Desalination Plant Design and Brine Management: A Comprehensive Assessment for Australian Water Security

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1. Abstract/Executive Summary

Australia faces escalating water scarcity due to climate change and population growth, necessitating sustainable solutions like desalination. The report is focused on developing a strategy that is capable of addressing both environmental and technical considerations that are important for sustainable implementation and maintaining water security. This report assesses reverse osmosis (RO) desalination technology, focusing on advanced membrane selection, multi-stage configurations, and process optimization to meet strict Australian water quality standards, including the 0.3 mg/L boron limit. Environmental analysis highlights significant ecological risks, particularly to cuttlefish populations, from conventional brine disposal methods. To address these, the report proposes innovative mitigation strategies such as advanced brine treatment, zero liquid discharge, and optimized diffuser systems.

A strategic framework for sustainable brine mining in Sydney is also presented, accounting for ecological sensitivities, socio-economic impacts, and regulatory requirements. The proposed approach focuses on responsible resource extraction methodologies while maintaining alignment with long-term environmental sustainability principles and community engagement. Key recommendations include renewable energy integration, continuous environmental monitoring, and stakeholder engagement to support circular economy principles. The findings of the report conclusively indicate that a well-designed desalination system, along with sustainable brine management practices and stakeholder engagement, can help significantly contribute towards the water security objectives of Australia while simultaneously reducing the environmental impacts and creating viable economic opportunities for the community.

2. Background

2.1. Australia's Water Security Crisis and Challenges

Australia is currently confronted with unprecedented water security challenges that stem from the harsh and unique climatic conditions of the continent, characterized by highly irregular rainfall patterns, severe and prolonged droughts, and consistently increasing temperatures (Greer et al., 2021). The distinctive geography of Australia, with arid and semi-arid regions comprising nearly 70% of the total landmass, makes the traditional surface water resources significantly vulnerable to climatic variability and unreliable for sustainable use (Sola et al., 2021; Sola et al., 2021).

Figure 1: Dying Red Gum floodplain forests at Psyche Bend, along the Murray River near Mildura, Vic, in 2009 (left) and in 2023 (Source: Anderson, 2024)

The Murray-Darling Basin is the most ecologically and economically significant freshwater system of Australia (Huang et al., 2022). However, it has experienced extensive and severe stress over the past decade because of historical overallocation of the water resources, intensification of competition among different stakeholders, including industrial users, agricultural producers and increasing urban population and prolonged drought conditions, as shown in *Figure*

1. This highlights the vulnerability of the conventional water resources to variability in climatic conditions and the significant requirement for drought-independent water supply systems (Moreno-Silva et al., 2025).

Historical water management approaches are fundamentally dependent on rainfall-fed reservoirs and river systems. However, these alternative approaches have been observed to be inadequate for meeting the increasing demand for high-quality water while maintaining sustainable and environmental flow requirements (Liu et al., 2022). The frequency and intensity of drought conditions have increased over the past few years, with the millennium drought from 1997 to 2009 acting as an important moment that transformed the approach of water resource planning and management in Australia (Scotney & Pinder, 2022).

2.2. Strategic Role of Desalination in National Water Security

Desalination technology has become one of the most prominent, strategic and indispensable components of the diversified water supply portfolio of Australia, providing critical drought-resistant water security for major industrial operations and population centers (Reeve et al., 2025). Currently, Australia operates several large and world-class desalination facilities, including the technologically advanced desalination plants in Adelaide, Perth, Sydney, Gold Coast and Melbourne (Reeve et al., 2025). These collectively represent an investment that exceeds AUD 10 billion (Campero et al., 2021).

The Perth Seawater Desalination Plant (*Figure 2*) was commissioned in the year 2006 and was the first major desalination facility in Australia. It was able to demonstrate the technological viability of a desalination plant for large-scale municipal water supply. Subsequently, investment was made for the establishment of the Gold Coast desalination plant in 2009, followed by the Sydney desalination plant in 2010, the Melbourne desalination plant in 2012 and the Adelaide desalination plant in 2013 (Campero et al., 2021). These plants have helped in collectively establishing Australia as a pioneer in the desalination technology implementation and operations.

Figure 2: Perth Seawater Desalination Plant (Source: Water corporation, n.d.)

