



Australian Embassy
Thailand

THE
**AUSTRALIAN
WATER
PARTNERSHIP**

Dispute Mitigation Guidance Water Management and River Basin Thailand

December 2024

Chapter 1: Introduction

1.1 Background to the Project

Thailand has experienced rapid economic growth over previous decades and is committed to becoming a high-income economy by 2037 enjoying ‘Security, Prosperity and Sustainability’. A more integrated and sustainable approach to water management is essential for the Kingdom’s future, yet a growing population, economic expansion, rapid urbanisation and the impact of climate change will result in a number of water related challenges.

Thailand is highly vulnerable to climate variability, with a likely increase in natural hazards, such as heavy rainfall, floods and droughts, whilst sea level rise will impact on coastal areas.

Several water challenges coexist in Thailand, such as competition and increases in the demand for water across the agriculture, industry and service sectors, the deterioration of water quality due to various pollutants, impacts from floods and droughts and the effective and shared management of various water resources across regions. An example is the impact of water availability and flooding as constraints to the future development of the Eastern Economic Corridor (EEC).

In response, the Government of Thailand has set water security as an overarching priority and is pursuing a number of critical water management reforms. Three key pillars set the direction for improving water management in Thailand:

- Water Resources Act, B.E. 2561 (2018)
- 20-year Master Plan on Water Resource Management (2018-2037)
- Organizations

As various water challenges are realised and the implementation of Thailand’s water reforms progress, it is likely that disputes will arise between various stakeholders and communities. There is an opportunity for Thailand to consider how it proactively implements planning and other mechanisms to mitigate potential disputes through the reform process.

In September 2021, the governments of Thailand and Australia signed a Memorandum of Understanding (MOU) on water cooperation as a mechanism for sharing knowledge on water management frameworks and approaches. This memorandum commits Australia and Thailand to work collaboratively in areas such as:

- Water use and drought
- Water resource management
- The water-food-energy nexus
- Soil management.

In July 2023, the Australian Department of Foreign Affairs and Trade and the Thailand Office of National Water Resources held the first Thailand-Australia Water Dialogue and Joint Steering Committee meeting. These presented the progress and outputs achieved to date in water cooperation projects in areas of mutual interest and presented draft work plans for proposed future joint initiatives.

During the dialogue, Australia's experience in dispute mitigation in water planning and basin management was presented, noting that a proactive approach to mitigation could reduce the cost and complexity of water reform and hence support a rapid implementation of the new Thai water policies.

In late 2023, both countries agreed to pursue a Thailand Australia Dispute Mitigation Guidance project to jointly develop a resource on effective water and basin dispute mitigation approaches, with a particular focus on water scarcity, flooding and water quality, and recommendations for consideration by the Thailand Government.

Following a workshop between Thai and Australian water experts in April 2024 on dispute mitigation structures in both countries and associated case studies, this guidance document has been prepared to summarise the key themes and recommendations for further consideration in the Thai context and potential additional areas for future cooperation in this space with Australia.

1.2 Objectives of the Project

The overarching objectives of this project were to:

- Summarise the water management frameworks in Thailand and Australia as they related to the mitigation/management of disputes
- Analyse the key elements of the approach in both countries and any similarities and differences
- Assess how the dispute management frameworks apply in both countries in regard to situations of water scarcity/drought, flooding and water quality impacts through targeted case studies
- Summarise key themes and learning
- Consider options for improving water related dispute mitigation in Thailand.

Accordingly, this guidance document has been structured in a form that aligns with the needs of the Office of the National Water Resources in Thailand as follows:

- Water resource management laws and regulations
- Water management organisations and governance
- Water and basin management dispute mitigation measures
- Water scarcity case studies - East-Coast Gulf River Basin (Thailand) and Water Allocation Plan for the (South Australian) River Murray Prescribed Watercourse (Australia)
- Flooding case studies - Chao Phraya River Basin (Thailand) and Flooding in Eastern Australia since 2010 (Australia)
- Water quality case studies - Mae Klong River Basin (Thailand) and Salinity in the Murray-Darling Basin (Australia)
- Summary and recommendations.

Chapter 2: Water Resources Management

2.1 Laws/Regulations

THAILAND

The principles for water resources management in Thailand comprises of 3 pillars:

- 1) Water Resources Act, B.E. 2561 (2018)
- 2) 20-year Master Plan on Water Resource Management (2018-2037)
- 3) Organizations

The Water Resources Act, B.E. 2561 (2018) provides for the allocation, use, development, management, maintenance, rehabilitation and conservation of water resources and rights.

The act comprises of 9 Chapters:

- Chapter 1 - Water resources
- Chapter 2 - Right in water
- Chapter 3 - Water resource management bodies
- Chapter 4 - Water allocation and water usage
- Chapter 5 - Drought and flood
- Chapter 6 - Conservation and development of public water resources
- Chapter 7 - Competent officials
- Chapter 8 - Civil liability in the case of damage to public water resources
- Chapter 9 - Penalties.

The act also outlines the structure for water resources management bodies at the national level, river basin level and local level, including respective roles and responsibilities. In addition, the act provides for the establishment of a Command Centre in case of a water crisis that will affect the living of human-beings, animals or plants, or cause serious damage to property of the people or the state.

The use of public water resources is classified under three types:

- (1) Water Usage Type One - use for household consumption, agriculture, household industry, ecosystem conservation, disaster mitigation and transport. This type of water usage does not require a water license and has no charge.
- (2) Water Usage Type Two - use for industry, tourism, electricity generation, waterworks and others. This type of usage requires a license from the department responsible for water resources, with approval from the relevant river basin committee. Water charges will be applied as per Ministerial Regulation approved by the Prime Minister.

- (3) Water Usage Type Three - for a large-sized industry or where there is a possibility to cause transboundary or large area impact. This type requires a license from the department responsible for water resources, with approval from the National Water Resources Committee. Water charges will be applied as per Ministerial Regulation, approved by the Prime Minister.

In Thailand, river basins are classified and described in the Royal Decree, with a map showing the basin boundaries. Matters such as hydrological, geographical, ecosystem, human settlement, city planning, water charts and administrative issues are considered under such classification. The structure of a river basin committee for each basin, including the establishment process, duties and authorisations are detailed in the Water Resources Act.

Water user groups are also defined in the act, with these being persons in the same river basin with a common interest in utilising, development, management, maintenance, rehabilitation and conservation of the water resource. Final establishment and registration are provided through Royal Decree.

The 20 year Water Resources Master Plan, B.E. 2561-2580 (2018-2037) was approved by the Thai Cabinet and announced in the Government Gazette in 2019 to be in-line with the 20-year National Strategy, which seeks to manage water resources throughout the whole system for the country's water security. The Master Plan will be reviewed and updated every 5 years.

Originally, the Master Plan had 6 strategies, however, a first revision of the plan was undertaken in 2023. Recently, Thailand has commenced implementation of the 20 Year Water Resources Master Plan (1st Revision) for the period 2023-2037.

The Master Plan provides a framework for water resources management and development over the next 20 years, including droughts, floods and water quality matters, comprising of five strategies:

Strategy 1 - water consumption management

Strategy 2 - building water security in the production sector

Strategy 3 - flood management

Strategy 4 - water quality management and water resources conservation

Strategy 5 - management.

Strategy 1 addresses water consumption management and general use. Under this, the government is aiming to enhance the efficiency of water supply systems, further develop the quality of water supplies in city areas and economic zones and ensure that water supplied to villages countrywide is safe to drink.

Strategy 2 covers the improvement of water security in the farming sector, with measures to improve the efficiency of the existing water supply system. The goal is to develop a new system for diverting water and linking up all water resources to increase the volumes available for use. In addition, Strategy 2 is also aiming to:

- Develop new water storage and water delivery systems to their full potential
- Increase efficiency of water resource projects and improve water systems in irrigation, with land re-adjustment and the promotion of crops that use less water
- In rainfed agricultural areas, provide water for agriculture for at least one crop per year
- Develop water resources and water distribution systems to reduce risk or damage to create water resource security for industrial areas
- Improve water use structures and increase water use efficiency.

Strategy 3 focusses on flood management, which includes work to unblock water courses and natural waterways and preventing future floods in flood-prone communities in urban areas. Strategy 3 also includes measures to:

- Increase the efficiency of water drainage
- Develop flood prevention systems for urban areas
- Manage flooded and retention areas, including at the basin level and through the use of 'nature based solutions'
- Increase the capacity of local administrative organisations to adapt and respond to flood events
- Improve dams and reservoirs in response to climate change
- Develop plans for emergency situations.

Strategy 4 addresses water quality management and water resource preservation, which includes work to prevent and mitigate water pollution in watershed areas and the prevention and mitigation of soil erosion. Other areas covered include:

- Conservation and restoration of degraded watershed areas
- Prevention of soil erosion in watershed areas and agricultural areas attached to the conservation areas
- Improve and increase the efficiency of urban wastewater collection and treatment systems, including encouraging the use of wastewater treatment charges
- Reuse of wastewater
- Prevention and reduction in wastewater generation at source
- Restoration of rivers, canals, wetlands and natural water resources
- Develop a River Health Index for conservation and utilisation throughout the country
- Reduce saline intrusion and estuary erosion.

Strategy 6 covers the general management, covering elements such as the reform of laws, the establishment of organisation(s) to deal with water resources management, the development of a water information database and water research and development. It also covers:

- Administration of water resource management organisations (National Water Resources Board, River Basin Committee, etc.)
- Promotion of international cooperation and fund raising
- Development of a standard decision-making system
- Support for river basin organisations and local government organisations
- Support for the exchange of information between public and private sectors
- Use of technology for water resources management
- Preparation for future operational form
- Enhancement of public relations and public participation and related sectors to raise awareness of water resources conservation
- Promotion of research development, innovation and technology
- Support value-add in the service and production sectors, including a framework to improve water management in river basins by linking the market, energy, production and waste.

See Figure 1 for a pictorial overview of the basin management framework in Thailand.

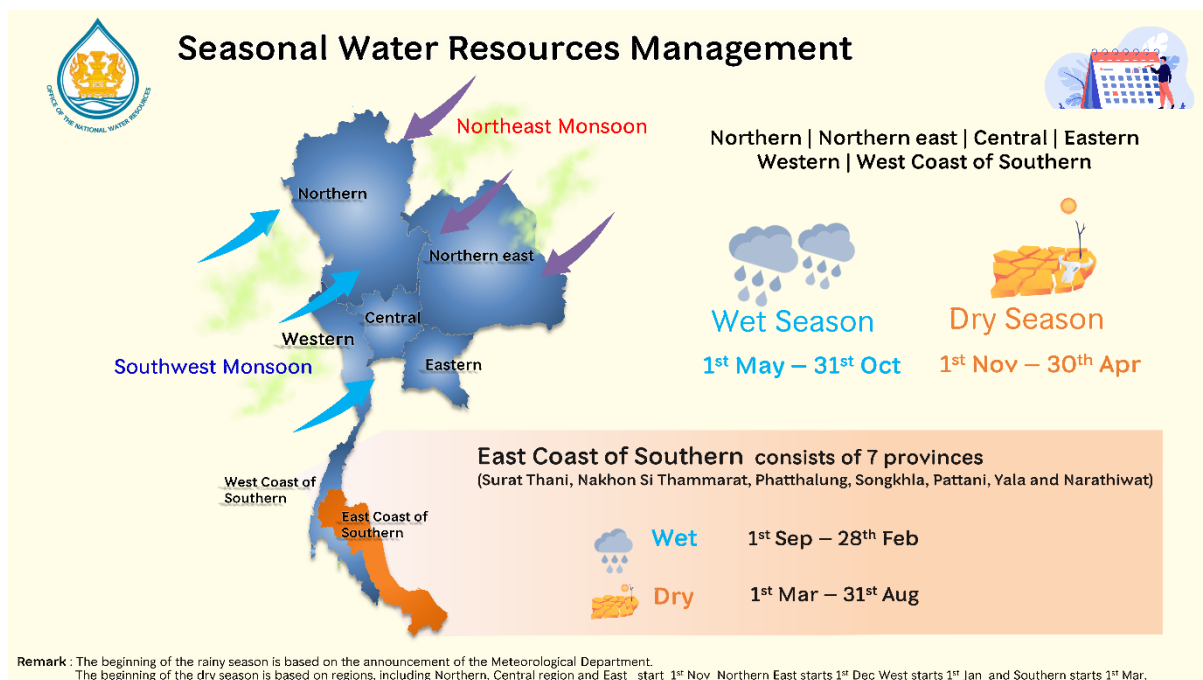
Figure 1 – Water Resources Management Framework in Thailand



Within the context of this framework, water resources management approaches in Thailand are also classified into 2 seasonal water resources scenarios, these being the wet season and the dry season.

The wet season is scheduled to be from 1 May to 31 October each year, whilst the dry season covers the period from 1 November to 31 April. However, for Southern Thailand the classifications are wet season (1 September to 28 February) and dry season (1 March to 31 August). See Figure 2 for relevant details.

Figure 2 – Seasonal Water Resource Management in Thailand



This seasonal water management framework has three stages, these being pre-season, during the season and end of season for both the wet and dry periods, as follows:

In dry season:

- Pre-season - preparation and raising awareness:
 - Assess the amount of water available, determine water allocation plan and Crop plan, forecast drought risk areas and propose the countermeasures to the NWRC and the Cabinet
 - Raise awareness and public relations and implement the seasonal plan of WRM and the countermeasures
- During the season - analysis, monitoring and evaluating the situation:
 - Driven Provincial Water Resources Subcommittee, the River Basin Committee and the NWRC throughout the season
 - Raise awareness and public relations the situation and ongoing assistance of related-agencies
- End of season – evaluation:
 - Summarise summarize the seasonal water resource management (After Action Review, AAR) in order to be the solution for next season and propose the NWRC and the Cabinet for acknowledgement

Figure 3 – Seasonal Water Resource Management Framework in Dry Season



In wet season:

- Pre-season - preparation and raising awareness:
 - Assess the amount of water available, determine water allocation plan and Crop plan, forecast flood risk areas and propose the countermeasures to the NWRC and the Cabinet
 - Raise awareness and public relations and implement the seasonal plan of WRM and the countermeasures
- During the season - analysis, monitoring and evaluating the situation:
 - Driven by the Provincial Water Resources Subcommittee, the River Basin Committee and the NWRC throughout the season
 - Raise awareness and public relations the situation and ongoing assistance of related-agencies
- End of season – evaluation:
 - Summarise the seasonal water resource management (After Action Review, AAR) in order to be the solution for next season and propose the NWRC and the Cabinet for acknowledgement

Figure 4 – Seasonal Water Resource Management Framework in Wet Season



AUSTRALIA

Historical Context

Australia has a highly sophisticated and integrated water catchment management system. The reform journey to achieve the current status has evolved over the past 40 years. What is clear from the Australian perspective is that water reform takes time and an overarching national long-term commitment is essential.

Australia is a federation of six states and two territories. Section 100 of the Australian Constitution allocates responsibility for water to state and territory governments¹:

‘The Commonwealth shall not, by any law or regulation of trade or commerce, abridge the right of a State or of the residents therein to the reasonable use of the waters of rivers for conservation or irrigation’

Between the early 1900’s and 1970, Australia’s primary focus was to develop water resources and infrastructure for various consumptive end uses. However, by the 1980s, this approach had resulted in a legacy of debt, poor pricing policies, service delivery challenges and widespread environmental degradation. In addition, recurrent drought and increasing concern over water scarcity catalysed a drive for reform to improve security of supply².

The Australian water reform journey has been an ongoing process for several decades, with significant milestones achieved over time. The regulatory and policy structures for water management have evolved since the early 1900s, but the journey toward water reform gained momentum in the 1990s and early 2000s.

Key elements of this reform process are:

- 1994: The Council of Australian Governments (COAG) initiated the National Competition Policy, which included water reform as one of its key components. This policy aimed to introduce competition and efficiency into the water sector.
- 2004: COAG endorsed the National Water Initiative, signalling a commitment from all Australian states and territories to implement water reforms consistent with its principles, and established the National Water Commission to oversee water reform progress.
- 2007: The Australian Government introduced the *Water Act (2007)* and established the Murray-Darling Basin Authority. This was aimed at addressing overallocation and unsustainable water use in the Murray-Darling Basin.
- 2008-2012: The Murray-Darling Basin Plan was developed and implemented started, setting water extraction limits and environmental flow requirements to restore the health of the basin's ecosystems.

¹ Source - https://www.aph.gov.au/-/media/05_About_Parliament/52_Sen/523_PPP/2023_Australian_Constitution.pdf?la=en&hash=D9117474455DBD5DDAA61E699329B64A598291C1

² Source - <https://waterpartnership.org.au/wp-content/uploads/2016/08/AWN-Australian-Water-Reform-Journey.pdf>

- 2014: The National Water Commission, established to oversee water reform progress, was abolished, with its functions transferred to other agencies.
- 2019: The Productivity Commission released its report on the National Water Initiative Review, highlighting achievements and recommending reforms to address ongoing challenges.

Overall, achieving water reform in Australia has been a complex and multifaceted process involving collaboration between national, state, and territory governments, as well as stakeholders from various sectors. While significant progress has been made, challenges such as water security, environmental sustainability and climate change adaptation continue to shape the future water reform agenda.

The Australian Government has an oversight, facilitation and funding role, ensuring that the national interest is adequately considered. This is particularly relevant for transboundary resources such as the Murray-Darling Basin, enabling some level of consistency across different jurisdictions.

The water reform journey has required significant investment in science to support evidence-based decision making and stakeholder/community engagement, informing a structured planning processes to gain sufficient consensus on water sharing and allocation.

It has also required parliamentary oversight to provide the necessary authority to implement reform and agree various trade-offs between parties.

A central tool for effective water reform in Australia has been the ongoing development and refinement of legislation. All of the key areas of reform have required changes in the legislative basis for water management. Under the national water reform program, it has been a critical requirement that states pass new legislation that update previous water laws to enable and give long-lasting effect to the desired outcomes³.

Water accounting underpins all management tools in Australia. Water accounting is a systematic approach to measuring, recording and reporting water flows and stocks within a defined system, such as a river basin or an aquifer. It enables water management by providing essential information for decision-making, planning and monitoring activities (see Chapter 3 for more details).

Water Management Challenges

Australia has an extremely variable climate and a history of drought, punctuated by periods of flooding. Despite regional differences in climate, Australia has irregular rainfall and high rates of evaporation, which results in limited reliable surface water for consumptive use. Australia therefore relies significantly on surface water storages, groundwater and other alternative water sources (desalination, wastewater, stormwater) to provide security of supply.

³ Source - <https://waterpartnership.org.au/wp-content/uploads/2016/08/AWN-Australian-Water-Reform-Journey.pdf>

Australia's key water challenges are as follows.

Over-allocation of water beyond system capacity:

- Stressed and threatened production capacity
- Investment uncertainty
- Threat to reliable water supply and quality

Stressed/endangered environment:

- Fish deaths
- Riverine forest deaths
- Floodplain degradation
- River mouth closure

Pollution impacting on the ability to supply fit for purpose water:

- Salinity
- Blue green algae
- Acid sulphate soils

Disputes between:

- State Governments
- Upstream and downstream users both within states and between states
- Irrigators and industry
- Urban needs and other needs

Strategic Water Management Objectives

Australia's overarching objectives for water management law and regulation are to increase the productivity and efficiency of water use and ensure the health of river and groundwater systems, whilst servicing rural and urban communities and enabling greater responsiveness to changing conditions, such as drought⁴.

