Implications of the clean energy transition for waterways: a case study of the Latrobe River, Victoria

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Key points

- The transition to clean energy has many potential implications for stream management.
- The Latrobe River (Durt'yowan) in Victoria, described as a working river, has been subject to decades of water extraction, river modification, land use change and declining water quality.
- The West Gippsland Catchment Management Authority is working to harness the energy and aspirations of agencies, Traditional Owners, industry and community groups to collectively respond to the moment, aiming for long-term transformational change in the river at an unprecedented scale that combines water recovery, targeted infrastructure, geomorphic and ecological restoration initiatives.
- The Latrobe River provides a case study of the surprising challenges of the clean energy transition which will radically change the distribution of water in the catchment but also offer a once-in-a-lifetime opportunity to change the trajectory from a working river - to a river that works again.

Abstract

Australia's transition to clean energy will have major implications for waterway management that are only now emerging. In this paper we explore how the transition away from coal mining in the Latrobe Valley has the potential to both heal and harm the Latrobe River.

The Latrobe River (Durt'yowan), once described as a working river, has been subject to decades of water extraction, river modification, land use change and declining water quality. Coal mine remediation, increasing demand for water and climate change will intensify pressure on the environmental, cultural, social and economic values of the river system, which is the largest tributary of the internationally significant Gippsland Lakes.

The energy transition offers a once-in-a-lifetime opportunity to change trajectory from a working river - to a river that works again. However, business as usual approaches and recurrent funding are insufficient to address the scale, complexity and interconnectedness of threats facing the River.

The West Gippsland Catchment Management Authority (WGCMA) is working to harness the energy and aspirations of agencies, Traditional Owners, industry and community groups to collectively respond to the moment, aiming for long-term transformational change at an unprecedented scale that combines water recovery, targeted infrastructure, geomorphic and ecological restoration initiatives. Progress has been made, but there is much work to do.

The Latrobe River provides a case study of the surprising opportunities provided by the clean-energy transition for waterway management. It also shows how, if not well managed, the clean energy transition could lead to further degradation of the river.

Keywords

Latrobe River, Gippsland Lakes, mine rehabilitation, clean energy transition, river restoration

Introduction

Australia's transition to clean energy will have major implications for waterway management that are only now emerging. We could imagine that the clean energy transition could improve waterways through reduced emissions, catchment revegetation, and river restoration, but we could also predict increased erosion, sedimentation, altered flows, water extraction, and habitat disturbance from coal mine rehabilitation, renewable infrastructure, transmission corridors, pumped hydro, and critical minerals mining. In this paper we explore how the transition away from coal mining in the Latrobe Valley has the potential to both heal and harm the Latrobe River.

Located in Gippsland, Victoria, the Latrobe River (Durt'Yowan) system is central to the region's environmental health, cultural identity and social wellbeing, making its restoration essential to securing Gippsland's future. The catchment comprises an interconnected network of rivers, floodplains, wetlands and estuarine environments that collectively sustain vital ecological processes and community values. The river and its wetlands form a cultural landscape of profound significance to the Gunaikurnai people, the Traditional Owners of the land and waters, whose ongoing cultural connections are intrinsically tied to the health of the river system. The river and its associated wetlands, including the Ramsar-listed Gippsland Lakes, also support rich biodiversity and provide critical habitat for numerous threatened species.

The resilience of the Latrobe River system has, however, been progressively undermined. Decades of water extraction, physical modifications, waste disposal, mine dewatering, changing land use and intensifying climate impacts have placed the river under sustained pressure. Hydrological modelling and ecological assessments have revealed that continued or increased water extraction, coupled with a drier future climate, will likely accelerate declines in environmental condition and the biodiversity that depends on it. These changes not only jeopardise ecological health but also threaten cultural values and the social fabric of communities reliant on the river system.

