintain and restore the structural diversity (zonation) of streamside vegetation and reduce terrestrial encroachment/invasion Increase the recruitment and growth of native in-stream, fringing and streamside vegetation			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2023-24 Flow Details	2023-24 Rationale	Priority (H/M/L)
	Periodic inundation of stream, low-lying benches and lower parts of the riparian zone to prevent encroachment of terrestrial weed taxa intolerant of prolonged submergence Maintaining physical form and functioning through the turnover of sediment, mobilising fine sediment, prevention of pool infilling, and deposition of sediment on existing bars and benches		Maintain or enhance physical form of the channel to provide a variety of channel features and habitats for aquatic animals Maintain or enhance river function by maintaining substrate condition and enabling carbon cycling	In a wet scenario this flow could be delivered in lieu of a bankfull event. Planning and good communication with storage operators could also see this achieved through piggybacking on unregulated flows.	wedge and contribute freshwater flows to the lower Latrobe wetlands. This estuary flow requirement would be **partially achieved, if not fully**, in 2023-24 with the delivery of a Spring fresh in Sept-Nov.	

Table 18 Heyfield Wetlands Potential Watering Actions for 2023-24

Heyfield Wetlands – Site Details	
Environmental Watering Reach	Heyfield Wetlands – Reach 4a
Measurement Point	Thomson River @ Coopers Creek (#225208B) and Rose St – Gippsland Water Raw Water Pump Station

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2023-24 Rationale	Priority (H/M/L)
Winter/ spring inundation (Full inundation) **Up to 10-15 ML (Aug - Sep)** **Maximum water depth ~ 1.5 m**	Fill wetlands to a depth that maintains water-dependent plant species and habitat for fish, frogs, and waterbird communities. Prevents terrestrialisation of wetland floor by drowning out any terrestrial plants that have colonised wetland fringes.		Maintain the existing vegetation, and promote the growth, establishment and resilience of semi-aquatic species	In 2022-23, rainfall and runoff in the area were able to naturally provide the inundation events outlined in the previous watering proposal. In an average to drier scenario, the likelihood of this event happening naturally is low. The ability to deliver this event in the absence of natural filling is important for supporting the flora and fauna of the site as it is not connected directly to the Thomson River. The objective of this delivery is to improve the ecological value of the wetlands by supporting spring growth of water-dependent vegetation and increasing the availability of surface water and habitat for fauna.	**H**
		 	Maintain, and where possible improve, the diversity and quality of fauna habitats		

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2023-24 Rationale	Priority (H/M/L)
Potential Watering Action	**Expected Watering Effects**	**Environmental Objectives**		**2023-24 Rationale**	**Priority (H/M/L)**
Mid-spring to early summer top-ups **Up to 10-15 ML (Oct-Dec)** **Maximum water depth ~ 1 m – 1.5 m**	Top-ups provided to maintain full inundation after mid/late spring (Oct – Nov), to provide water levels that maintain water-dependent plants, including fringing emergent plants. Water depth also maintains aquatic habitat for fish, frogs and waterbirds – timing also coincides with spring/summer waterbird and frog breeding. Episodic top-ups over late spring/early summer (Nov – Dec) to maintain high water levels that maintain water-dependent plants, including fringing emergent and woody plants. Water depth also maintains aquatic habitat for fish, frogs and waterbirds. Maintained water levels also prevent rapidly falling water levels which may compromise water bird breeding success.		Maintain the existing vegetation and promote the growth and establishment of semi-aquatic species	In 2022-23, rainfall and runoff in the area were able to naturally provide the inundation events outlined in the watering proposal. In an average to drier scenario, the likelihood of this event happening naturally is low. The ability to deliver this event in the absence of natural filling is important for supporting the flora and fauna of the site.	**H**
		 	Maintain, and where possible improve, the diversity and quality of fauna habitats		

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2023-24 Rationale	Priority (H/M/L)
Late summer top up (Feb-March) **0-5 ML** **Max water depth ~1m-1.5m**	Fill wetlands to a depth that supports newly planted water-dependent species		Maintain the existing vegetation and promote the growth and establishment of semi-aquatic species	As part of the Heyfield Wetland Committees' vision to improve habitat availability and amenity at the Heyfield Wetlands site, a planting schedule for both aquatic and ephemeral plant species has been developed. This includes planned plantings in the environmental water receiving wetlands (Boomerang and Donut). The plantings are to occur in February 2024, when soil temperatures are still warm but the hottest part of summer has passed. The proposed top-up in late February-March, is intended to support the survival of aquatic plants during the initial establishment phase. Increasing the abundance and diversity of aquatic plants will improve the ecological value of the wetlands in the long-term, particularly in providing habitat for fish, birds and frogs. With warmer and drier conditions currently forecast and the specific timing of this delivery, it is unlikely that inundation from the Oct – Dec top ups or natural runoff will provide the depth required to submerge these plants.	**H**
			Maintain, and where possible improve, the diversity and quality of fauna habitats		

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2023-24 Rationale	Priority (H/M/L)
Late summer/autumn draw down (average and dry years) **(April – May)**	Water levels in these wetlands significantly lower over late summer/autumn. Wetlands will have either low water levels (<0.6m in average years) or be almost dry (dry years) over April – May.		Maintain the existing vegetation and promote the growth and establishment of semi-aquatic species	The objective here is to replicate a natural drying event over the summer months. This drawdown will allow for the breakdown of accumulated organic matter, nutrient recycling, oxygenation of surface soils and provide increased mudflat and shallow water habitats for water birds as water levels recede. This is highly likely to occur naturally through evaporation.	**M**
			Maintain, and where possible improve, the diversity and quality of fauna habitats		

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2023-24 Rationale*	*Priority (H/M/L)*
				Recommended to occur 1-3 times/decade	

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2023-24 Rationale*	*Priority (H/M/L)*
Late Summer to autumn top-ups **5 – 10 ML** **(Feb – May)** **(Drought years only)**	Episodic top-ups over late summer/autumn to maintain low water levels in wetlands over the Feb – May period. This maintains wetland function and availability of wetland habitats (as refuges) over periods of prolonged dry conditions.		Maintain the existing vegetation and promote the growth and establishment of semi-aquatic species	The objective of this watering action is to provide drought refuge over periods of prolonged dry conditions (e.g. drought). It is not expected to be required under dry-average-wet scenarios.	**L**
			Maintain, and where possible improve, the diversity and quality of fauna habitats		

Delivery constraints

The main constraints and issues associated with delivery of the priority watering actions in the Thomson River are described in Table 19.

Table 19 Constraints associated with effective environmental water delivery for the Thomson River

Constraint	Description	Implications for environmental watering
Outlet capacity sharing	• Water can be released from the Thomson reservoir to the river via the hydropower station (max. capacity of 480 ML/d) • There are also two other outlets with a combined capacity of 2,300 ML/d – however these maximums are achieved only when the reservoir is full, and capacity is lower as the water level drops	• To date the hydropower plant has been able to deliver sufficient releases for environmental and consumptive water demands • It is unlikely that outlet capacity sharing will impact on the watering actions proposed for 2023-24
900 ML/d volume delivery constraint	• As per the Thomson operating arrangements, to reduce the risk of flooding adjoining property, releases from Thomson Reservoir shall not exceed 900 ML/d without development of a detailed risk and flood assessment.	• This approach is not expected to impact on the ability to meet the majority of desired environmental flow regime (with most freshening flows up to a maximum of 800 ML/d). At times when releases from storage are made to meet an environmental release order immediately downstream of the Thomson Reservoir, rather than at Coopers Creek, it will be necessary to consider the potential impact of these release volumes on flooding downstream of the Aberfeldy River confluence.

Constraint	Description	Implications for environmental watering
Notification requirements	• The minimum 2 week period required for notifications to the public and storage operators, prohibits a flexible planning environment, prohibiting storage operators from being able to release environmental watering event more dynamically based on rainfall and a lull in irrigation demand (due to outlet capacity sharing constraints – see above) • The current operating arrangements do not allow for the flexibility required to deliver environmental watering events to piggyback on naturally occurring, which may allow for greater water savings, permitting the delivery of more watering actions	• Environmental water delivery will not be able to opportunistically piggyback onto naturally occurring events • A dynamic environmental flow delivery system (using shorter notification times – or providing flexibility with delivery timing) would mean that a watering event can be timed to follow a rainfall event, and therefore potentially deliver greater ecological benefits (as the ecosystem anticipates a rise in streamflow) • In future, all partners should work together to establish a real time notification resource (e.g. a website) that consolidates planned releases – whether it be consumptive/environment. This would reduce the need for such a long notification period, and greatly reduce the effort required to notify various groups.

Triggers for action

In administering the environmental water entitlement for the Thomson River, the West Gippsland Catchment Management Authority use several decision support tools:

- Data and reports from monitoring programs within the systems
- Latest scientific knowledge/understanding relevant to the systems
- System understanding and emerging issues
- BoM climate outlooks
- Projected trend in season conditions and inflows
- Flow modelling and scenario evaluation tools
- Ecological condition
- Historical environmental flow compliance
- Flow data at Coopers Creek (target reach)

This information is used to determine the current and predicted watering operation scenario and flow deliveries for the systems throughout the watering year.

Ecological objective evaluation

Ecological objectives may be met by natural flows, thereby negating, or lessening the requirement to release environmental water. For example, a spawning flow event for Australian grayling is best timed between late April and mid-May. If a natural event occurs at the end of April under a dry scenario no release will be required, however under a wet scenario a release in May could be undertaken. Or, if several high flow freshes occur in winter, this water may be used to release an additional autumn fresh.

Allocation of Entitlement

Ability to deliver flows is dependent on the availability of water held in storage. This proposal has been developed so proposed flow components can be achieved by the predicted volumes in storage for each scenario.

However, storage spills, emergency releases in cases of very poor water quality, qualification of rights, significant water shortages or other factors may result in a shortfall of environmental water to meet all flow components. When water availability is unexpectedly reduced the volume required to meet priority flow components will be recalculated against projected allocations. Flows under each scenario have been assigned a priority so any shortfall will result in the lower priority flow event not being delivered. Please note that all flow components outlined are considered as ecologically important flows, assigning a priority ranking allows water managers to manage the annual allocation with those flows deemed critical each year being given highest priority. In some cases, providing a specific event may be considered a lower priority, as its volumetric demand would preclude the delivery of other higher priority watering.

Scenario planning

Four climatic scenarios are used to plan environmental water usage in the Thomson River system: drought, dry, average, and wet. In 2023, these scenarios were reviewed and updated to provide consistency in approach across the four WGCMA managed environmental entitlements, and to reflect best practice more broadly.

From this review the following information, summarised in Table 20, has been incorporated into the scenario planning process for the Thomson River.

The 2023-24 potential watering actions under each scenario are shown in Table 21. Watering actions are divided into categories, Tier 1 and Tier 2 as outlined by the Victorian Environmental Water Holder Seasonal Watering Proposal Guidelines (VEWH, 2022).

Tier 1 watering actions are identified as being required under specific planning scenarios this year given current environmental conditions. Tier 1a priorities are watering actions that are proposed for delivery (whether partially or fully) with predicted supply under each climate scenario. Tier 1b priorities are those watering actions which are considered important but are not expected to be delivered with the estimated allocation. Tier 2 watering actions are those not prioritised for delivery this year to achieve intended environmental objectives but are needed on occasion to meet long-term condition outcomes.

Four scenarios are considered for the Thomson River: drought, dry, average and wet. Expected conditions under each scenario are summarised in Table 20.

Table 20 Climate scenario summary for the Thomson River

		Drought				Dry				Average				Wet			
Environmental Objectives		**PROTECT**				**MAINTAIN**				**RECOVER**				**ENHANCE**			
Expected River Conditions	**Thomson Reservoir inflows POE (%)**	≥90%				66-90%				33-66%				≤33%			
	Likelihood of spill from Thomson Reservoir in July-June when Thomson Reservoir volume ≥ 88% of full supply level on preceding 1 Feb	Unlikely				Unlikely				May or may not occur				Likely			
	Passing Flows	Passing flows at Coopers Creek as per BE for all months Reduced passing flows at Wandocka (50 ML/d or higher)				Passing flows at Coopers Creek as per BE for all months Reduced passing flows at Wandocka (50 ML/d or higher)				Passing flows at Coopers Creek as per BE for all months				Passing flows at Coopers Creek as per BE for all months			
	Unregulated Flows	No unregulated flows Spill unlikely				Some unregulated flows from the Aberfeldy River potentially contributing to baseflows and freshes Spill unlikely				Unregulated flows from the Aberfeldy River likely to contribute to baseflows and freshes Spills possible if Thomson Reservoir ≥88% capacity on 1 Feb of previous water year				Unregulated flows from the Aberfeldy River highly likely to contribute to baseflows and freshes Spills likely if Thomson Reservoir ≥88% capacity on 1 Feb of previous water year			
	Consumptive Water	100% delivery of SRW share (45 GL) 300-400 ML/d continuous (Nov-Mar)				Delivery of a portion of SRW share (10 GL) ~300ML/d 1 month duration (Dec, Feb-Mar)				Delivery of a portion of SRW share (3-3.5 GL) ~150 ML/d, 1-2 week duration (Dec, Feb-Mar)				Delivery of a portion of SRW share (1 GL) ~150 ML/d, 1-2 week duration (Dec, Feb-Mar)			
	Median flow (ML/d)	**Summer**	**Autumn**	**Winter**	**Spring**	**Summer**	**Autumn**	**Winter**	**Spring**	**Summer**	**Autumn**	**Winter**	**Spring**	**Summer**	**Autumn**	**Winter**	**Spring**
		203	157	241	312	246	164	253	284	238	172	262	304	275	177	318	342

The scenario planning for proposed 2023-24 watering actions are outlined in Table 21.