The Australian water management framework is based on a system of statutory water allocation plans which define the rules for water use and water quality management.

Australia's approach to basin planning and management is focussed on:

- Delivering overarching security of supply for all
- Balancing rural/urban/agricultural/cultural and environmental demands
- Ensuring efficient water and wastewater services and pricing
- Improving water licensing and access rights
- Maintaining appropriate water quality
- Mitigating flood risk at 1 in 100 year levels
- Protecting strategic environmental assets
- Supporting industry and agriculture productivity and community adaptation.

Over the last 30 years of water reform, four key areas, underpinned by two essential enablers, have been consistently pursued⁵.

Transforming water allocation and establishing water markets:

Moving from an old administrative method of water allocation which assumed no environmental limits to the resource, to a new system of tradeable water entitlements and water markets, working within sustainable resource limits and providing more flexibility and economic value to individual holders of water rights and to the nation overall.

Improving environmental management:

Achieving a sustainable water resource base, to underpin water allocation and the water market, by improving environmental condition through providing a legally-recognised share of water to the environment and tackling over-commitment of water to other uses.

⁴ Source - <https://waterpartnership.org.au/wp-content/uploads/2016/08/AWN-Australian-Water-Reform-Journey.pdf>

⁵ Source - <https://waterpartnership.org.au/wp-content/uploads/2016/08/AWN-Australian-Water-Reform-Journey.pdf>

Reforming pricing of water services:

Applying the principles of consumption-based pricing, full cost recovery and the removal of cross-subsidies, to promote efficient and sustainable use of water resources and assets, as well as financial viability of businesses and adequate revenue streams for service delivery.

Modernising institutional arrangements:

Transforming old institutions and local water authorities into organisations that are financially viable and can deliver water services to their communities efficiently, within environmental constraints.

Ensuring community and stakeholder engagement in all reform processes (enabler)

Stakeholders, including communities, water users, industries, environmental groups and Indigenous communities, possess valuable local knowledge and insights. Engaging them in the reform process ensures that decision-makers have access to diverse perspectives, enabling more informed and balanced decision-making.

Improving water information and water knowledge (enabler):

Improving metering, monitoring, modelling, water accounting and water knowledge to underpin advances in every element of water planning and management.

Water Management Instruments – National

Noting the important role of the Australian constitution in providing power to the states to manage their own water resources, there have been a number of key national water policy initiatives that have been agreed by all government's which continue to guide on-ground management practices and local implementation. These agreements are generally authorised/enabled through local legislation in each state and territory.

The first of these is the 1994 Council of Australian Government's Water Reform Framework⁶ which responded to a range of identified issues around water. This framework included a number of elements related to:

- Pricing reform and cost recovery
- Sustainable investment in new irrigation infrastructure
- Establishing water allocations or entitlements, including for the environment
- Identifying environmental needs based on best available science
- Separating land and water rights
- Institutional reform
- Consultation and public education
- Research and public education.

⁶ Source - <https://www.ielrc.org/content/e9401.pdf>, where the Council of Australian Government's or COAG is a forum involving the Prime Minister, Premiers and Chief Ministers and the President of the Local Government Association, now referred to as National Cabinet.

This agenda was implemented in all states and territories across Australia, with most effort focused in the Murray–Darling Basin, Australia’s most highly developed and complex river system⁷.

By 2003, the knowledge base on water and markets had expanded significantly, whilst the national demand for water had increased exponentially. As a result, in 2004 the Australian Government and all states and territories agreed to the National Water Initiative (NWI)⁸.

The NWI committed state and territory governments to:

- Prepare water plans with provisions for the environment
- Achieve sustainable water use in over-allocated or stressed water systems
- Introduce registers of water rights and standards for water accounting
- Expand trade in water rights
- Improve pricing for water storage and delivery
- Better manage urban water demands.

Implementation of the NWI at the state and territory levels has continued since this time, with the initiative subject to three yearly review processes.

The current Australian Government is currently in the process of renewing the NWI to *‘better reflect climate change, provide for increased First Nations influence in water resource management, ensure access to safe and secure drinking water and take a strategic approach to groundwater management’*⁹.

In March 2024, the Australian Government announced a consultation process on a new framework and principles to underpin the sustainable management of Australia’s precious water resources, leading to a new NWI that will continue to support consistency across states and territories, focusing on strengthening the connection between climate science and water planning, alongside a greater consideration of, and influence for, First Nations Peoples in water management¹⁰.

National Frameworks for the Murray-Darling Basin

Additional national instruments for the Murray-Darling Basin also exist, recognising its position as the most important and complex basin in Australia.

Whilst water sharing arrangements for the River Murray system between New South Wales, Victoria and South Australia were first established through the River-Murray Agreement in 1914, in 1982 the first Murray-Darling Basin Agreement was reached between all four basin states.

⁷ Source - <https://waterpartnership.org.au/wp-content/uploads/2016/08/AWN-Australian-Water-Reform-Journey.pdf>

⁸ Source - <https://www.dcceew.gov.au/sites/default/files/sitecollectiondocuments/water/Intergovernmental-Agreement-on-a-national-water-initiative.pdf>

⁹ Source - <https://www.dcceew.gov.au/water/policy/policy/nwi#daff-page-main>

¹⁰ Source - <https://minister.dcceew.gov.au/plibersek/media-releases/albanese-government-deliver-new-national-water-agreement>

Through this new agreement, a Murray-Darling Basin Commission was established, replacing the existing River Murray Commission, with an expanded role including water quality, the environment and recreational use of the system. A Murray-Darling Basin Ministerial Council was also established for high level and coordinated decision making across the basin states.

This agreement was the beginning of a total catchment management approach to the basin, with it being ratified through supporting legislation being passed by the four state/territory parliaments that year.

The Murray-Darling Basin Agreement has continued to evolve as various challenges across the basin have arisen and the climate has changed, including the introduction of a basin wide cap on diversions in 1995 and in 2008, provisions for the prioritisation of critical human water needs and a storage right for South Australia to defer and store part of its annual water entitlement in River Murray storages in upstream jurisdictions.

Overall, the agreement responds to six key drivers for the management of the Murray-Darling Basin¹¹:

1. Critical human water needs – states set aside water for core human needs such as drinking, food preparation and hygiene. Critical human water needs are a practical measure to help safeguard communities in drought.
2. System demands (conveyance water) – conveyance water is the water needed to keep the system running. It includes water lost to evaporation and through seepage. It can vary through the year and between years depending on river flows and climate. Without it, water could not be delivered.
3. Water in reserve – most river catchments are operated so that a certain amount of water is kept in reserve. In the River Murray system, water is set aside to assist with system needs for the following year. Some water is set aside at the start of the water year, and some is set aside progressively throughout the year.
4. Water delivery – the Murray-Darling Basin Authority (MDBA, replacing the Murray-Darling Basin Commission) delivers water through the river to entitlement holders who have placed water orders through the states. This can be for consumptive use or water for the environment. There are several challenges in delivering water to where it needs to go and the MDBA and other water managers must plan for and manage these challenges. These include how long it takes water to travel, the amount of water that will be lost along the way, and physical constraints.
5. Assets – under the agreement the MDBA is responsible for overseeing the construction, operation and maintenance of the physical assets (the dams, weirs and locks used to store water and regulate flows in the River Murray system), with the investment being a shared cost between jurisdictions according to an agreed funding formula.
6. Water sharing – defines an agreed approach between basin states for how water is shared.

¹¹ Source - <https://www.mdba.gov.au/water-use/allocations/murray-darling-basin-agreement>

In 2007, the Australian Parliament passed the *Water Act (2007)*¹² as an agreed legislative framework for managing the Murray-Darling Basin, including the establishment of the Murray-Darling Basin Authority. The act's primary objectives are to:

- Improve water security for all uses of water resources in the Murray–Darling Basin
- Promote the use and management of the Basin's water resources in a way that optimises economic, social and environmental outcomes
- Ensure the return to environmentally sustainable levels of extraction for water resources that are overallocated or overused
- Protect, restore and provide for the environment of the Basin
- Maximise the economic returns to the Australian community from the use and management of the Basin's water resources
- Implement relevant international agreements to address the threats to the Basin's water resources
- Ensure that the management of the Basin's water resources takes into account the broader management of natural resources in the Basin
- Achieve efficient and cost-effective water management and administrative practices in relation to the Basin's water resources
- Provide for the collection, collation, analysis and dissemination of information about Australia's water resources and the use and management of water in Australia.

Alongside other provisions, the act established a head of power for the Murray-Darling Basin Authority to prepare a strategic plan for the integrated and sustainable management of water resources known as the Murray-Darling Basin Plan (The Basin Plan)¹³. The Basin Plan was agreed by all governments and passed into law in 2012.

The Basin Plan:

- Sets limits on how much water can be taken from the basin for consumptive use on an annual basis (Sustainable Diversion Limits), enforced through local, nationally accredited water resource plans
- Provides water for the environment, through water recovery, planning and delivery
- Establishes process for infrastructure development, operation and maintenance
- Establishes frameworks for sustainable groundwater management
- Establishes frameworks for managing water quality
- Provides the overarching rules and structures for water markets and trade;
- Enables appropriate monitoring and enforcement of compliance
- Establishes a five yearly process for monitoring and evaluating the effectiveness of water management across the basin.

The Basin Plan is based on the foundation and principles of adaptive management.

¹² Source - <https://www.legislation.gov.au/C2007A00137/2021-09-01/text>

¹³ Source - <https://www.legislation.gov.au/F2012L02240/latest/text>

Other Cross-Jurisdictional Water Resource Frameworks

In addition to the Murray-Darling Basin, a number of other strategic national water resources exist in Australia. Two other examples of interjurisdictional basins are the Great Artesian Basin and the Lake Eyre Basin.

For the Great Artesian Basin, the largest groundwater resource in the world (see Figure 5), a coordinated approach to management is delivered through the Great Artesian Basin Strategic Management Plan (2019). This has been agreed by the Australian, New South Wales, Queensland, South Australian and Northern Territory governments and in consultation with community stakeholders.

Figure 5 – Great Artesian Basin



The Great Artesian Basin Strategic Management Plan establishes seven guiding principles for the management of the basin, which are then implemented through various legislative and policy instruments at the state and territory level¹⁴:

- Coordinated governance
- A healthy resource
- Aboriginal and Torres Strait Islander values, cultural heritage and other community values
- Secure and managed access
- Judicious use of groundwater
- Information, knowledge and understanding for management
- Communication and education.

¹⁴ Source - <https://www.dcceew.gov.au/sites/default/files/documents/strategic-management-plan.pdf>

The Lake Eyre Basin is one of the world's largest internally draining river systems, with none of its various streams reaching the sea (see Figure 6). It is also the largest unregulated (no dams or weirs) basin globally.

Figure 6 – Lake Eyre Basin



This system is managed through the Lake Eyre Basin Intergovernmental Agreement, established between the Australian, Queensland and South Australian governments in 2000, with the Northern Territory also signing in 2004.

The agreement sets a number of agreed objectives, which are¹⁵:

- To provide a means for the jurisdictions to come together in good faith to achieve the purposes of the agreement
- To define a process and context for raising and addressing water and related natural resource management issues in the Lake Eyre Basin Agreement Area that have cross-border impacts, particularly those related to water quantity and quality, and flow regimes
- To establish institutional arrangements for the development or adoption of policies and strategies and for the adoption of any relevant management plans established by a state

¹⁵ Source - <https://www.dcceew.gov.au/sites/default/files/documents/lake-eyre-basin-intergovernmental-agreement.pdf>

- To provide for each of the jurisdictions, so far as they are able, to progress the implementation of policies and strategies developed or adopted under this agreement and to make management decisions and allocate resources accordingly
- To provide a mechanism to review policies and strategies
- To provide for jurisdictions to jointly promote and support the management of water and related natural resources through a cooperative approach between community, industry and other stakeholders, and all levels of government in the sustainable management of the Lake Eyre Basin Agreement Area
- To encourage, promote and support water and related resource management practices which are compatible with the spirit and intent of the agreement
- To encourage and promote research and monitoring to improve understanding and support informed decision making in the Lake Eyre Basin Agreement Area
- To provide for the review and, if necessary, revision of the agreement from time to time
- To raise general public awareness of the special biodiversity and heritage values of the Lake Eyre Basin Agreement Area.

Water Management Instruments – State/Territory

Given the Australian Constitution, a majority of water regulation and policy occurs at the state and territory level. These vary across jurisdictions due to local needs and issues, but are nationally consistent where required through mechanisms such as the NWI and Murray-Darling Basin Plan.

In the context of this guidance document and its focus on disputes related to water scarcity, flooding and water quality, local legislative and management practices at the state and territory level generally include:

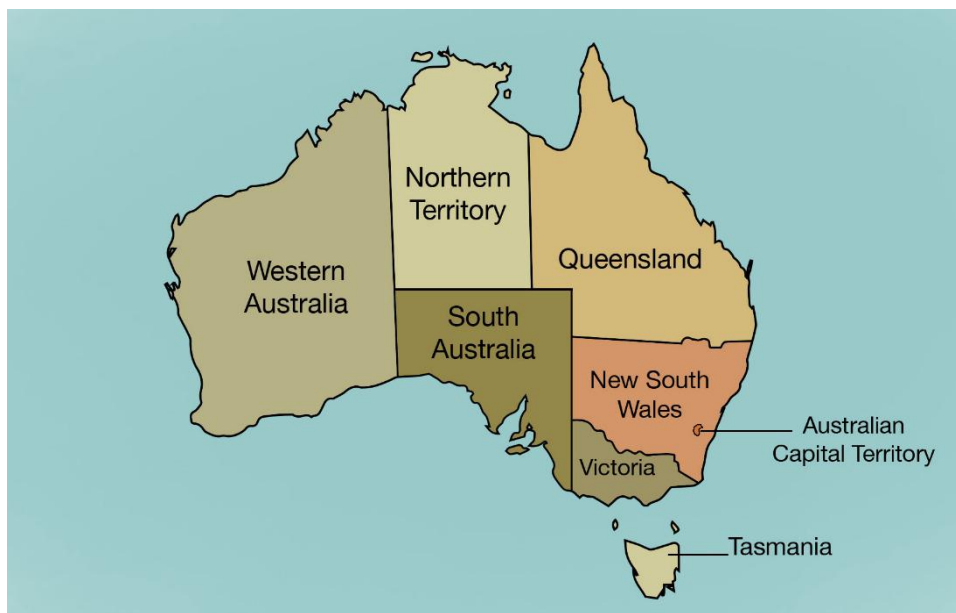
- Mechanisms for sharing and allocating water to the environment and consumptive uses
- Market based mechanisms for the transfer of water licences and allocations to new, higher value uses
- Periodic, targeted investments in supporting community and industry adjustment
- Future demand and supply planning and water accounting
- Pricing of water on the basis of long-run marginal cost
- Flood and emergency planning
- Warning and alert systems for climatic events
- Investment in flood mitigation infrastructure and monitoring
- Polluter pays and offset methods for reducing the discharge of various contaminants.

Case Study of Local Water and Basin Management Frameworks (South Australia)

As a case study to demonstrate national and state government interfaces and water management at the local level, South Australia provides a useful example.

South Australia is located at the end of the Murray-Darling Basin, Great Artesian Basin and Lake Eyre Basin and is therefore highly impacted by water management decisions in other states (see Figure 7). The state is also the driest in Australia, subject to significant dry-periods, with intermittent periods of flooding.

Figure 7 – The State of South Australia



The primary water related legislation in South Australia is the *Landscape South Australia Act (2019)*¹⁶. This act establishes a head of power for the state government to 'prescribe' a strategic or important water resource and for local Landscape Boards to develop a water allocation plan (or WAP) for its ongoing management¹⁷.

A WAP is a legal document that sets out the rules for managing the take and use of water in a sustainable manner. They are developed in consultation with community members, First Nations, industry and key stakeholders. Overall, a WAP ensures the needs of the environment are taken into account when determining how much water is made available for consumptive use.

They do this by setting an amount of water available for use, processes for how that water may be allocated to water users, rules around water trade and the types of activities permitted with water. Once a WAP is in place, water users can apply for a water licence,

¹⁶ Previously the *Water Resources Act (1997)* and *Natural Resources Management Act (2004)*

¹⁷ Source -

https://www.legislation.sa.gov.au/_/legislation/lz/c/a/landscape%20south%20australia%20act%202019/current/2019.33.auth.pdf

transfer water between users and perform a range of other activities subject to the rules and limits of the water allocation plan.

A water licence provides an ongoing right to take water from the resource.

WAPs are developed through a staged process:

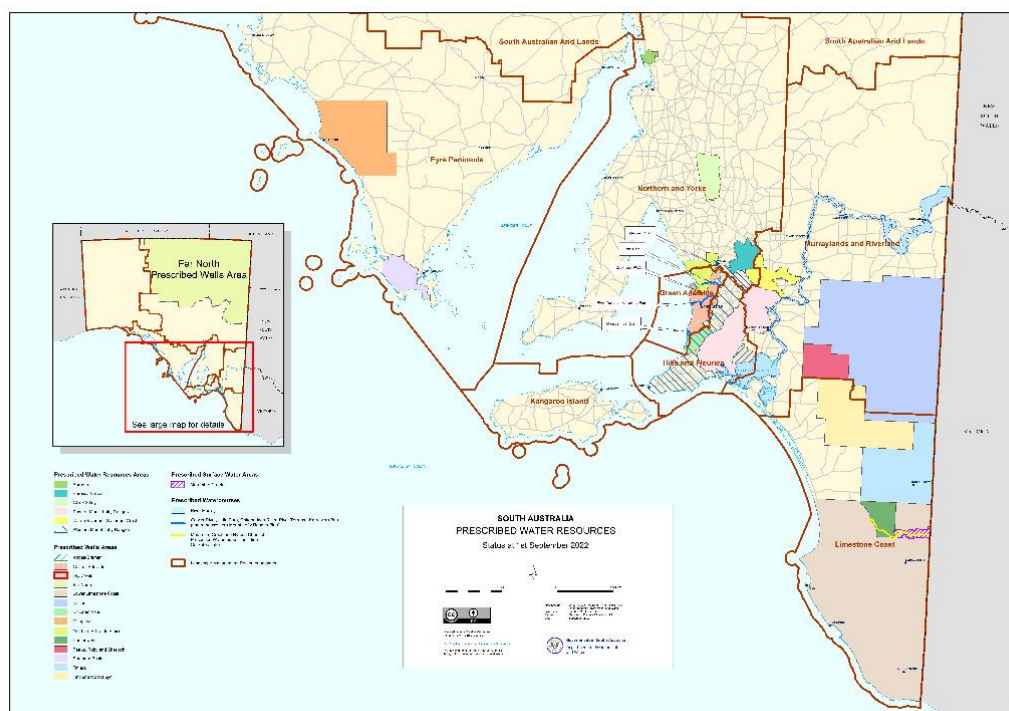
1. Prescription of a water resource
2. Plan development - risk assessment using best available science, community engagement, allocation of water for environment and consumption
3. Plan adoption – statutory instrument
4. Implementation – licenses, permits, annual allocations, trade, monitoring and enforcement
5. Review and amendment – within 10 years.