Desalination technology provides several strategic advantages, including independence from climatic variability, the ability to provide consistently high-quality non-portable and portable water that meets the strict Australian drinking water standards, and exceptional scalability for meeting the increasing demand for high-quality water. The modern desalination plants can continuously supply clean water regardless of droughts, high temperatures, or weather variability, providing ensured water supply security that the traditional sources are not able to provide (Huang et al., 2024). However, desalination technology is also associated with several significant challenges, which include considerable capital investment cost, substantial energy consumption requirements and complicated environmental concerns associated with brine disposal management and marine intake operations.

2.3. Technological Advancement and Energy Efficiency

The desalination plants currently operating in Australia have acquired extensive advancement in energy efficiency, consuming approximately 3.5 to 4.5 kWh/m³, highlighting advancement from the previous generation technologies that needed approximately 6 to 8 kWh/m³ (Nielsen et al., 2024). This improvement in efficiency can be attributed to advancements in energy recovery systems, improvement in membrane technologies, optimization of process design and integration of renewable energy sources (Nielsen et al., 2024). For example, the Perth Seawater Desalination Plant currently operates using a significant amount of renewable wind energy, which highlights the potential for promoting environmentally sustainable desalination operations.

2.4. Economic Viability and Cost Considerations

The economic viability associated with desalination projects is based on several interconnected dimensions, which include technology advancement rates, energy costs, efficiency of integration with renewable energy systems and membrane performance improvements. The levelized cost of water from the contemporary Australian desalination plants ranges approximately AUD 1.50 to 3.00 for each cubic meter (Voutchkov, 2022). This makes desalination significantly competitive with the alternative water sources, specifically during extended drought when the traditional sources of water experience an increase in cost.

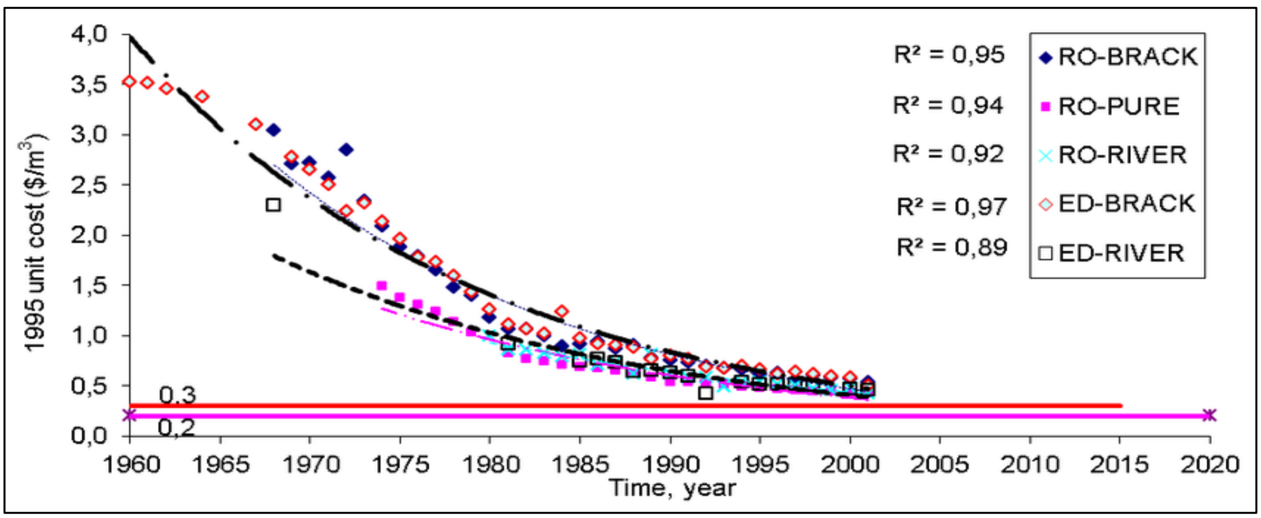

Figure 3: Average unit cost of wastewater desalination by different technologies (Source: Bashitialshaaer & Persson, 2013)

The capital cost requirement for the desalination plants has reduced because of standardization of design approaches, economies of scale in manufacturing, government incentives and investments and technology maturation (Zhu et al., 2024). The operating cost also shows a consistent decline, because of improvement in membrane longevity, energy efficiency and maintenance strategies (*Figure 3*). The integration of renewable energy systems also provides the potential for a reduction in cost while simultaneously ensuring environmental performance improvements (Zhu et al., 2024).