Table 21 Scenario planning for watering actions in the Thomson River over 2023-2024 based on allocation as of 1st March 2023*

		Drought				Dry				Average				Wet			
Estimated allocation volume (GL)		13 -15.1 GL				15.1 -17.2 GL				17 .2 - 19.4 GL				19 – 24.5 GL			
Estimated Carryover (GL)		0.7 GL*				0.7 GL*				0.7 GL*				0.7 GL*			
	Watering action	**Magnitude (ML/d)**	**Frequency**	**Duration (days)**	**Estimated volume (GL)**	**Magnitude**	**Frequency**	**Duration**	**Estimated volume (GL)**	**Magnitude**	**Frequency**	**Duration**	**Estimated volume (GL)**	**Magnitude**	**Frequency**	**Duration**	**Estimated volume (GL)**
Tier 1a Potential Watering Actions	Autumn Fresh (April)	800	1	5	4.9	800	1	7	6.1	800	1	7	5.9	800	1	7	5.9
	Spring Fresh (Oct – Nov)	800	1	5	4.5	800	1	7	5.7	800	1	7	4.4	800	1	7	3.6
	Winter/spring/autumn low flow (July)	125	continuous	31	Typically met by passing flow provisions	125	continuous	continuous	Typically met by passing flow provisions	350	continuous	31	2.7	350	Continuous	31	1
	Winter/spring/autumn low flow (Oct – Nov)	350	1	7	1	350	1	7	1	350	1	7	0.4	350	1	1	0.6
	Winter/spring/autumn low flow (May – June)	230	continuous	45	3.6	230	continuous	45	3.6	300	continuous	61	5.1	350	Continuous	77	12.8
	Summer-autumn Fresh (Dec – Jan)	350	1	7	1	350	1	7	1	350	1	7	0.8	350	1	7	0.5
	Summer-autumn Fresh (Mar)	230	1	7	0.5	230	1	7	0.5	230	1	7	0.5	230	1	7	0.4
	Heyfield Winter-Spring fill (Aug – Sep)	15	1	2 - 3	0.015	15	1	2 - 3	0.015	15	1	2 - 3	0.015	15	1	2 - 3	0.015
	Heyfield Spring-summer top ups (Oct – Dec)	15	>1	1 - 3	0.015	15	>1	1 - 3	0.015	15	>1	1 - 3	0.015	15	>1	1 - 3	0.015
	Heyfield Summer-Autumn top ups (Feb – May)	15	>1	1 - 3	0.015	15	>1	1 - 3	0.015	15	>1	1 - 3	0.015	15	>1	1 - 3	0.015
Tier 1a Est. Water Demand (GL)		**15.6 GL**				**17.9 GL**				**19.8 GL**				**24.8 GL**			

Tier 1b	**Autumn-Winter low flow** - Increase magnitude of flow from 125 ML/d to 300 ML/d, continuous (July) **Autumn fresh** - 800 ML/d, 5 days (May)	**Autumn-Winter low flow** - Increase magnitude of flow from 125 ML/d to 300 ML/d, continuous (July) **Autumn fresh** - 800 ML/d, 7 days (May)	**Autumn-Winter low flow** - Increase magnitude of May – June continuous flow from 300ML/d to 350 ML/d **Autumn fresh** - 800 ML/d, 7 days (May)	**Spring fresh** - 800-900 ML/d, 7 days (Sep)
Tier 1b Est. Water Demand (GL)	**7.7 GL**	**10.6 GL**	**3 - 7.3 GL**	**3.6 GL**
Tier 2	Nil	Nil	Nil	Nil
Tier 2 Est. Water Demand (GL)	**0 GL**	**0 GL**	**0 GL**	**0 GL**
High Priority Carryover Requirements	**0 GL**	**0 GL**	**0 GL**	**0 GL**

4. Macalister River seasonal watering proposal

The following section provides details for the proposed watering actions for the Macalister River 2023-24.

Figure 20 Macalister River looking downstream to Lanigans Bridge

Flow components and considerations

Target reach

The relevant target reach(es) are identified based on the ecological objective. For example, M2 is the target reach for winter freshes peaking at 700ML/d as the ecological objective for this watering action is to trigger downstream migration of tupong and Australian bass. Only this reach has unimpeded connectivity to the coast for this objective to be achieved (reach M1 is separated by Maffra Weir).

Environmental objectives

The ecological objectives and flow recommendations for the lower Macalister River are detailed in the Macalister River Environmental Water Management Plan (Alluvium, 2015). The Macalister River objectives were refined through direct consultation with stakeholders associated with the Macalister River, landholders, urban and rural water suppliers and environmental interest groups through a Project Advisory Group (PAG). Subsequent Traditional Owner guidance on objectives and values is being received from GLaWAC via the Gunaikurnai Cultural Water Team and will be updated in future proposals.

Objectives and values are summarised in Table 22.

Table 22 Macalister River environmental values and objectives, as outlined in the Macalister Flow study.

Symbol	Value	Overarching objective/s
	Fish	Increase the distribution and abundance of Australian Grayling Increase the distribution and abundance of all native fish species Improve spawning and recruitment opportunities for native migratory fish species
	Macroinvertebrates	Increase the abundance and number of functional groups of macroinvertebrates
	Birds, turtles, frogs	Maintain the abundance of frog, turtle, and waterbird communities
	Platypus and rakali	Increase the abundance of platypus and rakali
	Vegetation	Improve native emergent (non-woody) and fringing woody vegetation Re-instate submerged aquatic vegetation
	Geomorphology	Improve physical habitat

Flow Components

The proposed flow regime for the Macalister has been categorised into three components - low flows, freshes and bankfull flows, each of which are important for maintaining ecosystem health, function and processes.

Flow Recommendations

The watering actions evaluated in this proposal are consistent with those outlined in Alluvium (2015), with two major change detailed below:

- **Autumn fresh in M2 to trigger Australian grayling spawning**: the recommended magnitude for this event is 140 ML/d, however irrigation releases are generally of this magnitude during this time. Australian grayling require a rise in flow to commence downstream migration (Koster et al. 2009) and as such, the M1 magnitude for this event (350 ML/d peak) has been adopted. The recommended duration of this event may vary depending on the climatic scenario, but a minimum of six days is recommended before the event begins to ramp down.
- **Summer-Autumn protecting low flows:** Drought conditions in 2018-19 saw reduced passing flows in reach M2, due to reduced inflows to Lake Glenmaggie. With reduced flow and decreasing water quality, a formal variation to use environmental water was required to keep the river flowing and maintain water quality. As such, it is now written into drought scenarios to protect these low flows and avoid catastrophic events such as critical drops in water quality and fish deaths.

Scenario planning and prioritisation

The 2022-23 water year has continued the trend of the previous two water years, with rainfall and river flow being consistently high. In terms of planning scenarios, this has seen most of the 2022-23 water year as falling in the “wet” scenario for management.

Leading into the water year, inflows to Glenmaggie put storage levels above the average volume for that time of year, with Lake Glenmaggie again spilling from the 1st July 2022. Continued inflows and rainfall from July onwards saw increased SRW operational releases to manage the storage levels. SRW, the VEWH and WGCMA communicated regularly prior to and throughout planned spilling events.

At the time of writing this proposal, there have been no environmental flow deliveries in the Macalister for the 2022-23 water year as planned watering actions have been met, and often exceeded via operational releases. This also includes multiple flow events of >3000 ML/d. Three planned deliveries remain for the water year from April through to June (i.e., continuous low flow and 2 freshes), and with drier conditions forecast for the remainder of the water year and no expected spill releases from Lake Glenmaggie, these are still considered a high priority for delivery. Autumn-winter low flows and two freshes are intended to provide connectivity between habitats, fish passage (autumn-winter low flow), and important spawning and migration cues for native fish species in April 2023 (autumn fresh) and May-June 2023 (winter fresh).

Figure 21 illustrates the streamflow in Reach 2 of the Macalister River, from July 2016 through to March 2023. Flow volume recommendations for low flows, low flow freshes and high flow freshes have been included on the hydrograph. Figure 22 illustrates the streamflow in Reach 2 of the Macalister River, from June 2022 through to remaining planned flows in June 2023.

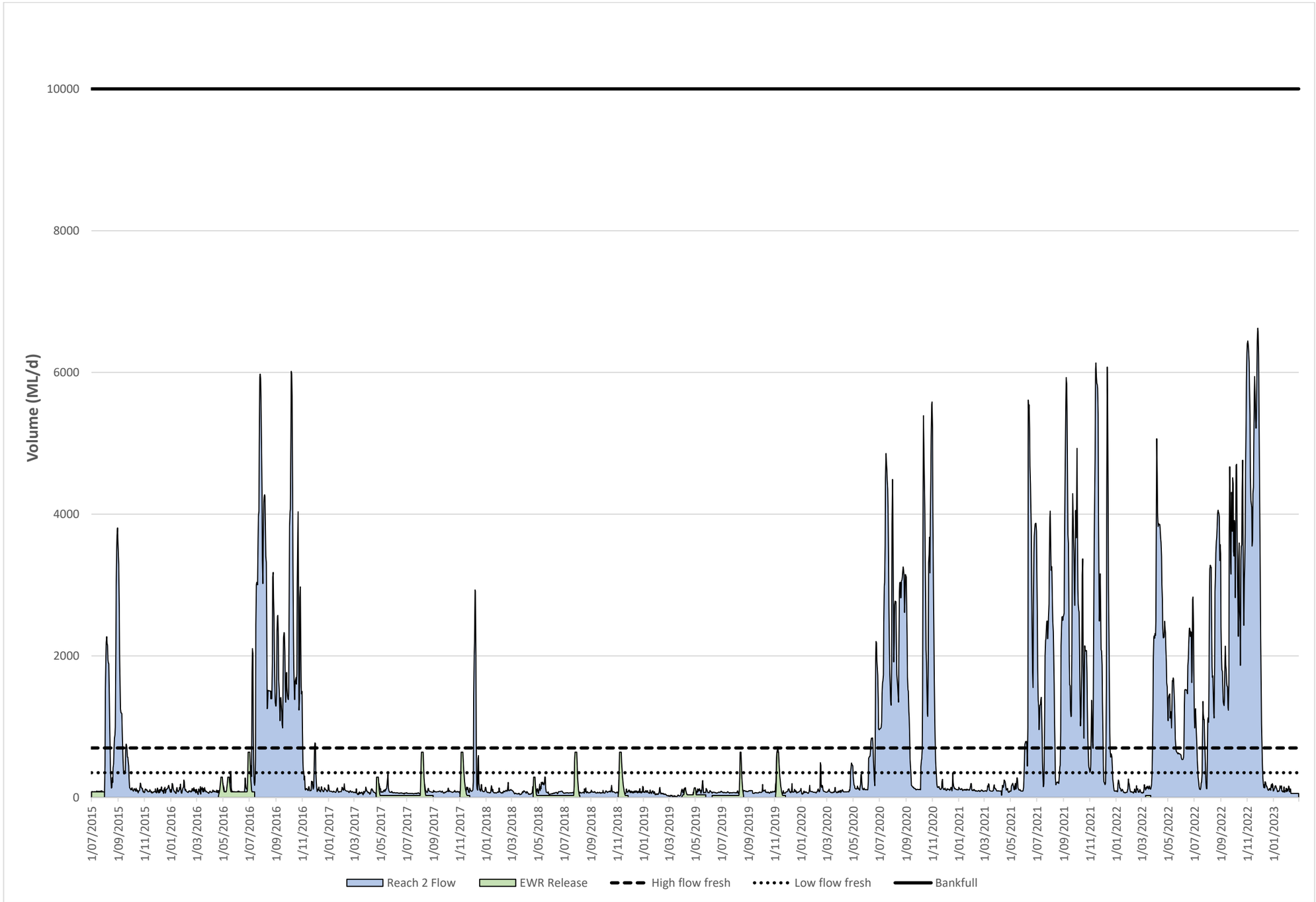


Figure 21 Hydrograph of managed and unmanaged flows occurring in the Macalister River in Reach 2 (Riverslea gauge) from July 2016 – March 2023

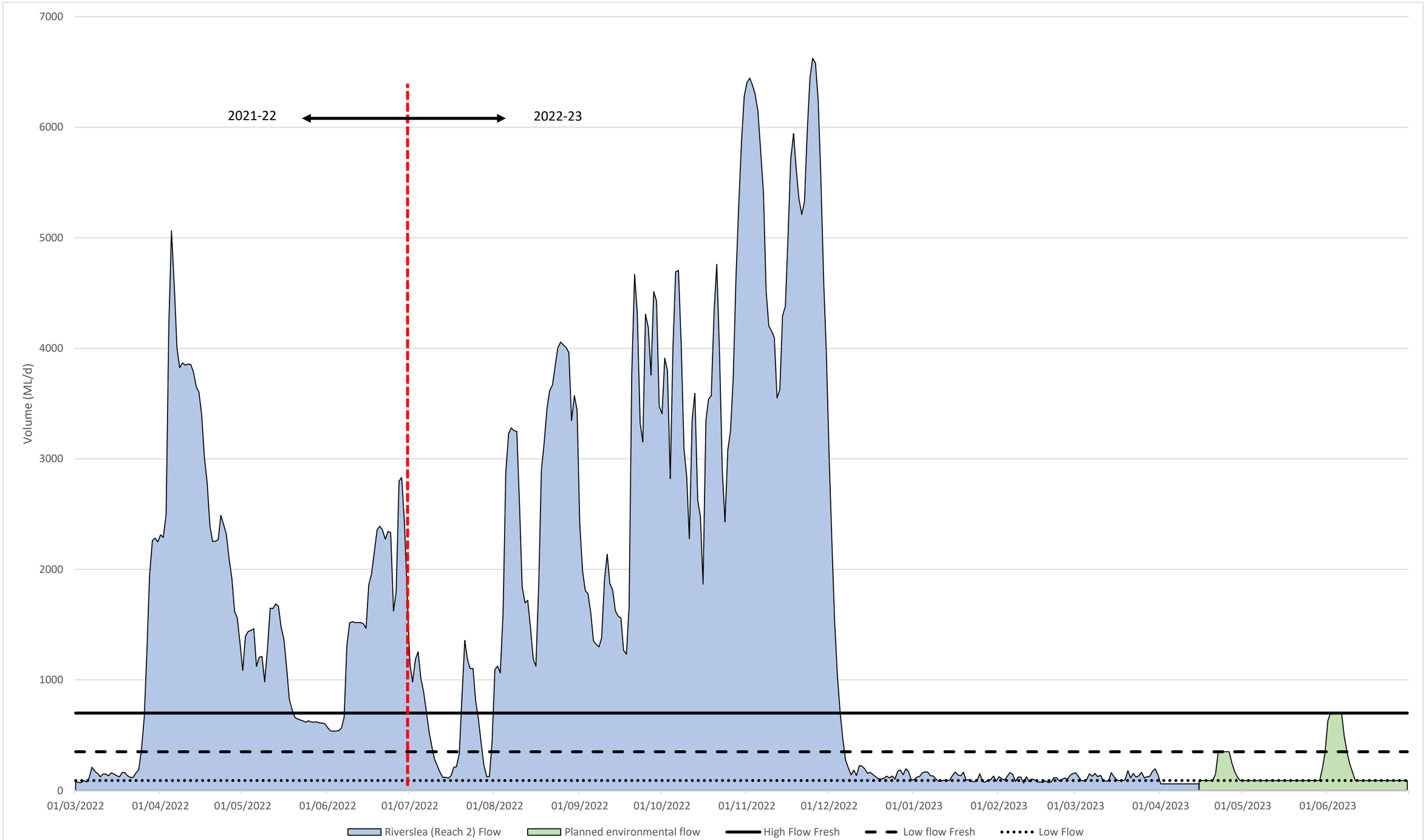


Figure 22 Macalister River streamflow recorded at Riverslea (Reach M2) from March 2022 to June 2023 (includes planned e-flows)

Observations and provision of flow recommendations

Assessment of hydrologic compliance involved assessing the provision of flow events based on a set of specified rules – these rules correspond with the flow recommendations for the Macalister River. The rules include the target magnitude, minimum duration and time of year of each flow event. The compliance table has been updated to reflect the current flow recommendations the past historical flow compliance tables can be found in previous proposals.

Streamflow was assessed at the two hydrologic compliance points in the Macalister River (i.e. D/S of Lake Glenmaggie and Riverslea). Table 23 summarises the results from the Riverslea gauge, indicating the extent to which the flow recommendations specified in the Macalister Environmental Flows Study (Alluvium, 2015) have been delivered via managed and natural flows. This compliance point is of particular interest as it is placed at the end of reach M2, indicating the flow experienced by this reach and receives minimal inflows from other tributaries.