WAP's are subject to specified community engagement requirements and were historically subject to Parliamentary approval or disallowance. Currently, adoption is now the responsibility of the relevant minister, which ensures appropriate political oversight.

WAPs are an important mechanism for responding to drought situations and allocating water against agreed state priorities.

Figure 8 provides a map of the prescribed water resources in South Australia, which require WAPs to be in place.

Figure 8 – Prescribed Water Resources in South Australia



Other legislative instruments in South Australia that are relevant for this guidance document covering disputes in regard to drought, flood and water quality are:

- *Environment Protection (Water Quality) Policy 2015* – for managing water quality
- *Local Government (Stormwater Management Agreement) Amendment Act (2016)*
- State Emergency Management Plan – for flood planning, mitigation and emergency response.

Environment Protection (Water Quality) Policy 2015

Water quality in South Australia is protected by the Environment Protection Act (1993) and the environment protection policies made under it¹⁸. The *Environment Protection (Water Quality) Policy 2015* provides the most specific and detailed protection of the state's surface, marine and underground water sources.

This policy, which is a legislative instrument, provides the structure for the regulation and management of waters. It is a flexible document that allows values to be changed without undue delay and creates specific controls to deal with particular situations. It is also used regularly by local government as part of their general stormwater management programs.

The policy regulates both specified activities and diffuse sources of pollution by calling up a range of codes of practice which have legal effect through the policy. The codes are formally recognised as another tier in the statutory enforcement and compliance scheme.

The current policy replaces the 2003 policy, with its various revisions being based around the core question of - '*Will they lead to a better environmental outcome overall?*'.

Changes to the policy created requirements that enable water quality issues to be dealt with in a more flexible manner, in some cases replacing mandatory requirements with defined and measurable targets enforceable by environmental protection orders, while at the same time being adaptable enough to allow for an active program of continuous improvement.

Local Government (Stormwater Management Agreement) Amendment Act (2016)

The *Local Government (Stormwater Management Agreement) Amendment Act (2016)* sets the legal framework and processes for managing stormwater through a collaborative approach between the state government and local councils, including for flood mitigation and to negate water quality and environmental impacts from urban run-off¹⁹.

The legislation is enabled through the *Agreement on Stormwater Management between the Government of South Australia and the Local Government Association of South Australia (2013)*, which effectively commits both levels of government to work in partnership through the Stormwater Management Authority.

The Stormwater Management Authority is an independent statutory body, comprised of a nine-member board appointed by the Minister for Climate, Environment and Water, with representatives from both the state and local government sectors.

¹⁸ Source - https://www.epa.sa.gov.au/files/11256_wqepp_notes_nov2015.pdf

¹⁹ Source - <https://www.sma.sa.gov.au/>

The authority acts as a stormwater planning and prioritisation body for South Australia, hence managing urban related flood and water quality issues. It does this through requiring the preparation of catchment-based stormwater management plans for priority catchments across the state.

Such plans are required to be developed by the council(s) that cover the geographical area of the catchment, consistent with guidelines published by the Stormwater Management Authority. These plans will identify various economic, social and environmental risks posed by stormwater in the catchment and outline infrastructure based and other mechanisms for addressing these issues.

The Stormwater Management Authority provides funding for both the development and implementation of stormwater management plans (up to a level of 50%) through a dedicated Stormwater Management Fund, administered independently by the authority.

State Emergency Management Plan

The State Emergency Management Plan is a requirement under the *Emergency Management Act (2004)*, setting out comprehensive emergency management arrangements for South Australia. It outlines a coordinated approach to building resilience and reducing vulnerability across all aspects of the community, including state and local government, business, the non-government sector and individuals²⁰.

For flooding, the State Emergency Management Plan designates the Department for Environment and Water as the 'flood hazard leader', responsible for developing a Flood Hazard Plan outlining the specific arrangements for how floods are managed and coordinated in South Australia²¹.

The flood hazard leader is also responsible for preparing and coordinating information to enable emergency response agencies to plan and implement operations in emergency flood events, such as:

- Collating flood maps across metropolitan and rural South Australia to help the public understand their flood risk
- Undertaking risk assessments to identify and prioritise new and recurring flood risks
- Providing advice about River Murray flows and flood in the state
- Working with the SA State Emergency Service to provide information for community education programs for flood hazards and flood warnings
- Working with government agencies, councils and other stakeholders to improve flood management in areas such as flood warning, land use planning, community awareness, mitigation and emergency management.

This framework sets the overall approach to managing floods in South Australia, across both urban and rural landscapes.

²⁰ Source - <https://www.dpc.sa.gov.au/responsibilities/security-emergency-and-recovery-management>

²¹ Source - <https://www.environment.sa.gov.au/topics/flood/planning-and-roles>

2.2 Water Resources Management Organisation (Structure/Roles/Responsibilities)

Governance is defined as referring to all processes of governing, whether undertaken by a government, market or network, whether over a family, tribe, formal or informal organisation or territory, and whether through laws, norms, power of language²².

The OECD Principles on Water Governance provide a framework for governments to consider when designing and implementing water policies. The 12 principles were introduced in 2015 and seek to guide the development of effective, efficient and inclusive water structures²³:

1. Clearly allocate and distinguish roles and responsibilities for water policymaking, policy implementation, operational management and regulation, and foster co-ordination across these responsible authorities
2. Manage water at the appropriate scale(s) within integrated basin governance systems to reflect local conditions, and foster co-ordination between the different scales
3. Encourage policy coherence through effective cross-sectoral co-ordination, especially between policies for water and the environment, health, energy, agriculture, industry, spatial planning and land use
4. Adapt the level of capacity of responsible authorities to the complexity of water challenges to be met, and to the set of competencies required to carry out their duties
5. Produce, update, and share timely, consistent, comparable and policy-relevant water and water-related data and information, and use it to guide, assess and improve water policy
6. Ensure that governance arrangements help mobilise water finance and allocate financial resources in an efficient, transparent and timely manner.
7. Ensure that sound water management regulatory frameworks are effectively implemented and enforced in pursuit of the public interest
8. Promote the adoption and implementation of innovative water governance practices across responsible authorities, levels of government and relevant stakeholders
9. Mainstream integrity and transparency practices across water policies, water institutions and water governance frameworks for greater accountability and trust in decision-making.
10. Promote stakeholder engagement for informed and outcome-oriented contributions to water policy design and implementation
11. Encourage water governance frameworks that help manage trade-offs across water users, rural and urban areas, and generations
12. Promote regular monitoring and evaluation of water policy and governance where appropriate, share the results with the public and make adjustments when needed.

²² Source - <https://waterpartnership.org.au/wp-content/uploads/2020/11/BasinGuide-full-web.pdf>

²³ Source - <https://waterpartnership.org.au/wp-content/uploads/2020/11/BasinGuide-full-web.pdf>

THAILAND

Water resources management organisation in Thailand is categorised under three levels through the Water Resources Act, B.E. 2561. The chronology of institutional and operational water resources management structures in Thailand is shown in Table 1.

At the national level, the National Water Resources Committee (NWRC) is the key actor responsible for publishing, regulating and driving water resources management policies. The NWRC has three sub-committees responsible for (1) water resources development and conservation, (2) water resources management and (3) technical and academic support. The NWRC also has sub-committees for different areas through a provincial water resources subcommittee and a regional water resources subcommittee.

At the river basin level, the River Basin Committee (RBC) has been established to be responsible for specific river basins. Each basin is managed by such a committee, with the structure defined in the Water Resources Act. The role and responsibility of RBCs is to regulate and drive water resources management policies at the basin scale.

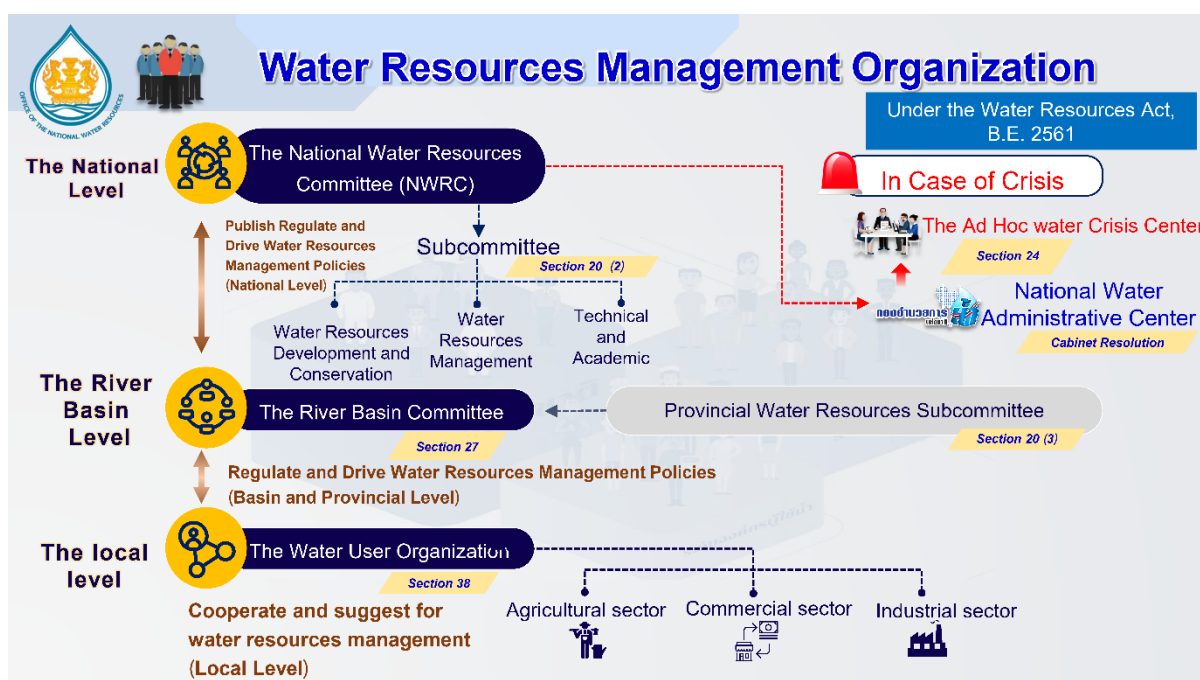
Table 1 – Evolution of Water Resource Managing in Thailand

1992	First establishment of Water Resource Committee under Regulation of the Office of Prime Minister on National Water Resource Management B.E. 2532 (1989)
1996	Established Office of National Water Resource Committee
2002	Established Department of Water Resources under Bureaucratic Reform Act 2002
2008	Established the 25 River Basin Committees according to the Order of the National Water Resource Committee
2015	Approved National Water Resource Management Strategies (2015-2026)
2017	Established Office of the National Water Resources (ONWR) under Office of Prime Minister
2018	Re-established the National Water Resources Committee (NWRC)
2018	Established and enforced the Water Resources Act, B.E. 2561 (2018)
2018	Approved the 20 year water resources master plan, B.E. 2561-2580 (2018-2037)
2021	Re-established the 22 River Basins

At the local level, water user organisations, including representatives from the agricultural, industrial and commercial sectors, promote cooperation and provide suggestions for effective water resource management, in line with the Water Resources Act.

Figure 9 provides a pictorial overview of this structure.

Figure 9 – Water Resource Management Organisations in Thailand



AUSTRALIA

Strategic Context

As Australia's water reform journey has continued, the institutional frameworks and governance structures at both the national and state levels have also shifted. Through the provisions of the Australian Constitution and state legislation, water is vested in and owned by state governments and there is a requirement for these resources to be managed in the public interest.

As a summary of water governance in Australia, this section focusses on the structures and institutions by which decisions concerning water policy and management are made and implemented.

The Australian experience has confirmed that an appropriate and enabling governance environment is essential for successful water management and basin planning, with institutional arrangements involving organisations with both the management and technical capacity to effect change being critical.

Reaching agreement on decision-making processes and governance arrangements provides stability and predictability that supports economic and social development, whilst enabling environmental sustainability.

Australia's federal system has had both advantages and disadvantages for national water reform. A national program requires the agreement of the states and territories, as well the

Australian Government. This can be a difficult process, as generally there has to be 'something in it for everyone'²⁴.

However, once agreement is reached and there is a commitment to proceed from all sides, a collaborative approach can provide the necessary drive and ensure longevity.

If one or two parties start to flag, pressure can be applied from the others. Moreover, it allows stakeholders, industry and communities to hold governments to account over the long-term.

In an Australian perspective and in the context of the constitution, the relevant roles and responsibilities for water are as follows:

- Australian Government – national coordination, agreements, limited legislation, guidelines, financial incentives, strategic research, data consolidation
- State and territory governments – legislation, policy, strategy, compliance and enforcement, science and research
- Local government – specified roles through legislation (flooding, stormwater), land development approvals, local community representation
- Stakeholders (industry/community) – input into policy/legislation.

Governance Structures - National

Australian water governance structures and entities at the national level include the following.

National Cabinet	A forum including the Australian Prime Minister, State and Territory Premiers/Chief Minister that can establish national agreements
Department of Climate Change, Energy, the Environment and Water	Coordination and leadership of national policy, regulation and agreements
National Water Reform Committee	A forum of national, state and territory officials, reporting to National Cabinet and driving nationally consistent water policy agendas and overseeing the NWI
Inspector-General of Water Compliance	National leadership of Water Act compliance
Productivity Commission	Lead for regular reviews of the NWI and Murray-Darling Basin Plan
National Water Grid Authority	Coordination and investment in water infrastructure

²⁴ Source - <https://waterpartnership.org.au/wp-content/uploads/2016/08/AWN-Australian-Water-Reform-Journey.pdf>

Governance Structures - Transboundary

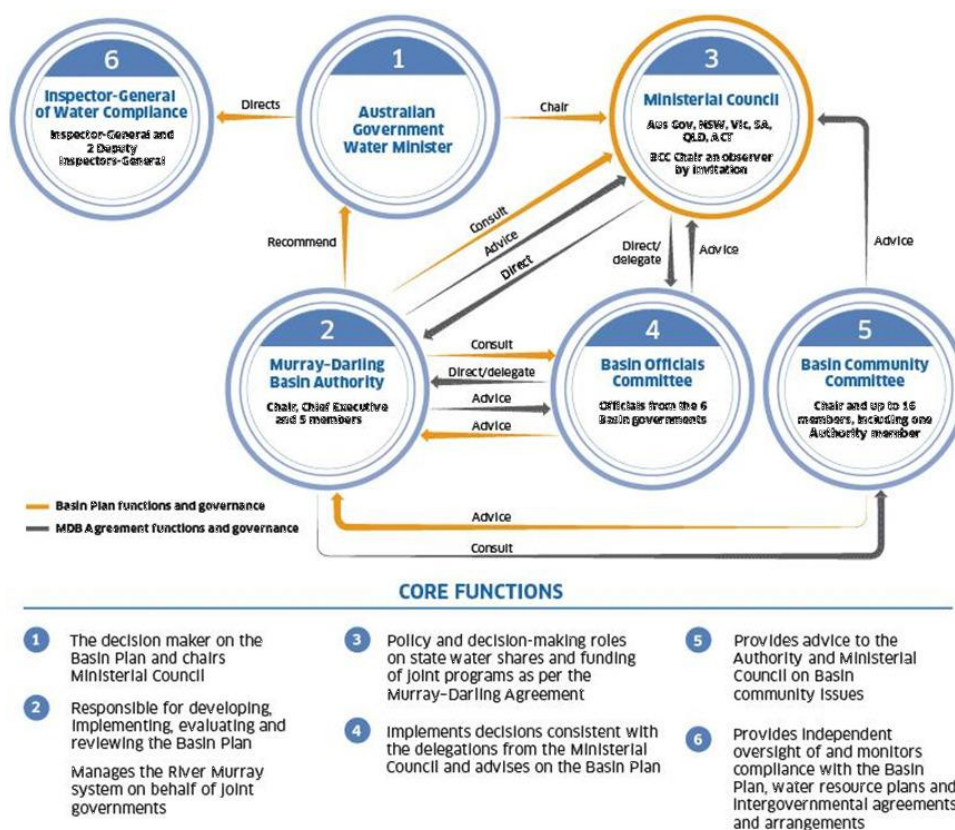
Transboundary structures in Australia include:

Murray-Darling Basin Ministerial Council	A forum on national, state and territory water ministers, with specific oversight and decision-making authority for the Murray-Darling Basin
Basin Official Committee	A forum of national, state and territory officials reporting to the Murray-Darling Basin Ministerial Council
Murray-Darling Basin Authority	Independent Statutory Authority with oversight of Murray-Darling Basin Plan and river operations

Within this governance structure, there is a significant emphasis on the Murray-Darling Basin, recognising its transboundary complexity and strategic significance to the nation.

Figure 10 provides an overview of how the various institutions interact in the management of this basin.

Figure 10 – Governance of the Murray-Darling Basin



In regard to the Murray-Darling Basin it is also worth noting that the governance around allocations and water sharing has fundamentally shifted over the last 100 years from a partnership/consensus model to one where the national government has set extraction limits (through the Basin Plan) and the states are required to comply.

A partnership model has been retained for other issues such as salinity and river management. As a result, the governance of the Murray-Darling Basin is now a mix, where the national government is a regulator on issues of water allocation and a water entitlement owner and also a partner government on other natural resource management issues. This arrangement continues to evolve²⁵.

Governance Structures – State/Territory

As noted in Section 2.1, governance arrangements differ slightly in each state and territory in response to local needs and issues. However, in general there will be a lead government agency assigned with responsibility for water allocation, drought management, flooding and water quality. These agencies have responsibilities for the management of various legislative provisions.

The lead agencies will also have responsibility for engaging with other agencies (such as the agriculture department) and community in the conduct of its legislative priorities.

Any new legislation required will be passed through the local parliament, subject to standard political and parliamentary processes, hence providing community accountability through ministers.

Local government will also have dedicated responsibility for stormwater and for wastewater treatment and drinking water supplies in some regional areas. These responsibilities will be set through legislation passed again by the local parliament.

²⁵ Source - <https://waterpartnership.org.au/wp-content/uploads/2016/08/AWN-Australian-Water-Reform-Journey.pdf>

South Australia as a Case Study of Local Water and Basin Management Governance

As a case study demonstrating water governance at the state/territory level, South Australia provides a relevant example.

South Australian water governance structures and entities at the state level include the following.

South Australian Parliament	Passing of water and other legislation
South Australian Cabinet	Decision making forum of ministers for the executive arm of government
Minister for Climate, Environment and Water	Approval of regional water plans, water allocation plans, legislative responsibilities
Department for Environment and Water	State water policy development, allocation planning policy and support, flood hazard leader
Landscape SA Boards	Lead responsibility for regional natural resource management plan and water allocation plan development. Lead on community engagement on water allocation
Stormwater Management Authority	Stormwater/urban flooding planning
Environment Protection Authority	Water quality legislation, policy and compliance
Essential Services Commission of South Australia	Pricing and economic regulation
Office of the Technical Regulator	Technical regulation of water infrastructure
SA Water	Government owned water utility
Local Government	Stormwater/flood mitigation infrastructure and maintenance

Chapter 3: Dispute Mitigation

3.1 Mechanisms (Foundational Structures and Criteria/Policy Frameworks)

THAILAND

Under the Water Resources Act, an announcement from the Thai National Water Resources Committee on criteria and methods for proposing disputes, mediation and arbitration sets the framework for managing disputes between river basin committees. This announcement sets the process for proposing disputes for mediation and arbitration.

