

Pilbara

Water Resources Situational Analysis

DRAFT

Prepared for
BHP Western Australian Iron Ore
by Curtin University, RFF Pty Ltd and Winyama Pty Ltd

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Curtin University



Acknowledgements

We acknowledge the First Nations People of the Pilbara region and their continuing connection to Country and culture. We pay our respects to their Elders past and present and extend that respect to all Traditional Owners who continue to live in a spiritual and sacred relationship with this country.

We thank all stakeholders who participated in the engagement process and shared their valuable insights with the project team.

This project was undertaken as a collaboration between Curtin University, RFF Pty Ltd and Winyama Pty Ltd. The project team included specialists in various fields (water, environment, Aboriginal studies and economics) and was supported by consultants with expertise in regional planning, resource management, engagement, and geographic information systems.

The report was prepared with funding support from BHP, in the context of its vision for a 'water secure' world by 2030, an aim consistent with the United Nations Sustainable Development Goals. A world where water resources are conserved, and their resilience protected so they can continue to support healthy ecosystems, maintain cultural and spiritual values, and sustain economic growth. BHP initiated this process of engagement with key stakeholders with a direct interest in water in the regions where BHP Western Australia Iron Ore operates. The aim of sharing the results of the WRSA is to stimulate opportunities for coordinated collective action on water, by helping build a common understanding of the shared water challenges and stakeholder priorities with other water users.

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Introduction

Water is a critical resource in the Pilbara region of Western Australia, a vast and diverse landscape that has been home to more than 31 Aboriginal language groups for at least 50,000 years. It is also home to globally significant mining and energy production, which represented 3.1% of Australia's Gross Domestic Product (GDP) of \$1.985 trillion in 2020.¹

The allocation, use, and relocation of water are major components of the Pilbara's economic activity. Thus, all sectors of the community face a range of water-related challenges. A Water Resources Situational Analysis (WRSA) is one way of documenting these challenges. It combines a review of documented information and stakeholder insights to identify water-related values, challenges, and opportunities.

As such, it aims to foster more dialogue between any stakeholders with an interest water stewardship in the Pilbara, and hopefully provide a platform for reform.

This document includes an overview of the Pilbara region and associated water resources and outlines the approach taken in developing this WRSA. The process involved a review of publicly available information and engagement with stakeholders. The findings of this review are presented. Further, the document identifies potential collective actions.

¹ Remplan- Pilbara Development Commission

What is a Water Resources Situational Analysis?

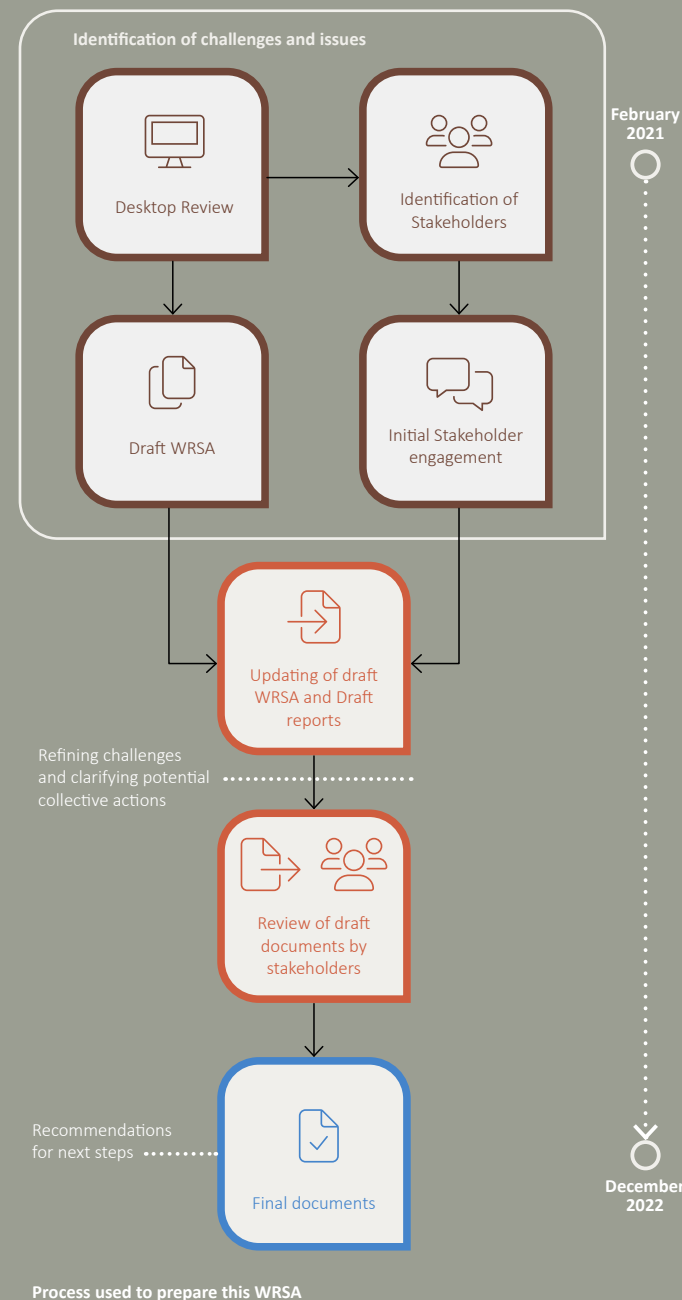
This document identifies the water challenges and potential collective impact opportunities based on a review of available information, specialist knowledge, and interviews with key stakeholders in the area. It provides a further basis for understanding the catchment context, existing, planned, and potential future water challenges and identifies potential collective impact opportunities.²

This analysis is an initial step in a longer-term journey to foster enhanced water stewardship across the region. It begins an on-going dialogue with stakeholders around collective impact opportunities. Water stewardship means that water use is "socially and culturally equitable, environmentally sustainable and economically beneficial, achieved through a stakeholder-inclusive process that involves site- and catchment-based actions."³

"Good water stewards understand their own water use, catchment context and shared concerns in terms of water governance, water balance, water quality and important water-related areas; and then engage in meaningful individual and collective actions that benefit people, the economy and nature."⁴

Shared water challenges may be related to a broad range of issues, such as the following: access to water; cultural, social and economic values of water; flood risk; industrial, agricultural and domestic water demands; impacts on water quality and quantity; and effects on water-related ecosystems. WRSAs are new at both the global and Australian scale. The United Nations Global Compact CEO Water Mandate⁵ and the Alliance for Water Stewardship drafted guidelines for developing a WRSA.⁶ The development of a WRSA for the Pilbara region drew on insights from these guidelines and followed the process shown in the adjoining diagram.