2.5. Objective and scope of report

This report aims to design an advanced reverse osmosis desalination plant for Australian conditions, addressing water security challenges. It evaluates technical, environmental, and economic factors, including sustainable brine management, boron removal, and brine mining potential, while proposing innovative, environmentally responsible strategies to support long-term resilience and regulatory compliance.

3. Desalination Plant Design Assessment

3.1. *Comprehensive Process Flow Chart and System Configuration*

The proposed state-of-the-art desalination plant design incorporates a sophisticated and comprehensive treatment train specifically optimized for variable Australian seawater conditions, addressing seasonal variations in temperature, salinity, and biological activity, as demonstrated in *Figure 4*. The integrated system design begins with carefully engineered seawater intake structures utilizing advanced submerged intake technology positioned strategically to minimize environmental impact while ensuring consistent water quality and reliable supply under varying oceanic conditions (Rezaee, 2024).

The intake system design incorporates multiple parallel intake lines with velocity caps and comprehensive screening systems engineered to prevent marine life entrainment while maintaining optimal hydraulic performance. Fish-friendly intake designs include wedge-wire screens with 2mm slot spacing, providing effective debris removal while allowing fish passage. Intake velocity is maintained below 0.15 m/s to minimize marine life impingement and ensure compliance with environmental regulations (Pagliero et al., 2024).

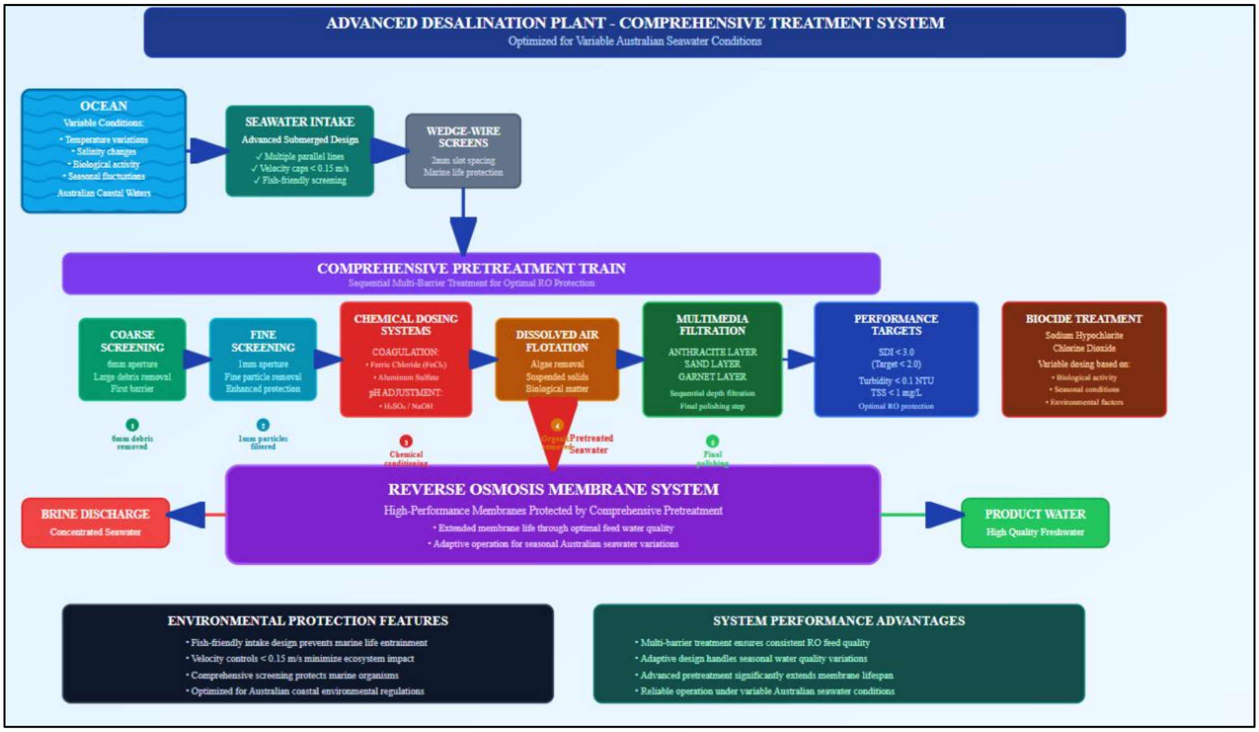

Figure 4: Advanced desalination plant process flow chart and system configuration (Source: Author)