In the case of a dispute occurring between river basin committees, a committee can submit the dispute to ONWR or the regional office responsible for the area within thirty days from the date the dispute arises, for NWRC to consider the need for mediation and arbitration.

When ONWR receives such a dispute from a river basin committee or regional office, the office has the authority to determine the dispute issue and prepare preliminary opinions for NWRC to consider pathways for resolution. If there are a number of related issues in the dispute, ONWR may combine several dispute issues into a single dispute process as appropriate.

Dispute Mediation

In the case that ONWR has considered and determined the dispute issue and has the opinion that the dispute can be resolved by means of mediation, the office will submit the advice to the NWRC requesting authorisation to be the mediator. In this dispute mediation process, ONWR is assigned by the NWRC to work with neutrality and to take into account the duties and responsibilities of each river basin committee together with relevant facts. They are also to consider any joint work between basin committees in the past or that will occur in the future and any principles and objectives that can strengthen the integration of allocation, utilisation, development, management, maintenance, restoration and conservation of water according to the law.

The dispute under mediation is required to reach a resolution in short time-frame and relevant documentation is required. After a dispute resolution is reached, ONWR, as assigned by the NWRC, will report the results of the dispute mediation, along with guidelines, to the NWRC for review and approval.

Once approved, ONWR will communicate the resolution and guidelines to the respective river basin committee(s).

Dispute Arbitration

In the case of a dispute that ONWR considers and determines that it cannot be resolved through mediation, or in cases where the person assigned by the NWRC has mediated the dispute, but no resolution could be found, ONWR shall submit such advice to NWRC to consider arbitration. The NWRC may invite representatives from the river basin committee or ONWR or regional office to provide additional information on the disputed issue.

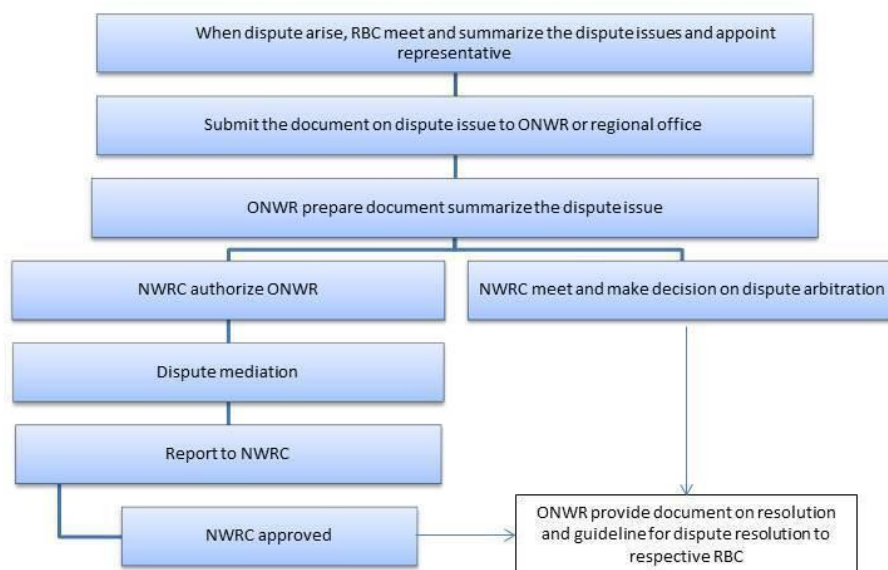
If the dispute is in relation to a basin which has a representative on the NWRC, that representative is not allow to attend meetings that consider and arbitrate on that dispute.

After the dispute arbitration is completed, ONWR will inform the respective river basin committee of the decision and guideline.

These processes are summarised in Figure 11

Figure 11 – Basin Dispute Mitigation Structures in Thailand

Process for Dispute Proposing, Mediation and Arbitration between River Basin Committee



AUSTRALIA

Basin and Water Related Disputes in Australia

A key element of the Australian approach to water management has been to mitigate the risk of disputes by having clearly defined rules that establish water rights and priorities for water sharing. The framework is based on a system of statutory water allocation plans which define the rules for water use and water quality management. Robust water accounting underpins the integrity of the system.

Water and basin management related disputes in Australia can occur between a range of different parties and on a number of different scales. The most common areas where disputes arise are as follows.

Water sharing between jurisdictions:

Where a water resource crosses state boundaries, disputes occur when the impacts of water extracted in upstream jurisdictions affects the availability and/or quality of water for downstream uses and the environment.

At the time of the Federation of Australia in 1901, the impact of potential large-scale irrigation schemes in upstream jurisdictions of the River Murray was the cause of considerable contention during negotiations on the Australia Constitution. This resulted in water management remaining a state responsibility.

The way water in the River Murray is shared between states was first agreed between the states of New South Wales, Victoria and South Australia in 1914 as part of the River Murray Waters Agreement, which also included a minimum volume of water to flow to South Australia (minimum entitlement flow)²⁶.

This arrangement stood the test of time until the extraction of water increased to levels that exceeded the sustainable limits of the system. For the downstream state of South Australia, it became evident that the 'minimum entitlement flow' was insufficient to maintain the health of the riverine environment. Attempts to redress this situation through negotiation between basin states and territories failed to resolve the impasse.

In 2007, the Australian Government stepped in and committed over AU\$13 billion to reverse the overallocation of water resources in the Murray-Darling Basin and introduce new sustainable diversion limits through the Murray-Darling Basin Plan. Access to this funding required the states to cede some constitutional powers to the Australian Government.

It has cost the Australian tax payers substantially to redress historic decisions that led to the overallocation of water in the Murray-Darling Basin and decisions around water recovery for the environment remain highly contentious.

An early and robust water sharing agreement between jurisdictions, based on scientific analysis of the sustainable yield of the system before development reaches an unsustainable level, could have avoided the need for remedial action and associated disputes between jurisdictions.

Water sharing between the environment and consumptive use:

Up until the 1980's, Australian state and territory governments were driven by irrigators, developers and local communities to improve economic prosperity through the exploitation of water resources for irrigation and other productive/consumptive uses, with associated flow on benefits in the form of employment.

²⁶ Current water sharing arrangements across the whole of the Murray-Darling Basin were agreed in 1989 under the Murray-Darling Basin Agreement.

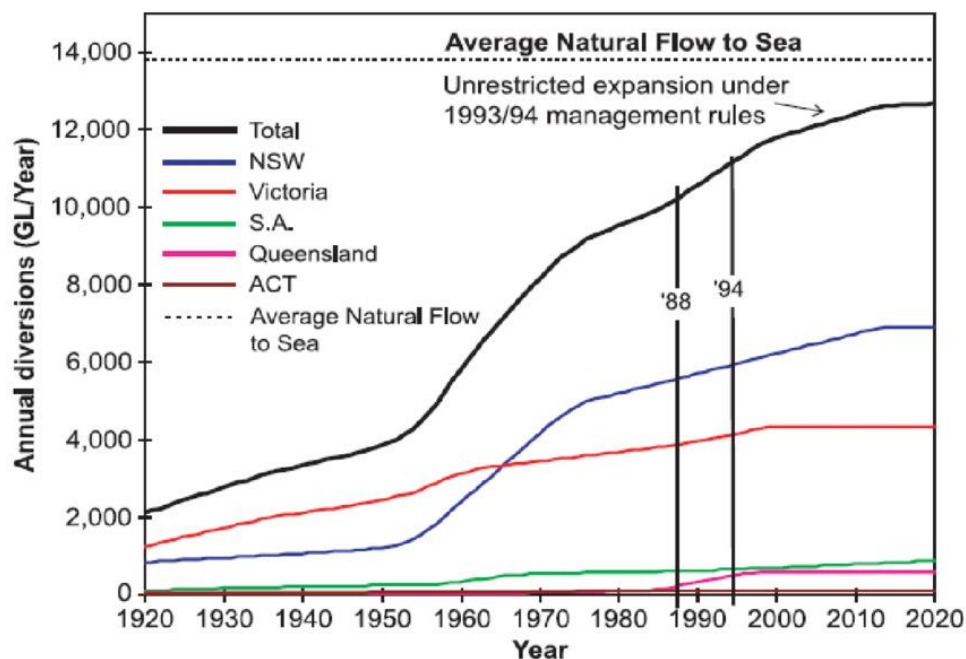
In the Murray-Darling Basin, water use increased exponentially from the 1950's onwards (see Figure 12).

During the 1980's the basin experienced major blue green algae outbreaks, critical salinity increases and the mouth of the River Murray closed to the sea for the first time since settlement. Water managers became very concerned about the serious degradation of the environment and the sustainability of the ecosystems from which water was being taken.

It became clearly evident that decisions driven by economic imperatives only had led to the environment bearing the full cost of development. Failing to consider the needs of the environment as water take continued to increase resulted in over allocation of the resource, with devastating environmental consequences.

Importantly this also put at serious risk the security of supply to all water users.

Figure 12 - Growth in Water Use in Murray-Darling Basin since 1920²⁷

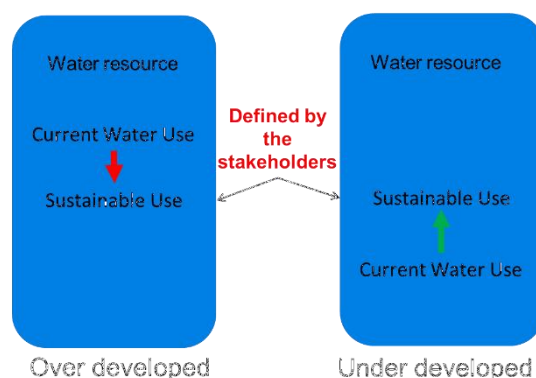


Australia's experience in the Murray-Darling Basin demonstrates the importance of working with stakeholders and the community to establish the sustainable yield of a water resource before the resource is over developed. When a resource is over allocated, recovering water from productive uses to return to the environment is extremely challenging and costly, but essential if water security and quality are to be attained (See Figure 13).

²⁷ Source – to be included.

Figure 13 – Managing Towards Sustainable Levels of Water Use

Managing towards sustainable level of use



Water diversion limits in Australia are now formally set through state/territory level 'water resource plans', which draw on scientific and technical knowledge and stakeholder/community input to consider various water demands and the environmental needs of the system.

This process can be complicated by different stakeholders having differing 'points of truth', often conflicting with technical assessments. In some instances, the science is not accepted by communities at the local level at all. Disputes in this space generally occur during the development process of a water resource plan. Once a water resource plan is formally adopted by the respective minister they become law.

They generally have a 10-year lifespan and are monitored and reviewed regularly, adding additional political oversight and public accountability to the process.

Sharing between water users:

Over the past four decades Australia has progressively moved towards the metering and licensing of all water use activities, using water resource planning as the legislative tool for implementation. Metering and licencing of water use enables water managers to monitor activity, enforce compliance and manage the resource sustainably. It also ensures transparency and accountability of use to underpin confidence in the effective management of the resource and to reduce disputes.

Legally enforceable water resource plans ensure that disputes between water users are mitigated up-front. Disputes that arise between water users and how the government is enforcing the rules of water resource plans are then determined through the courts.

With the introduction of water accounting, along with metering and licensing, Australia has been able to implement water trading as an efficient way to move water between users, using a market system to facilitate the transfer of water to its highest value use.

As in many countries, agriculture is the largest consumer of fresh water resources in Australia. Irrigation demands, economic growth and urbanisation has placed considerable strain on the allocation of water between different users, particularly during periods of drought.

Critical human water needs are well recognised as the highest value use for water in Australia, with the price paid for drinking water far exceeding that for agriculture or other economic applications. Rural communities and the agricultural sector can be concerned that water will be purchased from regional areas for drinking water security, hence reducing the volumes locally available. Such concerns are further complicated when an urban area has access to other water sources, such as desalinated seawater.

Governments manage the potential for dispute in this space by setting clear rules in water resource plans, including priorities for allocating seasonally available water to different classes of water license holders, of which critical human water needs holdings are of the highest level of security (see Box 1 for an example).

Box 1 – South Australian Water Planning Process

Example:

South Australian Water Resource Plan - Water allocation plan process

1. Prescription of a water resource

Important water resources in South Australia are protected and managed by being 'prescribed' under the Landscape South Australia Act 2019. Prescription means the water resource must be sustainably managed to provide security for all water users, including the environment, now and into the future.

2. Development of a water allocation plan

For each prescribed water resource, a water allocation plan must be developed by the relevant regional landscape board or designated entity. A water allocation plan must meet the water needs of the environment and the community. To ensure this, scientific investigations of the water resource and extensive community engagement are undertaken in the development of a water allocation plan.

There are 6 stages in the development of a water allocation plan:

- *A risk assessment is undertaken to identify risks to the water resource and water users, including the environment.

- *The community is given opportunities to provide input into the content of the water allocation plan, based on the risks it is aiming to manage.

- *Based on the decisions made about the risks to the water resource, the environment and water users, a draft water allocation plan is prepared.

- *A consultation process is undertaken to seek community input and views about the draft water allocation plan.

- *The regional landscape board takes the community feedback into account when making decisions on any changes to the draft before submitting a final water allocation plan to the Minister for Environment and Water for adoption.

- *The adopted water allocation plan is reviewed within 10 years to ensure it is still effectively managing the risks to the water resource, the environment and the community.

3. Implementation of a water allocation plan: licences and permits

Once the water allocation plan is adopted by the Minister, it is implemented by the Department for Environment and Water. The department manages the allocation of the water resource to existing and new users in accordance with the rules set out in the water allocation plan.

To be allocated water, water users apply for a water licence which sets out the allocation and conditions applying to taking water. Those wanting to carry out activities on a water body (like a dam, a lake, a watercourse or a floodplain) may need to apply for a permit.

Environmental water recovery methods (for overallocated resources):

Where a water resource is over developed and water needs to be returned to the environment from the consumptive pool, significant debate occurs around the best methods to secure such water. Historically, the purchase of water by government from willing sellers was the preferred approach, with this being the most cost-effective method.

However, in response to regional community concern about the removal of water from local economies and associated unintended consequences (such as the increase in risk of disease, pests and fire from abandoned farming land), the last decade has seen a preference for the use of efficiency projects to identify and secure water for environmental purposes. This debate continues to be ongoing in the Murray-Darling Basin, with the current national government now re-introducing water buybacks.

Additional funding support from government to facilitate industry and community adjustment to less water being available for consumption can assist resolve such disputes.

Water pricing and cost:

The cost of water has traditionally been an area of contention in Australia, but less so in recent years. National Competition Policy (1994) and the National Water Initiative (2004) have been important drivers for a move to full cost recovery for water infrastructure and delivery of water services over the last four decades. In drinking water, there were significant increases in price in the early 2010s as large infrastructure investments made, in response to the Millenium drought, were recovered from consumers. In the agricultural sector, the overall price of water is influenced by a range of factors, but for irrigators it is an increasing proportion of their cost base. Disputes regarding the price of this water are generally related to increased competition in the trade of water rights, rather than the cost of water delivery services.

Flood planning, mitigation and emergency response:

In regard to flooding, disputes can arise across all elements, from planning through to emergency response. Significant additional effort has been directed to flood management and response in eastern Australia over the last decade, in response to larger and increased frequency of such events. Disputes can occur in a number of ways, from debate about flood modelling baseline data, the extent to which climate change and urban development needs are adequately considered, where flood infrastructure should be constructed, who pays for operation and maintenance of infrastructure, to the adequacy of flood warnings. As a result, a greater focus is being placed on forecasting, scenario planning and community education and engagement. This is becoming increasingly challenging due to the uncertainty of climate change, where the past is not necessarily an accurate guide to the future.

Other disputes in the flooding space occur in regard to legal and financial recompense after a major flood event. Robust land use planning and rules that limit the type of development or prevent new/further development on floodplains will play a significant role in reducing the impact of floods in the future, but is likely to also be an area in which additional disputes will arise.

Water quality and pollution:

A polluter pays methodology often applies to point source pollution that impacts water quality in Australia. In these situations, where an individual and entity has clear responsibility and has failed to comply with relevant regulation, disputes are likely to be resolved through legal processes and/or mediation.

Where the source of pollution is distributed across a number of parties and not able to be identified at a point source level, or arise from upstream decisions, disputes occur in regard to the allocation of responsibility to different parties. Often a basin wide and collaborative approach is required in such situations. The Basin Salinity Management 2030 strategy is an example of a successful multi-jurisdictional and whole of basin approach to water quality which has mitigated ongoing disputes between different jurisdictions and stakeholders regarding salinity in the Murray-Darling Basin over many decades.

Key Elements of Australia's Approach to Dispute Mitigation

There are a number of fundamental elements to Australia's approach to resolving water and basin management related disputes, with a key driver being to proactively mitigate these issues.

Targeted research and scientific input:

Evidence based decision making is a cornerstone of public policy in Australia and is utilised extensively in complex situations such as water. Investing in and using robust science in water management frameworks provides an independent method of assessing trade-offs and public value outcomes. By having a clear and transparent pathway for government decision making, public trust can be built and hence mitigate disputes progressing through more formal avenues.

Community input and engagement:

Community engagement is an essential mechanism in the dispute mitigation approach to water. Whilst robust science assists in the decision-making process, such technical foundations can often disregard the social and people dynamics at play. Further, some local communities will have a 'source of truth' that may differ with the scientific consensus and external science may be disregarded and not trusted. Effective community engagement processes provide a mechanism to work through differences of opinion towards an agreed pathway forward.

National level policies and principles:

By setting nationally agreed and consistent policy directions and principles for water management, implementation can occur at the local level in a standardised manner and timeframes can be somewhat flexible to minimise implementation costs and negative impacts. This mitigates the scope for future dispute, as different jurisdictions are working within the same constructs and towards the same objectives.

Ministerial approval:

Ministerial approval is often required in the establishment of new water policy and regulation at a state level, providing another mechanism for public accountability. By ensuring that basin management instruments and reform are approved at the political level by elected officials, decision making pathways and trade-offs will be more transparent.

These mechanisms also provide an extra way for communities to engage with the political and government decision making process on water reform.

Monitoring and evaluation:

Monitoring and evaluation of the implementation of a basin management policy or regulatory framework provides a valuable way of assessing impact on the ground and enable an adaptive management approach. The data collected is also useful for continuing to engage with and inform affected communities and maintain support, or to amend the approach to reform as required.

Compliance and enforcement:

Public trust in water reform and basin management is often improved by ensuring compliance with the regulatory provisions and the enforcement of any penalties. Those that are complying with the requirements of regulation need to be assured that others are also in compliance. If various parties feel like others are not 'playing by the rules', then the motivation for compliance can be weakened, making maintaining implementation difficult.