It is essential to acknowledge that while we consulted a range of stakeholders, only very preliminary engagement was undertaken with Traditional Owners on water use and management as part of this process. This preliminary consultation highlighted the need for deeper, ongoing engagement with Traditional Owners to explore options for shared decision-making about water use and the management of these important resources. Further details on the preparation of the WRSA are provided in **Appendix 1**.



The Pilbara Region

Its environment,
water, people and
economy



Environment

The Pilbara bioregion is a vast and ancient area, extending over 178,060 km² from the Indian Ocean in the west to the Great Sandy and Little Sandy Deserts in the east. It includes a diverse range of geographical landscapes, including mountain ranges, stony plains, intertidal flats, and archipelagos. The region is known for its spinifex-covered plains, rugged ranges, plunging gorges, iron-rich geology, granite plains, and abundant wildlife.

In broad terms, the ecological systems of the Pilbara bioregion include the following:

- The coastal zone, comprising the alluvial plains and offshore islands (Roebourne subregion);
- The Pilbara tablelands, roughed basalt uplands and granitic plains of the Chichester Range (Chichester subregion);
- The banded-iron formation uplands and elevated plateau of the greater Hamersley Range (Hamersley subregion); and
- The low-lying alluvial plain, flats, and samphire marsh with supporting freshwater wetlands and riparian systems of the Fortescue Valley (Fortescue subregion).

Transecting all four subregions is a network of permanent and ephemeral river systems. The most significant are the De Grey, Turner, Yule, Robe, Cane and Fortescue rivers, as well as the headwaters of the Ashburton River.

These subregions contain significant elements of biodiversity and ecological diversity. There has, however, been a widespread decline in biodiversity,⁷ resulting from the following factors: rapid growth of mining and associated infrastructure; an increase in the regional population; replacement of traditional Aboriginal burning practices with more frequent and intense fire regimes; introduced predators (such as feral cats); competition from grazing livestock and feral herbivores (e.g., donkeys, camels); the spread of ecosystem transforming weeds (e.g., buffel grass, ruby dock, caltrops); altered hydrology; and habitat fragmentation associated with land degradation and clearing.

Climate

The climate in the Pilbara is hot and arid. Generally referred to as the 'arid tropics,' it is characterised by periods of dryness and extreme temperatures (average daily maxima exceed 35°C from October to March) and high levels of evaporation (that can exceed 3,000mm per year), followed by infrequent cyclonic and rain-bearing tropical conditions. These conditions drive flooding events, which provide periodic stream flow and help recharge groundwater aquifer systems across the region. Climate change scenarios suggest that the region will be hotter in the future, but rainfall estimates are not as clear because of modelling uncertainties over the frequency and intensity of cyclones.⁸

People

Aboriginal people were the first humans to have custodianship of the Pilbara. There is clear evidence of continuing occupation of the region dating back over 50,000 years. Their connection, custodianship, systems of land ownership, and land and water management continue, despite the colonisation of Western Australia and the Pilbara, which began in the early to mid-1800s. People of Aboriginal and Torres Strait Islander descent represent approximately 14% of the estimated residential population of over 60,000 people in the Pilbara region.⁹ This proportion is significantly higher than the 3.1% recorded for the Western Australian population in total.

The Pilbara's largest population centres are Karratha and Port Hedland, followed by the smaller towns of Newman, Tom Price, Onslow, and Marble Bar. The region is one of Australia's most important and productive resource regions. Its two-sector economy features development of high-grade iron ore deposits and offshore gas reserves, alongside other industries, such as pastoralism, irrigated agriculture (currently as adjuncts to mining operations to use excess mine water), solar salt production, and nature-based and cultural tourism.

⁷ A Biodiversity Audit of Western Australia and Pilbara Conservation Action Plan

⁸ Charles et. al., 2015 Hydroclimate of the Pilbara: past, present and future.

⁹ ABS, 2016 census

Impacts of dewatering

In 2021, the total volume water license allocation in the Pilbara was over 700GL per year, with about 100GL for irrigation and public water supply. Most of the balance is licensed for mining operations and mineral processing, although at many locations this volume is not fully taken up.¹⁰ While the exact volume extracted for mining purposes in 2021 is not available, it is estimated to be 60-80% of the licenced volume, yielding 360 to 480GL per year.

About one-half the groundwater extracted at mine sites is used for mining operations, with much of the balance returned to the environment through aquifer reinjection or discharge to creeks. The level of water extraction resulting from industrial and population growth was estimated in 2014 to grow to over 700GL per year by 2042 (under a medium-growth scenario) and to over 900GL per year (under a high growth scenario).¹¹ As a broad comparison, these extraction levels can be compared to the amount of water provided by the Water Corporation to the greater Perth metropolitan area: which is some 264GL per year for a population of approximately 2 million people.

The modification of hydrological regimes resulting from water extraction (both extraction and subsequent disposal) can change the quality of both groundwater and surface water, thus potentially affecting cultural and environmental values both in specific locations and in contributing to wider cumulative impacts.

Economy

The most recent figures from Remplan¹² estimate that the region generates \$88 billion of output annually. In total, \$70 billion comes from the iron ore and liquefied natural gas industries (which equates to 70% of Western Australia's mineral and energy production). As an indication of the dominance of mining in the regional economy, more than one in three workers who live in the Pilbara are employed in mining (35.8%), compared to 6.6% for Western Australia overall. The Pilbara makes a significant contribution to national wealth, representing 19.7% of Western Australia's Gross State Product (GSP) of \$316.324 billion, and 3.1% of Australia's GDP of \$1.985 trillion.

Water

The CSIRO undertook a comprehensive assessment of water resources of the Pilbara region in 2015.¹³ Prepared for the Government of Western Australia and industry partners, it provided an overview of the contemporary and future climate and water resources of the Pilbara to aid water planning and management.

This detailed assessment, complemented by work by the Western Australian Department of Water and Environmental Regulation in water-allocation planning, establishes the governance framework for water resource management in the region.