Comprehensive pretreatment processes form the foundation of reliable RO system operation, including sequential coarse screening (6mm), fine screening (1mm), dissolved air flotation (DAF) for algae and suspended solids removal, and advanced multimedia filtration incorporating anthracite, sand, and garnet media layers. Chemical dosing systems provide precise coagulation using ferric chloride or aluminum sulfate, pH adjustment with sulfuric acid or sodium hydroxide, and biocide treatment using sodium hypochlorite or chlorine dioxide as environmental conditions require (Pagliero et al., 2024). The pretreatment train is engineered to consistently achieve Silt Density Index (SDI) values below 3.0, with a target performance of SDI <2.0, ensuring optimal RO membrane performance and extended membrane life. Turbidity removal to <0.1 NTU and total suspended solids reduction to <1 mg/L provide additional protection for downstream RO membranes (Kelaher et al., 2022).

*3.2. **Advanced RO Process Design and Configuration***

The core of the desalination plant features an advanced two-pass reverse osmosis (RO) system tailored to meet Australian water quality standards. The two-pass reverse osmosis will have a 3-stage first pass (seawater membranes) and a second pass (brackish water membranes for boron removal), helping to meet the stringent water quality standards and improve boron removal efficiency (Miller et al., 2024). The system components required as indicated in Table 1:

Table 1: Advanced RO Process Design System Components (Source: Author)

System Component	Description	Purpose/Benefit
High-Pressure Pumps	Equipped with variable frequency drives for precise control	Optimizes energy use and ensures reliable pressure management
Energy Recovery Devices	Pressure exchangers with >96% energy recovery efficiency	Reduces operational costs and minimizes environmental impact
Pump Selection	Efficient feed and high-pressure pumps are designed for varying operational conditions.	Enhances system durability and performance consistency
pH Adjustment	Uses CO_2 or sulfuric acid	Stabilizes pH, controls corrosion, and enhances water quality
Remineralization	Via limestone contactors or chemical dosing	Ensures proper mineral balance for taste and corrosion control
Disinfection	Final disinfection with chlorine dioxide or UV treatment	Guarantees microbiological safety and compliance with drinking water standards
Compliance Goal	Australian Drinking Water Guidelines (e.g., boron < 0.3 mg/L)	Ensures potable water quality and regulatory adherence

*3.3. **Detailed RO System Engineering Specifications***

The advanced RO system design incorporates spiral-wound polyamide thin-film composite membranes specifically selected for superior salt rejection capabilities, fouling resistance, and extended operational life under Australian seawater conditions (Quon et al., 2021). The first-pass RO configuration consists of three stages with an optimized 6:4:2 vessel arrangement, utilizing standard 8-inch diameter membrane elements manufactured by leading suppliers such as Dow, Hydranautics, or Toray (Moreno-Silva et al., 2025).

Each pressure vessel contains seven membrane elements, providing approximately 440 m^2 of active membrane area per vessel. The system design incorporates parallel RO trains to provide operational flexibility, maintenance capability, and redundancy for critical water supply applications. Total membrane area exceeds 50,000 m^2 for a 100 ML/day capacity plant.

Critical design parameters include:

- Feed pressure: 55-65 bar for first pass, 15-25 bar for second pass
- Recovery rate: 45% first pass, 85% second pass, 38% overall
- Flux rate: 16-18 L/m^2/h (first pass), 25-30 L/m^2/h (second pass)
- Salt rejection: >99.4% (first pass), >98% (second pass)
- Design capacity: 100 ML/day with 15% design margin
- Membrane life expectancy: 7-10 years with proper maintenance

The second-pass RO system treats first-pass permeate to achieve challenging boron removal requirements and provide final water polishing (Huang et al., 2022). Second-pass membranes are selected specifically for boron rejection performance, typically utilizing thin-film composite membranes with enhanced boron rejection characteristics.