Legal challenge:

Legal challenge should be seen as a last resort for mitigating disputes in basin management and water reform. These pathways are costly, erode public trust and can often result in unforeseen negative outcomes for communities and the environment. In Australia, there are generally two pathways for legal challenge to occur. The first is through the High Court, which rules on the legality of legislation as against the constitution. The second is through environmental courts at the state level (such as the Environment, Resources and Development Court in South Australia), which deal with disputes and the enforcement of laws relating to the development and management of land, the natural and built environment and natural resources.

In addition, civil legal pathways are also used where recompense for past events/impacts are being pursued.

Dispute Mitigation Mechanisms

Aligning with the core elements for dispute management referenced above, there are a range of formal mechanisms in place in Australia at the national and state levels that assist with mitigating and resolving disputes in regard to water and river basin management. A summary of these is provided in Table 2²⁸

Table 2 – Key Water and Basin Dispute Mitigation and Resolution Mechanisms in Australia

Water Metering	Where water is taken for consumptive use through a water licence in Australia, consumption is often measured through a water meter. In those parts of Australia where metering is less extensive, plans are in place to facilitate the introduction of formal metering systems. Water meters are also used to measure household consumption of water. Metering provides a way of identifying overconsumption, illegal take and leakage and can therefore be used to initiate pre-emptive discussions with water users and feed into formal legal action and enforcement as required.
Water Accounting	Water accounting is an essential element of water management in Australia, aligning with the concept that it is 'difficult to manage what you cannot measure'. Accounting provides essential information for decision-making, policy development and ensuring the sustainable and equitable allocation of water resources, thereby providing a point of evidence that can assist mitigate disputes upfront.
National Water Accounts	Under the <i>Water Act (2007)</i> , the Bureau of Meteorology is responsible for compiling and delivering comprehensive water information across Australia, including an annual National Water Account. The National Water Account provides a detailed insight into the management of water resources at the national and sub-national scale, disclosing the total water resource, the volume of water available for extraction, the rights to extract and the actual extraction of water for economic, social, cultural and environmental benefit across Australia. The account provides a nationally consistent data set for engaging with communities and assessing trade-offs in various water policy developments.
Water Licence Compliance and Monitoring	Aligned with water metering requirements, the monitoring and enforcement of compliance of water licence holders with the conditions of their licence is a valuable way of ensuring community confidence in a water management regime. Whilst prosecution of licence holders can be one outcome from of a water licencing enforcement system, many jurisdictions utilise an engagement/mediation process as a prior step to formal legal proceedings. This can minimise the extent to which illegal water take and overconsumption cases end up in costly legal action.
National Water Initiative	The National Water Initiative is a cornerstone for ensuring a national approach to water in Australia, also allowing for some variance at the state and territory level. By working towards common principles, pathways for dispute are minimised across jurisdictions and different stakeholders.

²⁸ Note - This is intended to provide a high-level summary only. Further details on the regulatory and policy environment under which these operate is provided in Chapter 2.

Parliamentary Oversight	As water related legislation is required to establish heads of power for policy in Australia, parliamentary oversight adds a process by which communities can have their grievances heard and championed through their local elected member. The parliamentary process also enables debate to occur across various perspectives, with decisions then made in the national or state interest.
Model Legislation	Model legislation is a way of enabling national consistency in regulation where the powers to enact are held by the states and territories. In this process one state will take the lead in drafting the legislation required, with other states copying this in their own jurisdictions.
Register of Water Interests	Each state and territory often have a register of water interests that records relevant information about water licences and water access entitlements. A register of water rights held by foreign entities is also maintained at the national level. These registers provide a transparency mechanism around water access rights to ensure community confidence.
National Guidelines	At a level below the National Water Initiative, Australia also have a range of guidelines for various elements of water, such as the Australian Drinking Water Guidelines. These effectively establish standards for local implementation of different water management requirements, informed by expert scientific and stakeholder input.

Importance of Effective Community Engagement and Participation

Within Australia and globally, the central nature of community engagement to successful basin management and water reform continues to be recognised. *‘Community Voices: An Australian Perspective on Community and Stakeholder Engagement’* published by the Australian Water Partnership in 2023, provides the most extensive overview of the Australian perspective on the complexity and challenges of water reform from a community point of view²⁹.

The report notes that *‘the high potential for conflict³⁰ among stakeholders over a limited resource like water requires leaders that create an environment where all voices can be heard’*. Successful water reform in Australia often only happens when leaders from across the stakeholder landscape come together and work with a shared purpose.

In the context of the Murray-Darling Basin, consultation has often occurred *‘...using pre-selected modelled options and supporting science undertaken by government agency staff and scientists that often look, speak and act differently to the communities they are talking to’*. This can create a knowledge and cultural divide, leading to mistrust and leaving communities in fear and feeling powerless to influence the reform agenda and outcomes.

A technical rather than a people centric approach is concluded to often result in high levels of dispute among stakeholders and often delay reform or result in failure to implement the reform as required.

²⁹ Source - <https://waterpartnership.org.au/wp-content/uploads/2023/11/22607-AWP-Community-Voices-FA-WEB.pdf>

³⁰ Note - in the context of this report ‘conflict’ means ‘dispute’

The Community Voices document proposes six principles for effective community engagement and participation in water as follows.

1. Leadership:

Create “leaderful” communities and commit to inclusive, transparent, and well-resourced engagement with a wide range of stakeholders.

2. Building Trusted Relationships:

Provide a safe environment to build trusted relationships through exploration of values, culture and conflict* (people matter).

3. Clarity of Purpose:

Provide clarity on the reform purpose, roles, responsibility, and accountabilities.

4. Problem Definition and Joint Discovery:

Share power through knowledge exploration, problem definition and joint discovery of workable solutions.

5. Time, Flexibility and Windows of Opportunity:

Allow for flexibility in time and process.

6. Decision Making and Change Management:

Demonstrate how decision making and reform implementation reflects the outcomes of the engagement process.

As noted above, a range of mechanisms in the Australian water and basin management system provide pathways for community engagement and participation, but the success of these often varies. This continues to be a challenge for governments and there has been more investment in this space over recent years, recognising its central importance and the need to do better.

It is also important to note that the ‘journey’ to effective engagement is different at the national and state level. As an example, in South Australia water legislation has evolved from being highly prescriptive about consultation, to now being less directive as public trust in the process has developed. At the national level, however, engagement can still be uncoordinated, inflexible and less effective.

There is a need for better community engagement and participation in water reform at the national level, but this is always challenging due to the variety of perspectives and needs at the local level.

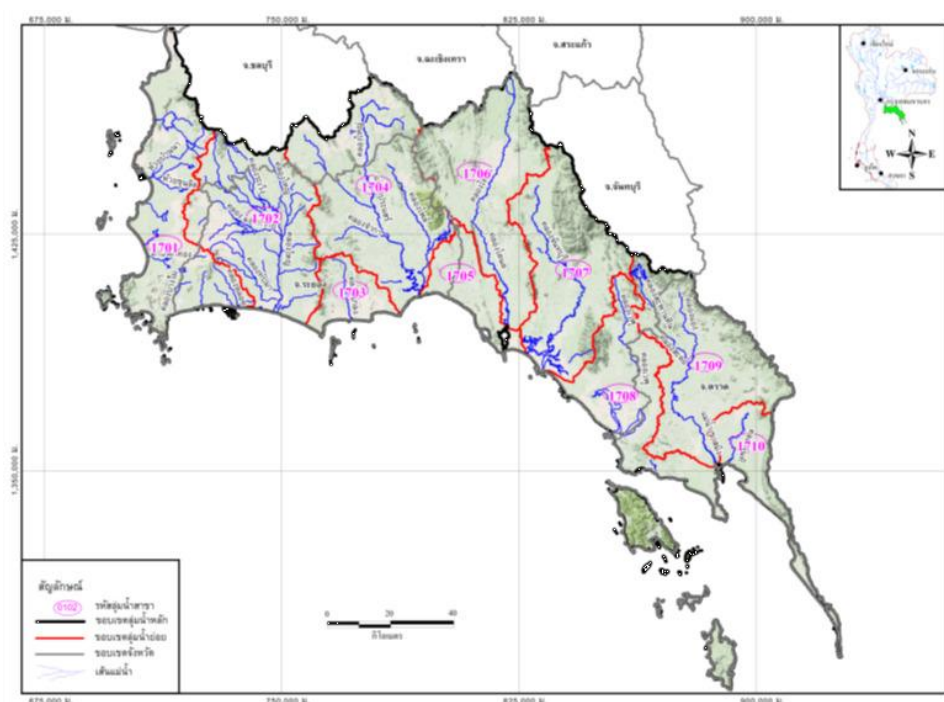
3.2 Water Shortage Case Studies

THAILAND

East Coast Gulf Group River Basin

The East Coast Gulf Group River Basin is located in the east of Thailand, with an area of 13,127 km² and covering four provinces (Chonburi, Rayong, Chanthaburi and Trat). The basin is aligned west to east, with a topography of mostly mountain ranges from north to south, alternating with plains in between, and mountain ranges running along the eastern side from the upper part of the basin down to Chao Phraya and Bang Pakong parallel to the sea all the way to Rayong province. See Figure 14.

Figure 14 – East Coast Gulf Group River Basin



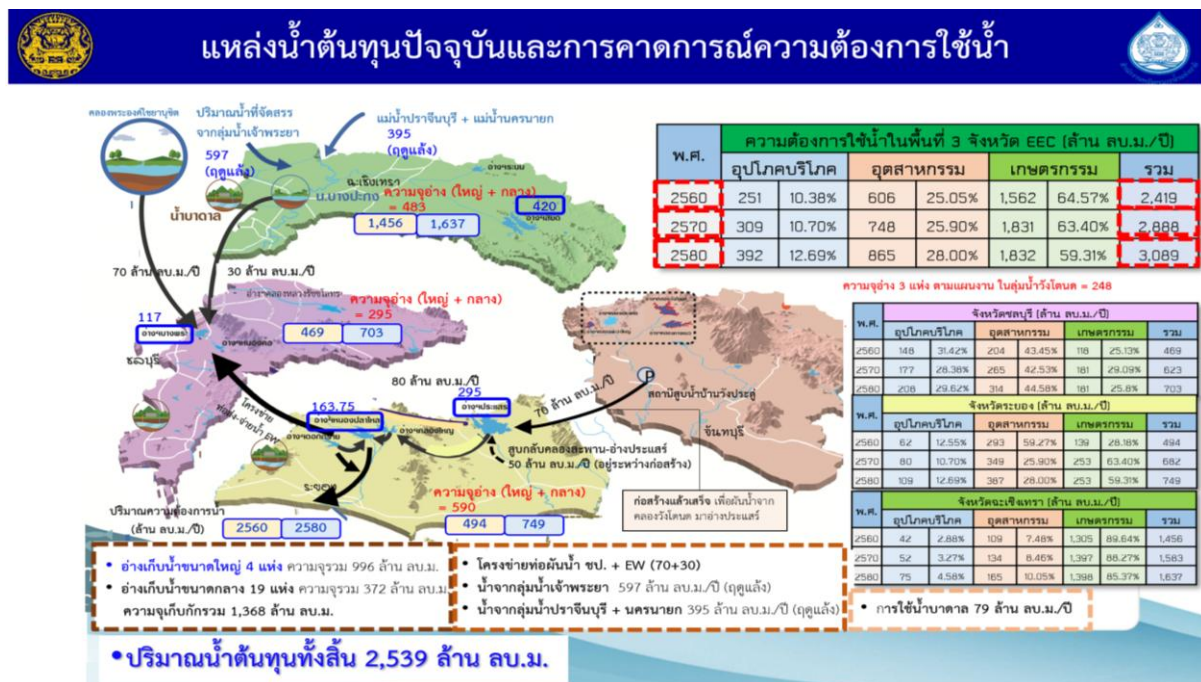
The East Coast Gulf Group River Basin comprises of a number of unconnected rivers, including - Khlong Yai (Rayong River), Prasae River, Khlong Tanod River, Chanthaburi River, Muang Trat River. Each of these rivers flow into the Gulf of Thailand.

Average monthly rainfall in the basin is 1,770 mm, with this occurring mostly (approximately 83%) during the rainy season from May to October.

Water resource development and irrigation projects in these basins are categorised as large if they have a storage volume of >100 million m³, medium if they have a storage capacity of >2 million m³, but less than 100 million m³ and small if they have a storage capacity <2 million m³.

The water in the basins is used for domestic consumption, agriculture, industry, tourism and environmental flows (see Figure 15).

Figure 15 - Water Demand in East Coast Gulf Group River Basin



Key Problems in East Coast Gulf Group River Basin

Water shortages and droughts:

Water shortages and droughts are the most common problems in this basin. These result from insufficient and unseasonal rain, together with the changed ecosystem of the basin cause by urbanisation, industrialisation and expansion of agriculture. This has resulted in increased demand for water, leading to increasing water scarcity.

There are limits on the availability of water that can be used for further development. Existing reservoirs are also inadequate for agricultural, domestic and other demands. A range of water resource development initiatives are being proposed for the basins and in support of the Eastern Economic Corridor area-based economic development initiative of the Government of Thailand, as detailed in Figure 16.

[illegible]

- 1) The demand for water is increasing due to the expansion of community, industry and tourism
- 2) There is limited rainfall in some of the basins and there is a lack of adequate storage to address demand. In some basins, such as Chonburi River Basin, there is a lack of available space for the construction of large-scale reservoirs, so water is diverted from other basins to supplement supplies
- 3) Problems with project approvals for large-scale water resource development projects, due to environmental issues (eg forest conservation)
- 4) Problems related to reserved forests and public area invasion due to increases in population, resulting in the need for more land for agriculture, causing issues in water resource development
- 5) Problems of water use efficiency, especially low efficiency in water supply systems and irrigation projects.

Flooding:

The flood problems in the East Coast Gulf Group River Basin mostly occur in urban areas and communities near the coast. The causes of flooding can be summarised as follows.

- 1) Heavy rainfall occurs in the basin due to its location in a monsoon trough and depression from the eastern side of the country. This area has one of the highest rainfalls in Thailand.
- 2) The watershed and streams have been invaded and deforested, resulting in a decrease in capacity for flood retention. Consequently, floods come down faster than in the past and cause landslides in some areas due to continuous rainfall over a period of time. This also causes flooding in downstream areas.
- 3) There is insufficient water retention before water flows into urban areas and communities.
- 4) The capacity of the drainage system from upstream to downstream and through the city and community areas is insufficient for the volumes that occur. One reason is unregulated urbanisation without appropriate land use zoning. There are also drainage obstacles from construction of buildings, land filling and the topography of the communities in lowland areas.
- 5) Some areas downstream have gentle slopes and some areas have been influenced by seawater, so the river system can be shallow, impacting the capacity of the drainage system.

Key Strategies for Water Scarcity in East Coast Gulf Group River Basin

To respond to scenarios of water scarcity, the following strategies are currently being used:

1. Visualisation: understand the situation of water and weather, including water resources management in the eastern region.
2. Risk Management and Mitigation: prepare together with other stakeholders for the situations that may occur through the Water Grid of the eastern region, such as the water pumping project that will release into the sea or return it to be kept in a reservoir.
3. Engagement of Stakeholders: understand water management, water security in the area, reduce the impact of water scarcity and jointly develop to achieve sustainability.

AUSTRALIA

The Murray-Darlin Basin is arguably the most important water resource in Australia. The system covers a large geographical area in the interior of southeastern Australia (See Figure 17), encompassing the drainage basin of the tributaries of the Murray River (Australia's longest river) and the Darling River (a tributary of the Murray and Australia's third-longest river).

Figure 17 – The Murray-Darling Basin



The basin is 3,375 kilometres long, covering an area of 1,061,469 km² which is flat, low-lying and far inland. It receives little direct rainfall and the many rivers it contains tend to be long and slow-flowing, carrying a volume of water that is large only by Australian standards.

The basin traverses four states and one territory (Queensland, New South Wales, the Australian Capital Territory, Victoria and South Australia) and has hence been a focus of water disputes in Australia since the late 1800s.

The main focus for dispute resolution in the Murray-Darling Basin are in regard to:

- The sharing of water between the various states and territories, particularly in times of low flows
- The allocation of water for environmental purposes, including the volumes required and the method of recovering water
- The accuracy of the science in regard to environmental needs and water recovery targets
- Cost sharing arrangements between the states and territories for the operation, maintenance and construction of new infrastructure across the system
- The best methods for managing salinity across the basin and the respective accountabilities of each jurisdiction and various stakeholders
- Methods of utilising environmental water for maximum impact, including the use of built structures and also in regard to flooding impacts on land.

An overview of the policy and legislative instruments applying to the management of the Murray-Darling Basin are outlined in Chapter 2.

The various provisions of the *Water Act (2007)*, the Murray-Darling Basin Agreement and the Basin Plan collectively establish the current management framework for the whole of the basin. Under the Basin Plan, each state and territory is required to implement the agreed reforms through local water resource plans, which need to be formally accredited by the Murray-Darling Basin Authority. The following case study focuses on the South Australian section of the Murray-Darling Basin

Water Allocation Plan for the River Murray Prescribed Watercourse (South Australia)

The state of South Australia is at the end of the system and is most greatly impacted by decisions made upstream. It is significantly reliant on access to an annual entitlement flow of 1,850GL as set through the Murray-Darling Basin Agreement and the implementation of the Basin Plan for the future security of water in the River Murray system.

The Water Allocation Plan for the River Murray Prescribed Watercourse (an accredited water resource plan) is the primary instrument for managing the River Murray in South Australia, including during times of drought.

The water allocation plan has evolved significantly since the Millenium Drought in the early 2000s, when it was recognised that the regulatory and governance structure had not envisaged inflows as low as received.

Historically, the Murray-Darling Basin Agreement allowed for water shortages to be managed by agreed 'triggers' that invoked special accounting measures for the sharing of water for irrigation during such drought periods. The agreement did not provide for sharing arrangements in situations where inflows were so low that critical human water needs were impacted.

The agreement was effectively set aside during the height of the Millennium Drought and senior government officials at the state and national level met monthly to assess inflows and distribute water under what was called a 'Dry Inflow Contingency Planning' process.

During this time, governments agreed amendments to the Murray-Darling Basin Agreement to introduce tiered decision-making criteria to prioritise critical human water needs and set new rules to manage sharing between jurisdictions during droughts.

The current Water Allocation Plan for the River Murray Prescribed Watercourse (2023) takes onboard the lessons from the Millenium Drought and further dry periods since that time to now provide a multifaceted and community accepted approach to allocating water during times of low flows.

Overview of the Water Allocation Plan for the River Murray Prescribed Watercourse

Water allocation plans in South Australia are a statutory instrument under the *Landscape South Australia Act (2019)* and set the amount of water available for use, how that water may be allocated to water users, rules around trade of water and the types of activities

permitted with that water. Once a water allocation plan is in place, water users can apply for a water licence, transfer water between users and perform a range of other activities subject to the rules and limits of the plan. Importantly a water licence provides an ongoing right to take water from the resource.

Water allocation plans provide certainty to water users, whilst considering environmental, social and economic needs, long-term sustainability and water security. They are developed by the relevant landscape board, which are responsible overall for facilitating the management of natural resources within a specified geographical region, in partnership with key stakeholders.