Water availability in the Pilbara is highly dependent on climatic conditions dominated by tropical cyclones. The region's low rainfall and high evaporation levels are compounded by the tendency for long periods of drought followed by unpredictable and extreme flooding. Episodic flooding is crucial to replenishing the region's groundwater aquifers and recharging surface water systems. As the number of cyclones and the amount of water they bring changes annually in this region, water is a highly variable and unreliable resource.

The influence of climate change will exacerbate this variability. The assurance of an ongoing supply requires long-term planning and adaptive management. Thus, there is a need for collaboration among communities, government, business, non-government organisations, and not-for-profit organisations to meet current water needs in a responsible manner, while safeguarding water supplies for future generations.

There is a need for an understanding of the large-scale natural water systems of the Pilbara by acknowledging three different geographical perspectives:

- **River systems and catchments:** representing the volume and nature of water entering and exiting the Pilbara's surface and groundwater systems;
- **Subsurface hydrogeology:** demonstrating how water moves through groundwater systems;
- **Water quality distribution:** characterised by levels of salinity of surface and groundwater systems (influenced by the distance from the ocean and salinity of the surface flows and discharge to groundwater).

All these distinct aspects of the Pilbara's water systems play an integral part in defining the region's ecological characteristics and biodiversity.

Many dimensions have significance beyond the physical attributes of the water systems. Critical to any deeper understanding is the importance of water as a feature of the Aboriginal cultural landscape. It has symbolic, cultural, and physical dimensions that create bonds of attachment for individuals and groups to specific water features. Aboriginal people conceptualise water sources and rivers as deriving from the actions of mythic beings during the Dreaming (when the world was soft).¹⁴ An essential component of the journey towards better stewardship and caring for water is the recognition of the cultural significance of water and the importance of specific places.

Perspectives

Insights from the information review and stakeholders

The Pilbara region faces some diverse water resource challenges. Some challenges are regionally significant, whereas others are subregional or locally focused. They extend across cultural, social, environmental and economic domains. The review of publicly available information and the stakeholder engagement process highlighted several important challenges that require ongoing focus and attention, along with a range of the potential collective impact opportunities. These are discussed following.

Challenges, causes and drivers

The diagram below illustrates the challenges, causes, and drivers raised by stakeholders in the engagement process.



Discussed below are issues associated with water resource management, along with potential underlying causes, that were identified in the information review and the stakeholder engagement process. Unattributed and anonymised quotes are provided to highlight the sentiments expressed in the stakeholder engagement process.

Dewatering and Surplus Water Management

The extent of dewatering and subsequent management of the surplus water is a matter of growing concern. The modification of hydrological regimes from water extraction and subsequent disposal can affect groundwater and surface water regimes, and, potentially, water quality.

Dewatering can affect the cultural and environmental values of water, both in specific locations and in contributing to wider cumulative impacts. It is beyond the scope of this investigation to quantify the extent of this issue. However, the stakeholder engagement process provided a clear indication of concern that the volume of water extraction is increasing, as mining operations move into new areas (and require greater volumes of dewater per unit of ore extracted).

“Managing surplus water (from dewatering) is probably the biggest ticket item we have. There is lot more surplus water than there is need for other mining processes. You have to get it back in the ground and demonstrate it's not having a direct impact and / or a cumulative impact on receiving environments. The volumes involved are of a state significance.”

Cumulative impacts of mining and dewatering

The cumulative impacts of mining and dewatering are key issues of concern at local, subregional, and the broader landscape scale because of the interconnected nature of the complex systems involved. An expressed view is that often there is a lack of baseline knowledge to help decision makers understand the impacts of past water extraction, ongoing extraction, and the increasing levels of extraction. Further, unresolved questions remain about the level of skills, science and knowledge and the suitability of tools for a cumulative impact assessment. There is a need to understand how to address these issues from a regulatory perspective. Stakeholders expressed a common view about the wisdom of revisiting previous attempts to address specific cumulative impacts (e.g., the Fortescue Marsh). The last broad-scale cumulative impact assessment identified by this process was undertaken in 2014 by the Western Australian Environmental Protection Authority (EPA).¹⁵ The CRC TiME¹⁶ reviewed approaches to cumulative impact assessment, which provides a basis for potentially developing a systematic approach to this challenge.

“There are not only the cumulative impacts now, but the intergenerational factor ...it's about the sum of all those parts over whole area and over time. I think that's really important, the intergenerational cumulative impacts influencing the hydrological regime.”

¹⁵ Cumulative environmental impacts of development in the Pilbara region

¹⁶ CRC Time - transformations in Mining Economies

Deficiencies with data sharing and knowledge

A related issue is a perception of the 'absence' of water resources baseline data to establish a comparative reference point for informing sustainable and reliable water resources management. Despite the vast array of water related scientific investigations undertaken for industry (e.g., hydrogeological and engineering) very little has been published or is in the public realm. Its release will require regulatory reform and/or requirements for data sharing. Further, it will be essential to overcome real and perceived limitations to data sharing from an anti-competitiveness perspective to resolve this challenge.

"The story about access to baseline data has been around for a long time. There needs to be a real focus on getting shared data to understand how water extraction is sustainable, what are the impacts on the environment with continued and growing extraction rates. I just think that's a real data sharing and availability gap and there needs to be focus on this area."

Emerging conflicts around water

The water-related environmental values and the cultural needs of the Traditional Owners are increasingly coming into conflict with the water-management needs of the mining sector. Some stakeholders expressed concern about growing competition among the mining industry, agriculture, pastoralists, and horticulture. An uneven economic power differential exists between the different sectors, for example, pastoralism versus mining. More sophisticated management regimes across the region are required.

"There are a whole lot of emerging conflicts. There are non-productive, cultural views of how the landscape and water systems should be. And you got all these other people who want water, pastoral stick their hands up, the horticulturalists stick their hand up. For example, 20 Giga litres of mining water produces 50 mega tons a year of iron ore. Whereas 20 Giga litres of water per year produces how many head of cattle?"

Need for legislative reform

This review revealed that stakeholders regard current legislation as out of date and urgently needing amendment. Although a Water Reform Bill is currently being developed, participants were concerned that any change is seen as incremental at best. All sectors agree that this is a significant issue and further reform is needed to provide a legislative and regulatory framework that would enable the many ongoing water resource management challenges to be addressed.

"The challenge we all have is with the regulatory environment because the legislation is so out of date, and, you know, problematic. Industry can help by encouraging the reform of the regulatory and legislative environment to be updated. A collective voice from industry might move it in the right direction."