The transition of water use from power generation to mine rehabilitation represents a critical turning point. The transition creates an opportunity to improve long-term water outcomes for the river system. It also introduces significant risks if not guided by a coordinated and adaptive strategy. In particular, the filling of mine voids with river water, when layered on top of existing and emerging stressors, risks further constraining the ability to provide the water required to sustain critical ecological processes and the values dependent on them. These constraints are already evident in the lower reaches and wetlands, where salinity, habitat loss, and water quality issues are most acute.

In addition to flow-related concerns, the Latrobe River system is impacted by ongoing water quality pressures. Elevated nutrient and sediment loads, toxicant influxes, and ongoing land use changes have contributed to water quality degradation, algal blooms, and shifts in wetland vegetation, further diminishing the resilience of ecosystems, particularly in the river reaches and wetlands below major storages and coal mines.

Collectively, this evidence underscores the need for change. Business as usual approaches and recurrent funding are insufficient to address the scale, complexity and interconnectedness of threats facing the Latrobe River (Durt'Yowan) system.

The Latrobe River (Durt'yowan): Background

Geographic scope and connected ecosystems

The Latrobe River Basin covers approximately 4,700 km^2, extending from the southern slopes of the Yarra Ranges and Great Dividing Range to Lake Wellington (Figure 1). Major tributaries include the Tyers, Tanjil, Morwell Rivers and Traralgon Creek, along with smaller waterways such as Waterhole

Creek, Narracan Creek and Moe Drain. This paper primarily covers the mid-to-lower Latrobe system downstream of major storages and under the influence of existing and future coal mine rehabilitation.