Preliminary Native Fish Report Card monitoring results (Feb 2023) indicated good numbers of Australian Bass and detection of Australian Grayling in the Macalister River.

Survey results from 2022 detected recruitment in Australian Bass and multiple size classes, likely aided by stocking from 2016-2021. Australian Grayling juveniles were detected in 2020 and 2021, pointing towards a successful recruitment event, however no individuals were captured in 2022. Informal field observations from 2023 indicate that grayling were detected, however age and abundance information has not yet been provided. At this stage it is not certain what the impacts of extended spill periods throughout 2021 and 2022 have had on the fish populations of the Macalister River. Further monitoring information is required to identify longer-term population trends and responses to these conditions.

Given this year and previous year's fish survey results in both the Thomson and Macalister, the overarching objective for environmental deliveries will again focus on supporting native fish after good recruitment events.

Table 23 Historical environmental flow compliance in reach M2 of the Macalister River (Riverslea).

Name	Detail	16/17	17/18	18/19	19/20	20/21	21/22	22/23	Ecological outcomes/observations 2022/23
Low flow	All year; 35 ML/d	O	O	O/E	O	O/U	O/U	O/U	These flows were provided, and often exceeded thanks to managed spill and passing flow releases from Lake Glenmaggie.
Autumn-Winter Low flow	Apr-Aug; 35-90 ML/d	U/E	U/E	U/E	U/E	U/E	O/U	O/U/E	This is a planned environmental water delivery. The timing provides continuous connectivity for fauna to access habitat and food resources during the typical filling period for Lake Glenmaggie.
Spring-Summer Low flow	Sep-Dec; up to 90 ML/d	U	U/E	U/E	U/E	O/U	O/U	O/U	These flows were provided, and often exceeded thanks to managed spill and passing flow releases from Lake Glenmaggie.
Winter-Spring Low flow	Jun-Nov; 300 ML/d	U	[1]	[1]	[1]	O/U	O/U	O/U	This flow component was achieved via operational spill releases from Glenmaggie from July 1st through to December.
Summer-Autumn fresh	Dec-May; 140 ML/d; 3 days (or min 20 days in DRT)	U	U	E	U	O/U	O/U	O/U	With flows in the Macalister River being >100 ML/d over December – March, the objectives of this fresh were provided, in that water quality has not been reduced throughout this period. Should this change from March – May, there is still sufficient allocation to allow for an environmental delivery.
Autumn fresh	Apr-May; 350 ML/d; 3 days	E	E	[2]	E	E	O	E	This is a planned environmental water delivery. The timing of this delivery is to trigger downstream migration and spawning of Australian Grayling.
Autumn-Winter fresh	May-Aug; 700 ML/d; 3 days	U/E	E	E	E	E	O	E	This is a planned environmental water delivery. The timing of the delivery provides migration cues for Tupong and Australian Bass.
Spring fresh	Sep-Oct; 700 ML/d; 3 days	U	E	E	E	O/U	O/U	O/U	These flow components were fully achieved and exceeded via operational/unregulated spill releases in September, October, and November. River flows often reached >1000 ML/d for the majority of September. In October-November River the majority of flows were >2000 ML/d, peaking at 6600ML/d in late November.
Spring-Summer fresh	Sep-Dec; 700 ML/d; 3 days	U	E	E	E	O/U	O/U	O/U	
Spring-Summer fresh	Sep-Dec; 1500 ML/d; 3 days	U	U	[3]	U/E	O/U	O/U	O/U	
Fresh	Anytime; 1500 ML/d; 3 days	U	U	[3]	U/E	O/U	O/U	O/U	
Bankfull	Anytime; 10,000 ML/d; 1 day	U	[4]	[4]	[4]	O/U	O/U	O/U	No bankfull events of 10,000 ML/d have occurred to date, and this event is unlikely to occur in the remainder of the water year. This flow component was partially achieved throughout the year, with multiple operational spill release events exceeding 4000 ML/d throughout September – November.

Key
Fully achieved
Partially achieved
Not achieved
Planned delivery
E
O
U

Footnotes

*Note: This assessment is as of 6th March 2023

[1]This flow event is not currently deliverable through managed environmental releases as its requirements far exceed the current entitlement volume.

[2]This event was not delivered in 2018-19 due to ongoing drought conditions. A small freshening flow of 140 ML/d was delivered in late April to maintain river water quality

[3]This event was not met by unregulated flows in 2018-19 due to drought conditions

[4]Bankfull events may only be provided by unregulated flows, due to flooding risks

Potential watering actions

The potential watering actions in this proposal (listed in Table 24) are adopted from the recommendations and learnings articulated from the Macalister River Environmental Flows Study (Alluvium, 2015), the draft Macalister River Environmental Water Management Plan (WGCMA, 2022) and the Macalister Shortfalls Report (Alluvium, 2019). Priorities were determined based on the hydrologic compliance assessment, latest known condition of the target ecological value, likelihood to achieve the desired flow function and the potential for other flows to provide the event (e.g., consumptive water delivery, storage spills).

The relevant target reach(es) are identified based on the ecological objective. For example, M2 is the target reach for winter freshes peaking at 700ML/d as the ecological objective for this watering action is to trigger downstream migration of tupong and Australian bass. Only this reach has unimpeded connectivity to the coast for this objective to be achieved (reach M1 is separated by Maffra Weir).

As the Latrobe, Thomson and Macalister all contribute to flows in the estuary (and the lower Latrobe wetlands), there are times when high flow releases for river objectives across all systems can be delivered in a coordinated approach to have benefits for both the river systems and the estuary. Releases from the Macalister will at times assist in meeting these flow recommendations, where climatic conditions, timings and other constraints allow. Where flows have benefits for the estuary and/or lower Latrobe wetlands, this has been included in the rationale for priority watering actions.

Table 24 Priority watering actions in the Macalister River for 2023-24.

Macalister River – Site Details	
Environmental Watering Reach	The relevant target reach(es) are identified based on the ecological objective. For example, **M2** is the target reach for winter freshes peaking at 700ML/d as the ecological objective for this watering action is to trigger downstream migration of tupong and Australian bass. Only this reach has unimpeded connectivity to the coast for this objective to be achieved (reach **M1** is separated by Maffra Weir).
Measurement Point	**M1:** Macalister River @ D/S Lake Glenmaggie (#225204D) **M2:** Macalister River @ Riverslea (#225247)

Potential Watering Action	***Expected Watering Effects***	***Environmental Objectives***	***2023-24 Flow Details***	***2023-24 Rationale***	***Priority (H/M/L)***
Autumn-winter low flow **60-90 ML/d continuous (Mar – Aug)** Proposed deliveries: 60 – 90 ML/d (July – mid-August) 90 ML/d (Mar – June)	Provide hydraulic habitat through sufficient water depth in pools Provide fish passage for local movement through minimum depth over riffles	 Increase the distribution and abundance of all native **fish** species, and increase opportunities for the spawning and recruitment of native migratory fish (such as Australian grayling)	Flow priority the same across each scenario (drought-dry-average-wet) **Drought scenario: ~**60 days <u>60 ML/d magnitude (July-mid-Aug)</u> <u>90 ML/d (April-June)</u> **Dry scenario: ~**105 days <u>90 ML/d (July-mid-Aug)</u> <u>90 ML/d (April-June)</u> **Average-Wet scenario:** 110 – 145 days <u>90 ML/d (July-mid-Aug)</u> <u>90 ML/d (March – June)</u>	At a catchment/connected rivers scale, the Thomson 2023 fish surveys indicate high numbers of Tupong in the system. Provision of baseflows allows continued migration, dispersal and survival of these and other migratory species. For reach **M1**, this flow provides complete longitudinal connectivity, allowing aquatic fauna to move between different habitats to access refuge areas and food sources. Such connectivity is routinely provided through consumptive water deliveries during the irrigation season, and if Lake Glenmaggie spills. However, this connectivity is not continuous throughout the reservoir filling period (autumn to early winter). Providing this baseflow may also provide additional benefit if provided in conjunction with an autumn fresh, as it provides continuous fish passage for migratory species completing (i.e. Australian Grayling) or about to complete (i.e. Tupong, Australian Bass) migration in reach **M2**.	**H**
	Provide permanent wetted habitat through minimum water depth in pools	 Increase the abundance and number of functional groups of waterbugs			
	Provide longitudinal connectivity for local movement, protection from predation, access to food sources and to maintain refuge habitats	 Increase the abundance of platypus and rakali (water rats)			

Potential Watering Action	***Expected Watering Effects***	***Environmental Objectives***	***2023-24 Flow Details***	***2023-24 Rationale***	***Priority (H/M/L)***
Spring-summer low flow **M1 & M2:** **60 - 90 ML/d continuous (Sep – Jan)** Proposed partial delivery in drought-average scenarios: **90 ML/d, 7-14 days following spring fresh (Nov)**	Provide hydraulic habitat through sufficient water depth in pools Provide fish passage for local movement through minimum depth over riffles	 Increase the distribution and abundance of all native **fish** species, and increase opportunities for the spawning and recruitment of native migratory fish (such as Australian grayling)	**Drought-Dry scenario:** <u>90 ML/d for 7 days after the spring fresh</u> Sep – Jan 60-90 ML/d is typically covered by provision of passing flows **Average scenario**: <u>90 ML/d for 14 days after the spring fresh</u> Sep – Jan 60-90 ML/d is typically covered by provision of passing flows **Wet scenario:** <u>90 ML/d for 14 days after the spring fresh</u> <u>90ML/d, continuous (Dec – Jan)</u>	For reach **M1**, this flow provides complete longitudinal connectivity, allowing for aquatic biota to move between different habitats Providing this flow may also provide additional benefit if provided in conjunction with a spring fresh, as it provides fish passage for migratory species completing or about to complete migration in reach **M2**. At a catchment/connected rivers scale, the 2023 fish surveys in the Thomson River have detected high numbers of Tupong. Provision of these low flows allows continued migration, dispersal and survival.	**H**
	Provide permanent wetted habitat through minimum water depth in pools	 Increase the abundance and number of functional groups of macroinvertebrates			
	Provide longitudinal connectivity for local movement, protection from predation, access to food sources and to maintain refuge habitats	 Increase the abundance of platypus and rakali			

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2023-24 Flow Details*	*2023-24 Rationale*	*Priority (H/M/L)*
Autumn fresh 350 ML/d, 5 days (April – May)	**M2:** Delivers a trigger for downstream migration and spawning of Australian grayling.		Increase the distribution and abundance of all native **fish** species, and increase opportunities for the spawning and recruitment of native migratory fish (such as Australian grayling)	Flow delivery the same across each scenario (**drought-dry-average-wet**) This flow is likely to be scheduled for late April-early May 2024, coinciding with an Autumn fresh in the Thomson River – which provides secondary benefits to the upper Thomson estuary.	At a catchment/connected rivers scale, the 2023 fish surveys in the Thomson River have detected high numbers of Tupong. Provision of these low flows allows continued migration, dispersal and survival. Native Fish Report Card surveys (Feb 2023) captured Australian Grayling in the Macalister River, below Lake Glenmaggie (further species and abundance data was not available at the time of writing). As grayling are an EPBC listed species and regarded a significant value in the Thomson and Macalister, it is a high priority to deliver flows in 2023-24 that support their migration, spawning and recruitment.	**H**

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2023-24 Flow Details*	*2023-24 Rationale*	*Priority (H/M/L)*
Spring Fresh 700 ML/d, 5 days (Sep – Nov)	Provide flows cues through increases to water depth to promote upstream migration of adult anadromous species (e.g. short-headed lamprey), and recruitment of juvenile catadromous (e.g. tupong, common galaxias, Australian bass, short and long-finned eels) and amphidromous species (e.g. Australian grayling)		Increase the distribution and abundance of all native **fish** species, and increase opportunities for the spawning and recruitment of native migratory fish (such as Australian grayling)	Flow delivery the same across each scenario (**drought-dry-average-wet**) Proposed flow delivery in late October – early November. Where possible, delivery of this fresh will be timed to coincide with flows in the Latrobe and Thomson which provides secondary benefits to the upper Thomson estuary.	The objective of this flow is to promote the upstream migration of adult and juvenile migratory fish species. It also provides some wetting of fringing woody vegetation. The provision of this fresh, particularly when timed to coincide with freshening flows in the Thomson will also provide flushing flows to the Upper Thomson estuary. This will improve water quality by displacing the salt wedge and contribute freshwater flows to the lower Latrobe wetlands.	**H**
	Inundate a greater area of stream channel (increasing water depth) to limit terrestrial vegetation encroachment Inundate low benches to provide water level variability and facilitate longitudinal dispersal of emergent vegetation Inundate mid-level benches to provide water level variability for fringing vegetation		Improve native emergent (non-woody) and fringing (woody) vegetation in the streamside zone			

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2023-24 Flow Details*	*2023-24 Rationale*	*Priority (H/M/L)*
Winter Fresh 700 ML/d, 5 days (May – Aug)	Provide flows cues through increases to water depth to promote downstream migration and spawning for tupong and Australian bass, and another opportunity for Australian grayling		Increase the distribution and abundance of all native **fish** species, and increase opportunities for the spawning and recruitment of native migratory fish (such as Australian grayling)	Flow delivery will be the same across the **Dry-Average-Wet scenario**: In a **drought scenario** this flow would not be considered a high priority delivery, particularly if providing the flow threatened the ability to deliver other priority flows.	For reach **M2**, the objective of this flow is to provide a flow trigger for the downstream migration of fish species, such as Tupong and Australian bass. At a catchment/connected rivers scale, the 2023 fish surveys in the Thomson River have detected high numbers of Tupong. Provision of these low flows allows continued migration, dispersal and survival. Providing flows that encourage spawning of these species is important for maintaining and improving the native fish population in both the Macalister and the Thomson. The timing of this flow coincides with the filling period for Lake Glenmaggie, so the majority of upper catchment river inflows are harvested. The provision of this fresh, particularly when timed to coincide with freshening flows in the Thomson will also provide flushing flows to the Upper Thomson estuary. This will improve water quality by displacing the salt wedge and contribute freshwater flows to the lower Latrobe wetlands.	**H**
	Flush pools to improve water quality Increase wetted area to provide habitat		Increase the abundance and number of functional groups of macroinvertebrates			
	Inundate a greater area of stream channel (increasing water depth) to limit terrestrial vegetation encroachment Inundate low benches to provide water level variability and facilitate longitudinal dispersal of emergent vegetation Inundate mid-level benches to provide water level variability for fringing vegetation		Improve native emergent (non-woody) and fringing (woody) vegetation in the streamside zone			