Cultural values of Traditional Owners

Water is an important feature of the Aboriginal cultural landscape, with symbolic, cultural, and physical dimensions that attach individuals and groups to specific water features. A significant challenge relates to valuing the cultural perspective of Traditional Owners, including the protection and intergenerational management of cultural assets. Going forward, it is important that all processes respect the principle of free, prior, and informed consent of Aboriginal heritage, culture, and connection to Country. Stakeholders suggested considering the cultural values and impacts on these values as an important lens through which to see actions flowing from the WRSA.

"Many TO groups are favourable to mining.... but they can see the degradation of the environment, particularly from below water table mining. They want us to do better. They can see that mining is a short-term proposition, and it won't last forever, so they are looking for intergenerational solutions."

Monitoring and mitigating damage to natural systems

Closely aligned with data sharing are issue monitoring and mitigation. There is a need for a more proactive approach to understanding how ecosystems respond to changing conditions. Enhanced scientific understanding is needed of the impacts of mine dewatering on natural systems via more sophisticated monitoring and mitigation of identified impacts. Critically, the interconnected and complex nature of landscapes and water systems must be acknowledged. They must be regarded as functioning as a whole. To achieve this, increased emphasis is required on considering groundwater dependent ecosystems (GDEs) and the impact of water displacement, not simply confined to a mine site or its immediate surrounds. The broader landscape must be considered.

"Just imagine that you identify through hydrological modelling that the groundwater level is going to drop by five centimetres every year for the next 20 years in such and such ecosystem. Now tell me exactly what the implications of that are for the vegetation growing on it, and they wouldn't know. We wouldn't know because nobody would know.... There needs to be a proactive approach to understanding how ecosystems respond to changes and then plan for the impacts."

Water management in relation to the townships and settlements

On the local scale, participants reported concerns associated with water management in relation to the townships and settlements. For example, water quality concerns in some locations and opportunities to enhance the amenities of townships with appropriate greening programs.

"We have a strong desire to improve the amenity and improve the image of Pilbara towns. If we want more tourists, we need to enhance the amenity for locals and tourists- more recreational resources like park(s) and water playgrounds."

Post-mining landscapes

This issue relates to mine closure, mine pit voids, post-mining water systems, and mine rehabilitation and restoration. Although the physical extent of mining is small in terms of the vastness of the Pilbara region, the physical impacts are significant. Each mining operation is subject to its own approval conditions. The main challenge moving forward involves ensuring effective mine-closure planning and ensuring (from a water resources perspective), optimisation of post-mining land use and water use opportunities.

“There are more and more questions emerging about how we leave these post-mining landscapes. It used to be a given that there would be a pit and waste dump – that is just how mining is was the point of view – but now mine closure planning is requiring the sector to be more judicious about all end of mine land uses, water quality in pit lakes etc., etc.”

Proposals for integrated water management systems

Some stakeholders valued the notion of integrated water systems operated by a third party as a better way (than current approaches) of managing available resources and delivering productive use of excess water. This approach represents both a challenge for the proponents and an opportunity for a potentially more sophisticated and productive way of managing surplus water.

“More needs to be done to evaluate options for productive use of surplus water. It is likely to be financially positive for an agriculture operation that is near a mine than having to move the water very far away. As soon as you must move water, it becomes expensive. I think we need a better understanding of economics of these water opportunities and what economic development opportunities might emerge.”

Shared collective impact opportunities

The diagram below highlights key insights derived from the review and stakeholder engagement processes related to shared collective impact opportunities.



The potential opportunities for collective impact were derived by the specialist team from its review, along with insights provided by the stakeholder engagement processes. This material is offered to support further dialogue among stakeholders about progressing relevant initiatives. Unattributed and anonymised quotes are provided for emphasis about the opinions expressed.

Data and knowledge sharing

Coordination and sharing of data and modelling was the most common theme. Ideally, this work would involve developing an open source and collated water resources database to reduce duplication and strengthen the science around water management, mining, and future climate considerations. Areas for potential collaboration included the following:

- Sharing of mining industry strategic assessments of their water resource challenges;
- Systematic monitoring of vegetation; and
- Data on water usage and water quality assessment to enable a greater pooling and sharing of resources and information.

This issue has been an ongoing conversation among stakeholders for some time, with no resolution. This area of potential collaboration could extend to working towards long-term initiatives, such as building broader regional groundwater models and real-time monitoring systems. Given the extent of investigations and science undertaken in the region,

opportunities exist for more formal systems of publishing knowledge that is already developed. Real and perceived issues are associated with anti-competitive behaviour within industry that has inhibited progress on this matter (discussed below). Further, some participants said that without a regulatory requirement, improved data sharing is unlikely. However, potential models for data sharing and accessibility exist and they could be implemented for the information-sharing protocols now in place within the *Mining Act 1978* (WA) and associated regulations. One example is waiving copyright and access to information after two years.

This issue needs concerted effort to determine potential avenues. There could be significant potential cost savings and shared knowledge benefits if appropriate protocols could be established. Improving data and knowledge sharing has the potential to enhance relationships among parties and improve overall problem solving for adjoining stakeholders and for operations with shared catchments. There is also potential for Traditional Owners to work with industry to undertake water monitoring and sharing of water monitoring data.

“Data sharing is a starting point. We tried for a long time to get people to share, everybody has, and we tend on a technical level. I know all the water players and the other companies we can probably meet quite easily. Simple fact is, we can't operate without each other's inputs ... it just adds to the whole story ... as opposed to a whole lot of incremental decisions. We are often talking about the same problem but in isolation.”

Overcoming real and perceived anti-competitiveness barriers

Directly related to the previous issue is the need to overcome industry concerns over risks of collusion or anti-competitive behaviour if more open data sharing occurs. Stakeholders suggested that one way of overcoming this hurdle might be a process that clarifies the purpose and scope of collaborations, particularly knowledge or data-sharing. If this were achieved, participants saw real potential for progress on this issue. Stakeholders reported that where collaboration aimed for the greater good (for example, where collocated companies share information on catchments or on managing aquifer recharge), more effort is required to overcome barriers. Stakeholders identified opportunities for a third party to facilitate or manage the collaboration.

"I think it's hard for industry players to collaborate just because they're, they're kind of competitive. You need to find a forum that is safe for them to collaborate, and potentially that's through a third party. If you've got the four big miners and there's a few peripheral ones, if they all started collaborating too closely, then you know there can be perceptions that these collaborative processes could lead 'fixing' of the prices of iron ore. We have to be careful."