3.4. Advanced RO Process Optimization Strategies

Comprehensive process optimization focuses on maximizing water recovery while simultaneously minimizing energy consumption, chemical usage, and operational costs. Energy recovery devices, specifically isobaric pressure exchangers, recover approximately 96% of hydraulic energy from the high-pressure brine stream, reducing overall energy consumption by 25-30% compared to systems without energy recovery (Huang et al., 2022). These devices operate with minimal maintenance requirements and provide consistent energy recovery across varying operational conditions.

Sophisticated membrane fouling control strategies incorporate comprehensive pretreatment optimization, precise operating condition control, and systematically scheduled cleaning protocols. Advanced antiscalant dosing systems prevent mineral scale formation using environmentally acceptable antiscalants, while carefully controlled biocide treatment prevents biological fouling without creating harmful disinfection byproducts (Liu et al., 2022). Membrane cleaning procedures utilize both acidic and alkaline cleaning solutions to remove different fouling types, with cleaning frequency optimized based on performance monitoring and fouling indicators. Clean-in-place (CIP) systems provide automated cleaning with precise chemical dosing, temperature control, and circulation optimization.

*3.5. **Comprehensive Boron Removal Strategy***

Achieving the stringent boron limit of 0.3 mg/L requires sophisticated attention to second-pass RO design and operation, as boron presents unique challenges due to its neutral molecular form in seawater and relatively low rejection by standard RO membranes (Reeve et al., 2025). The comprehensive boron removal strategy includes pH elevation to 10.8-11.0 using sodium hydroxide, ensuring >90% conversion of boric acid to borate ions, which exhibit significantly higher rejection by RO membranes.

Specialized low-energy membranes with enhanced boron rejection capabilities are employed in the second-pass system, specifically selected for optimal performance under alkaline conditions. These membranes maintain high salt rejection while providing superior boron removal, typically achieving >95% boron rejection under optimized conditions (Scotney & Pinder, 2022). The second-pass system operates at carefully controlled recovery rates (85%) to maintain acceptable boron concentrations in the concentrate stream while maximizing overall water recovery. Regular monitoring of the boron levels in concentrate, permeate and blended product streams will help in ensuring viable compliance with the regulatory limit of boron (Scotney & Pinder, 2022). Integrating a blend of different boron removal strategies will help in optimizing the system performance by combining the first and second pass permeate to acquire the target boron concentration while ensuring maintenance of the water quality parameters.

4. **Environmental Impact Assessment of Brine Disposal on Cuttlefish**

*4.1. **Literature Review on Cuttlefish Ecology and Brine Sensitivity***

Cuttlefish (*Sepiida*) are important fauna for the coastal marine ecosystem. However, they are extensively sensitive to the changes in Environmental conditions because of their complex physiology and high metabolic rates. Research conducted recently has indicated that the disposal of desalination brine in the Marine ecosystem comprising cuttlefish has a negative impact on them. High salinity levels, reaching 5 to 8 ppt above the ambient concentration, reduce the hatching success of the eggs of cuttlefish by approximately 25 to 40% and also change reproductive behavior (Figure 5) (Omerspahic et al., 2022).