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2023-24 Flow Details*	*2023-24 Rationale*	*Priority (H/M/L)*
Summer-autumn freshening pulse, 140 ML/d (Dec – Mar)	Maintain a minimum depth in pools to allow for turnover of water and slow potential water quality degradation Flush pools to improve water quality Provide flows with sufficient shear stress to flush fine sediment from interstices to improve geomorphic habitat		Improve and maintain the form of the riverbank and bed to provide physical habitat for aquatic animals and plants	**Dry-Average-Wet Scenario:** <u>3 x 140 ML/d pulses, 3 day duration</u> ***In an average-wet scenario** this is regarded as a "M" priority	The objective of this flow in a **<u>dry to wet scenario</u>** is to provide opportunities for biota to move between refuges, and to maintain or improve the condition of available refuges (e.g. by flushing stagnant water and improving water quality). Maintaining access to in-stream refuge habitat is important for native fish species, particularly some of the small-bodied non-migratory species that only breed on the large-scale flood events.	**M**
	Inundate low benches to provide water level variability and facilitate longitudinal dispersal of emergent vegetation		Improve native emergent (non-woody) and fringing woody vegetation Re-instate submerged aquatic vegetation			
	Flush pools to improve water quality Increase wetted area to provide increased wetted habitat		Increase the abundance and number of functional groups of macroinvertebrates			
	Provide hydraulic habitat through sufficient water depth in pools Provide fish passage for local movement through minimum depth over riffles		Increase the distribution and abundance of all native **fish** species, and increase opportunities for the spawning and recruitment of native migratory fish (such as Australian grayling)			

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2023-24 Flow Details*	*2023-24 Rationale*	*Priority (H/M/L)*
Summer-autumn water quality low flow, 140 ML/d (Dec – Mar) ***trigger-based (when passing flows drop below 60 ML/d and WQ is likely to be compromised**	Maintain a minimum depth in pools to allow for turnover of water and slow potential water quality degradation Flush pools to improve water quality Provide flows with sufficient shear stress to flush fine sediment from interstices to improve geomorphic habitat		Improve and maintain the form of the riverbank and bed to provide physical habitat for aquatic animals and plants	**Drought Scenario:** <u>40 ML/d baseflow (5-13 days) with a 3-day 140 ML/d pulse</u> ***In a drought scenario this flow would be considered a "H" priority**	At time of assessment, it is considered low likelihood that allocations and climatic conditions in 2023-24 will trigger the delivery of this flow. The objective of this flow is to provide opportunities for biota to move between refuges, and to maintain or improve the condition of available refuges. In a drought-dry scenario the intention is to protect assets and reduce the likelihood of a catastrophic water quality event. In a **<u>drought scenario</u>**, there is an increased likelihood of passing flow volumes from Lake Glenmaggie being reduced to match inflow volumes (i.e. when inflows fall below 60 ML/d) increases. Depending on timing and duration this may compromise water quality and impact on aquatic fauna.	**L**
	Inundate low benches to provide water level variability and facilitate longitudinal dispersal of emergent vegetation		Reinstate submerged aquatic vegetation			
	Flush pools to improve water quality Increase wetted area to provide increased wetted habitat		Increase the abundance and number of functional groups of macroinvertebrates			
	Provide hydraulic habitat through sufficient water depth in pools Provide fish passage for local movement through minimum depth over riffles		Increase the distribution and abundance of all native **fish** species, and increase opportunities for the spawning and recruitment of native migratory fish (such as Australian grayling)			

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2023-24 Flow Details*	*2023-24 Rationale*	*Priority (H/M/L)*
Spring fresh 1500 ML/d, minimum 3 days (Sep – Oct)	Inundate a greater area of stream channel to limit terrestrial vegetation encroachment Inundate low benches to provide water level variability and facilitate longitudinal dispersal of emergent vegetation Inundate mid-level benches to provide water level variability for fringing vegetation Inundate higher benches to provide water level variability for fringing woody vegetation		Improve native emergent (non-woody) and fringing (woody) vegetation in the streamside zone (**M1**: wetting intact riparian vegetation, in particular tea tree and paperbark)	**<u>Average-Wet Scenario only</u>**: Spring freshes can potentially be provided during the storage spill season, however the duration and shape of these events many not meet the target flow volumes and durations required for fringing vegetation species in **M1**. Provision of this flow can be achieved in small spill years (i.e. <4000 ML/d), by augmenting/piggy-backing the spill volume with an environmental release.	With multiple years of Lake Glenmaggie spilling and exceeding this flow magnitude and duration, this flow is considered a low priority for delivery in 2023-24. If piggybacking a spill were an option, this flow could be delivered in place of the 700 ML/d Spring fresh. This flow would also have benefits for the Upper Thomson estuary and Lower Latrobe wetlands, providing a full flush. To provide these flows with environmental water alone would create shortfalls in other possible deliveries, so they are not currently considered a high priority watering action (i.e. this flow is only to be delivered if an operational release event occurs).	**L**
	M2: Provide flows with sufficient shear stress to enable scouring of biofilms and other food sources and prevent accumulation of fine sediment		Increase the abundance and number of functional groups of macroinvertebrates			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2023-24 Flow Details	2023-24 Rationale	Priority (H/M/L)
	M2: Inundate higher benches to move organic material into the channel to provide habitat and food sources					
	Provide flows cues through increases to water depth to promote upstream migration of adult anadromous species (e.g. short-headed lamprey), and recruitment of juvenile catadromous (e.g. tupong, common galaxias, Australian bass, short and long-finned eels) and amphidromous species (e.g. Australian grayling)		Increase the distribution and abundance of all native **fish** species, and increase opportunities for the spawning and recruitment of native migratory fish (such as Australian grayling)			
	Improve physical habitat		Improve and maintain the form of the riverbank and bed to provide physical habitat for aquatic animals and plants			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2023-24 Flow Details	2023-24 Rationale	Priority (H/M/L)
Summer-Autumn low flow 35 – 90 ML/d continuous (Dec – May)	Maintain a minimum depth in pools to allow for turnover of water and slow water quality degradation Expose and dry lower channel features for re-oxygenation		Improve and maintain the form of the riverbank and bed to provide physical habitat for aquatic animals and plants	**Average-Wet Scenario:** Passing flows in the Macalister (60 ML/d) provide this baseflow requirement in both reaches. As such delivery is not planned. **Drought-Dry:** To provide these flows in their entirety with environmental water alone would likely exceed the EE or create shortfalls in other possible deliveries. Should baseflows be required, the Summer-Autumn pulse PWA will be delivered	In **average and wet scenarios**, passing flows (60 ML/d) would typically provide this flow component in **M2**.	**L**
	Provide flows with low water velocity and appropriate depth and to improve water clarity and enable establishment of in-stream vegetation		Reinstate submerged aquatic vegetation			
	Provide longitudinal connectivity for local movement, protection from predation, access to food sources and to maintain refuge habitats		Increase the abundance of platypus and rakali			
	Provide hydraulic habitat through sufficient water depth in pools Provide fish passage for local movement through minimum depth over riffles		Increase the distribution and abundance of all native **fish** species, and increase opportunities for the spawning and recruitment of native migratory fish (such as Australian grayling)			

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2023-24 Flow Details*	*2023-24 Rationale*	*Priority (H/M/L)*
Spring-Summer Fresh 2500 ML/d, 3 days (Sep – Dec)	Inundate higher benches to move organic material into the channel to provide habitat and food sources		Increase the abundance and number of functional groups of macroinvertebrates	**<u>Wet Scenario only</u>**: Freshes can potentially be provided during the storage spill season. Provision of this flow can be achieved in small spill years (i.e. <4000 ML/d), by augmenting/piggy-backing the spill volume with an environmental release.	Although considered an important flow ecologically for the river and the upper Thomson estuary, providing this flow would require a significant volume and precludes the ability to release other priority watering actions in an average climate scenario. Spill releases from Lake Glenmaggie over 2020, 2021 and 2022 have provided magnitudes that meet the desired objective in reach **M1**, and as such delivery of this event is not considered a priority.	**L**
	Inundate higher benches to provide water level variability for fringing woody vegetation		Improve native emergent (non-woody) and fringing (woody) vegetation in the streamside zone			

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2023-24 Flow Details*	*2023-24 Rationale*	*Priority (H/M/L)*
Fresh, anytime 3000 ML/d, 1 day	Provide flows with sufficient shear stress to enable scouring of biofilms and other food sources and prevent accumulation of fine sediment		Increase the abundance and number of functional groups of macroinvertebrates	**<u>Average-Wet Scenario only</u>**: Freshes can potentially be provided during the storage spill season. Provision of this flow can be achieved in small spill years (i.e. <4000 ML/d), by augmenting/piggy-backing the spill volume with an environmental release.	Spill release from Lake Glenmaggie in 2020, 2021 and 2022 have achieved this magnitude for short durations and naturally provided for the desired objectives of reach **M1**, and so this flow is not considered a high priority to deliver. Although considered an ecologically important flow for the river and the Upper Thomson estuary, providing this fresh would require a large proportion of the entitlement and preclude the ability to release other priority watering actions. The delivery of this event is not considered an effective use of the environmental entitlement given current volumetric constraints.	**L**
	Provide flows with sufficient shear stress to flush fine sediment from interstices to improve geomorphic habitat		Improve and maintain the form of the riverbank and bed to provide physical habitat for aquatic animals and plants			

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2023-24 Flow Details*	*2023-24 Rationale*	*Priority (H/M/L)*
Spring low flow 300 ML/d, continuous (June – Nov)	Provide fish passage for local movement		Increase the distribution and abundance of all native **fish** species, and increase opportunities for the spawning and recruitment of native migratory fish (such as Australian grayling)	In a **dry-drought** and **potentially average scenario** (depending on volume), this flow will not be delivered. In a **wet scenario**, there may be an opportunity to increase baseflows throughout the winter and spring months If Lake Glenmaggie does spill, and carryover is "lost" from the account, it may mean there is insufficient water to sustain baseflows for extended periods	Ongoing spills from Lake Glenmaggie over 2021 and 2022 have provided this flow in previous water years. Although considered an ecologically important flow for both the river and the Upper Thomson estuary, providing the minimum duration of this baseflow needs to exceed 120 days to achieve partial objectives for reducing vegetation encroachment, which would still require a volume over and above the current entitlement.	**L**
	Provide permanent wetted habitat in pools		Increase the abundance and number of functional groups of macroinvertebrates			
	Provide sustained wetting of low-level benches (increasing water depth) to limit terrestrial vegetation encroachment		Improve and maintain the form of the riverbank and bed to provide physical habitat for aquatic animals and plants			

Delivery constraints

Releases during irrigation season

Watering actions that occur during the irrigation season (i.e., mid-August to mid-May), will compete for outlet capacity with irrigation demand. This is particularly the case during the spring/summer season in a drought/dry scenario during which irrigation demand will be high. Whilst the releases of low flows may be provided simultaneously with irrigation orders, SRW have trouble releasing freshes (>700 ML/d) whilst simultaneously meeting irrigation demand. Additionally, releases prior to storage spills are also considered a sensitive issue for the district, as watering releases may reduce the probability of Lake Glenmaggie spilling. A spill bestows significant benefits to consumptive water users through the provision of spill entitlement.

To strike the balance between watering and meeting irrigation demands; the WGCMA and SRW will work together ahead of time (i.e., well in advance of when the watering action is due to be delivered), to work out different scenarios that work best to meet both consumptive and environmental needs. If an environmental watering action is to be delivered during this time, the Macalister Customer Consultative Committee should be engaged prior to the release to convey the collaborative process and the purpose of the release.

The main constraints and issues associated with delivery of the high priority watering actions in the Macalister River are described in Table 25.

Table 25 Constraints associated with effective environmental water delivery for the Macalister River

Constraint	Description	Implications for environmental watering
Outlet capacity constraints	Flow releases from Glenmaggie weir can be made through the hydropower plant or the environmental offtake on the northern irrigation channel. Both have capacity constraints. The capacity at the hydropower gate is limited by the volume of water in the weir due to changes in head pressure. Releases from the environmental offtake are limited in the northern channel as a large volume of irrigation orders will reduce the outlet capacity share available for environmental water. To deliver watering actions ≥ 1500 ML/d, the reservoir needs to be a minimum of 119 GL, so that the storage can physically deliver such an event	Environmental watering events planned for release within the irrigation season (i.e., spring and summer freshes) may not be released if large irrigation orders overlap with the release timing. To deliver watering events during the irrigation season, the CMA should work through different scenarios with SRW to optimise the timing of the event with irrigation orders and storage spills. Providing the storage operator flexibility on the timing of the environmental water release (within ecologically appropriate timeframes) will ensure that environmental watering events are still delivered within the irrigation season. Watering events > 1500 ML/d are only planned to piggyback with Lake Glenmaggie spilling. Outside of this instance, all other freshes peak at 700 ML/d

Constraint	Description	Implications for environmental watering
		Piggybacking off Lake Glenmaggie spills will mean notice of a potential release < 1 week; the CMA will need to be ready for such an event (in terms of notifications etc)
Maffra weir filling	SRW will also be gradually filling Maffra Weir during the last week of July 2023 in preparation for the irrigation season	The WGCMA will need to work with SRW to plan the timing of 2023 winter freshes. Winter freshes planned in July/Aug should be timed on either end of the Maffra Weir filling period – timing will be co-ordinated with SRW as a potential piggybacking event
Fish barrier at Maffra weir	Maffra Weir is operational for nine months of the year and is a fish barrier that inhibits movement of fish species into and out of M1 during this time. The presence of a low-level stream gauge weir downstream of Maffra weir is only drowned out during high flows (flows approx. >1300 ML/d). Funding for a finalised designs and building of a fishway have been announced, however the barrier will still be present for this water year.	Priority watering actions for this system are focussed on the restoration of fish populations – watering actions with fish migration objectives are currently focussed entirely on M2 due to the presence of this barrier Lack of fish passage at this weir reduces the effectiveness of low flows that provide a continuous period of longitudinal connectivity The barrier also limits ability of fish downstream of Maffra Weir from recruiting into M1 which contains higher quality in-stream habitat to increase chances of survival
High reliability and low reliability water allocations	There are two key allocation announcements throughout the water year; July - HRWS, December - remaining HRWS. Following this, allocations are reviewed fortnightly with LRWS provided depending on inflows into Lake Glenmaggie. During this time the climate scenario may change from a wet winter/spring to a dry summer/autumn, impacting on the LRWS allocations. As the highest priority watering actions occur later in the year (i.e., autumn and winter), they are reliant on the provision of the LRWS	If, during the water year, the climate changes from wet winter/spring to average or dry summer/autumn, there will be insufficient water to deliver both the autumn fresh and the autumn-winter low flow to completion. The seasonal outlook forecast will be monitored regularly to assess the appropriateness of flow priorities
Maffra weir gate operations	From mid-August to mid-May, Maffra weir's gates are in operation and open and close in a way to maintain a stable weir pool height The opening and closing of the gates occur throughout the day, resulting in fluctuating water levels during the release of flows > 600 ML/d	The fluctuation of water levels impacts on the delivery of watering events > 600 ML/d These impacts are during the irrigation season from late July 2023 to 1 May 2024 when the weir gates are closed. Although the effectiveness of these freshes is compromised, fish ecologists from ARI have

Constraint	Description	Implications for environmental watering
		recommended that fish will still sporadically move with increases in water level. Deliveries of watering events < 600 ML/d during irrigation season will not be impacted, as they will be passed through the bypass which offers greater stability in flow delivery

Triggers for action

In administering the environmental water reserve for the Macalister River, the West Gippsland Catchment Management Authority use several decision support tools:

- Data and reports from monitoring programs within the systems
- Latest scientific knowledge/understanding relevant to the systems
- System understanding and emerging issues
- Climatic predictions
- Flow modelling and scenario evaluation tool
- Ecological condition
- Historical environmental flow compliance
- Entitlement allocation

This information is used to determine the current and predicted watering operation scenario and flow deliveries for the systems throughout the watering year. Implementation of watering actions will be undertaken collaboratively with Southern Rural Water (SRW), such that events are delivered within the appropriate time frame.