Cumulative impacts and adaptive management

As highlighted above, there is an urgent need to establish systematic approaches to developing systems, processes, and tools for cumulative impact and management. Ideally, cumulative impact approaches could be enhanced at two scales: (1) specific subregions and (2) the wider Pilbara region. At the local level, there are examples of shared or collective action around specific areas. For example, in the Fortescue Marsh area in the mid-2010s, there was shared-issue identification and development of management responses between industry and government stakeholders. Stakeholders suggested the need for a re-examination of these types of processes. Suggestions also focused on previous examples of cumulative impact assessment dialogues facilitated by CSIRO and Chamber of Minerals and Energy that could be revived. CRC-TiME presents a potential platform to explore and develop responses to this identified need. It is clear that all stakeholders and industries need to cooperate to understand, evaluate, and manage the cumulative impacts of water use and climate change at the regional and subregional scales. A starting point

could be coordination and sharing of water resources, hydrogeological knowledge and water-monitoring data (including climate, water quantity and water quality data). A viable approach could include development of real-time monitoring and adaptive response management of water resources across the Pilbara.

"Some while back CSIRO started doing some work on this. The mining companies along with the Chamber of Minerals and Energy had a series of cumulative impacts workshops. They did about three or four workshops, to try and address all these issues. And we know the CRC TiME is working in that space now also. Who would be a broker to make this happen?"

Strengthening and enhancing engagement processes with Traditional Owners

The information review and the stakeholder engagement process highlighted the need for deeper engagement with Traditional Owners, as they are the local custodians of land and waters. Increasingly, water users and regulators must listen and act upon the experience, insights and contributions of Traditional Owners regarding water resources management. There was a call for more respectful and inclusive engagement of Traditional Owners' opinions, water values, and their articulation of the importance of the cultural landscape throughout the life of the mine, starting at the planning phase. Stakeholders expressed a desire to modify the modes of engagement to permit Traditional Owners to walk alongside representatives of other sectors to achieve better water resource management. The recently established Pilbara Cultural Land Management Project, which has brought together 11 Traditional Owners groups in the Pilbara, is an important initiative that could be an avenue to foster improved engagement¹⁷.

"I think that the first step would be to have, as early in the process as possible, some really respectful and inclusive opportunity for Indigenous peoples to give their thoughts and opinions and values about water. Not the usual kind of box ticking process, a deeper engagement about our hydrological strategy, and then we will all know what we're up to. But we need to listen, of course, and that rarely happens."

Township water systems and amenities

The study identified several opportunities (some of which are already underway) to enhance settlement and township water-management systems, including water quality. Further, opportunities exist to develop township greening and amenities improvements programs. This issue is an ongoing challenge for local authorities, water utilities, and local communities. However, it is well recognised that greening programs enhance local pride and help strengthen communities.

"Water quality for settlements remain an issue. It needs to be monitored and ideally made more transparent, with improved sharing of information between those responsible for maintenance and monitoring providing access to the information to the local health services."

Governance and decision making

This process also identified the potential value of establishing a stewardship forum for co-management involving government, industry, and Traditional Owners to enhance collaboration, cooperation and knowledge sharing as a foundation for better water management.

This process could also seek to establish industry and community support for legislative reform. Further, it could explore how water resource planning could recognise and incorporate Traditional Owners' cultural connections to water and establish mechanisms that allow for the provision of water for cultural, environmental, and economic opportunities for Traditional Owners.

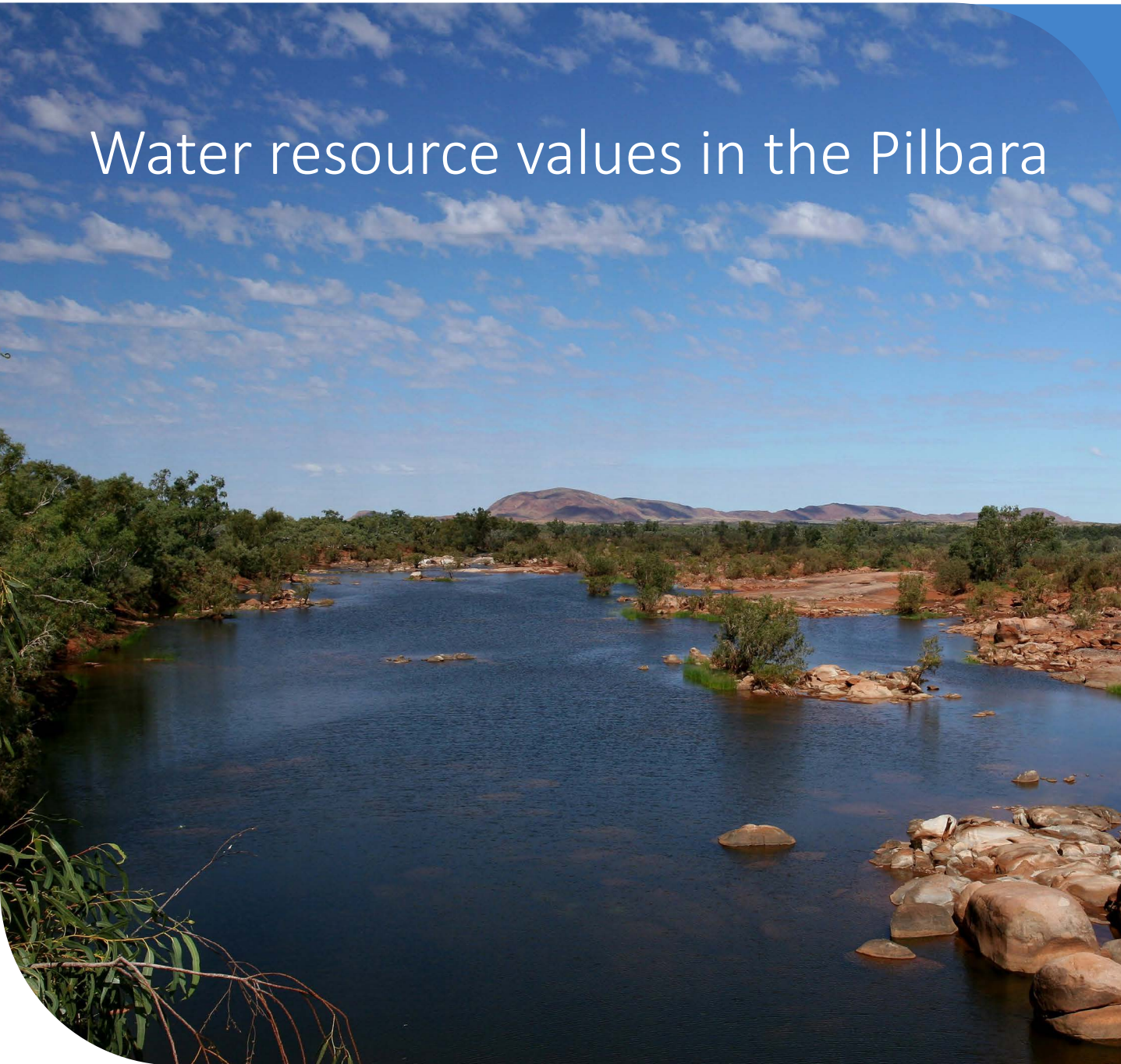
"They've been talking about this Water Resources Management bill for a long time. We need the industry to push for changes. But it's more than legislation. We need the industry to work together. We need to understand how major mine dewatering projects or sustainable water projects impacts on the environment; therefore, cultural values need to be embedded in the thinking."