The Water Allocation Plan for the River Murray Prescribed Watercourse was first adopted in 2002, with the current version being endorsed by the South Australian Minister for Climate, Environment and Water in 2023. The plan complies with the requirements of the Murray Darling Basin Plan and the *Landscape South Australia Act (2019)*.

Table 3 provides an overview of the history of the plan since 2002 to the present day.

Table 3 – History of the Water Allocation Plan for the River Murray Prescribed Watercourse

10 August 1978	Prescription of River Murray Watercourse
1 July 2002	First Water Allocation Plan for the River Murray Prescribed Watercourse adopted
12 January 2004	Minor amendments to the first Plan
2007	Minor amendments to the first Plan
August 2008	Concept statement for second Water Allocation Plan for the River Murray Prescribed Watercourse adopted
15 July 2009	Amendments to the first Plan
January 2011	Minor amendments to the first Plan
25 November 2014	Draft of the second Water Allocation Plan for the River Murray Prescribed Watercourse released for public comment
3 October 2017	Adoption of the second Water Allocation Plan for the River Murray Prescribed Watercourse
13 July 2018	Draft of the third Water Allocation Plan for the River Murray Prescribed Watercourse released for public comment
28 February 2019	Adoption of the third Water Allocation Plan for the River Murray Prescribed Watercourse
7 January 2020	Draft of the fourth Water Allocation Plan for the River Murray Prescribed Watercourse released for public comment
15 April 2020	Adoption of the fourth Water Allocation Plan for the River Murray Prescribed Watercourse

28 September 2020	Draft of the fifth Water Allocation Plan for the River Murray Prescribed Watercourse released for public comment
24 September 2021	Adoption of the fifth Water Allocation Plan for the River Murray Prescribed Watercourse
14 February 2022	Draft of the sixth Water Allocation Plan for the River Murray Prescribed Watercourse released for public comment
27 April 2023	Adoption of the sixth Water Allocation Plan for the River Murray Prescribed Watercourse

This history demonstrates the significant extent to which local communities have been engaged in the process of review and update of the plan over many years. It also highlights that the plan is an adaptive management instrument for the system, responding to national policy requirements and changing climatic, social, economic and environmental conditions at the local level.

Overall, the objectives of the current water allocation plan are to³¹:

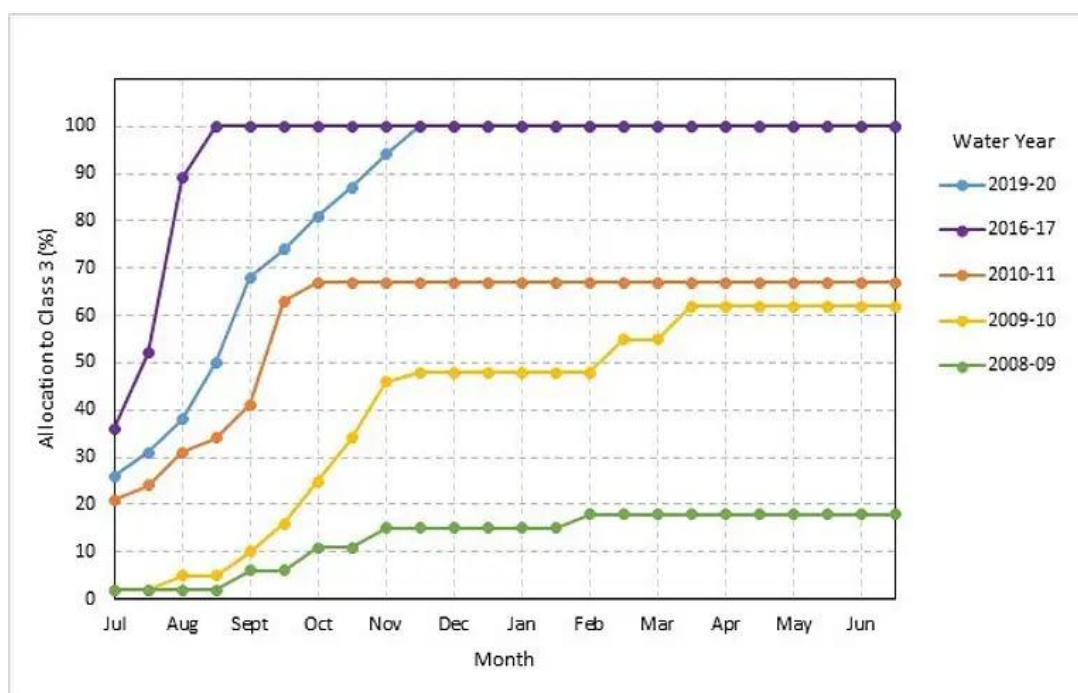
- Provide allocations that contribute to the water needs of water-dependent ecosystems
- Allocate water in a sustainable and equitable manner between different users
- Promote efficient use of water from the prescribed watercourse
- Contribute to fulfilling South Australia's obligations under basin-wide plans and legislation
- Contribute to the prevention of loss of condition, number or extent of refuge habitats and dependent aquatic biota of floodplains, wetlands and sites of significance
- Contribute to the prevention of adverse impacts on water quality
- Contribute to the prevention of increased soil salinity and acid sulphate soils and associated land management issues.

A number of low flow periods and drought have occurred in the South Australian River Murray system since the early 2000s. To address this, the Water Allocation Plan reduces starting allocations for water licence holders to less than 100% of their annual entitlement (calculated by modelling the low inflow forecasts), with allocations increasing when and if inflow improves.

Figure 18 highlights the years since 2008-09 where starting allocations have been less than 100%, also indicating how allocations have increased as the water year has progressed.

³¹ Source - https://cdn.environment.sa.gov.au/landscape/images/2023-amended-river-murray-wap-FIN_WEB.pdf

Figure 18 – Water Allocations under the Water Allocation Plan for the River Murray Prescribed Watercourse³²



The methodology for reducing and increasing allocations in response to inflow projections is detailed in the water allocation plan.

The Water Allocation Plan for the River Murray Prescribed Watercourse continues to be the primary instrument for enabling the implementation of the Murray-Darling Basin Plan, *Water Act (2007)* and the Murray-Darling Basin Agreement and for managing drought events within the South Australian River Murray system.

Drought Mechanisms of the 2023 Water Allocation Plan for the River Murray Prescribed Watercourse

As noted above, the Water Allocation Plan for the River Murray Prescribed Watercourse has evolved a number of times since the original plan in 2002, responding to changing climatic conditions, national policy directions and community and environmental needs.

In most years, South Australia receives its full entitlement of 1,850GL (set through the Murray-Darling Basin Agreement), comprising of a:

- Dilution and Loss Entitlement (696GL)
- Consumptive Entitlement (1,154GL).

However, in dry years access to the full entitlement may not be available. This in turn limits the water available for consumptive purposes, including for irrigation and critical human water needs.

³² Source - <https://www.environment.sa.gov.au/topics/river-murray/information-for-industry/water-allocations-and-announcements-redirect/historical-water-allocations>

The water allocation framework sets out the approach for sharing water and takes into account economic, social and environmental considerations. The actual volume of entitlement that South Australia receives each year is determined by the Murray-Darling Basin Authority in accordance with the water sharing rules of the Murray-Darling Basin Agreement.

Chapter 5 of the water allocation plan outlines how water is allocated, including in dry years. Once the entitlement volume is determined by the Murray-Darling Basin Authority, the principles in the water allocation plan guide the process for allocating the water to end users in South Australia.

It does this by:

1. Identifying four consumptive pools in the River Murray Prescribed Watercourse
2. Establishing a methodology for how the volume within each consumptive pool will be calculated
3. Detailing principles for guiding the Minister for Climate, Environment and Water in determining the volume of water available for allocation from each consumptive pool
4. Determining how water will be allocated to licence holders.

Allocation decisions are made based on the volume of entitlement available to South Australia, the volume of water held under the state's storage rights in upstream dams in other jurisdictions and the requirements for critical human water needs, irrigation and the environment.

In dry periods, the plan accounts for the fact that there may not be adequate water in the system to meet the needs of all water users.

A volume of 696GL is provided to meet some operational losses and provide salinity dilution. Up to 20GL is then provided for critical human water needs, which are the highest priority for allocation after dilution and loss.

The actual volume of critical human water needs required, both in the current and following year, can change annually depending on how much water can be provided to Metropolitan Adelaide from other sources.

A maximum volume of 693.9GL may be allocated from an 'All Purpose Consumptive Pool', through which irrigation water is allocated.

South Australia can also defer and store water from its entitlement for use in future years. When required, stored water can be made available for critical human water needs and private (irrigator) carryover. This provides a mechanism to plan ahead for future dry periods and provide a 'back-up' water supply.

In addition, the water allocation plan accounts for the Adelaide Desalination Plant in the allocation framework (a 100GL seawater desalination plant constructed to provide backup drinking water supply for periods of drought). In dry periods, this allows for the allocation of an additional 50GL of River Murray water to licence holders, with this water being replaced for Adelaide by desalinated seawater.

This equates to an 8% increase in irrigator allocations during low flows than has historically been the case. This 50GL increase is also subject to an allowance for the growth of Adelaide. Under the plan, the Minister for Climate, Environment and Water has the option to make an allowance for demand growth for Adelaide, but not more than once every four years.

The 2023 plan also introduced specific carry-over provisions as an additional tool for managing low flow periods and providing irrigator certainty and water access, whilst not impacting the environment. Under the plan, where annual allocations to irrigation are less than 50%, access to carry-over provisions may be available for the following water year, on the decision of the Minister for Climate, Environment and Water.

This mechanism enables irrigators to carry-over any unused water from that year to the next, providing some flexibility in water access and security during drought.

Dispute Mitigation Linkages

As the most important water resource in Australia, from an economic, social and environmental perspective, the Murray-Darling Basin is subject to one of the most sophisticated water management frameworks around the world. The approach to this system has evolved significantly since the 1980s, when issues of water quality and overextraction across the basin were recognised by governments, irrigators and communities.

The need to restore the balance between the environment and consumptive allocation of water, regulation to address water quality considerations, operational processes around storage and the release of water, upstream and downstream irrigation development, foreign investment in the water market and irrigation sector, urban versus rural water use and uncertainty over the potential impacts of climate change on water availability, have all been the catalysts for debate and disputes across the Murray-Darling Basin.

Such disputes have occurred mainly at a jurisdiction to jurisdiction and a stakeholder (or user) to stakeholder level.

The current management framework has developed over time in response to these debates and to specifically mitigate more formal dispute processes occurring. It does this through:

- Having national legislation and complementary state legislation to lock in water targets, goals and principles across the basin
- Utilising extensive engagement with key stakeholders across the basin and locally in the establishment of regulatory and policy directions
- Drawing on significant scientific research and modelling
- Providing clear rules and processes around water access and allocation during times of drought.

Within South Australia, ongoing and effective community engagement in the evolution of the Water Allocation Plan for the River Murray Prescribed Watercourse has been essential in building a trusted framework for managing drought in an agreed fashion across the River Murray system.

3.3 Flood Case Studies

THAILAND

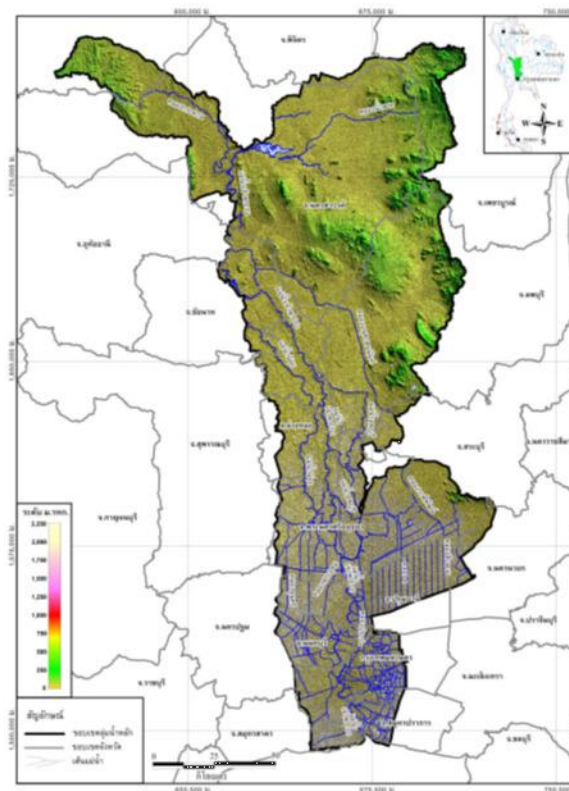
Chao Phraya River Basin

Chao Phraya River Basin is located in centre of Thailand, covering an area of 20,442km² and the Nakhon Sawan, Uthai Thani, Chainat, Sing Buri, Ang Thong, Phra Nakhon Si Ayutthaya, Pathum Thani, Nonthaburi and Bangkok provinces. The basin is aligned north to south (see Figure 18).

The eastern side of the basin in Nakhon Sawan and Lopburi provinces is a plateau, with low hills separating the Chao Phraya River and the Pa Sak River. The lower part of the basin is in Saraburi and Chachoengsao provinces, which is a plains area with a slope leading to Chao Phraya River and a coastal plain in Samut Prakan Province. The western side of the basin is also a plains area, whilst the upper and lower parts are lowland areas which combine with the Tha Chin River, sloping down to the coast of the Gulf of Thailand.

The Chao Phraya Basin has the Chao Phraya River as its main river, which originates from the joining of two rivers (Ping River and Nan River) at Pak Nam Pho Subdistrict, Nakhon Sawan Province. In addition, the Sakae Krang River flows to join upstream of Chao Phraya Dam. From there the river flows through various provinces down to Gulf of Thailand at Pak Nam Samut Prakan Province. The total river length is 378km.

Figure 19 - Chao Phraya River Basin



Key Issues in Chao Phraya River Basin

Water shortages and droughts:

The Chao Phraya River Basin has a water shortage problem due to the following:

- 1) The irrigation and agricultural areas in river basin are greater than the available water capacity. This area is also a key economic area for Thailand, an urban area, industrial area and tourism area, with water for transportation and environmental flows resulting in a high overall demand
- 2) There is high water demand for irrigation, with some areas having rice crops up to three times a year
- 3) There is high water demand due to the expansion of communities, industry and tourism, which have demands for water throughout the year.

Flooding:

In the past, the Chao Phraya River Basin has experienced many flood events. The main cause of flood in the Chao Phraya River Basin from the upper tributaries, where heavy rain can occur and overflows due to obstacles in the drainage system or high seawater levels. The causes of floods can be summarised as follows.

- 1) Management of large-scale reservoirs and decision-making processes for water resource management
- 2) Limited potential for reservoir construction in upstream areas. Although additional operations can still be implemented in some tributaries, these will support flood management in the main river basin and its tributaries only, not the whole catchment
- 3) Illegal living in flood prone areas
- 4) Changes of land use from agriculture to residential and industrial in Phra Nakhon Si Ayutthaya, Pathum Thani, Bangkok and Samut Prakan
- 5) The volume of flood water that can be stored in downstream and the capacity of the drainage system have decreased over time causing more severe floods.

Dispute Issues of Flood Case Study in the Chao Phraya River Basin

There are effectively two categories under which disputes around flooding will occur in the Chao Phraya River Basin:

- Within the River Basin: disputes will come from receiving flood water in or through receiving areas
- Outside of the River Basin: disputes will come from the flood diverting through the neighbouring river basin.

Flooding in the basin is currently managed through three approaches:

(1) Delaying floods at the upper regions of the basin

(2) Slowing down floods at the middle of basin

(3) Draining flood waters effectively, determined by the participation of water user groups, local government organisations, provincial bodies, relevant authorities, the provincial water resources sub-committee, the River Basin Committee, the National Water Resource Committee, in accordance with the Master Plan of Chao Phraya River Basin Management.

AUSTRALIA

Flooding in Eastern Australia since 2010

Despite also suffering from periods of drought, the eastern seaboard of Australia, particularly the states of Queensland and New South Wales, have experience a number of significant flood events over recent decades.

Two of Australia's worst floods on record have occurred in this region since 2010, with a number of other minor floods also seeing significant damages and the loss of life.

The region of Australia where this flooding has occurred is highlighted in green and orange in Figure 20.

Figure 20 – Eastern Australia Flood Case Study Area



In 2010 and 2011, a series of floods impacted Queensland, forcing the evacuation of thousands of people. At least 90 towns and over 200,000 people were affected, with estimated damages of \$2.38 billion and the loss of 33 lives.

Beginning with rains in September and then culminating with Category 1 Cyclone Tasha crossing the Far North Queensland coast on 24 December 2011, this is one of the most significant floods in Australia's history.

In Brisbane (Queensland), the river peaked at 4.46m on 13 January, flooding more than 28,000 homes and leaving 100,000 without power. An additional cyclone (Yasi) also hit on 3 February, causing further flooding.

In 2022, a series of floods throughout February and March engulfed a region spanning two states, with torrential rainfall and flash flooding leaving extensive damage. In Brisbane, up to 15,000 properties were estimated to have been damaged. Throughout South East Queensland, more than 20,000 homes were inundated.

While Brisbane's river peak was lower than the 2011 flood event at 3.85m, other towns broke records. In Lismore in northern New South Wales, the Wilsons River peaked at 14.1m, leaving more than 10,000 people homeless.

Damages from this series of floods totalled \$4.3 billion, the fourth highest damage bill from a natural disaster in Australia's history. The flood also cost the lives of 22 people.

Other flooding events in the region during this time include³³:

- 2012 Eastern Australia (February to March), affecting NSW, VIC and QLD, with 3 recorded deaths
- 2013 Eastern Australia (January), affecting QLD and NSW, with 6 recorded deaths
- 2015 Hunter Valley/Central Coast/Sydney, affecting NSW, with 8 recorded deaths
- 2015 South-East Queensland, affecting QLD, with 5 recorded deaths
- 2016 Central West and Riverina, affecting NSW, with 1 recorded death
- 2017 Eastern Australia caused by Cyclone Debbie, affecting QLD and NSW, with 12 recorded deaths
- 2019 Townsville, affecting QLD, with 5 recorded deaths
- 2020 Sydney, Blue Mountains, affecting NSW, with 0 recorded deaths
- 2021 Sydney, Mid-North Coast, South East Queensland, affecting NSW and QLD, with 3 recorded deaths
- 2021 Central Queensland (November), affecting QLD, with 0 recorded deaths
- 2022 Wide Bay-Burnett, Fraser Coast and Gympie caused by ex-Tropical Cyclone Seth (January), affecting QLD, with 3 recorded deaths
- 2022 Eastern Australia, affecting QLD and NSW, with 4 recorded deaths
- 2022 New South Wales (July), affecting NSW, with 1 recorded death
- 2023 Cairns (December), affecting QLD, with 0 recorded deaths.

³³ Note – these are based on data available in January 2024. Further flood events have happened since this time, but are not documented in this guidance due to timing.

There has been an increase in the frequency and severity of flooding in eastern Australia since 2010, necessitating a range of reforms to management and mitigate impacts over this time.

It is anticipated that this region of Australia will also likely see an ongoing increase in the frequency and severity of flood events due to climate change over the coming decades.