Given the population dynamics of migratory fish species in the region, the broader fish population will have benefited from recent high flows and flooding across Gippsland. Providing continued opportunities for migration, spawning and recruitment in the Thomson, Macalister and Latrobe rivers will be a priority to support the native fish population and to increase the likelihood of survival for new recruits (i.e., young-of-year) under all climate scenarios.

Releases will be determined based on water availability, and seasonal conditions.

There are two key allocation announcements throughout the year:

1. In July, High Reliability Water Share (HRWS) allocations are announced with a maximum allocation of up to 100% depending on availability of water stored in the Thomson drought Reserve.
2. December 15th HRWS allocations are reviewed, due to the end of the spilling period with a maximum allocation of 100%.

After the Dec 15th announcement, allocation is reviewed fortnightly. Once 100% HRWS is reached and water is paid back to the Thomson Drought Reserve (should it have been used due to dry conditions in previous year), further inflows into Lake Glenmaggie may lead to an announcement of LRWS with a maximum allocation of 100% i.e. a wet year.

Ecological objective evaluation

Ecological objectives may be met by natural flows, thereby negating, or lessening the requirement to release water. For example, a spawning flow event for Australian grayling is best timed between late April and mid-May. If an event occurs at the end of April under a dry scenario no release will be required, however under a wet scenario a release in May could be undertaken. Or, if there have been several high flow freshes in winter, this water may be used to release an additional autumn fresh.

Allocation of Entitlement

Ability to deliver flows is dependent on the availability of water held in storage. This proposal has been developed so all flow components specified can be achieved by the predicted volumes in storage for each scenario.

However, storage spills, emergency releases in cases of very poor water quality, qualification of rights, significant water shortages, or other factors may result in a shortfall of environmental water to meet all flow components. When water availability is unexpectedly reduced the volume required to meet priority flow components will be recalculated against projected allocations to identify any shortfalls. Flows under each scenario have been listed in order of priority so any shortfall will result in the lowest priority flow event not being delivered.

Scenario planning

Four scenarios have been identified for the Macalister River: drought, dry, average, and wet. In 2023, these scenarios were reviewed and updated to provide consistency in approach across the four WGCMA managed environmental entitlements, and to reflect best practice more broadly. From this review the following indicators, summarised in Table 26, have been incorporated into each of the planning scenarios for the Macalister River.

The 2023-24 potential watering actions under each scenario are shown in Table 27. Watering actions are divided into categories, Tier 1 and Tier 2 as outlined by the Victorian Environmental Water Holder Seasonal Watering Proposal Guidelines (VEWH, 2022).

Tier 1 watering actions are identified as being required under specific planning scenarios this year given current environmental conditions. Tier 1a priorities are watering actions that are proposed for delivery (whether partially or fully) with predicted supply under each climate scenario. Tier 1b priorities are those watering actions which are considered important but are not expected to be delivered with the estimated allocation. Tier 2 watering actions are those not prioritised for delivery this year to achieve intended environmental objectives but are needed on occasion to meet long-term condition outcomes.

Table 26 Climate scenario summary for the Macalister River

		Drought		Dry	Average	Wet
Environmental Objectives		**PROTECT**		**MAINTAIN**	**RECOVER**	**ENHANCE**
Expected River Conditions	**Lake Glenmaggie inflow POE (%)**	≥90%		66-90%	33-66%	≤33%
	Lake Glenmaggie inflow (GL/yr)	**Min**	57%	103%	118%	136%
		Average	83%	113%	126%	155%
		Max	103%	118%	136%	200%
	Passing Flows	Likely reduced passing flow volumes based on inflows: 35-60 ML/d or natural (as per the Bulk Entitlement Rules)		Likely reduced passing flow volumes based on inflows: 35-60 ML/d or natural (as per the Bulk Entitlement Rules)	Passing flows 60 ML/d	Passing flows 60 ML/d
	Unregulated Flows	No unregulated flows		Low likelihood of reservoir spill/s, volume dependent on rainfall; up to minor flood level Spills most likely in to occur in winter/spring	Reservoir spill/s in spring likely, volume dependent on rainfall; minor to moderate flood level Spills most likely in to occur in winter/spring	Reservoir spill/s likely anytime during the spill period, volume dependent on rainfall; moderate to major flood level
	Consumptive Water	Low consumptive water delivery throughout the irrigation season (15 Aug – 15 May) – most of this water diverted downstream of Maffra Weir. Water availability a likely constraint on irrigation deliveries.		High consumptive water delivery from late spring (post-spill period) to end of irrigation season, predominantly during the warmer months – most of this water diverted downstream of Maffra Weir	Moderate to high consumptive water delivery from later spring (post-spill period) to end of the irrigation season, predominantly during the warmer months – most of this water diverted downstream of Maffra Weir	Low demand for consumptive water delivery from late spring (post-spill period) to end of irrigation season. Rainfall likely to reduce the need for irrigation deliveries.

Median flow (ML/d)	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring
	78	62	89	82	129	88	114	167	104	84	190	653	95	97	252	827

Table 27 Scenario planning for watering actions in the Macalister River over 2023-2024 based on HRWS allocation of 100% and LRWS allocation of 20% as of 1st March 2023*. Note: M1 = reach 1, M2 = reach 2.

		Drought				Dry				Average				Wet			
Estimated allocation volume (GL)		85% HRWS 0% LRWS 10.6 GL				100% HRWS 15% LRWS 13.4 GL				100% HRWS 30% LRWS 14.3 GL				100% HRWS 100% LRWS 18.7 GL			
Estimated Carryover (GL)		4.9 GL*				4.9 GL*				4.9 GL*				4.9 GL*			
	Watering action	**Magnitude (ML/d)**	**Frequency**	**Duration (days)**	**Estimated volume (GL)**	**Magnitude**	**Frequency**	**Duration**	**Estimated volume (GL)**	**Magnitude**	**Frequency**	**Duration**	**Estimated volume (GL)**	**Magnitude**	**Frequency**	**Duration**	**Estimated volume (GL)**
Tier 1a Potential Watering Actions	Autumn-winter low flow (July – Aug)	35 – 60	Continuous	45	Typically met by passing flow provision	90	Continuous	45	1.4	90	Continuous	45	1.4	90	Continuous	45	1.4
	Autumn-winter low flow (March – June)	90	Continuous	60	2.2	90	Continuous	60	1.8	90	Continuous	84	2.5	90	Continuous	99	2.9
	Spring-summer low flow (Nov)	90	1	7	0.2	90	1	7	0.2	90	1	14	0.4	90	1	14	0.4
	Autumn Fresh (April)	350	1	5	1.9	350	1	5	1.9	350	1	5	1.9	350	1	5	1.9
	Summer-Autumn Fresh (Dec – Mar)	-	-	-	-	140	3	3	0.7	140	3	3	0.7	140	3	3	0.7
	Spring Fresh (Sep – Nov)	700	1	5	5.4	700	1	5	5.5	700	1	5	5.5	700	1	5	5.5
	Winter Fresh (May – June)	-	-	-	-	700	1	5	5.3	700	1	5	5.3	700	1	5	5.3
	Summer-autumn low flow (Sep – Jan)	60 – 90	Continuous	153	Typically met by passing flow provision	60-90	Continuous	153	Typically met by passing flow provision	60-90	Continuous	153	Typically met by passing flow provision	90	Continuous	62	1.7
	Summer-autumn low flow (water quality trigger*) (Sep – Jan)	40	1	5-13	0.3	-	-	-	-	-	-	-	-	-	-	-	-
	Summer-autumn fresh (Water quality trigger*) (Sep – Jan)	140	1	3	0.3	-	-	-	-	-	-	-	-	-	-	-	-
Tier 1a Est. Water Demand (GL)		**10.3**				**16.8**				**17.7**				**19.8**			
Tier 1b		**Autumn-winter low flow** - Increase from 35-60ML/d to 90 ML/d continuous (July-mid August)				**Autumn-winter low flow** - Extend low flow provision to include March @ 90 ML/d continuous (Mar-June)				**Spring-Summer low flow** - 90 ML/d continuous (Sep-Jan) **Spring fresh[2]**				**Spring low flow** - 300 ML/d, continuous for a minimum of 120 days (June – Nov) **Spring fresh[2]**			

	- Extend low flow provision to include March @ 90 ML/d continuous (Mar-June) **Spring-Summer low flow** - 90 ML/d continuous (Sep-Jan) **Winter fresh** 700 ML/d, 5 days (May – June)	**Spring-Summer low flow** - 90 ML/d continuous (Sep-Jan)	Piggybacking on a 1500 ML/d operational releases (Sep – Dec) (used to shape the ramp down from 1500 ML/d)	Piggybacking on a 1500-3000 ML/d operational releases (Sep – Dec) (used to shape the ramp down from 1500-1800ML/d)
Tier 1b Est. Water Demand (GL)	**11.5 GL**	**4.7**	**6.7**	**35.2**
Tier 2	Nil	Nil	Nil	Nil
Tier 2 Est. Water Demand (GL)	**0 GL**	**0 GL**	**0 GL**	**0 GL**
High Priority Carryover Requirements	**0 GL**	**1.4 GL**	**1.4 GL**	**0 GL**

Footnotes:

[1]Delivery of this event will be dependent on water quality and passing flow volumes in the lower sections of M2.

[2]If possible, the spring fresh can piggyback on a spill event from Lake Glenmaggie (provided a spill occurs by early November – for fish recruitment). This scenario requires varying volumes of the environmental entitlement to either (a) extend the duration of a spill event and/or (b) slow down the ramp down rates of the spill release. Refer to Appendix item 1 for further information.

5. Risk management & Engagement

Risk management

A risk assessment workshop hosted by the Victorian Environmental Water Holder (VEWH) was held in February 2023. The workshop participants identified the key potential risks that may occur in the 2023-24 water year to prevent the objectives of the environmental watering program being achieved. The risks were considered within the context of the likely watering actions proposed for 2023-24, and the current conditions of environmental assets across each system in light of the extensive natural watering that had been achieved in the current water year.

The risk assessment was undertaken using the likelihood, consequence and risk rating tables contained in the updated Victorian Environmental Watering Program Risk Management Framework. The risk assessment process also had regard for dynamic risks that are more likely to vary from year to year, depending on seasonal conditions or the specific watering actions proposed.

Risks and mitigation strategies identified at this workshop are shown in Table 38, in Item 2 of the Appendix. Many of the risks were categorised as low risks, with the balance rating as medium risks with only one high risk. There were no extreme risks prior to mitigations. All of the medium and high risks were assessed as having low residual risk levels for 2023-24 following the application of the identified mitigations.

Engagement

This section outlines the engagement that has occurred in the development of the West Gippsland seasonal watering proposal as well as relevant engagement that supports environmental water planning and delivery for 2023-24 (see Table 28 for a comprehensive list).

Significant engagement has been made through the Macalister Environmental Water Advisory Group (EWAG), established 2016, and the Thomson and Latrobe River EWAGs (established 2022). Membership of these newer groups were formed from previous Flows Study project advisory groups as well as an expression of interest process designed to target a diverse range of communities of interest such as Friends of groups and recreational users. All three groups are now functioning well with positive feedback about meeting style and level of engagement obtained from members in November 2022.

The Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) have Registered Aboriginal Party (RAP) status under the *Aboriginal Heritage Act (2006)* and their area of determination covers all West Gippsland rivers that receive environmental water. The WGCMA has a Memorandum of understanding (MoU) in place with GLaWAC. In this MoU the WGCMA agrees to involve the Aboriginal corporation in all WGCMA projects from the beginning as well as build capacity of GLaWAC to protect and conserve natural resources. In this instance, this was achieved by having direct one-on-one engagement with GLaWAC cultural water officers in person in April 2023 as well as their inclusion in all three EWAGs. This provided them an opportunity to not only provide feedback on the 2023-24 proposed watering actions and observations of previous deliveries on behalf of their community, but also to look for opportunities where environmental water can support shared values or objectives. The WGCMA is working towards supporting GLaWAC to progress from ‘collaborate’ to ‘empower’ into the future.

Beyond the EWAGs, other engagement that supports environmental water planning and in-season delivery in the system includes:

- In person gatherings such as field visits, meetings with partners, speaking at community meetings (e.g. Newry creek irrigators meetings),
- Media such as informative social media posts, photography competition, videos, and print media such as posters, fliers and fact sheets,
- Partnering to collect environmental data used for monitoring purposes e.g., Birdlife Australia conducting bird monitoring at Heyfield wetlands.
- Subscriber E-flow notifications via email and text message to inform and educate interested community members on planned flows.

As part of the SWP engagement, EWAG members from all three groups were informed about the process of translating the environmental objectives, flow recommendations, allocations, and climate scenarios into potential watering actions for the 2023-24 seasonal watering proposals. The groups were then invited to discuss and provide feedback on the proposed flows and their specific priorities for the upcoming water year. The groups were highly engaged in these discussions and valuable feedback obtained, particularly around the priority of carry-over in the Thomson and Macalister Rivers and the potential for water trading in the Latrobe system. Member’s questions and concerns were also discussed and resolved.

Table 28 Summary of engagement undertaken in development of the 2023-24 Seasonal Watering Proposal

Category	Stakeholder	IAP2 level	Engagement method	Engagement purpose
Community and Environment Groups	• Friends of Bellbird corner (Macalister EWAG) • Field Naturalists (Macalister EWAG) • Friends of Tyers Park (Latrobe EWAG) • Friends of Latrobe Water (Latrobe EWAG)	Collaborate	• Formal advisory groups • Direct engagement (one-on-one, emails)	• Provide an opportunity to represent their group's interests in the development of the proposed watering actions and intended outcomes. • Seek feedback on previous environmental water actions including observations. • Identify opportunities to achieve shared benefits. • Increase collaboration and shared knowledge of environmental water.
	• Birdlife Australia • Greening Australia	Involve	• Direct engagement (one-on-one, emails), • Community environmental monitoring.	• Seek feedback on previous environmental water actions including observations. • Identify opportunities to achieve shared benefits. • Increase collaboration and shared knowledge of environmental water.
	• Latrobe Valley Field Naturalists • Latrobe Landcare Network • Friends of Bellbird Corner (Macalister River system) • Friends of Tyers River (Latrobe system)	Inform	• Eflows distribution list (email, SMS notifications), • Invitations to relevant WGCMA events in the relevant river catchment.	• Identify opportunities to achieve shared benefits. • Increase collaboration and shared knowledge of environmental water.
Government agencies	• VEWH (Latrobe, Thomson and Macalister EWAGs) • DEECA (Thomson EWAG) • Gippsland Water (Latrobe, Thomson and Macalister EWAGs) • Southern Rural Water (Latrobe, Thomson and Macalister EWAGs)	Collaborate	• Formal advisory groups, • Partnership meetings, • Direct engagement (one-on-one, emails).	• Provide an opportunity to represent their group's interests in the development of the proposed watering actions and intended outcomes. • Seek feedback on previous environmental water actions including observations. • Identify opportunities to achieve shared benefits.