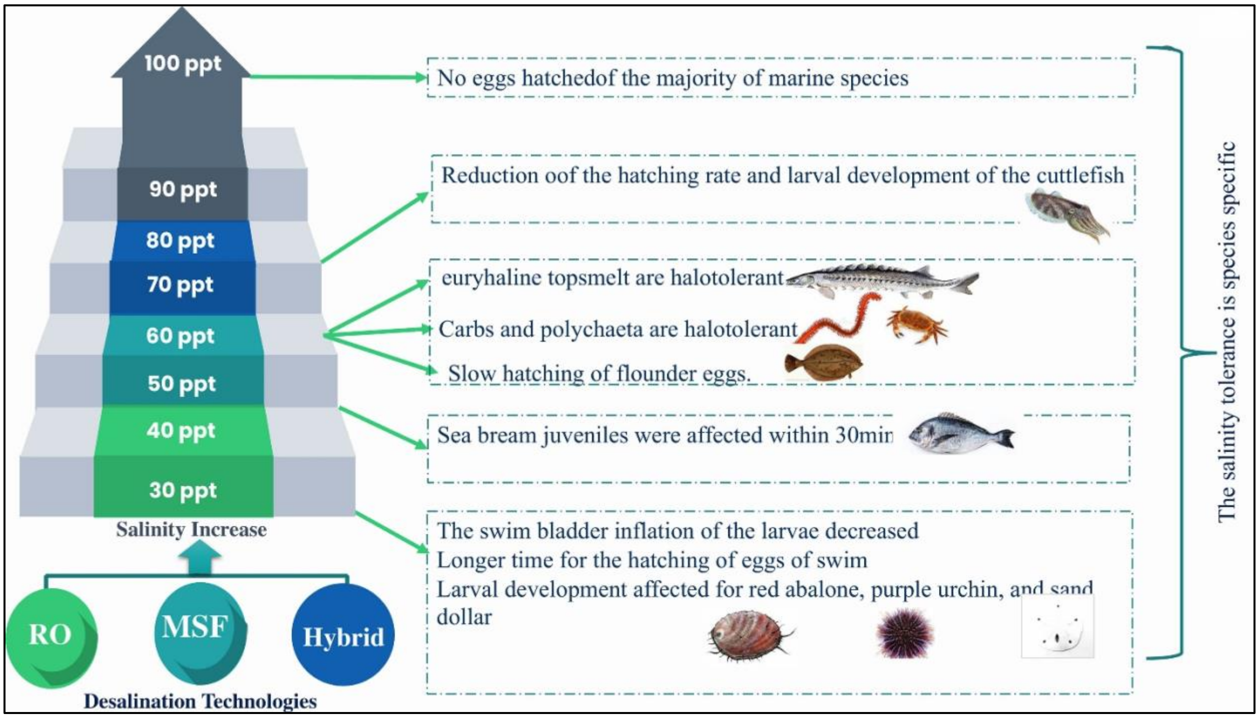

Figure 5: Potential impacts of the brine's salinity on fauna, including cuttlefish (Source: Omerspahic et al., 2022)

On top of this, adult cuttlefish that are exposed to the brine show impaired predator avoidance, disrupted feeding behavior and reduced territoriality. Brine also impacts their efficiency in camouflaging, interfering with the chromatophores, which leads to a reduction in predator evasion by nearly 30% (Campero et al., 2021). These changes compromise the ecosystem stability and their survival. Thermal stress that is induced by brine has been particularly linked with an exponential increment in mortality of cuttlefish, particularly when the temperature increases above 3 °C (Nielsen et al., 2024).

On top of this, trace heavy metals like nickel and copper, even at sub-lethal concentrations, accumulate in the tissues of cuttlefish and cause reproductive and neurological impairment

(Voutchkov, 2022). The findings highlight the requirement for maintaining significant salinity, metal discharge and temperature control in the desalination plant operations.

4.2. Innovative Mitigation Strategies for Brine Disposal

It is important to integrate significant mitigation strategies to eliminate both immediate discharge impacts and the long-term ecosystem impacts through the use of integrated approaches that combine operational modifications, engineering solutions and adaptive management practices. An innovative mitigation strategy for brine disposal has been presented in Table 2:

Table 2: Innovative Mitigation Strategies for Brine Disposal (Source: Author)

Category	**Description**	**Benefits**
Advanced Diffuser Systems	Multi-port systems are placed at optimal depths/distances using CFD modelling to optimize port spacing, orientation, and flow rates.	Rapid dilution (within 2 ppt of ambient in 100–200m), reduced local salinity impacts (Rezaee, 2024)
Membrane Distillation Systems	Uses waste heat or solar energy to concentrate brine and recover additional freshwater (Rezaee, 2024)	Reduces brine volume by 50–70%, enables freshwater recovery, improves energy efficiency
Solar Evaporation Ponds	Utilizes solar energy for passive brine evaporation in suitable climates	Cost-effective, low-energy, enables mineral recovery
Hybrid Systems (Pond + Crystallizer)	Combines evaporation ponds with crystallization for enhanced recovery and volume reduction (Voutchkov, 2022)	Near-zero liquid discharge, resource recovery of salts/minerals
Zero Liquid Discharge (ZLD)	Full recovery system using advanced crystallization to eliminate liquid waste	Eliminates brine discharge, complies with strict environmental standards (Zhu et al., 2024)