“Across the Pilbara there are all these cultural sites. They are like the individual players in an orchestra, contributing to the overall singing of the landscape. But instead of considering the impact on the whole orchestra and the song it’s playing, the legislative system allows each place to be considered individually. Approval to disturb and destroy sites happens in piece meal way. The resonance of the song across the whole landscape might be being lost.”

Hamersley Gorge, Karijini National Park

Water resource values in the Pilbara



A value is something that is important, useful, or has worth. A shared value emerges when multiple people, or groups of people, hold the same or similar values. In the context of water resources of the Pilbara region, the information review and multiple stakeholders identified the following values about water-related matters.

Shared water values

A broad range of water-related challenges exists across the Pilbara. The information review and stakeholder engagement process highlighted several high-level water-related values that underpin the views held by different water users in relation to the area's water resources.

To enhance collaborative approaches to managing water resources of the region, all participants need a shared (and deeper) understanding and appreciation of these values.



Water resource sustainability and security

We value the responsible management of the resource for present and future generations, including ensuring supplies for pastoral stations, livestock and productive uses, as well as supplies of safe, reliable, drinking water for towns and communities.



Water for mining and energy industries

We recognise the significant contribution that water plays in the region's mining and energy industries. Mining below the water table is required to allow these industries to support local, state, and national economies.



Maintaining water quality in the Pilbara

We value the importance of water quality for present and future generations to ensure maintenance of ecological systems, environmental values and the sustainability of beneficial uses of water.



Water for economic diversification

We promote opportunities that seek to improve the utilisation of water resources in ways that diversify the economy beyond mining.



Valuing cultural perspectives

We acknowledge and respect the cultural connections of Aboriginal people to the water and water environments and seek ways to ensure the maintenance and enhancement of enduring cultural, social, and spiritual connections.



Recreational waters and amenities

We seek to enhance the amenity value and recreational opportunities provided by water resources. These features provide opportunities to experience biodiversity and local natural and cultural features. These environmental and landscape values are values in their own right, as well as being important to regional communities, visitors, and tourists.



Environmental integrity

We value the water-dependent natural ecosystems and seek to enhance management of natural ecosystems and regional biodiversity and areas of environmental significance, rare and endangered species, and threatened communities.



Governance and decision making

We seek a water resource management framework that enables fair and equitable water allocations for water users. To achieve this, we must address the needs of the environment. Water use must be balanced in sustainable ways that acknowledge Aboriginal people's connections to country, as well as supporting business confidence.

Shared water challenges

A water challenge refers to a problem, concern or threat related to water. A shared water challenge arises where there is a gap between current conditions and the shared water values, or when there is a tension between or among competing values.

The Pilbara is the recognised economic engine room of Western Australia and a significant thread woven into the Australian economic fabric. It is also a landscape rich in cultural significance and ecological diversity. This research sought to document the range of water resources and related environmental management challenges that must be addressed to ensure enhancement of the cultural, ecological, and economic resilience of the system wherever possible through collective action.

The challenges described below are directly related to the “shared values” discussed above. This is intentional, as the region’s challenges are considered threats to the shared values identified in the literature and the stakeholder interviews. Although the challenges are documented in what might be seen as a hierarchy, we must emphasise the interconnected nature of these challenges.



Water resource sustainability and security

Cumulative impacts

Manage long-term cumulative impacts from modification to groundwater and surface water flows from human activities.

Consequences

- Uncertainty about the extent of impacts on ecological systems and cultural water values, including threats to conservation of significant species and ecological communities.
- Inability to ensure long-term sustainable, safe, and reliable water supplies to meet environmental, social, cultural, and economic demands across the Pilbara landscapes.

Causes

- The volume of water extracted in mining zones is increasing.
- Limitations of existing water allocation planning for major water resources and aquifers.
- Anticipated variability because of climate change, particularly changing rainfall patterns.
- Limitations of existing mechanisms for collaboration and knowledge-sharing among stakeholders.
- Inadequacy of existing water science and modelling technology.

Relevant stakeholders

Industry, government, regulators, Traditional Owners, and local communities.

Current collective action

- Pilbara Cultural Land Management Project.
- Subregional cumulative impact management around specific locations, such as the Fortescue Marsh.
- Previous CSIRO workshops with industry and W.A. Chamber of Minerals and Energy.
- CRC TiME has undertaken a scoping exercise on approaches to Regional Cumulative Impact Assessment that may provide a basis to move forward in this area.¹⁸



Maintaining water quality in the Pilbara

Water quality

Maintain environmental water quality from mining and industrial processes in the Pilbara.

Consequences

- Effect of site-based impacts, such as acid mine drainage, tailings disposal, industrial hydrocarbons, and effluent disposal.
- Potential changes in water chemistry from reinjection of surplus water from dewatering.
- Potential saline intrusion caused by climate change, industrial and agricultural activity.

Causes

- Current site-based management practices.
- Transparency of water regulation, monitoring and reporting.
- Inadequacy of knowledge about causes and effects.

Relevant stakeholders

Industry, government, Traditional Owners, and local communities.