Category	Stakeholder	IAP2 level	Engagement method	Engagement purpose
	• Melbourne Water (Thomson EWAG)			• Increase collaboration and shared knowledge of environmental water.
	• East Gippsland Catchment Management Authority • Arthur Rylah Institute	Inform/Consult	• Direct engagement (one-on-one, shared field work), • Collaboration on community events.	• Seek feedback on previous environmental water actions including observations and monitoring data. • Identify opportunities to achieve shared benefits. • Increase collaboration and shared knowledge of environmental water.
Landholders/farmers	• Landholders and Irrigators on the Latrobe EWAG • Irrigators on the Macalister EWAG • Irrigators on the Thomson EWAG	Collaborate	• Inclusion in Lake Wellington Irrigator advisory group, • Direct engagement with all EWAG members (one-on-one, emails)	• Provide an opportunity to represent their group's interests in the development of the proposed watering actions and intended outcomes. • Seek feedback on previous environmental water actions including observations. • Identify opportunities to achieve shared benefits. • Increase collaboration and shared knowledge of environmental water, • Increase advocacy of environmental water.
	• Irrigators and landholders throughout the rest of West Gippsland	Involve/consult	• Eflows distribution list (email, SMS notifications). • Information sharing via social media and public events.	• Identify opportunities to achieve shared benefits. • Increase collaboration and shared knowledge of environmental water, • Increase advocacy of environmental water.
Recreational users	• Whitehorse Canoe Club (Thomson EWAG) • VR Fish (Latrobe, Thomson and Macalister EWAGs) • Native Fish Australia (Thomson and Macalister EWAGs)	Collaborate	• Formal advisory groups, • Direct engagement (one-on-one, emails),	• Provide an opportunity to represent their group's interests in the development of the proposed watering actions and intended outcomes. • Seek feedback on previous environmental water actions including observations.

Category	Stakeholder	IAP2 level	Engagement method	Engagement purpose
				• Identify opportunities to achieve shared benefits. • Increase collaboration and shared knowledge of environmental water.
	• Recreational users (individuals and organisations)	Inform	• Eflows distribution list (email, SMS notifications), • Information sharing via social media and public events.	• Increase awareness and shared knowledge of environmental water.
Traditional Owners	• Gunaikurnai Land and Waters Aboriginal Corporation (Latrobe, Thomson and Macalister EWAGs)	Collaborate	• Formal advisory groups, • Project steering committees, • Collaboration on EWMPs • Participation in monitoring programs e.g. Eel surveys • Collaboration on filming projects such as the Latrobe River story. • Direct engagement (one-on-one).	• Provide an opportunity to represent their group's interests in the development of the proposed watering actions and intended outcomes. • Seek feedback on previous environmental water actions including observations. • Identify opportunities to achieve shared benefits. • Increase collaboration and shared knowledge of environmental water. • Provide opportunities for on-country learning and connection.
Land managers	• Heyfield Wetlands Committee of Management (Thomson EWAG)	Collaborate	• Formal advisory groups • Direct engagement (one-on-one, emails), • Participation in water quality monitoring program, • Collaboration on the development and completion of the Heyfield EWMP,	• Provide an opportunity to represent their group's interests in the development of the proposed watering actions and intended outcomes. • Seek feedback on previous environmental water actions including observations and monitoring data. • Identify opportunities to achieve shared benefits. • Increase collaboration and shared knowledge of environmental water.

Actions in the 'Water for the Environment Community Engagement Plan' for 2019 – 2024 are being progressively completed by the WGCMA. Looking into the 2023-24 water year the following engagement activities are planned (Table 29):

Table 29 Summary of planned engagement activities for 2023-24

Activity	Engagement purpose:
New interpretative signage emphasising the importance of environmental water at publicly accessible sites. E.g., Lake Glenmaggie weir, Blue Rock dam, Heyfield wetlands.	• Inform and engage the recreational user. • Increase advocacy for environmental water in the community. • Work collaboratively with our partners to strengthen relationships
Commission new drone images of Heyfield Wetlands, and the Latrobe, Macalister and Thomson rivers	• Compare against previous images to show natural landscape changes and impacts from watering activities. • Use for communications purposes e.g., new social media posts, videos, informative posters and interpretive signage for Heyfield wetlands community centre
Continue to work with GLaWAC environmental water officers to find out what they need and provide this e.g., They have recently expressed an interest in an on Country event (eg. kayaking) which we can fund. They have also mentioned an interest in specialist training on Country such as with ARI.	• Engage and empower our traditional owners. • Identify shared benefits. • Two-way knowledge sharing • Collaborate and strengthen relationships
Revise and update the *'Stories of Wirn wirndook Yerrung: The Macalister River'* book, reprint copies and engage with schools within the Wellington shire to create teaching resources, presentations etc.	• Increase collaboration and shared knowledge of environmental water. • Increase advocacy for the importance of environmental water. • Inspire the next generation of environmental scientists.

6. Shared Benefits

The primary purpose of water supply systems is for the reliable supply of water to entitlement holders for towns, industry, agriculture and environment. The storage, delivery and use of this water may also provide secondary, opportunistic socio-economic and cultural benefits. These benefits are recognised as shared benefits. Through the Water for Victoria plan, the Victorian government has committed to considering opportunities for shared benefits in water and waterway planning.

Environmental water program partners and officers are asked to consider the shared benefits in the environmental water planning, delivery and reporting phases. Shared benefits should be provided, where possible, so long as it does not compromise on the targeted ecological outcome(s). In West Gippsland, there are several known shared benefits provided by environmental watering.

In developing priority watering actions, community groups and other agencies were engaged to identify shared benefits or impacts from environmental watering activities. These are taken into consideration in prioritising watering actions; however, they are not the primary driver for environmental flow planning.

Latrobe River

Traditional Owner Values

The Latrobe River is an important resource for the Gunaikurnai people. Numerous registered Indigenous cultural heritage sites and values such as scarred trees, artefact scatters, earth features and shell deposits are located along the river and its tributaries. Through more focused engagement with Gunaikurnai people regarding the cultural significance of the Latrobe River, further shared benefits will be identified for the use of the Latrobe environmental water entitlement. This engagement is planned to continue through the 2023-24 water year. Traditional Owner guidance on objectives and values was received from GLaWAC via the Gunaikurnai Cultural Water Team.

GLaWAC have representation on all three river system EWAGs, and are directly engaged with on the lower Latrobe Wetlands watering proposal.

In discussing the 2023-24 watering proposals, and opportunities to align with or support cultural objectives, it was raised by GLaWAC that data and monitoring information is still a key knowledge gap.

For context, an event on one of the rivers was discussed as an opportunity to be on Country and share knowledge. The timing and focus of such an event could be informed by monitoring information, for example fish surveys identifying large numbers of one or more culturally significant species. An event could then be tailored around that species, with the potential for fishing, electro-fishing, kayaking, etc. The same approach could also be used following autumn or spring bird or vegetation surveys.

Shared Benefits

The timing of environmental water releases takes into consideration water skiing events held at Lake Narracan, typically between January and March. Through communication with the local water ski club, environmental water releases are timed to not impact on the water levels at Lake Narracan during the event. This communication is also part of the environmental entitlement operating arrangement between the VEWH, WGCMA and

Southern Rural Water (storage operator). Shared benefits for 2023-24 are summarised in Table 30.

Table 30 Summary of the shared benefits of the potential watering actions in the Latrobe River, 2023-24.

Who?	Shared benefit
Lake Narracan ski club	Ski events on Lake Narracan require set and stable water levels. Flow releases shall be managed outside of these planned ski events to avoid conflicting requirements.
Recreational fishers	Freshes linked with recreational fish movements and behaviour (e.g. black bream and estuary perch become active during high flows providing fishing opportunities).
Shooters / field and game hunters	Delivering flows for wetland watering improves waterbird diversity and abundance providing game hunting opportunities.
Commercial fishers	Low flows create continuous instream habitat, providing for fish distributions and increasing commercial fishing abundance.
Gippsland water	Base flows improve water quality for stock watering and irrigation, while also reducing water treatment required by urban water suppliers.
Irrigators/farmers	Base flows improve water quality for stock watering and irrigation, while also reducing water treatment required by urban water suppliers.
Regional economy and tourism	Overall benefit of flows and river health for the regional economy and tourism values

Thomson River

Traditional Owner Values

GLaWAC view Country as connected, with the Latrobe, Thomson and Macalister rivers being integral to the lower Latrobe wetlands and the Gippsland Lakes. Environmental watering contributes to maintaining or improving the health of the river which is important to improve/maintain the integrity of the Country of the Gunaikurnai.

The Thomson River is an important feeder into the lower Latrobe wetlands, which are very important - traditionally and today.

Water-dependent species and values were identified through the Thomson flows study process, with GLaWAC represented on the Project Advisory Group. Traditional Owner guidance on objectives and values was received from GLaWAC via the Gunaikurnai Cultural Water Team, who completed Aboriginal Waterways Assessments for the Thomson, and took part in workshops as part of the Thomson flow study review in 2020.

GLaWAC have representation on the Thomson EWAG, and WGCMA Environmental Water staff have engaged with individual Cultural Water Staff on the flow priorities for 2023-24.

In discussing the 2023-24 watering proposals, and opportunities to align with or support cultural objectives, it was raised by GLaWAC that data and monitoring information is still a key knowledge gap.

For context, an event on one of the rivers was discussed as an opportunity to be on Country and share knowledge. The timing and focus of such an event could be informed by monitoring information, for example fish surveys identifying large numbers of one or more culturally significant species. An event could then be tailored around that species, with the potential for fishing, electro-fishing, kayaking, etc. The same approach could also be used following autumn or spring bird or vegetation surveys.

Shared Benefits

In West Gippsland, there are several known shared benefits provided by environmental watering. Table 31 summarises the Thomson River shared benefits identified in 2023-24.

Table 31 Thomson River Shared benefits review for 2023-24

Who?	Shared benefit
Canoe clubs, outdoor education companies, and recreational canoers/kayakers	Autumn, winter and spring freshes create ideal white water rafting conditions for avid canoers/kayakers in the upper Thomson. The 2023 watering event is likely to coincide with the Easter holidays. Over 2022-23, several kayakers/canoers have subscribed to receive environmental watering notifications in the Thomson, and we now have recreational users represented on the Thomson EWAG.
Recreational bird watchers **Recreational duck/game hunters**	Deliveries to the Heyfield Wetlands provide habitat and attract waterbirds providing bird watching opportunities. Freshening flows from the Thomson, Macalister and Latrobe rivers all contribute to the health of the lower Latrobe wetlands.

Who?	Shared benefit
	Freshes bring in waterbirds into these wetlands and provide both bird watching and game hunting opportunities, particularly in the lower Latrobe wetlands
Recreational fishers/anglers	Winter and spring freshes encourage the downstream migration and recruitment of Australia bass and estuary perch, both popular recreational fish species
Local and international tourists (including campers, hikers)	Flushing of waterholes and improved in-stream habitat with environmental watering events, provides high quality swimming and camping opportunities in the upper Thomson River, which is a popular location for recreational users
Landholders with river frontage & public land	Environmental watering contributes to the protection of riverbanks and land loss from erosion through the watering of riparian vegetation and maintenance of in-channel vegetation

Macalister River

Traditional Owner Values

GLaWAC view Country as connected, with the Latrobe, Thomson and Macalister rivers being integral to the lower Latrobe wetlands and the Gippsland Lakes. Environmental watering contributes to maintaining or improving the health of the River which is important to improve/maintain the integrity of the Country of the Gunaikurnai.

The Macalister flows study preceded the creation of the GLaWAC Cultural Water Team, and as such culturally significant water-dependent values and objectives are not well defined for the Macalister. Through reviewing the Macalister EWMP in 2022, and watering proposals in 2023, the WGCMA is looking to correct this and plan to work with GLaWAC's Cultural Water Team to meaningfully include these going forward/

GLaWAC have representation on the Macalister EWAG, and WGCMA Environmental Water staff have engaged with individual Cultural Water Staff on the flow priorities for 2023-24.

In discussing the 2023-24 watering proposals, and opportunities to align with or support cultural objectives, it was raised by GLaWAC that data and monitoring information is still a key knowledge gap.

For context, an event on one of the rivers was discussed as an opportunity to be on Country and share knowledge. The timing and focus of such an event could be informed by monitoring information, for example fish surveys identifying large numbers of one or more culturally significant species. An event could then be tailored around that species, with the potential for fishing, electro-fishing, kayaking, etc. The same approach could also be used following autumn or spring bird or vegetation surveys.

Shared Benefits

Table 32 summarises the Macalister River shared benefits identified in 2023-24.

Table 32 Macalister River Shared benefits review for 2023-24.

Who?	Shared benefit
Locals and other visitors from outside the region	Watering that refreshes waterholes, particularly over summer, may improve the water quality key waterholes and thus the swimming conditions. Freshes throughout the year, also increase the longitudinal connectivity of the river, improving kayaking conditions
Recreational fishers/anglers	Planned winter and spring freshes encourage the spawning and recruitment of Australia bass, a popular recreational fish species
Landholders with river frontage & public land	Watering in autumn and spring helps to maintain bankside vegetation, preventing erosion and potential land loss. This watering complements any on-ground riparian rehabilitation works also undertaken as part of the WGCMA's Waterway Strategy

7. Increasing knowledge and addressing constraints/ impacts

Latrobe River

There is limited environmental monitoring being undertaken in the Latrobe River currently.

Water quality data from sites that are part of the regional water monitoring network and from Waterwatch volunteers or WGCMA staff will be used to provide insight into water quality conditions throughout the year. The target reach will be the focus.

Empirical data will be supplemented with on-ground observations made by WGCMA staff and where possible, landholders and other interested individuals.

Monitoring of the ecological effects of environmental flow releases in the regulated Latrobe River would be a useful inclusion, especially the effect on in-stream vegetation (natural regeneration or revegetation), physical habitat and fish. Part of this could be to extend previous fish monitoring further up the Latrobe River to locate populations of Australian grayling and undertake larval monitoring to improve knowledge and management of Latrobe River releases for spawning.

The WGCMA will continue to explore opportunities with government and community organisations to collect ecological monitoring data in the Latrobe River.

Key knowledge gaps and limitations that WGCMA are currently aware of, and proposed actions to address these, are summarised below (Table 33).

Table 33 Key knowledge gaps and limitations for the Latrobe River.