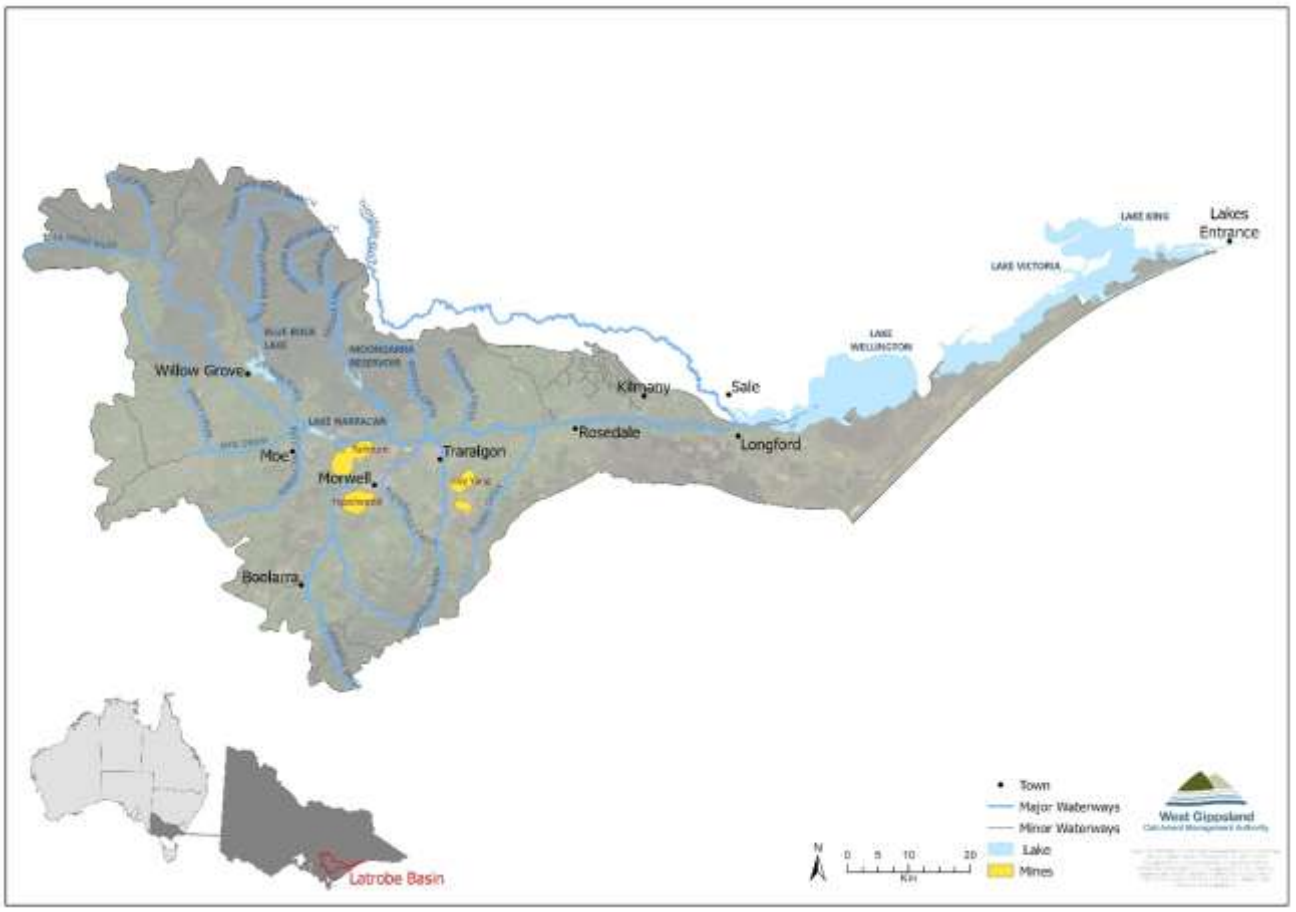

Figure 1 Map of the Latrobe River basin

Ecological values

The Latrobe River system supports significant ecological values along its watercourses and wetlands including (Alluvium, 2020):

- The Gippsland Lakes Ramsar site, a wetland of international importance listed for its waterbird, fish and native vegetation values;
- Riparian vegetation communities including largely intact Damp Forest, Wet Forest and Riparian Forest in the upper reaches and endangered Floodplain Riparian Woodland in the mid to lower reaches;
- A diversity of native freshwater and estuarine fish species, including several diadromous species including the nationally vulnerable Australian Grayling.
- A diversity of frog species including the nationally vulnerable growling grass frog and green and gold bell frog and an abundance of waterbirds, which occur along the rivers and estuaries, but are more numerous in the wetlands of the system.
- The Lower Latrobe wetlands also support a number of international migratory species, listed under migratory bird treaties whilst the River and tributaries support platypus and rakali as well as several species of freshwater turtle.

Cultural values

The Latrobe River (Durt'Yowan) system is situated across the traditional lands of multiple Traditional Owner groups. The majority of the catchment, and the focus areas of the strategy, are situated within Gunaikurnai country.

*"Our Country possesses a rich Aboriginal culture. Our heritage is strong across our landscape, and Aboriginal cultural sites and artefacts can be found along our songlines, and trade routes, mountain ridges and waterways. They remind us about the ways of our ancestors and show our close and continuing connection to Country" (*GLAWAC, 2015).

Social and economic values

The Latrobe River system provides a wide range of social and recreational benefits, offering opportunities for boating, fishing, walking and nature-based tourism that support the region's liveability and community wellbeing. Its rivers, creeks and wetlands also offer important amenity, providing places for people to relax, enjoy nature and spend time outdoors. These waterways are closely woven into the identity of nearby towns such as Traralgon, Morwell, Rosedale and Sale, where communities particularly appreciate the recreational opportunities associated with the region's rivers, lakes and wetlands.

Community interest in the health of the Latrobe River and its wetlands is strong. Local Landcare groups, volunteer networks and environmental organisations actively participate in river health projects and advocacy for the river.

A brief history of evolving river management and contemporary threats

The Latrobe River system has been subject to a long history of catchment modifications designed to 'improve' the river and make it 'work' (Figure 2). Whilst significant land clearing for agriculture commenced soon after European settlement in the region, direct modifications to the river commenced early in the late 19th century with the opening of Lakes Entrance (permanently connecting the Latrobe estuary with the sea) and shortly after the construction of the Moe Drain. The drainage precipitated a cascade of river modifications and further drainage works throughout the catchment in an attempt to rid the catchment of 'nuisance flooding', the implications of which are still being observed today.