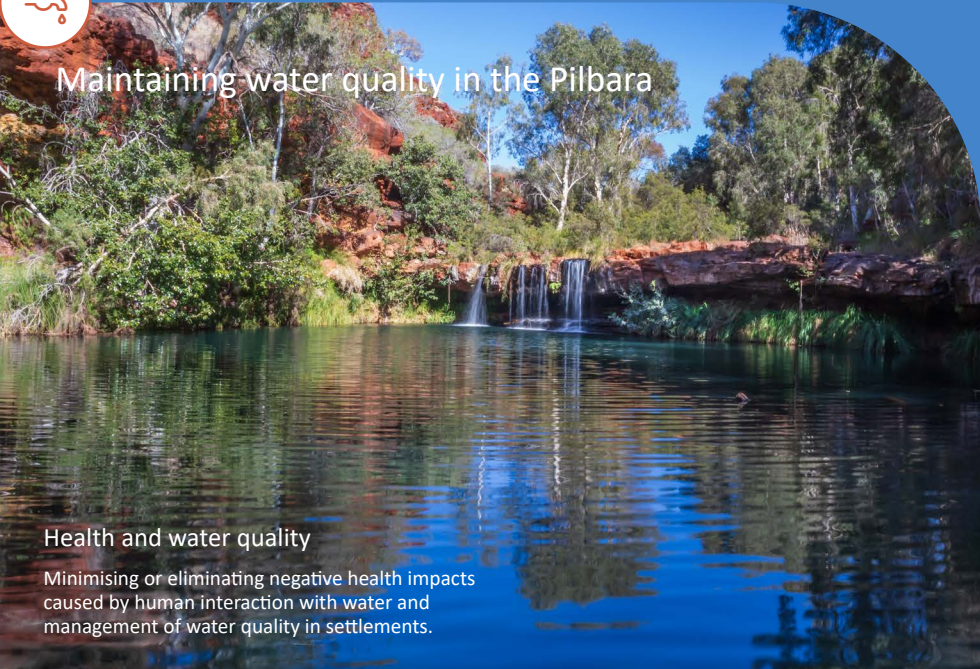
Current collective action

Nothing identified.

¹⁸ Towards a framework for regional cumulative impact assessment



Maintaining water quality in the Pilbara



Health and water quality

Minimising or eliminating negative health impacts caused by human interaction with water and management of water quality in settlements.

Consequences

- Ongoing risk of health impacts of poor water quality.
- Impacts on water quality in water resource protection areas.

Causes

- Inadequate management of water supply and water-treatment infrastructure in remote settlements.
- Availability of on-ground resources to respond to maintenance issues.
- Inadequate safeguards of water resource protection areas from encroachment.

Relevant stakeholders

Industry, government, Traditional Owners, and local communities.

Current collective action

Nothing identified.



Valuing cultural perspectives



Integrating cultural perspectives to water management

Ensuring intergenerational management and protection, incorporating free, prior, and informed consent of Aboriginal heritage, culture and connection to Country.

Consequences

- The impacts of existing mining and water-management practices on places of important cultural and ecological value, including excess water from dewatering, which could affect places of important cultural and ecological value.
- Aboriginal voices, cultural values, and knowledge are not given primary consideration in the use, extraction, and management of water.

Causes

- Current levels of engagement with Aboriginal people on their values in the use, distribution, and management of water.
- Existing legislative framework, which limits the degree of consideration of Aboriginal people's culture and heritage relationships to water.
- Limitations of communities' and decision-makers' cultural awareness about relationships between Aboriginal people and water, including the spiritual, cultural, and ecological values of water for their culture.

Relevant stakeholders

Industry, government, Traditional Owners, and local communities.

Current collective action

- Pilbara Cultural Land Management Project.



Valuing cultural perspectives



Provide access to water features

Recreational and cultural use by Aboriginal people and broader communities can be limited by mining and industrial activities.

Consequences

- Potential for intergenerational loss of culture, identity, and connection to Country.
- Reduced recreational amenity for wider communities.
- Potential conflicts among users arising from Indigenous Land Use agreements or other commercial agreements that limit others' access to water features.

Causes

- Mine safety limits access to water features.
- Limited understanding by some parties of Native Title rights and interests as they relate to water.
- Public expectations around access to water features.

Relevant stakeholders

Industry, government, Traditional Owners, and local communities.

Current collective action

Nothing identified



Environmental integrity



Protecting ecosystems

Protect the integrity of all natural ecosystems, regional biodiversity, and areas of environmental significance, including managing impacts of dewatering on subterranean fauna communities and ecosystems.

Consequences

- Impacts on groundwater-dependent vegetation from groundwater extraction.
- Modification of the ecology of ephemeral creeks and river systems from discharge of surplus water.
- Uncertain impacts of aquifer reinjection, including changes in water chemistry from reinjection effect on subterranean fauna.
- Risks to threatened species and their associations from changes in water regimes.

Causes

- The extent and growth of groundwater extraction to sustain production levels.
- Limited understanding of the resilience of subterranean fauna.
- Surface water run-off affected by interaction with exposed, reacting pyritic materials.
- Saline water intrusion through changes in the water table in areas of poor water quality.

Relevant stakeholders

Industry, government, Traditional Owners, and local communities.

Current collective action

A report entitled *The Enduring Pilbara: A conservation vision a land rich in nature, culture and resources*, is being prepared by the Partnerships for The Outback program of the Pew Trust for Conservation.

Existing collaborative research on subterranean fauna aimed at better understanding diversity and resilience to changed conditions.

The Pilbara Environmental Offsets Fund may provide resource to enhance conservation and biodiversity outcomes.



Economic development value of water



Diversify the economy

Improve utilisation of water resources to diversify the economy.

Consequences

- Longer term opportunities for use of water to transition economies beyond mine operation life.

Causes

- Perception that existing water management practices focus on optimising mine production outcomes and pay limited attention to the value of water resources use or extraction for non-mining uses to diversify the economy.

Relevant stakeholders

Industry, government, Traditional Owners, and local communities.

Current collective action

- Improved legislative settings are proposed and some engagement between key stakeholders has commenced between government and Tradition Owners.



Governance and decision making



Existing Resource-Management Frameworks

Develop collaborative frameworks among all stakeholders that enhance monitoring and management of water resources.

Consequences

- Perceptions of different water allocation provisions for different users resulting from varying regulatory frameworks in the Pilbara.
- Limited cooperative planning for water resource allocation.
- Limited attention to allocation of water for environmental and cultural uses.