Knowledge gap/limitation	Proposed action
Entire river system	
Monitoring of species of cultural significance	Work with GLaWAC to identify target species, locations and knowledge gaps to help inform cultural water planning and events
Location and abundance of preferred Australian grayling habitat	Undertake electrofishing in upper reaches and main tributaries, and larval monitoring in the lower Latrobe.
Lack of understanding of system losses, travel times and flow attenuation limit ability to effectively piggyback on natural events and coordinate flow releases from multiple storages.	Continued investigation of data from recent Thomson and Latrobe environmental water release monitoring
The daily natural time series for the Latrobe River have been derived by disaggregating monthly model output.	Develop a daily water resource model for the Latrobe River system and produce output for natural, current and other relevant scenarios.
Data from a single year was used for the re-definition of flow recommendations and scenario planning.	Make use of a tool such as eFlow Predictor to analyse data from multiple years to characterise scenarios.
The practicalities and accounting issues associated with using the greater release capacity of Lake Narracan to	Investigate these issues in conjunction with SRW and other entitlement holders to Lake Narracan. Document

increase daily releases to the Latrobe River.	agreement reached in operating arrangements.
Major structural works are required (e.g. fish ladders and meander reinstatements) to realise the full potential of the Latrobe River and to maximise the value of environmental water deliveries.	Develop and implement a large-scale works program (see specific reaches below).
Reach 5: Kilmany to Thomson River	
There is only so much that environmental flows alone can do to promote establishment/maintenance of in-stream vegetation.	Undertake complementary works to provide niches for the establishment of in-stream vegetation e.g. installation of large wood and/or meander reinstatements; and to maintain/encourage in-stream vegetation e.g. fencing and revegetation.
The effect of environmental flow releases on in-stream vegetation (natural regeneration and revegetation) and physical habitat.	Undertake a geomorphological study of the Latrobe River system. Use this to inform the design and implementation of a tailored monitoring program.
Implications of meander reinstatements for the hydraulics of reach 5 and the magnitude of freshes needed to trigger ecological conditions where meanders are reinstated.	Technical review of environmental flow recommendations. This would involve use of the reach-scale hydraulic models developed for the meander reinstatement investigation (MIKE11), rather than the HEC-RAS models used for the original FLOWS study.
Reach 8: Tanjil River	
Risks to the stability and ecological function of this reach arising from high flows and a seasonal shift in flows due to its use as a delivery channel.	Technical investigation – could be investigated as part of a broader geomorphological study of the Latrobe River system.
Reach 9: Tyers River	
Passage past Gippsland Water's weir is a limitation to fish migration/habitation in this reach which is in relatively good condition.	Investigate options to provide fish passage over Gippsland Water's weir on the Tyers River.

Thomson River

Monitoring and knowledge improvement activities

Targeted monitoring programs are planned in the Thomson system for 2023-2024.

These three programs are outlined below:

Victorian Environmental Flows Monitoring and Assessment Program

As part of VEFMAP, annual native fish surveys will continue to be undertaken in the Thomson River to understand native fish distribution, and the recruitment and dispersal of native migratory fish.

VEFMAP monitoring conducted in other coastal, regulated systems with the same or similar water dependent values may also provide transferrable knowledge that may inform environmental water management for the Thomson River.

Specific information from the VEFMAP program will be used to fill knowledge gaps and increase our understanding of the diversity and condition of vegetation communities and fish populations in the Thomson system (both identified as system scale environmental objectives for the Thomson River).

Native Fish Report Card Program

This is an annual monitoring program focused on collecting long term information on the condition of native recreational fisheries across the state. The program commenced in 2017 and is a partnership between DELWP, the Victorian Fisheries Authority and Recreational Fishing Licence Holders. The program will be collecting information on various indicators of fish population health including abundance, year-class distribution for specific fisheries and target recreational species and priority threatened species. The Thomson River has been prioritised as a key fishery where monitoring will focus on Australian bass and Australian grayling. Monitoring is continuing in this year and is likely to continue next year.

Whilst this program is not directly targeted at environmental watering responses, it has the ability to supplement the native fish surveys collected under VEFMAP. It may also prove useful to understand the status of Australian bass in the river. Australian bass is considered a flow dependent species that is targeted during winter and spring freshes, but there are still large knowledge gaps associated with flows required to trigger spawning and recruitment responses.

Specific information from this monitoring program will be used to fill knowledge gaps and increase our understanding of how to deliver flows to maintain and enhance self-sustaining populations of native fish species in the Thomson system (an identified system scale environmental objective for the Thomson River).

Lower Latrobe Water Quality Monitoring

The WGCMA undertake salinity and water flow monitoring in the lower Latrobe River to measure the movement of the salt wedge as it relates to inflows. Releases from Thomson River influence freshwater conditions in this reach and monitoring will help inform the benefits of environmental flow releases from Thomson Reservoir on estuary conditions.

Specific information from this monitoring program will be used to fill knowledge gaps and increase our understanding of how flow deliveries in the Thomson affect and interact with the lower Latrobe system. Synchronised timing of releases across systems is important for being able to deliver environmental water to restore and maintain lateral connectivity (an identified system scale environmental objective for the Thomson River).

Heyfield Wetlands

The passion of the Heyfield Wetlands Committee means that ecological monitoring (i.e., bird surveys and frog monitoring), rehabilitation works, and maintenance will continue. This will aid in the knowledge sharing and monitoring required to ensure environmental water is used most effectively in this area.

The WGCMA is also looking to implement more routine water quality monitoring through Waterwatch at Heyfield in 2023.

Knowledge Gaps and Limitations

Tailored monitoring to assess the achievement of the environmental objectives that underpin all watering actions for the Thomson River have not been undertaken, as many of these objectives are inherently difficult and expensive to measure. This is because the objective stipulates an ecological outcome that is influenced by multiple factors, other than flow alone (many of which are non-flow related).

Table 34 lists objectives that are difficult to measure and the associated knowledge gaps/potential monitoring activities associated with each objective.

Table 34 Objectives and associated knowledge gaps and monitoring activities

Objective	Can the objective be measured?	Knowledge gaps and potential monitoring activities
Monitoring of species of cultural significance	Work with GLaWAC to identify target species, locations and knowledge gaps to help inform cultural water planning and events	
Restore or maintain natural macroinvertebrate community	Difficult to measure. Macro-invertebrate communities are sensitive to multiple factors, flow being only one of these factors	Difficult to measure. Macro-invertebrate communities are sensitive to multiple factors, flow being only one of these factors
Maintain/enhance native fish community structure	This objective has been measured in part through the VEFMAP annual fish surveys and monitoring of Australian grayling spawning behaviour. However, fish communities are also influenced by a number of other factors (e.g. habitat, water quality, food availability)	Monitoring to further understand relationship between streamflow and diadromous fish recruitment (particularly for Australian grayling, tupong and Australian bass). Monitoring to better understand characteristics of flow triggers for female adult tupong (and Australian bass) spawning migration. Limited understanding of the habitat requirements, food sources and flow requirements of *all* native fish species present in the system. Limited understanding of the influence of flow on non-flow components of habitat (e.g. water quality, in-stream vegetation). Requirement for a statewide data sharing facility that is used by all CMAs and Melbourne Water so that conceptual models are shared freely and easily and new knowledge is distributed to all CMAs.
Maintain/restore distinctive riparian vegetation	Difficult to measure. Vegetation survey data collected under VEFMAP cannot be used to	Limited understanding and articulation of the water requirements of in-stream and

Objective	Can the objective be measured?	Knowledge gaps and potential monitoring activities
community and structure, with zonation up the bank	assess this objective as it cannot isolate the influence of flow from other factors	fringing native vegetation present (that may be influenced by environmental water releases) Limited understanding on the effect of Thomson Reservoir on the distribution of seeds and propagules downstream of the reservoir Requirement for a statewide data sharing facility that is used by all CMAs and Melbourne Water so that conceptual models are shared freely and easily and new knowledge is distributed to all CMAs
Maintain channel form diversity	Difficult to measure. It is difficult to isolate the influence of flow on channel form given the land uses that predominate the catchment	Limited data on the flows required to scour substrate due to use of potentially outdated 1D hydraulic model. No data on flows required to scour biofilms. Requirement for an updated hydraulic model.
Improve water quality	This is a potentially measurable outcome. It is dependent on how influential environmental watering can be on water quality for the Thomson River, given the surrounding land use.	Limited understanding of relationship between flow and water quality variables in pools and riffles in the Thomson River. Require water quality measurements in major pools (particularly those downstream of Cowwarr Weir) before during and after the release of an event to identify the impacts of the flow release on water quality. Require water quality measurements before, during and after major unregulated flow events to elucidate the magnitude of flows required to significantly impact water quality in pools.

Macalister River

Monitoring and knowledge improvement activities

Targeted monitoring programs are planned, or relevant to, the Macalister system for 2023-2024 are outlined below:

Victorian Environmental Flows Monitoring and Assessment Program

VEFMAP fish surveys conducted in February 2023 in the Thomson River and other coastal, regulated systems with the same or similar water dependent values will provide transferrable knowledge to inform environmental water management for the Macalister River.

Native Fish Report Card Program

This is a multi-year monitoring program focusing on the collection of long-term information on the condition of native recreational fisheries across the state. The program is a partnership between DELWP, the Victorian Fisheries Authority and Recreational Fishing Licence Holders. The program commenced in 2017, collecting information on various indicators of fish population health including abundance, year-class distribution for specific fisheries and target recreational species and priority threatened species. The Macalister River has been prioritised as a key fishery where monitoring will focus on Australian bass and Australian grayling.

Whilst this program is not directly targeted at environmental watering responses, it has the ability to supplement the native fish surveys collected under VEFMAP. It may also prove useful to understand the status of Australian bass in the river. Australian bass is considered a flow dependent species that is targeted during winter and spring freshes, but there are still large knowledge gaps associated with flows required to trigger spawning and recruitment responses.

Knowledge gaps and limitations

The knowledge gaps, limitations and the work required to address have been specified in the Draft Macalister River Environment Flow Management Plan (WGCMA, 2022) and are summarised in Table 35.

Table 35 Summary of Macalister River knowledge gaps

Objective	Description	Knowledge gaps and potential monitoring activities
Monitoring of species of cultural significance	Work with GLaWAC to identify target species, locations and knowledge gaps to help inform cultural water planning and events	
Increase the abundance of platypus and rakali	Little information on current distribution and abundance on platypus and rakali in the Macalister system. Little quantitative data on the flow requirements of both species, the impacts of regulated flow regimes on their	**Monitoring** Population study to delineate distribution and abundance in the system over time (for longevity, it may be useful to harness community knowledge through an established system,

Objective	Description	Knowledge gaps and potential monitoring activities
	populations and food sources (benthic macroinvertebrates)	extraction of information at engagement events) **Research projects** Understand the response of platypuses and rakali to variable flow regimes with particular focus on very low and very high flows
Improve spawning and recruitment opportunities for native migratory fish species	Need greater understanding on how flow affects movement (e.g. the hydraulic characteristics of physical habitat that influence swimming ability)	Research projects Use telemetry (tagging) techniques to monitor movement of these species
Improve spawning and recruitment opportunities for native migratory fish species	Need further understanding on how specific mechanisms of flow influence spawning success for this species	**Research projects** Data on primary productivity and spawning behaviour analysed in conjunction with streamflow may help identify correlations between flow event characteristics and spawning success **Monitoring** of primary productivity rates, Australian bass spawning behaviour in spawning habitats is required
Re-instate submerged aquatic vegetation	There is a need to understand the limiting factors preventing in-stream vegetation establishment in this system in order to identify management actions that may support its re-instatement	Identify and map current presence of any remnant in-stream vegetation Monitoring to determine whether submerged vegetation establishes in the main river channel
Improve emergent and fringing woody vegetation in the riparian zone	Fringing vegetation in the system has changed considerably over time. For example, abundant and healthy beds of common reed are now rare. There is little understanding on when they have disappeared and what has caused this loss	Analyse historical documents (e.g. aerial photographs, and supplementary photographs from the local community) to determine where and when riparian vegetation has changed to obtain a visual and guiding template of what the river “should” look like Monitoring of vegetation response (including in-stream vegetation response) from areas that have received complementary works to areas that have not

Objective	Description	Knowledge gaps and potential monitoring activities
Increase the abundance and number of functional groups of macroinvertebrates	The current structure of the macro-invertebrate community in the river is unknown. There is no information on the impact of the bushfires and floods over the last decade on the abundance and diversity of functional groups, since last survey in 2005–06	Macro-invertebrate surveys to capture what is present in the system and what has changed is required
Improve physical habitat	The relationship between environmental watering in the Macalister River and water quality is not understood. High turbidity events have been observed, however, it is not known if these events are due to a flow release or other channel or land use factors	Increase the frequency of turbidity monitoring to daily (or more) to discern spatial-temporal patterns, and the influence of environmental watering Determination of all sources of turbidity and nutrients and the proportional contribution of these sources

8. Approval and endorsement

I, the authorised representative of the agency shown below, approve the Seasonal Watering Proposal for the Latrobe River system, Thomson River System, and Macalister River system in 2023-24.

SIGNED FOR AND ON BEHALF OF

West Gippsland Catchment Management Authority

Signature of authorised representative

Name: *Martin Fuller*

Title: *Chief Executive Officer*

Date: 21/04/2023

Latrobe River System

I, the authorised representatives of the agencies shown below, acknowledge that the potential watering actions being proposed in the Latrobe section of the proposal are able to be delivered within existing system operations for the Latrobe River system in 2023-24, recognising that there may be additional information to endorse in relevant operating arrangements.

SIGNED FOR AND ON BEHALF OF

Southern Rural Water

Signature of authorised representative

Name: Matt Cook

Title: *Manager Water Supply East*

Date: 22/05/2023

Macalister River System

I, the authorised representatives of the agencies shown below, acknowledge that the priority watering actions being proposed in Macalister section of the proposal are able to be delivered within existing system operations for the Macalister River system in 2023–24, recognising that there may be additional information to endorse in relevant operating arrangements.

SIGNED FOR AND ON BEHALF OF

Southern Rural Water

Signature of authorised representative

Name: Matt Cook

Title: *Manager Water Supply East.*

Date: 22/05/2023

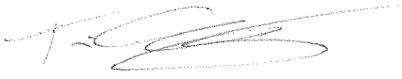
Thomson River System

I, the authorised representatives of the agencies shown below, acknowledge that the priority watering actions being proposed in the Thomson section of the proposal are able to be delivered within existing system operations for the Thomson River system in 2023-24, recognising that there may be additional information to endorse in relevant operating arrangements.

SIGNED FOR AND ON BEHALF OF

Melbourne Water

Signature of authorised representative



Name: Tommie Conway

Title: *Team Leader, Network Operations*

Date: 17/05/2023

SIGNED FOR AND ON BEHALF OF

Southern Rural Water

Signature of authorised representative

Name: Matt Cook

Title: *Manager Water Supply East.*

Date: 22/05/2023

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10. Appendices

Item 1 Recommended ramp up and ramp down rates for Lake Glenmaggie spill releases

Lake Glenmaggie is managed as a “fill and spill” storage. The release of water to maintain a pre-determined fill curve presents an opportunity for WGCMA and SRW to collaborate to deliver on various ecological objectives.

Flow recommendations that may be fulfilled during the storage spilling period (winter to spring) include winter and spring freshes of various peak magnitudes 700 ML/d, 1500 ML/d, 2500 ML/d and 3000 ML/d.

This section provides guidance on the release storage spills such that it may deliver on lower priority watering actions. The main considerations are detailed in Table 36 and Table 37, providing recommended release patterns for various event magnitudes recommended from the Macalister River environmental flows study (Alluvium, 2015).

Table 36 Considerations for storage operators to incorporate to achieve ecological benefits during Lake Glenmaggie spill releases.