Throughout the 20th century increasing development, including the establishment of the coal mine and power industry, combined with construction of large on-stream storages and increasing diversions for multiple uses resulted in compounding pressures on the river. Collectively, these changes have interrupted many of the natural river and wetland processes needed for a healthy ecosystem. Ongoing threats to the river system, mostly a result of these legacy modifications, are described below.

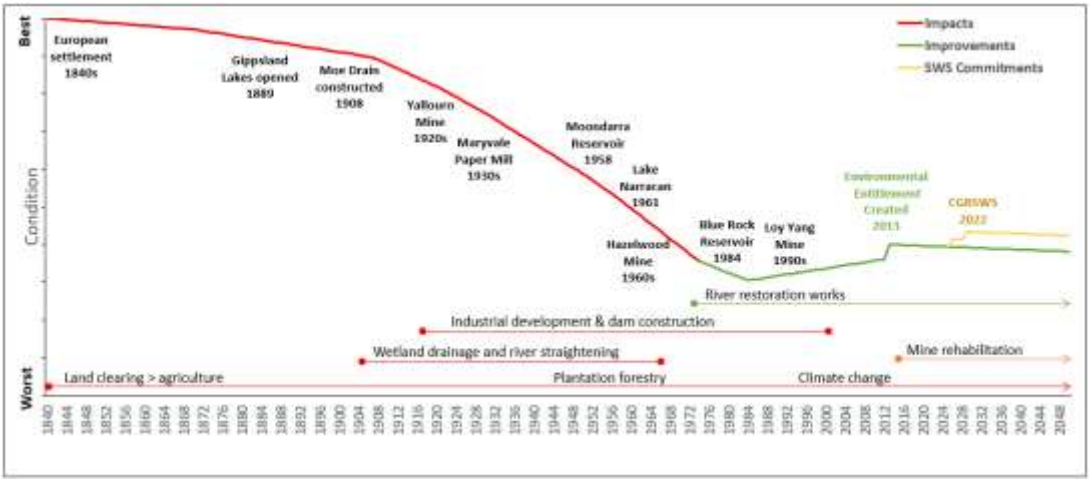

Figure 2 Timeline of major legacy modifications in the catchment overlayed on conceptual representation of river condition over time.

Water extraction and changing demand

Approximately a quarter of the total annual flow in the Latrobe system is extracted for consumptive use (DELWP, 2020), with power generation historically the largest user. Extraction proportions can be much higher in drought years (e.g., almost half of total flow in 2006/07), and lower in wet years. This variability means ecological stress can intensify precisely when ecosystems are most vulnerable.

The transition to mine rehabilitation, combined with emerging industrial demands and increasing urban and agricultural water use have the potential to exacerbate and 'lock-in' existing water pressures.

Climate change: Less rainfall, more evapotranspiration, much less runoff

High resolution climate change projections for the Latrobe Valley (Jacobs et al. 2017) projected the following aggregated changes in hydroclimate variables relative to the baseline period of 1975 – 2014:

- Increase in average annual temperature.
- Increase in annual potential evapotranspiration.
- Decrease in annual rainfall
- Decrease in annual runoff including extended low-flow periods, reduced freshes, and fewer overbank events that sustain floodplain and wetland processes.

Altered hydrology and connectivity (lateral and longitudinal)

Whilst many upper reaches of the catchment in the alpine areas remain in good condition and exhibit natural hydrological regimes, the hydrology of mid to lower reaches has been significantly altered. Major storages, diversions and farm dams have significantly altered both the quantity and timing of flows in the river.

Figure 3 highlights the step change in flows from the late 1990's (Millenium drought) including a significant reduction in bankfull and overbank flows and subsequent disconnection between the river and its floodplains and connected wetland ecosystems.