5. Brine Mining from Sydney Desalination Plant

5.1. Strategic Framework for Sustainable Development

The desalination plant in Sydney has unique and valuable opportunities for promoting sustainable brine mining development. It can use the existing infrastructure investment, strategic coastal location and proximity to the different potential market applications for brine mining. Table 3 proposes a strategic framework that focuses on a carefully planned phased approach for brine mining, starting from the comprehensive environmental baseline research to extensive stakeholder engagement programs:

Table 3: Strategic Framework for Brine Mining from Sydney Desalination Plant (Source: Author)

Phase	Key Activities	Objectives	Outcomes
Phase 1	Detailed assessment of existing brine characteristics, comprehensive environmental condition monitoring, and evaluation of potential resource recovery opportunities	Establish a scientific and regulatory basis, ensure full regulatory compliance, and build community acceptance.	Baseline data for design and impact assessment, stakeholder engagement foundation
Phase 2	Pilot-scale testing of resource recovery technologies, detailed engineering design, and comprehensive environmental impact assessment	Validate technology performance, refine project design, and evaluate environmental implications.	Proven feasibility and refined processes, regulatory readiness for scale-up
Phase 3	Full-scale implementation, adaptive management protocols, and continuous monitoring systems	Manage operational risks, maintain compliance and performance, and foster long-term stakeholder confidence.	Operational project with ongoing performance and compliance tracking

4.2. Environmental Sensitivities and Comprehensive Protection Measures

The coastal water of Sydney supports a rich ecosystem and biodiversity, which includes critical habitats and protected species. As a result of this, it is important to integrate feasible protections during brine mining. The environmental risks that are associated with brine mining include the proximity of Sydney Marine Park, impacts on fisheries, the disruption of whale migration processes and damage to the sensitive seabed (Greer et al., 2021). An extensive environmental baseline needs to be integrated and monitored continuously by using advanced technology like real-time telemetry and AUVs. Factors such as temperature, salinity, dissolved oxygen, pH, trace metals, and nutrients should be considered during chemical monitoring (Sola et al., 2021). During biological assessments, indicators like behavioral changes and the population growth rate of cuttlefish should be considered. These strategies, along with the existing programs, will help in detecting early stress indicators and ensuring minimal disturbance of the Marine ecosystem during the resource extraction process.

*4.3. **Socio-Economic Analysis and Community Engagement***

Socio-economic assessment of the brine mining process involves evaluation of the cost-benefit analysis and impacts on the local industries, employment and communities. The resource recovery process can help in creating employment opportunities, generating revenues from the recovered materials like salt, magnesium and lithium, and promoting service sector growth. However, it might simultaneously increase risks to fishing, tourism and recreational activities (Moreno-Silva et al., 2025). Community engagement is important for ensuring social and economic stability during brine mining, which can be done using public forums, ongoing consultations with the community and advisory groups to promote trust and transparency. Development of collaborations with Indigenous communities will also help in recognizing traditional cultural heritage and knowledge in the operational planning system, thereby enhancing social license and supporting responsible and inclusive development.

*4.4. **Regulatory Framework and Compliance Strategy***

The brine mining project should maintain compliance with the layered environmental laws, which include the NSW Planning and Assessment Act, the EPBC, and the Protection of the Environmental Operations Act (Huang et al., 2022). It is also important to acquire permits that require comprehensive operational transparency, environmental impact assessment and continuous compliance with the regulatory rules and standards. To ensure the sustainability of operations, it is important to maintain clear communication regarding the environmental performance and promote engagement with the legal authorities (Huang et al., 2022). A strong compliance strategy typically includes alignment with best practices, promoting collaborations with the regulators and meeting the reporting obligations. It is also important to develop customized guidelines for brine mining to streamline the approvals and simultaneously maintain high environmental standards.