Flood Management and Mitigation Mechanisms in Queensland and New South Wales

The Australian Government does not have a significant role in the management of floods, with most of the responsibility falling on the states and territories. However, in response to the increasing risk and experience of bushfires and floods, the Australian government has established a National Emergency Management Agency, with a strategic focus on³⁴:

- Leading and coordinating national action and assistance across the emergency management continuum
- Building scalable, coordinated emergency management capability for nationally significant, cross-jurisdictional and international crises
- Building evidence, intelligence and insights to empower communities, leaders and stakeholders to make effective decisions
- Contributing to saving lives, reducing harm, and maintaining public trust to mitigate the consequences of disasters and build back better through investment in people, capabilities and communities.

The Australia Government also provides funding support to build resilience against future disasters, with investments directed to understanding natural hazard disaster impacts, increasing the resilience, adaptive capacity and/or preparedness of governments, communities and others to minimise the potential impact of natural hazards and reducing exposure to risk, harm and/or severity of a natural hazard's impacts³⁵. The government also provides ad-hoc funding support for disaster recovery through an agreed cost sharing model with the states and territories (Disaster Recovery Funding Arrangements 2018)³⁶.

The final component of the Australia Government's role in flooding is in regard to the use of the Australian Defence Force to assist disaster agencies to respond to a flood event. When and how the defence force is activated in response to a natural emergency has been a particular area of debate between the Australian Government, states and territories over recent years.

At a state level, the Queensland and New South Wales Governments have a number of regulatory, policy and programmatic mechanisms for addressing flooding, varying slightly between the two jurisdictions.

In Queensland a multi-faceted approach to floods is pursued, encompassing planning, infrastructure, preparedness, response and ongoing adaptation to changing environmental

³⁴ Source - <https://nema.gov.au/#/map>

³⁵ Source - <https://nema.gov.au/programs/disaster-ready-fund>

³⁶ Source - <https://nema.gov.au/Disaster-Recovery-Funding-Arrangements-DRFA>

conditions. The Queensland Flood Risk Management Framework sets the overall strategic direction and approach to manage and respond to flood risks and events statewide. The purpose of the framework is to³⁷:

- Set the direction for flood risk management in Queensland
- Provide clarity around expectations
- Outline the roles and responsibilities of all stakeholders involved
- Guide and support decision-making by councils.

The flood risk management process in Queensland can be applied at local, regional and state levels, with the key steps being³⁸:

- Collect the necessary data
- Define the flood hazard
- Assess the risk, and consider options to manage the risk to acceptable levels
- Develop an implementation plan to manage the risk.

The delivery of flood risk management in Queensland is through a ‘collaborative dispersed model’. Roles and responsibilities are distributed across levels of government, along with industry and the community. Relevant state agencies involved in the management of floods include:

- Queensland Reconstruction Authority
- Department of Regional Development, Manufacturing and Water
- Department of State Development, Infrastructure, Local Government and Planning
- Queensland Fire and Emergency Services
- Department of Environment and Science
- Department of Energy and Public Works
- Department of Transport and Main Roads
- Department of Seniors, Disability Services and Aboriginal and Torres Strait Islander Partnerships.

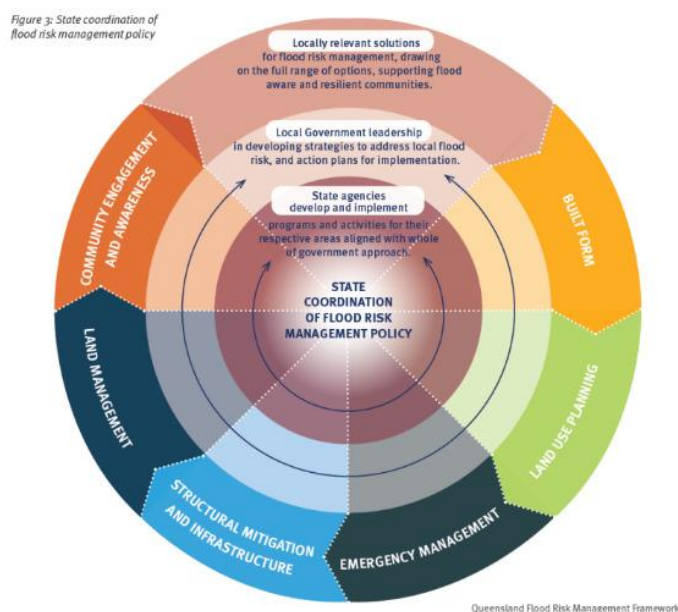
Formal collaboration across these organisations is enabled through the Queensland Resilience Coordination Committee.

An overview of how the Queensland Flood Risk Management Framework is provided in Figure 21.

³⁷ Source - <https://www.qra.qld.gov.au/QFRMF>

³⁸ Source - <https://www.qra.qld.gov.au/QFRMF>

Figure 21 - Queensland Flood Risk Management Framework



In New South Wales, the New South Wales State Flood Plan is the overarching framework for addressing flood risks across the state³⁹.

This is developed and issued under the provisions of the *State Emergency and Rescue Management Act (1989)*, the *State Emergency Service Act (1989)* and the New South Wales Emergency Management Plan. The flood plan is in fact a sub-component of the overarching emergency management plan.

The Flood Plan sets out the state level emergency management arrangements for flood across the spectrum of:

- Prevention
- Preparation
- Response
- Initial recovery.

Within this spectrum, the primary goals for flood management and mitigation in New South Wales are the:

- Protection and preservation of life
- Establishment and operation of flood warning systems
- Issuing of community information and community warnings
- Coordination of evacuation and welfare of affected communities
- Protection of critical infrastructure and community assets essential to community survival during an emergency incident
- Protection of residential property

³⁹ Source - <https://www.ses.nsw.gov.au/media/6438/nsw-state-flood-plan-dec-2021-endorsed.pdf>

- Protection of assets and infrastructure that support individual and community financial sustainability and aid assisting a community to recover from an incident
- Protection of the environment and conservation values considering the cultural, biodiversity and social values of the environment.

The various actions implemented under the plan across prevention, preparation, response and initial recovery are detailed in Table 4.

Table 4 – Flood Management and Mitigation Activities in New South Wales⁴⁰

Element	Actions
Prevention	<ul style="list-style-type: none"> • Flood Plain Development Manual • Input into land use planning and development approvals • Provision of support and guidance across government agencies and local councils • Training and technical resources
Preparation	<ul style="list-style-type: none"> • Flood emergency planning • Flood intelligence systems • Flood warning systems • Briefings, training and simulated exercises • Working with stakeholders at the local level to plan for and build community resilience
Response	<ul style="list-style-type: none"> • Incident management system(s) • State operations and command centre • Coordination of resources and logistics support during response operations • Collection and utilisation of flood intelligence • Provision of information and warnings to local communities • Protection of property • Protection of essential services • Evacuation • Evacuee management and welfare • Rescue
Recovery	<ul style="list-style-type: none"> • All clear and return notifications • Resupply • Coordination of recovery actions and resourcing across agencies • Post event review

A coordinated approach across national, state and local government entities and other organisations is central to New South Wales' management approach to flooding, combined with active community engagement and outreach.

⁴⁰ Source - <https://www.ses.nsw.gov.au/media/6438/nsw-state-flood-plan-dec-2021-endorsed.pdf>

Dispute Mitigation Linkages

Given the significance of the impact of flooding in north-eastern Australia in the form of the loss of life and property and infrastructure damage, there have been a number of disputes arising from the various flood events in this region since 2010.

In response to the 2010-11 flood, the Premier of Queensland instigated a Royal Commission (Queensland Floods Commission of Inquiry) to investigate seven specific matters:

- Preparation and planning for the floods by governments, agencies and the community
- The adequacy of the response to the floods
- Management of essential services
- The adequacy of forecasts and early warning systems
- Insurers' performance of their responsibilities
- The operation of dams
- Land-use planning to minimise flood impacts.

A final report from the inquiry was presented to the Queensland Premier in February 2012, a 650-page document containing 177 recommendations⁴¹.

The primary area of contention was in regard to the adequacy of the operation Wivenhoe Dam as a key flood prevention structure. Although the commission's own expert was quoted in the report as finding that the Flood Engineers in charge of the dam during the flood had achieved '*close to the best possible flood mitigation result*', the commission found that the dam engineers had not complied with the operation manual for Wivenhoe Dam.

Six other experts who appeared before the commission had previously disagreed with this finding and gave evidence during hearings to that effect.

The review also found that the manual for dam operations used by the engineers was ambiguous, unclear, impractical and not up to date.

Further, the report called for the Crime and Misconduct Commission (CMC) to investigate three particular flood engineers who were in control of the dam at the time. Following a six month investigation, the CMC found that there was no professional misconduct and the three engineers were cleared of any wrongdoing.

In 2014, the legal firm Maurice Blackburn lodged a class action with the New South Wales Supreme Court on behalf of 4,000 flood victims. The legal action alleged negligence and nuisance against the operators of various dams (Seqwater, SunWater and the Government of Queensland). In 2019, the court ruled that the class action members were victims of negligence.

⁴¹ Source - <http://www.floodcommission.qld.gov.au/publications/final-report/>

The final result of this legal action was a settlement of AU\$440 million in compensation from the Queensland government, Sunwater and the state-owned dam operator Seqwater, although Seqwater won an appeal against the judgement in September 2021.

The recommendations from the Royal Commission and the general learning of the 2010-11 flood event and other events since have significantly changed the approach to flood mitigation in Australia, across all states and territories. Greater proactive planning, improved forecasting and warning systems and more extensive community engagement have been key elements adopted since this time.

Whilst the scope for legal action remains, the multifaceted response to floods in both Queensland and New South Wales provides a robust framework for managing various risks and mitigating future disputes in this space.

3.4 Water Quality Case Studies

THAILAND

Mae Klong River Basin

The Mae Klong River Basin is located in the western part of Thailand and can be divided by topography into either the upper or the lower Mae Klong River Basin. The upper Mae Klong River basin starts in the Mueang Kanchanaburi District, where the Khwae Yai and Khwae Noi rivers flow down from the mountain ranges. The lower Mae Klong River Basin includes the two sides of the banks of the Mae Klong River, from Mueang Kanchanaburi District to the Gulf of Thailand (see Figure 21).

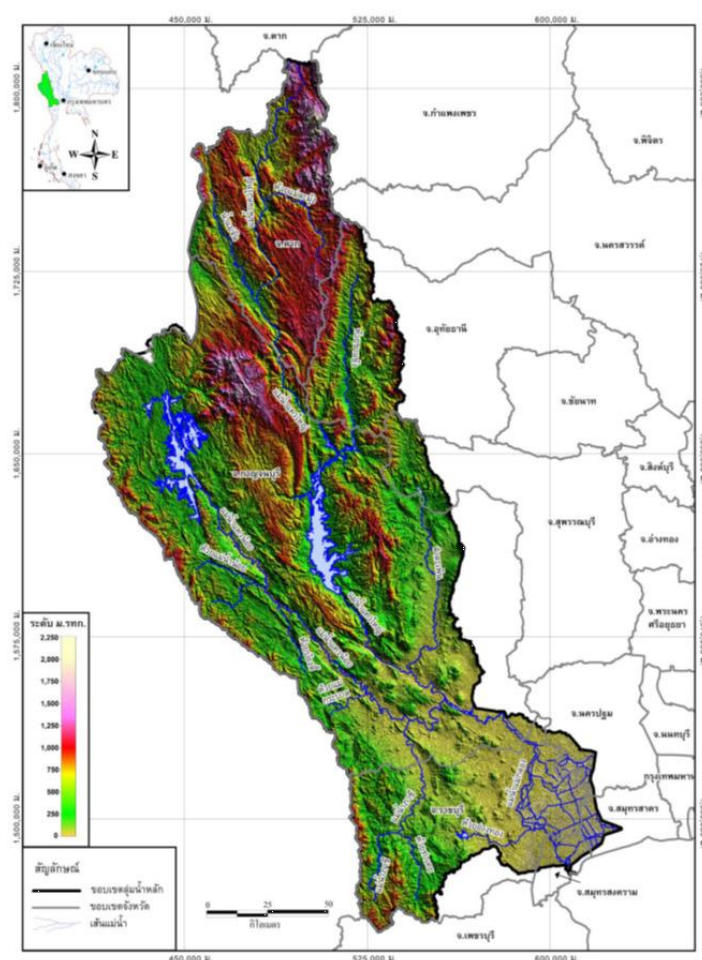
Water Quality Issues in the Mae Klong River Basin

Following the issuing of the Water Resources Act 2018, the Mae Klong River Basin Committee raised issues regarding wastewater management in the bordering areas of the basin's three provinces. This has been an ongoing issue.

The Mae Klong River Basin Committee requested a budget allocation through ONWR to resolve this issue. ONWR has assigned the Pollution Control Department (PCD) to urgently develop an action plan for wastewater management in the region.

The issue was also submitted to the working group and sub-committee of the NWRC, who were responsible through the water resources management master plan sub-committee to agree on the associated principles for water resources management and conservation in regard to policy and law.

Figure 23 - Mae Klong River Basin



In 2021, ONWR conducted a project to study water resources management in the basin boundary area of Mae Klong, in the Phetchaburi-Prachuap Khiri Khan province. The objective is to develop a resource plan and action plan to address water quality problems in a pilot area of the Mae Klong River Basin, in the Phetchaburi-Prachuap Khiri Khan boundary area. The study assessed canal capacity to receive pollution, as well as guidelines for addressing water quality problems.

This study also allowed for public participation, including through a workshop at Wat Pradu Phra Aram Luang, Samut Songkhram Province in December 2022

From this, the PCD has implemented an action plan in collaboration with the Environment and Pollution Control Office 8, Ratchaburi (EPO 8), which includes inspections at pollution sources (such as pig farms) and continuous. In addition, training has been organized in the area for network groups.

In 2023, water quality monitoring will be conducted twice a year, with training workshops to provide knowledge to relevant agencies.

The timeline covering key events in water quality in the Mae Klong River Basin is provided in Table 5.

Table 5 – Timelines for the Mae Klong River Basin

3 June 2019	One of Mae Klong River Basin Committee (representative of the agricultural water user organization of Samut Songkhram Province) notifies ONWR of an incident of polluted water in the canal, in Phraek Nam Daeng Subdistrict, Amphawa District, Samut Songkhram Province
5 July 2019	Mae Klong River Basin Committee No. 2/2019 acknowledged and agreed to prepare a draft terms of reference for a study on water quality management, including the identification of pollution sources that impact the basin and systematic management and by proposing funding from the Thailand Science Research and Innovation (TSRI). The Water Resources Region Office 7 was allocated responsibility for preparing the terms of reference, with other committees and related agencies providing relevant information
19 November 2019	Chairman of the Mae Klong River Basin Committee (Governor of Ratchaburi Province) issued a document to ONWR requesting the consideration of the project studying water quality management in Mae Klong River, Phetchaburi River in Ratchaburi, Samut Songkhram and Phetchaburi provinces, as priorities to be implemented in fiscal year 2021
December 2019	Mae Klong River Basin Committee No. 3/2019 acknowledged progress, with the Chairman assigning: 1. Environmental Region Office 8, Ratchaburi together with related agencies educational institutions and ONWR to jointly prepare a draft guideline for studying water quality management in the Mae Klong River and Phetchaburi River in Ratchaburi, Samut Songkhram and Phetchaburi provinces 2. A proposed budget from the TSRI for 2020. 3. A request to ONWR to include the project plan and budget in fiscal year 2021 and also recognise in the water resources management master plan of Mae Klong River Basin
2 March 2020	At Mae Klong River Basin Committee No. 1/2020, representatives of water user organisations in the commercial, service and tourism sectors in Samut Songkhram Province recommend that ONWR plan for the 2021 fiscal year budget, emphasising participation from the people in the area and a local philosopher and that ONWR should proceed with the preparation of a draft terms of reference in advance so that if the budget is allocated it can be able to proceed immediately
17 July 2020	At the Mae Klong River Basin Committee No. 2/2020, additional comments were raised as follows: 1. To solve the problem in a sustainable way and concerning economic development between provincial boundaries, it is proposed that the boundary area be turned into an industrial livestock zone with an appropriate management system 2. There should be a study of the impact from upstream areas on the downstream areas, focused on three provinces (Kanchanaburi Province Ratchaburi Province and Samut Songkhram Province)
2021	Implementation of a project to study water resource management in the boundary area of Mae Klong River Basin (Phetchaburi-Prachuap Khiri Khan)
20 December 2022	Workshop delivered to promote cooperation in solving water quality problems in the bordering areas of 3 provinces (Samut Songkhram Province Ratchaburi Province and Phetchaburi Province)

The responsible authorities for water quality management under relevant laws in Thailand are:

- 1) Ministry of Natural Resources and Environment:
 - a. Pollution Control Department
 - b. Department of Environmental Quality Promotion
 - c. Department of Water Resources
 - d. Provincial Office of Natural Resources and Environment
- 2) Ministry of Agriculture and Cooperatives:
 - a. Royal Irrigation Department
 - b. Provincial Livestock Office
 - c. Provincial Fisheries Office
 - d. Provincial Agricultural Extension Office
- 3) Ministry of Public Health:
 - a. Department of Health
- 4) Ministry of Interior:
 - a. Wastewater Management Authority
 - b. Department of Local Administration/Provincial Office for Local Administration
- 5) Ministry of Industry:
 - a. Department of Industrial Works
- 6) Ministry of Transport:
 - a. Marine Department
- 7) Office of the Prime Minister:
 - a. Office of the National Water Resources.

ONWR has recommended actions according to the enforcement and operations under the Water Resources Act 2018 for water pollution management, which are as follows:

1. River Basin Committee (Mae Klong River Basin/Phetchaburi-Prachuap Khiri Khan River Basin) should develop a master plan for utilisation, development, management, maintenance, restoration and conservation of water resources according to Section 35, paragraph one (1), to address water pollution management (prevention and correction) and monitoring and evaluation.
2. The Ministry of Interior and the Ministry of Natural Resources and Environment should expedite the issuance of ministerial regulations according to Section 74 and Section 78, and complete the appointment of officials to support operations according to the category 6 (conservation and development of public water resources).
3. Relevant agencies, especially local agencies, should implement activities according to the plans in point 1 and the ministerial regulations issued in accordance with point 2.

AUSTRALIA

Salinity in the Murray-Darling Basin

The Murray-Darling Basin has many diverse landscapes, but a majority of the system is characterised by vast semi-arid and flat riverine plains. The major source of water for the basin comes from the Great Dividing Range, which runs in a long arc along the east and south of the region.

This mountainous area has the highest rainfall and generates the most runoff, feeding the large water supply reservoirs located in many of the catchments. Moving west, the upland river valleys merge inland with the semi-arid riverine plains, which originally had a natural woodland vegetation cover, but are now largely cleared.

These riverine plains are now rangelands with sheep and cattle grazing, and large, mostly surface water sourced, irrigation areas.

The system is also divided north–south by climate. In the north, the Darling is influenced by sub-tropical weather patterns, with most rainfall occurring in summer (December to March), while in the south the Murray system is more influenced by winter-spring (June to September) rainfall.