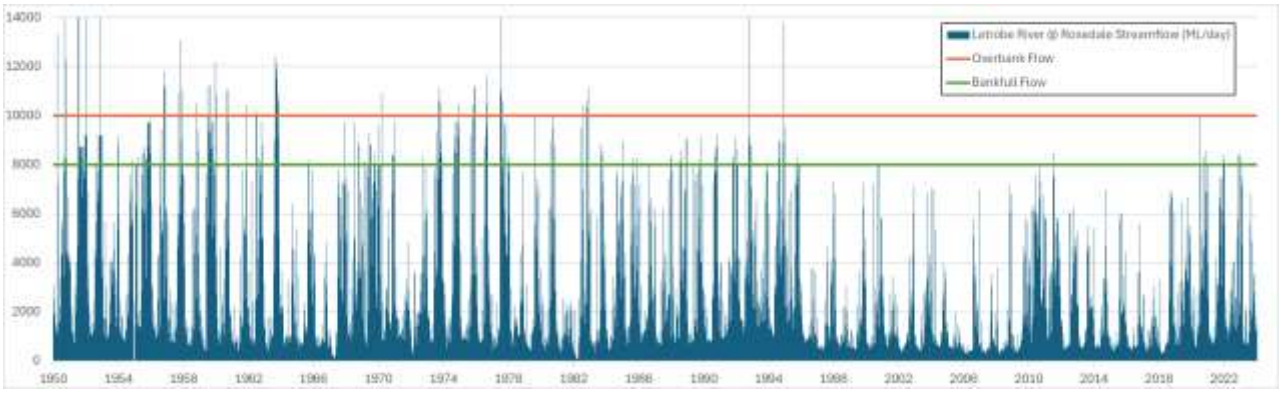

Figure 3 Hydrograph of daily flows in the Latrobe River @ Rosedale (ML/day) and flow thresholds for bankfull and overbank flows

Channel and floodplain modification

Major changes to the geomorphology of the Latrobe River have occurred in the long, alluvial, meandering tract of the river downstream of Lake Narracan. This is predominantly a sand bed system that has been dramatically affected by at least 66 meander cut-offs in between Yallourn and Lake Wellington (Reinfelds et al. 1995). This has reduced channel length by 25% and subsequently increased slope and stream energy. It has also undergone major 'desnagging' or wood removal since the 1930s. The consequences of these changes is a two-thirds increase in channel capacity, much larger bankfull flows, and a three-fold decrease in overbank flows.

Salinity intrusion and estuary–lake–wetland dynamics

Salinity in the Latrobe Estuary and Lake Wellington is shaped by the balance between freshwater inflows and marine incursions through the Gippsland Lakes system. Under prolonged low flows, saline water can extend far upstream (Brizga et al. 2013). However, in-channel freshes can flush salt from the upper layer of water and an increase in volume or duration can result in a fully flushed water column in the estuary. These interactions have important consequences for the long-term health of the Lower Latrobe Wetlands which are at risk of increased salinization (Hale, B., & Boon, P. 2022).

Water quality pressures

The Latrobe River is a dominant nutrient and sediment source to the Gippsland Lakes. These nutrients and sediments are a significant contributor to water quality issues, including algal blooms, in Lake Wellington and through to Lakes Victoria and King.

The clean energy transition: A new threat or a "once-in-a-lifetime" opportunity?

The Latrobe Valley's transition away from coal-fired power generation is creating a major structural shift for the community, the economy and the environment. The scale of change is substantial. It is now likely that the Latrobe Valley will be home to three large pit lakes with a combined volume of ~2,200 GL. This is equivalent to 4.5 times the average annual flow in the Latrobe River (also about 4.5 Sydney Harbours). Each pit is likely to take 10-30 years to fill depending on climate and water availability.