Characteristic of release	Recommendations	Relative priority of recommendation
Peak magnitude (ML/d)	• The target magnitudes of flow events range from 700 – 3000 ML/d • As such, the peak magnitude of the release should be a **minimum of 700 ML/d** in order to fulfil at least one ecological objective (migration trigger flows)	Low
Event ramp up (rising limb)	• The ramping up of spill releases should be incremental, increasing by **2.5 times** the flow of the previous day (e.g. day 1– 60 ML/d, day 2– 150 ML/d, day 3– 375 ML/d, day 4– 937 ML/d etc.)	Medium
Event ramp down (falling limb)	• Ramp down rates are critical to minimise the risk of fish stranding and provide sufficient time for completion of movement • The preferred **24-hour ramp down** rate is **0.7 times** the flow of the previous day (e.g. day 1– 700 ML/d, day 2– 490 ML/d, day 3– 343 ML/d, day 4– 240 ML/d etc.). • Where possible, the preferred **12 hour ramp down** rate is **0.85 times** the flow of the previous 12 hours (e.g. 8am– 700 ML/d, 8pm– 595 ML/d)	High

Table 37 Considerations for storage operators to incorporate to achieve ecological benefits during Lake Glenmaggie spill releases. Note that these patterns assume commencement from the passing flow of 60 ML/d on day 0 and return to this flow.

Day	Required flow (ML/d)			
	Peak magnitude 700 ML/d	Peak magnitude at 1500 ML/d	Peak magnitude 2500 ML/d	Peak magnitude 3000 ML/d
0	60	60	60	60
1	150	150	150	150
2	375	375	375	375
3	700	937	937	937
4	700	1500	2343	2343
5	700	1500	2500	3000
6	700	1500	2500	3000
7	490	1500	2500	3000
8	343	1050	1750	2100
9	240	735	1225	1470
10	168	515	857	1029
11	117	360	600	720
12	82	252	420	504
13	60	176	294	352
14		124	205	247
15		86	144	172
16		60	100	121
17			60	84
18				60

Item 2 VEWH 2023/24 watering proposal risk assessment

Table 38 Risk assessment for 2023/24 watering proposal – Macalister, Latrobe and Thomson systems (DG Consulting 2023) (Blue text indicates common risks across all systems, purple text indicates changes added in 2023, red text indicates changes added in 2022, black text indicates system specific risk)

		Pre-Mitigation Risk					Residual Risk			
Risk category	**Risk description**	**Likelihood**	**Consequence**	**Risk Rating**	**Mitigation actions**	**Lead organisn. for action**	**Likelihood**	**Consequence**	**Risk Rating**	**Risk type** Static or Dynamic
Environment	Target flows may not be achieved if tributary inflow contributions are lower than forecast.	Possible	Minor	Low	• Experience from recent events to be reviewed to inform planning. • Rainfall and catchment responses to be closely monitored during events and adjustments made to planned releases as necessary (using data inputs from storage operators).	WGCMA	Unlikely	Minor	Low	Static
Environment	Timing of environmental flow releases adversely impacts on Australian grayling breeding	Unlikely	Moderate	Low	• Base timing for events on monitoring data collected to date and improved knowledge from FLOWS study (note that learnings have been extrapolated to Latrobe, as specific Latrobe monitoring data is not available) • Share updated information on Australian grayling behaviour with other relevant waterway managers.	WGCMA	Unlikely	Minor	Low	Dynamic
Reputational	Inability to demonstrate outcomes achieved through environmental watering activities lead to a loss of public/political support for activities	Possible	Moderate	Medium	• Communicate benefits of environmental watering to the broader community and government and clarify various roles in environmental watering activities. • Implement community engagement strategy to communicate local successes and benefits from environmental watering and engage the community & EWAGS in environmental water management.	VEWH WGCMA	Unlikely	Moderate	Low	Static
Environment	Current adopted environmental flow recommendations fail to achieve the intended environmental objectives	Unlikely	Major	Low	• Undertake monitoring and research to improve understanding of ecological responses and review flow recommendations if required. • Implement results of recent flow study reviews, including using findings from other systems, and undertake review of flow studies in the Latrobe and Thomson.	WGCMA	Unlikely	Moderate	Low	Static
Legal	Environmental releases cause unauthorised inundation of private land, resulting in impacts on landowner activities and assets.	Possible	Moderate	Medium	• Update and ensure currency of any applicable agreements covering inundation of private land. • Development of cautious release plans designed to avoid overbank flows. • Monitoring of events and providing feedback to the storage operator for adjustment of releases to avoid overbank flows. • Communications to alert community of environmental watering actions. • Ensure pre-order communications process in Operating Arrangements document are implemented - Use local intelligence gathering processes (works crews) to identify impacts to banks/levees following major unregulated flow events	WGCMA	Unlikely	Minor	Low	Static
Environment	Constraints to environmental releases such as limited river channel capacity (and risk of flooding private land) and limited discharge capacity at low storage levels constrain environmental releases, leading to a failure to achieve environmental objectives across the system *- Note: Risk assessment based on environmental conditions in 2022-23. Need to review if drier conditions emerge and persist*	Possible	Minor	Low	• Update and ensure currency of any applicable agreements covering inundation of private land. • Development of cautious release plans designed to avoid overbank flows. • Monitoring of events and providing feedback to the storage operator for adjustment of releases to avoid overbank flows, particularly where landholder agreements are not in place. • Development of a strategy to address environmental flow limits. *Note: developing alternate release options to address constraints in the Latrobe, possibly using Moondarra & Narracan reservoirs*	WGCMA	Unlikely	Minor	Low	Dynamic
Safety	Environmental flow releases cause a rapid change in river conditions that mean ~~lead to safety risks as to~~ river users can quickly find themselves in conditions that are significantly different from those that they assessed before entering the water and therefore exceed their level of capability leading to potential safety risk	Possible	Extreme	High	• Include ramp-ups and ramp-down phases in release plans to reduce rapid water level changes. • Appropriate communications actions to alert users, especially for high use sites and high use periods. • Encourage river users to subscribe to website notification services of flow plans. • Implement communications plan about environmental water releases *~~(Note: This risk is still rated as medium after mitigation actions.)~~ Note: By gradually ramping flows up and down and providing advance notifications of planned watering actions to potential river users, these mitigation actions mean that rapid and unexpected changes to river conditions will not be a result of environmental flows and therefore the risk is diminished because conditions will not significantly change as a direct result of e-flows, and therefore river users' assessment of conditions at the time they started their activity remain (i.e. the residual consequence is minor).*	WGCMA	Unlikely	Minor	Low	Static
Environment	Environmental releases do not achieve planned/specified flow targets due to competing demand, outlet capacity constraints or maintenance at reservoirs	Possible	Minor	Low	• Scheduling of maintenance outside high demand periods (i.e. current practice). • Testing seasonal watering proposals with storage operators. • Communications on planned asset outages through BE holders' forums	Storage operator WGCMA Storage Operator	Unlikely	Minor	Low	Static
Environment	Environmental releases do not achieve planned/specified flow targets due to releases being diverted by other users before reaching delivery site.	Unlikely	Minor	Low	• Ensure diversions field staff are aware of planned events and are managing compliance with orders by all users. • CMA and SRW to collaborate to assess the scope of risks associated with diversion of environmental flows	SRW CMA	Unlikely	Minor	Low	Static
Reputational	Environmental deliveries affect water quality for urban purposes, leading to shortfalls in urban supply. *Note: Warragul and Moe urban supplies in the Latrobe system have been interconnected, providing greater resilience for towns in the region. Maffra on the Macalister still remains vulnerable as there is limited urban storage.*	Unlikely	Moderate	Low	• Communication and consultation with urban water authority to understand issues and concerns, and to provide 2 weeks advance notice of flow changes where possible • Modify delivery plans to reduce potential water quality impacts where possible, particularly in peak urban demand periods. • Include consideration of options for meeting demands from Lake Narracan where possible.	WGCMA WGCMA SRW	Unlikely	Minor	Low	Static

Environment	Works on waterway structures may prevent optimal timing of environmental deliveries, resulting in environmental impacts	Possible	Minor	Low	• Consultation on any proposed works and inclusion of appropriate conditions on works approvals/licences to ensure that there are no unacceptable impacts on timing and flow rates for environmental releases. *- Consider separate risk assessment for Maffra Weir works proposals as they are developed, not impacting 23-24 deliveries (basis for residual risk rating)*	WGCMA	Unlikely	Minor	Low	Static
Reputational	Any public safety risks posed by consumptive water releases are misconstrued as environmental water releases and are detrimental to the environmental water brand.	Possible	Moderate	Medium	• Broadcast a year-round public safety message raising awareness that river levels may rise and fall quickly due to irrigation releases and environmental watering. - Notification processes for environmental water delivery clarify the role of environmental water in river operations - Environmental water engagement plan also improves understanding of environmental water actions - Undertake state-wide programs to increase environmental water understanding - Rates of rise and fall of releases managed to avoid rapid changes, except in flood emergencies when significant notification processes led by SES are undertaken.	Storage operator (&WGCMA) WGCMA (& Storage operator) WGCMA VEWH Storage operator	Unlikely	Minor	Low	Dynamic
Environment	Insufficient water available to undertake planned environmental release actions.	Unlikely	Moderate	Low	• Undertake planning that considers the range of seasonal conditions or water availability scenarios that may unfold. • Manage carryover and consider trade as options to lessen the risks posed by supply shortfalls. • Consider options that combine environmental water with other sources (e.g. consumptive water en-route or withheld passing flows) to achieve hydrological objectives • For Thomson optimise passing flows in July/August to create water savings for use later in the season, including consideration of risk allocation for environmental and consumptive entitlement holders. (May require revision to OA document). - *Not for 22-23, further analysis planned for 22-23* *- residual risk based on 22-23 environmental conditions after widespread overbank flows*	WGCMA VEWH/ WGCMA WGCMA	Unlikely	Minor	Low	Dynamic
Environment	Debris from bushfires, including ash, or erosion from drought affected areas may enter reservoirs or waterways, leading to adverse environmental impacts	Unlikely	Moderate	Low	• Monitor ash related water quality issues and adjust environmental water releases as required to mitigate impacts	WGCMA	Unlikely	Minor	Low	Dynamic
Reputational	Insufficient resources available (including staff, funding for maintenance of roads, regulators etc), across partner organisations to deliver some planned environmental watering actions, leading to cancellation or interruptions of deliveries. *Note: Cumulative impacts of repeated cancellation may increase risk*	Unlikely	Moderate	Low	• Partners notify the CMA and VEWH of resourcing constraints in advance of deliveries and VEWH convenes meetings to consider implications and potential solutions, including seeking access to additional funding. • Continue to actively prioritise actions to match available resources and ensure key actions are delivered. • Reallocation of tasks and available funding. *- residual risk based on 22-23 environmental conditions after widespread overbank flows*	VEWH WGCMA WGCMA	Unlikely	Minor	Low	Static
Safety	Environmental watering generates or spreads a BGA bloom resulting in human health risks	Unlikely	Minor	Low	- Warning signage and notifications - Consider amending delivery plans to reduce risks - Activate and participate in regional BGA coordination process	Land manager WG CMA DELWP Gippsland	Unlikely	Minor	Low	Static
Business Costs	Inaccurate forecasts (underestimate) of tributary inflows may result in environmental flow targets being exceeded at the delivery site, with more environmental water released than necessary	Likely	Minor	Low	• Investigate options for improved control of releases to better match actuals to ordered flows. • Use best available forecasting of tributary flows to determine required releases.	Storage operator	Unlikely	Minor	Low	Static
Environment	Rapid filling of Heyfield Wetlands in dry conditions may lead to slumping of wetland pond banks, impacting on environmental values of the wetlands.	Unlikely	Minor	Low	• Monitoring will be undertaken during deliveries to detect any signs of slumping and pumping rates will be reduced if necessary. • Selection of water entry point in the rocky side of the pond to further prevent slumping/erosion	GW	Unlikely	Minor	Low	Dynamic
Business Costs	Inaccurate forecasts (underestimate) of tributary inflows may result in environmental flow targets being exceeded at the delivery site, with more environmental water released than necessary	Unlikely	Minor	Low	• Investigate options for improved control of releases to better match actuals to ordered flows. • Use best available forecasting of tributary flows to determine required releases.	Storage operator	Unlikely	Minor	Low	Static
Environment	Environmental releases may conflict with timing of recreational water-skiing events on the Latrobe River, leading to a reduction in environmental releases and inability to achieve environmental benefits.	Unlikely	Moderate	Low	• Communication and early advice of proposed ski events. • Review delivery plans and adjust schedules to reduce or avoid clashes with ski events	Storage Operator WGCMA	Unlikely	Minor	Low	Static
Environment	Constraints to environmental releases such as limited river channel capacity (and risk of flooding private land) constrain environmental releases, leading to a failure to achieve environmental objectives Reach 5 - Killmany constraint and tidal influence results in varying constraint (900 ML/d to 2,000 ML/d) - Note: Risk assessment based on env conditions in 2022-23. Need to review if drier conditions emerge and persist	Possible	Minor	Low	• Develop strategy and negotiate applicable agreements covering inundation of private land. • Development of cautious release plans designed to avoid overbank flows. • Monitoring of events and providing feedback to the storage operator for adjustment of releases to avoid overbank flows, particularly where landholder agreements are not in place. • Development of a strategy to address environmental flow limits.	WGCMA	Unlikely	Minor	Low	Dynamic
Environment	Dry seasonal conditions and low inflows may lead to a suspension of minimum passing flows requirements at Maffra Weir. Reversion to release of very low natural inflows may constrain the ability to undertake	Unlikely	Moderate	Low	• Modify watering strategies to incorporate options for supplementing baseflows during periods of reduced passing flow releases in very dry years. • Proactive communications between SRW, GW and WGCMA to forecast expected changes to passing flows	WGCMA SRW	Unlikely	Minor	Low	Dynamic

	desired environmental release actions, and may also lead to water quality issues.									
Safety	Negative community sentiment in relation to government decisions/actions creates a safety risk for staff involved in environmental watering actions **This is state wide risk, but may not apply in all systems - the risk rating will reflect local risk levels*	Possible	Moderate	Medium	- ensure staff are alerted to warnings about violent members of public - Strategic Communication of benefits of e-water and concern over safety to wider public (with co-ordination between partners) - ensure safe operational procedures for staff are followed, including staff training	All	Possible	Minor	Low	Static
Reputational	Trade of environmental allocations (available in Blue Rock) which is unable to be delivered in average - wet conditions due to delivery constraints in the Latrobe R creates a perception that additional environmental water is not required, potentially impacting the ability to secure additional e-water entitlements. **Note: rated unlikely as trades may not occur in 22-23*	Unlikely	Major	Low	- In VEWH Trade Strategy, communicate details of the delivery constraints hampering environmental deliveries which lead to decision to sell allocation in this system. - Communicate reasons for trade of water to local interest groups and community *- residual risk rating based on 23-24 conditions*	VEWH WGCMA	Unlikely	Moderate	Low	Dynamic
Service delivery	Wet seasonal conditions cause damage to or build up of debris on infrastructure, impacting the ability to deliver environmental water. *NEW RISK: SRW/WGCMA - this could be service delivery or environment risk category - please advise and also review consequence rating*	Unlikely	Moderate	Low	- Undertake debris clearing or conduct repairs as soon as possible and advise waterway manager of outcomes	SRW	Unlikely	Minor	Low	Dynamic