Although the system has also experienced issues with blue-green algae, the largest water quality issue in the Murray-Darling Basin is salinity. The southern basin in particular is vulnerable to salinity issues, impacting the environment, irrigator productivity and drinking water supplies for various towns and cities.

Groundwater across the Murray-Darling Basin is naturally highly saline and is not suitable for irrigation or other uses without significant treatment, which is often not economic.

Since European settlement in the 1800s, the clearance of native vegetation, combined with the expansion of irrigation, have resulted in greater infiltration to groundwater, mobilising the salt to the surface and into the basin's rivers and tributaries⁴².

Salinity issues in the Murray-Darling Basin were first identified in the 1960s, but elevated to be recognised as one of the most significant environmental and economic threats to the system and its dependent communities in the 1980s.

A concerted and cooperative approach to action against salinity threats to water quality have been implemented jointly the Australian Government and basin states and territories since 1988. This has involved the development and implementation of three consecutive salinity strategies (1988 to 2000, 2001 to 2015 and 2016 to 2030).

The basis of the approach across these strategies is multifaceted and includes:

- An agreed salinity target
- Joint works and measures to reduce salt entering the rivers
- An agreed accountability and governance system consisting of salinity credits to offset debits and a robust and agreed method to quantify credits and debits.

⁴² Source - https://www.researchgate.net/publication/342478824_Salinity_Management_in_the_Murray-Darling_Basin_Australia

Overall, this approach has been successful in maintaining an appropriate level of salinity across the Murray-Darling Basin, with its impact and longevity enabled by a number of core design factors⁴³:

- Salinity being recognised as a serious issue with environmental, economic and social impacts. Many communities were affected and the issue itself was not contested, resulting in significant pressure on governments to deliver remedial action.
- The management framework (including a cap-and-offset process) still enabling economic development to continue to occur, whilst reducing overall salinity to meet an agreed target.
- The use of salinity registers providing a formal and transparent process for acknowledging and keeping track of the impacts that increased salinity (debits) and actions that reduced salinity (credits).
- The managing framework having a strong technical underpinning that included peer reviewed modelling of salinity and the impacts of all actions on the salinity register.
- The use of an adaptive approach to management, which enabled new knowledge to be introduced and acted on progressively. In addition, all actions and models were subject to a 5-year review and the strategies themselves were subject to mid-term and final reviews.
- Regular independent auditing of the entire framework, including jurisdictional actions, modelling, technical studies, register management and salinity monitoring. These audits were also presented to the basin governments and made publicly available.
- The ability to demonstrate impact through an agreed salinity target that was simple, credible and effective at showing the results of a multi-decadal, multi-million-dollar program of actions to a range of audiences including funding governments, communities, and scientists.

Current Salinity Management Mechanisms in the Murray-Darling Basin

Despite the success to date in managing salinity issues in a coordinated and collaborative fashion, salinity is expected to require ongoing active management and mitigation.

The current strategy for salinity in the Murray Darling Basin (Basin Salinity Management 2030, or BSM2030) has been in place since 2015 and will deliver a program of coordinated salinity management out to 2030.

⁴³ Source - https://www.researchgate.net/publication/342478824_Salinity_Management_in_the_Murray-Darling_Basin_Australia

The focus of BSM2030 is to⁴⁴:

- Maintain the cap on salinity through the existing Basin Salinity Target and the existing accountability framework
- Bring environmental water fully into the accountability framework in a practical and pragmatic way
- Explore opportunities to responsively manage salt interception schemes so that operations can be further optimised and costs can be reduced when River salinity is forecast to be low
- Support Basin Plan flow management obligations to have regard to the salinity targets for managing water flows
- Support basin states managing salinity in their catchments through their land and water management plans and be consistent with their Basin Plan water resource plan obligations
- Develop fit-for-purpose governance arrangements which reduce the frequency of audit, reporting and reviews
- Invest in knowledge to reduce uncertainty and potentially avoid the need for future capital investment in new joint works and measures
- Undertake a major strategic review to ensure the strategy continues to guide effective management of salinity in the basin.

BSM2030 also recognises that the Murray-Darling Basin continues to be in transition, needing to accommodate the other complementary management arrangements specified in the Basin Plan.

The Basin Plan and Murray–Darling Basin Agreement (Schedule B) collectively outline the salinity management obligations for each basin state government. BSMS 2030 is a framework for enabling governments to work individually and collectively to meet their respective obligations.

In practical terms, the current phase of basin salinity management aims to:

- Maintain the cap on salinity through the existing Basin Salinity Target and the existing salinity accountability framework, which will ensure that partner governments continue to be accountable for offsetting actions that increase river salinity
- Explore opportunities to responsively manage salt interception schemes so that operations and costs can be reduced when river salinity is forecast to be low;
- Support implementation of the Basin Plan to manage in-river salinity outcomes through flow management decisions in response to elevated salinity events (such as using environmental water to dilute in-river salinity)
- Identify changes in salinity risks from catchments and support implementation of cost-effective measures, where appropriate, through water resource plans, land and water management plans or other relevant statutory instruments
- Invest in knowledge priorities to reduce uncertainty about future salinity risks and to potentially avoid future capital investment in new joint works and measures.

⁴⁴ Source - <https://www.mdba.gov.au/sites/default/files/publications/d16-34851-basinsalinitymanagementstrategybsm2030.pdf>

It is important to note that the Murray-Darling Basin Plan and BSM2030 are consistent and interlinked. Together they connect state catchment-based arrangements for salinity with the Basin Plan's water resource plan obligations, obligations to 'have regard' to the Basin Plan salinity targets for managing water flows and a mutual commitment to address salinity management.

The Basin Plan sets the high-level objectives and targets for salinity and aims to guide the states and territories in the development of water quality and salinity management plans within the required water resource plans at the local level.

However, the Basin Plan has no mechanism for joint state action for managing salinity of shared resources, hence BSM2030 is the vehicle through which governments agree to implement individual, collective, and coordinated actions.

Key on-ground actions that can be adopted under this framework include:

- Reducing saline drainage by improved irrigation efficiency and better delivery systems, including where possible the re-use of drainage waters on-farm
- Diverting saline groundwater before it enters the River Murray through salt interception and drainage diversion schemes
- Reducing groundwater recharge and flow by planting deep rooted perennials
- Adopting salinity impact zoning to direct new irrigation schemes to areas of low salinity impact.

The action implemented, validated through peer-reviewed modelling, then see impacts of entered as salinity credits on the salinity registers to offset salinity debits generated through irrigation or other development activities.

Dispute Mitigation Linkages

Salinity related disputes in the Murray-Darling Basin arise generally as a result of the complex interplay of water management, agriculture, environmental conservation and competing interests among various stakeholders across the basin.

Relevant points of debate include:

- Water allocation and use - disputes over water allocation and use have often centred around the impact of irrigation practices on salinity levels in the basin. Farmers and irrigators require water for agricultural production, but the extraction of water for irrigation can exacerbate salinity problems by raising the water table and mobilizing salts from the soil.
- Environmental degradation - salinity can have significant environmental impacts, including damage to aquatic ecosystems, loss of biodiversity, and degradation of soil fertility. Environmental groups and conservationists have raised concerns about the long-term sustainability of water use practices and their impact on salinity levels and ecosystem health in the basin

- Upstream versus downstream impacts - disputes between upstream and downstream water users have often arisen over the distribution of water resources and the allocation of responsibility for managing salinity. Upstream activities such as land clearing and irrigation can affect downstream water quality and salinity levels, leading to disputes between different regions and states within the basin.
- Government policies and regulation - the management of water resources and salinity in the Murray-Darling Basin is governed by a complex framework of state and federal laws, policies, and regulations. Disputes have occurred over the implementation and enforcement of these regulations, as well as the allocation of funding and resources for salinity management projects.
- Indigenous rights and traditional water uses - Indigenous communities have historical and cultural connections to water resources in the Murray-Darling Basin, and disputes have arisen over the recognition of Indigenous water rights and the protection of traditional water uses in the face of salinity and other environmental challenges.

The collaborative approach adopted through the three salinity management strategies for the Murray-Darling Basin has been critical to mitigating disputes and is now well expected by all stakeholders and governments.

Chapter 4: Summary and Recommendations

4.1 Summary

Water Scarcity

Australia's water resource and basin management system has focused on dispute mitigation by establishing a robust water accounting and water sharing rules that set the legal framework for water users. The system also clearly defines the decision-making processes for water allocation during periods of drought.

This approach mitigates against disputes arising between water users. The advantage of this system is that disputes are resolved during the planning process and not during a water scarcity event. Other benefits include:

- Water users have clearly defined access entitlements
- There are transparent rules for water sharing during times of water scarcity
- Security of supply underpins investment certainty.

Success is dependent on governments actively monitoring and enforcing compliance of the rules.

Thailand's approach has been to establish a process for dispute resolution that deals with disputes as they arise on a case-by-case basis. The current process is to arbitrate or mediate these disputes. There is a risk that this could lead to inconsistent decisions which could undermine confidence for future investment.

Flooding

In regions at risk of flood in Australia, an emphasis on improving flood forecasting and scenario analysis has become the basis on which risk management planning has developed.

Australia has acknowledged that it is not possible to mitigate against all flood risk, so early warning systems and emergency management planning are considered extremely important elements in minimising flood impacts. Australia has a state based approach to flood management which can be problematic when floods occur across state boundaries.

Thailand takes a national approach to flood management and has introduced significant powers for the NWRC to make decisions when a flood occurs. This has significant advantages, however, investment in early flood warning systems and localised community awareness would be beneficial to inform scenario planning and build local resilience to respond to flood risk at different scales.

Water Quality

Australia has a complex system of national and state based legislative tools to manage water quality. Due to the localised nature of most water quality issues, an adaptable framework that enables local responses has proven to be appropriate. Where the pollution is at scale (such as salinity in the Murray-Darling Basin), an intergovernmental approach has been adopted.

Australia has also established national guidelines on contaminants of concern enabling regulators at the state level to act in a consistent fashion.

Australia also frames its approach on whether the pollutant is from a point source or diffuse.

Point Source Pollution	Point source pollution refers to pollutants that enter water bodies from identifiable and discrete sources, such as pipes, ditches, or industrial outfalls.
Diffuse Pollution	Diffuse pollution refers to pollutants that enter water bodies from multiple, dispersed sources across a landscape, making it challenging to trace their origin.

Thailand has a commendable legislative framework to address pollution and water quality issues. Developing national standards would be beneficial as would engaging local communities to co-design solutions where the pollutant sources are diffuse.

4.2 Conclusions and Recommendations

Water Scarcity

Coping with water scarcity is essential for enabling sustainable economic development and prosperity in both Australia and Thailand. During dry periods where water demands exceed supply, disputes will occur between different end users, the environment and consumption and across jurisdictional boundaries.

The two case studies – East Coast Gulf Group River Basin in Thailand, and the Murray Darling Basin in Australia (with a focus on South Australia) – present different approaches for managing water in times of scarcity and ensuring that water is provided in priority to highest value uses.

With the introduction of the new water legislative and policy framework in Thailand, the country now has the ability to plan for and collectively respond to situations where inflows are less than needed. The three strategies currently utilised in responding to water scarcity in Thailand across the EEC region (i.e. visualisation, risk management and stakeholder engagement) are valuable approaches to managing emergency demand and supply imbalances as they occur, however the lack of a robust water accounting system incorporating legal water entitlements could prove problematic as development of resources expands.

Australia's experience in the Murray Darling Basin shows how continuous development of resources without a robust water accounting system, leads to overallocation of resources that ultimately undermines the security of supply for all users with devastating impacts on ecosystems.

Recommendation 1:

As an interim measure, Thailand could consider developing national criteria for the prioritisation of water use during times of scarcity. The criteria would assist in the resolution of disputes and could be the first stage in the process of developing water sharing plans.

Recommendation 2:

Over the longer-term, Thailand could consider developing a staged approach to the introduction of water accounting and water sharing plans to move from the current dispute resolution focus to a dispute mitigation focus. Key elements to consider include:

- Water rights and allocations
- Water monitoring and measurement
- Standardisation of measurement and reporting
- Accounting for intervalley transfers
- Environmental management including quantification of needs
- Move towards water pricing to reflect full cost of supply for all users (or where subsidies are considered appropriate, ensure transparency)
- Market mechanisms to enable the transfer of water rights.

The introduction of water accounting, water sharing plans and pricing mechanisms will strengthen the framework and the ability for the Government to respond strategically to future drought events.

(It is recognised that water accounting is currently being worked on by both ONWR and the Eastern Economic Corridor Office. Australia is involved in both these initiatives. ONWR is working with FAO and the Australian Water Partnership. EECO is working with ONWR, RID, Monash University drawing on experience gained in the Greater Melbourne metropolitan area and surrounding catchments).

Recommendation 3:

Thailand could consider developing of integrated catchment management plans which include:

- Scenario planning - detailed modelling of scenarios to assist with understanding the risk profile in a catchment and inform decision-making
- Water sharing structures - providing clear and transparent rules around who has what rights to water and the priority of uses
- Drought response structures - ensuring preparedness for periods of water scarcity and assisting to mitigate the impact of droughts on water supply systems and thereby reducing disputes.

Infrastructure Investment

The development of the water grid and supplementary water source options in Thailand will also assist to reduce the impact of water scarcity and disputes over the longer-term.

Government investment in water infrastructure provides the opportunity to introduce concurrent policy initiatives to improve water management and ensure sustainability of assets for the longer term.

Australia's experience demonstrates how communities of interest can be more effectively engaged to enable multiple policy outcomes during discussions around infrastructure investment, particularly in relation to the identification of the benefits of asset investment and willingness to pay.

Recommendation 4:

When considering new infrastructure investment in Thailand, the following key factors could be considered to ensure sustainability:

- Third party impacts fully (environment and other users)
- Concurrent policies to introduce appropriate pricing mechanisms for new and existing users where water security is enhanced
- Pricing that includes recovery for the ongoing cost of operation, maintenance and replacement over the life of the infrastructure.

Stakeholder and Community Engagement

The Australian experience shows that investment in community and stakeholder engagement to develop sustainable water planning solutions at the local catchment level is an effective tool for mitigating future disputes.

Thailand could consider an overarching, strategic and well-resourced approach to stakeholder and community engagement to inform decisions regarding the prioritisation of water use and the development of water management plans.

Recommendation 5:

Thailand could consider further resourcing and a strategy for stakeholder and community engagement.

Water Use Efficiency and Conservation

In managing water scarcity, demand management and investment in water use efficiency are important components for integrated catchment management of water in Australia. Improved water efficiency not only delivers water savings that can be used to expand production or improve environmental outcomes, it also can lead to improved water availability during times of scarcity and reduce impacts on productivity.

Thailand has already established robust legislative and policy frameworks. To assist with implementation and improve sustainability, Thailand could consider water demand management and water use efficiency programs to extend the value of the existing resource, particularly during times of water scarcity.

Water demand management can promote the sustainable use of water resources, ensure resilience to water-related challenges and safeguard water availability for future generations

Recommendation 6:

Thailand could consider introducing water demand management and efficiency programs to support communities to adjust to future water variability as a result of climate change. This could include:

- Water Infrastructure upgrades - aging or inadequate infrastructure can lead to water loss through leaks and inefficiencies. Upgrading infrastructure and implementing modern technologies can help mitigate these losses and enable the existing resource to be more productive.
- Water pricing - appropriate pricing mechanisms can influence consumer behaviour, encouraging water conservation and efficient usage. Consumers place a greater value on commodities they pay for.
- Technological innovations - advancements in water treatment, distribution systems and monitoring technologies enable more efficient water management and conservation and can provide for alternative water sources during drought.
- Alternative water sources - utilising alternative water sources such as rainwater harvesting, greywater recycling and desalination can reduce reliance on finite freshwater resources.
- Land use practices - sustainable land use planning, including zoning regulations and land management practices, can minimise water demand by reducing runoff and preserving natural water sources
- Industrial and agricultural practices - implementing water-efficient technologies and practices in industries and agriculture can significantly reduce water demand, as these sectors are major water consumers.

Flooding

Flooding is a significant and increasing concern for both rural and urban areas in Thailand and Australia and has the potential to cause significant damage to property and infrastructure, as well as the loss of life.

A multifaceted approach to floods is important and needs to consider flood mapping and risk identification, mitigation infrastructure planning, funding, construction and operation, early warning systems for communities and emergency response and evacuation/rescue measures. Structures for strong community engagement and participation in the processes for each of these is a key element for mitigating future disputes.

In considering infrastructure solutions to flooding, options for utilising nature-based approaches are important. These can include wetland restoration, floodplain preservation and reforestation.

It is important to recognise that the effective mitigation of all future flood events through constructed infrastructure will not be feasible, particularly given cost and the impacts of climate change, so it is inevitable that disputes across different affected parties will continue.

Community preparedness and resilience, through education, training and capacity building programs are critical. Early warning and emergency response strategies are also essential to mitigating the impact of flooding in Thailand as it occurs. This is currently a key priority for managing this risk in Australia.

In both countries there is scope to improve the extent to which flood risks are formally and transparently considered in the land use planning and approval system so that future development does not occur in high-risk locations and further exacerbate the issue.

Recommendation 7:

Thailand could consider the development of a strategic community engagement plan to inform government responses to flood risk and to generate knowledge in communities around the risks of flood.

Recommendation 8:

Thailand continues to develop its capability for flood early warning systems and incorporate this into communication products that will provide timely information to at risk communities:

Recommendation 9:

Thailand could consider introducing a process where development assessments include a formal referral system that assesses flood risk prior to approval. Clear criteria regarding acceptable risk would assist this process.

Water Quality

Water quality is an important factor in safeguarding public health, supporting ecosystem integrity and sustaining economic activities such as agriculture, manufacturing and tourism in Thailand and Australia. Sources of water pollution in Thailand and Australia that adversely affect water quality vary but are generally linked to industrial discharges, urban development, land-use change, vegetation clearing, and inadequate treatment.

Management of point source pollution to water resources can be achieved through use of both incentives and penalties, utilising a polluter pays methodology.

The management of diffuse sources of pollution which impact on water quality is more difficult and requires a collaborative and agreed approach across the various government, community and industry stakeholders involved.

In Australia, the approach to managing salinity in the Murray-Darling Basin was only able to be implemented from a base of agreement across stakeholders that there was an issue to be resolved and the causes of the problem. This requires time, appropriate funding and engagement with local stakeholders and communities.

When designing both policy and infrastructure measures to combat factors which impact on water quality, the use of local knowledge is important.

Water re-use can be an effective tool for reducing polluted discharges to waterbodies, whilst also enable water source diversification for addressing water scarcity.

Recommendation 10:

Thailand could consider adopting a community led process to develop local solutions to diffuse pollution sources

Recommendation 11:

Thailand could consider investment in a research program to better understand point and diffuse pollution sources.

Water Literacy/Water Academy

Thailand is to be commended for its initiative to establish a water literacy/water academy.

The Australian experience shows that it is critically important when tackling complex water issues to build capacity within government and the community. Developing leadership capacity at all levels will enable the community to be engaged in the co-design of solutions and provide for longer term sustainability of actions.

Investment in robust science to support decision making is essential and the water academy could consider the Australian co-operative research centre approach that brings industry together with researchers to better understand problems and jointly develop solutions.