Most of the water for mine rehabilitation is likely to be sourced from the river over the coming decades. At the same time, new large water users may also enter the system, as well as increasing demand from the urban and agricultural sectors plus climate-driven reductions, all point to a heightened risk of ecological decline without deliberate coordination. Even when full, the evaporative losses, water quality and geomorphological risks from the pit lakes will need to be managed carefully in perpetuity.

The energy transition also creates a rare opportunity, as major entitlements and infrastructure arrangements are renegotiated and redesigned. New and emerging opportunities through strategic and statutory planning processes include:

- The *Central and Gippsland Region Sustainable Water Strategy* (DELWP, 2022) acknowledged the significant environmental water shortfall (129GL/annum) in the Latrobe River and provides important policy signals to pursue water recovery opportunities. These include opportunities from the redistribution of water no longer required for power generation in the short term, and potentially larger volumes post mine rehabilitation in the long term.
- The Latrobe Valley Regional Rehabilitation Strategy (LVRRS)(DJPR, 2000) sets the Victorian Government's strategic guidance for rehabilitation planning and the LVRRS Amendment (DEECA, 2023) provided important guidance on the water access arrangements for mine rehabilitation to minimise the impacts on the River system and other users. Subsequent work (Ricardo, 2025) has determined an appropriate price for potential surface water access entitlements for mine rehabilitation.
- The above strategic work has set important guidance for ongoing statutory processes such as Environmental Effects Statements and Bulk Entitlement applications, for which the WGCMA have been proactively participating to minimise impacts and where possible improve the River's health.
- Further, a recent announcement by the Victorian Government will see the establishment of a fund, generated by the revenue from water used for rehabilitation. The fund will support the local community through the transition phase including investment in waterway health and the long-term resilience of the Latrobe River system.

Alongside the formal statutory processes, the WGCMA has enhanced efforts to engage and harness the momentum of stakeholders and community groups including:

- mine operators to raise awareness of River management challenges and seek opportunities to improve River health outcomes throughout the mine rehabilitation life-cycle;
- foster collaboration between regional water sector partners and Tradional Owners to set regional-led priorities and embed environmental and cultural outcomes that support investment in system-scale connectivity and habitat restoration projects to build resilience into the river system for future generations; and,
- proactively supporting community and organisational literacy through initiatives such as the release of a short film: Durt'yowan – The Life Source. The transition processes have solidified community driven advocacy for the River, and the strategic and statutory processes running concurrently have benefited from their input.

This collective momentum aims to seize a once-in-a-generation opportunity to change the trajectory of the River, from a working river that has been progressively degraded, to a river that works again through restored processes, improved flows, and community driven partnerships.

Meeting the moment: Preparing an integrated strategy for transformational change

The WGCMA is working to harness the energy and aspirations of agencies, Traditional Owners, industry and community groups to collectively respond to the moment, aiming for long-term transformational change at an unprecedented scale that combines water recovery, targeted infrastructure, geomorphic and ecological restoration initiatives.

The strategy builds on existing work, eg. Alluvium (2022), by improving the science underpinning proposed management options and developing a prioritisation and sequencing framework to ensure future investment is well targeted and will achieve stated objectives. Figure 4 presents a summary of the works and measures being proposed in the strategy.