*4.5. **Implementation Strategy and Project Management***

4.5.1. Implementation Strategy and Project Management

The implementation strategy should focus on outlining the key steps for the project development, starting from the initial feasibility study to the full-scale operations, which incorporates stakeholder engagement, risk management and adaptive management principles. Table 4 presents the structured approach to project implementation:

Table 4: Implementation Plant (Source: Author)

Phase	**Duration**	**Key Activities**	**Deliverables**
Phase 1: Feasibility & Planning	6–12 months	Environmental baseline studies, technology assessment, market analysis, and regulatory consultation	Feasibility report, environmental baseline, technology selection report, and regulatory pathway
Phase 2: Design & Permitting	12–18 months	Detailed engineering design, environmental impact assessment (EIA), permit applications, and financial structuring	Engineering drawings, EIA report, permit approvals, and financial agreements
Phase 3: Construction	18–24 months	Site preparation, infrastructure construction, equipment installation, system integration testing	Completed facilities, commissioning reports, performance test results, safety certifications
Phase 4: Commissioning & Operations	6–12 months	System commissioning, performance optimization, staff training, and market development	Operational facility, performance guarantees, trained workforce, sales agreements

4.5.2. Risk Assessment and Mitigation Framework:

During the establishment of the desalination project, several risks might be induced as mentioned in Table 5. To maintain long-term sustainability of the recommended desalination project, viable risk management and mitigation strategies need to be applied as indicated in Table 5:

Table 5: Risk assessment and mitigation strategies (Source: Author)

Risk Category	Specific Risks	Probability	Impact	Mitigation Strategies
Technical	Process performance below targets, equipment reliability issues, and integration challenges	Medium	High	Pilot testing validation, proven technology selection, redundant systems design (Liu et al., 2022)
Environmental	Ecosystem impacts, regulatory non-compliance, and climate change effects	Medium	Very High	Comprehensive monitoring, adaptive management, and best practice implementation (Scotney & Pinder, 2022)
Commercial	Market demand fluctuation, price volatility, competition	High	Medium	Diversified product portfolio, long-term contracts, and market analysis updates
Financial	Cost overruns, financing availability, and revenue shortfalls	Medium	High	Detailed cost estimation, multiple financing sources, conservative projections (Liu et al., 2022)
Regulatory	Permit delays, changing regulations, and compliance issues	Medium	High	Early engagement, legal expertise, and compliance monitoring

4.5.3. Financial Planning Structure:

The financial planning structure for the desalination project is presented in Table 6:

Table 6: Financial planning structure (Source: Author)

Financial Component	Phase 1-2	Phase 3	Phase 4	Total Estimate
Feasibility & Design	AUD 5–8M	–	–	AUD 5–8M
Construction & Equipment	–	AUD 80–120M	–	AUD 80–120M
Commissioning & Startup	–	–	AUD 10–15M	AUD 10–15M
Working Capital	–	–	AUD 5–10M	AUD 5–10M
Contingency (15%)	AUD 1–2M	AUD 12–18M	AUD 2–4M	AUD 15–24M
Total Investment	**AUD 6–10M**	**AUD 92–138M**	**AUD 17–29M**	**AUD 115–177M**

5. Conclusions and Recommendations

The report indicates that the expansion of desalination projects is significantly important for the water security of Australia. It helps in maintaining a drought-resilient supply of water while simultaneously mitigating economic and environmental challenges. The advanced two-pass reverse osmosis plant design will help in meeting the strict water quality standards, which include boron limits because of the use of advanced membranes. Environmental analysis also indicates that the disposal of brine might induce the development of risks for the marine ecosystem, particularly for the cuttlefish. However, employment of advanced diffuser systems, monitoring systems and brine treatment can help in mitigating the environmental impact of brine disposal. The strategic Framework that has been recommended for sustainable brine mining in Sydney could help in promoting resource recovery while protecting environmental systems and maintaining regulatory compliance. Table 7 provides an evaluation of the strategic recommendations that can be used for desalination projects, brine disposal and brine recovery operations in Australia:.

Table 7: Strategic Recommendations (Source: Author)

Strategic Area	**Recommendation**	**Details & Rationale**
Energy Efficiency	Implement energy recovery in all new plants	Reduces energy use and costs, improving plant efficiency.
Renewable Integration	Pair desalination with solar/wind energy	Enhances sustainability and supports renewable energy goals.
Brine Management	Develop site-specific brine management plans.	Include reuse, treatment, or zero liquid discharge based on local conditions.
Environmental Monitoring	Establish robust monitoring systems	Focus on marine health using advanced and real-time technologies.
R&D and Innovation	Invest in desalination research.	Target membrane tech, fouling control, and brine reduction through partnerships.
Stakeholder Engagement	Prioritize inclusive community engagement.	Ensure transparency and respect for Indigenous rights and cultural heritage.

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