Causes

- Complexity and inadequacy of regulatory framework for water allocation and management (partly because of age and limitations of the existing water rights legislation and existence of agreement acts).
- Limited incentives for water sharing, water trading, and data sharing.
- Perceived and real limitations on data sharing because of anti-competition requirements.
- Disparity in financial and human resources among stakeholders limits capacity of regulators to develop strategic responses.

Relevant stakeholders

Industry, government, regulators, Traditional Owners, and local communities.

Current collective action

Nothing identified.

Collective impact opportunities

The WRSA uncovered only limited examples of existing collective actions in the Pilbara. The shared challenges and their causes identified through this WRSA warrant further discussion. As well as the process of preparing this WRSA, several other initiatives might be included in a shared framework or an initial forum to consider shared objectives and identify potential collective impact opportunities. These include the following:

- Partnerships for the Outback initiative has prepared, *Enduring Pilbara: A conservation vision a land rich in nature, culture and resources*;¹⁹
- The Pilbara Cultural Land Management Project;²⁰
- Potential CRC TIME project on Regional Cumulative Impact Assessment for Transitions in Mining Economies;²¹ and;
- The Pilbara Environmental Offsets Fund process.²²

The table to the right summarises opportunities for collective impact drawn from insights gained through the information and literature review, the team's specialist knowledge, and the stakeholder engagement process. These opportunities can be seen as starting point for discussion among stakeholders aimed at enhancing shared water resource values.



1

FORUM: Establish a forum to explore opportunities for an ongoing 'platform' to resource the co-creation of improved water stewardship outcomes. This initiative would bring together government, industry, Traditional Owners, local communities, and the conservation sector to identify collective impact priorities.

2

DATA COORDINATION AND SHARING: Coordinate and share relevant hydrogeological knowledge and water monitoring data related to collective outcomes, including climate, water-level monitoring, water quantity, water-quality data, and development of more comprehensive modelling tools.

3

MANAGING CUMULATIVE IMPACTS: All stakeholders collaborate to understand, evaluate, and manage cumulative impacts of dewatering water and climate change at sub-regional and/or regional scales.

4

ANTI-COMPETITION BARRIERS: As part of any initiative to share data, clarify and establish strategies to overcome anti-competitiveness barriers.

5

LEGISLATIVE AND POLICY ADVOCACY: Support industry and community advocacy for legislative and policy reform to promote water stewardship.

6

ENGAGEMENT WITH TRADITIONAL OWNERS: Establish agreed engagement processes with Traditional Owner groups based on the principle of 'walking together' to achieve improved water resource management and protection of cultural assets.

7

WATER MONITORING BY TRADITIONAL OWNERS: Explore models for Traditional Owners to work with industry to undertake water monitoring and sharing of water-monitoring data, potentially through ranger programs.

8

AREAS OF HIGHER WATER-RELATED BIODIVERSITY VALUE: Identify areas of higher water-related biodiversity value to add to the conservation estate, increase the area of conservation consistent with Comprehensive, Adequate Reserve principles²³, and identify joint management opportunities with Traditional Owners groups.

9

SETTLEMENT AND TOWNSHIP WATER-MANAGEMENT AND WATER-QUALITY SYSTEMS: Explore opportunities to enhance settlement and township water-management systems and water quality, as well as enhancing townships' amenities through Water Sensitive Urban Design.

10

INTEGRATED WATER-MANAGEMENT STRATEGIES: Continue to explore integrated water-management strategies, including the role of third-party operators to optimise the economic development potential of surplus water.

11

ALTERNATIVE ECONOMIES FOR POST-MINING LANDSCAPES: Investigate alternative economies for post-mining landscapes, such as exploring beneficial use of pit lake water and end of mine life opportunities.

Water resource sustainability and security	Maintaining water quality in the Pilbara	Valuing cultural perspectives	Environmental integrity	Water for mining and energy industries	Water for economic diversification	Recreational waters and amenities	Governance and decision making

¹⁹ Partnership for the Outback

²⁰ Lotterywest grant to foster cultural land management in the Pilbara

²¹ Towards a framework for regional cumulative impact assessment

²² Pilbara environmental offsets fund overview

²³ Comprehensive, Adequate and Representative Reserve System for Forests in Australia



APPENDIX 1

Preparation of the WRSA

A desktop review involved collating and reviewing the literature on water and related matters in the Pilbara, including both published and grey literature. We identified and reviewed reports, environmental approval documents, and papers detailing major research initiatives in the region. We set no limits to the publication date of the source material. The main assessment criterion was the material's relevance to the WRSA.

This review, along with the team's specialist knowledge, allowed identification of the challenges in an earlier draft WRSA table, summarising key water challenges and opportunities. We provided this draft to stakeholders, and it informed the stakeholder interview and engagement process.

While the stakeholder engagement process was not exhaustive, it nevertheless focused on gaining insights from a variety of participants, including government agencies, local government, mining companies, and relevant industry associations. To date, we conducted only limited engagement with Traditional Owners. We informed them of the process and sought preliminary perspectives from the groups who agreed to participate. Beyond this WRSA, deeper, ongoing engagement with Traditional Owners is required to understand and share their water values. Initially, this process would involve co-designing Traditional Owner involvement.

In total, we held 21 semi-structured interviews (mainly online) with 25 people. They shared key issues identified in the review stage (documented in a draft WRSA table) and we collected feedback from interviews. Then we revised the WRSA. We undertook this process from July to September 2021, with follow-up conversations extending into December 2021. In December 2021, we conducted a further five interviews in Newman (specifically about local Newman-based issues).

The interviews were recorded, transcribed, coded, and summarised. The recordings were analysed using NVivo, a software program for qualitative analysis of unstructured text.

Our process involved the following:

1. Review of background information related to water resource management across the Pilbara from a range of disciplinary perspectives (hydrogeology, water quality, ecology, economics, Aboriginal studies, and regional planning);
2. Applying insights from the team's specialist knowledge; and
3. Identification of key water resource challenges likely to have significant adverse outcomes or potential opportunities.

We further refined these insights through the stakeholder engagement process. We synthesised our findings and documented challenges, causes, and drivers of water related impacts. This process identified a number of potential collective impact opportunities. The report has been prepared as the basis for stimulating generative dialogues aimed at enhancing water stewardship in the Pilbara.



Karijini National Park



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