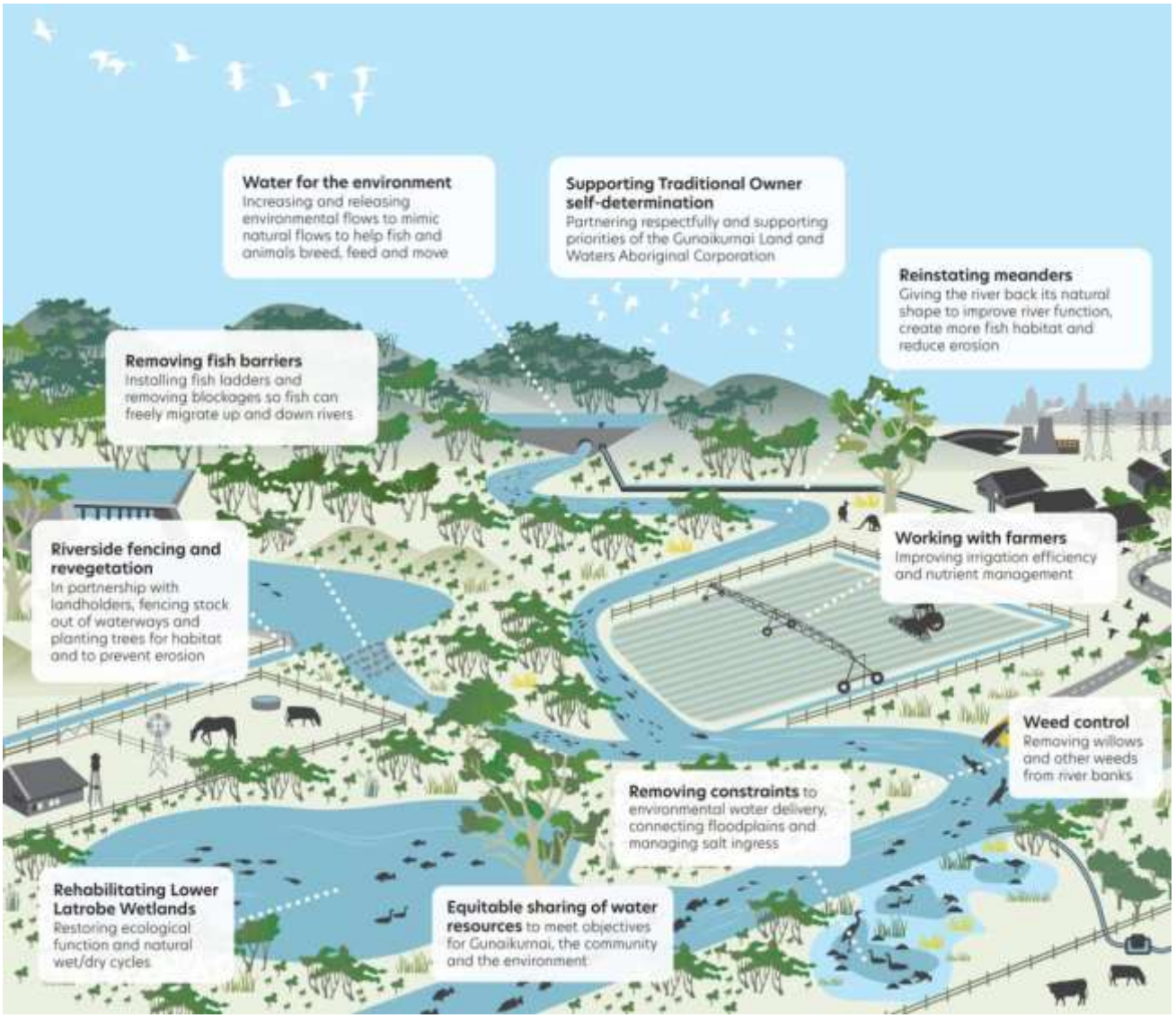

Figure 4 Summary of works and measures required to restore health to the River

Conclusion: From a working river to a river that works again

The Latrobe River system is at a critical juncture. Legacy physical modification, water extraction, poor water quality, and increased salinity pressures are now intersecting with climate change and the water demands of mine rehabilitation and potential new and expanded industries. Without coordinated action, the likely trajectory includes more frequent salt intrusion, reduced freshwater wetland habitat, declining water quality and biodiversity, particularly in the estuary and Lower Latrobe Wetlands.

In the context of "living and evolving with change," the WGCMA is working with Traditional Owners, agencies and the community to harness the opportunities of the clean energy transition in the Latrobe Valley to transform riverscapes: aligning rehabilitation, water governance and ecological restoration so that the Latrobe River can work again as a living system central to supporting the future prosperity of the region.

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